Draft Compatibility Determination

Title

Draft Compatibility Determination for Haying and Grazing, Big Stone National Wildlife Refuge.

Refuge Use Category

Agriculture, Aquaculture, and Silviculture

Refuge Use Type(s)

Haying or ensilage and grazing

Refuge

Big Stone National Wildlife Refuge

Refuge Purpose(s) and Establishing and Acquisition Authority(ies)

Big Stone National Wildlife Refuge (refuge) was established on May 21, 1975, when the U.S. Army Corps of Engineers transferred 10,540.43 acres to the U.S. Fish and Wildlife Service.

"…shall be administered by him [Secretary of the Interior] directly or in accordance with cooperative agreements … and in accordance with such rules and regulations for the conservation, maintenance and management of wildlife, resources thereof, and its habitat thereon, …" 16 U.S.C. § 664 (Fish and Wildlife Coordination Act)

"…suitable for - (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species …" 16 U.S.C. § 460k-1. "… the Secretary … may accept and use … real … property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors …" 16 U.S.C. § 460k-2 (Refuge Recreation Act (16 U.S.C. § 460k-460k-4), as amended)

"…the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions …" 16 U.S.C. § 3901 (b), 100 Stat. 3538 (Emergency Wetlands Resources Act of 1986)

…for the development, advancement, management, conservation and protection of fish and wildlife resources …" 16 U.S.C. § 742f(a)(4). "… for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude …" 16 U.S.C. § 742f(b)(1)e (Fish and Wildlife Act of 1956)

"… for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. § 715d (Migratory Bird Conservation Act)

National Wildlife Refuge System Mission

The mission of the National Wildlife Refuge System is 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 (Pub. L. 105-57; 111 Stat. 1252).

Description of Use

Is this an existing use?

Yes. This compatibility determination reviews, replaces and combines the 2012 haying compatibility determination and the 2012 grazing compatibility determination (U.S. Fish and Wildlife Service, 2012a). The uses were evaluated in conjunction with the Big Stone National Wildlife Refuge Comprehensive Conservation Plan and associated environmental assessment and found to be compatible (U.S. Fish and Wildlife Service, 2012a; 2012b). These uses are consistent with the 2022 habitat management plan (U.S. Fish and Wildlife Service, 2022).

What is the use?

Haying or ensilage is defined as the cutting or mowing of vegetation or fodder.

Grazing is defined as the feeding on vegetation by domestic livestock or native grazers (e.g., elk, bison). This includes trailing and watering of livestock.

Haying and grazing are considered refuge management economic activities (603 FW 2.6 N; U.S. Fish and Wildlife Service, 2000).

Is the use a priority public use?

No

This use is not considered one of the legislated priority wildlife-dependent public uses of the National Wildlife Refuge System (i.e., hunting, fishing, wildlife observation and photography or environmental education and interpretation).

Where would the use be conducted?

Big Stone National Wildlife Refuge is located within the prairie pothole region and northern tallgrass prairie biome (U.S. Fish and Wildlife Service, 2022). The refuge straddles the Minnesota River near its headwaters in west-central Minnesota, encompassing more than 11,500 acres of wetlands and grasslands interspersed with granite outcrops. Most of the refuge is within Lac qui Parle County with a little more than 1,000 acres in Big Stone County (U.S. Fish and Wildlife Service, 2012b; 2022).

The refuge is primarily a grassland system with a prairie-flooded forest transition. Riparian woodland dominates along the Minnesota and Yellow Bank River corridors, with scattered trees found in prairie coulees and surrounding wetlands. The wetlands vary by type and range from depressional temporary wetlands to large open water bodies. Wet meadows exist in the transition between the wetlands and upland prairie (U.S. Fish and Wildlife Service, 2022).

Within the refuge there are approximately 5,800 acres of wetlands and impoundments, 5,500 acres of grasslands including wet meadow, remnant prairie, restored and partially restored grassland and areas dominated by non-native grasses, 100 acres of granite outcrops and 1,050 acres of forest-shrub areas. The refuge would use haying and grazing as tools to manage grassland habitats and to create vegetation heterogeneity to support a higher diversity of grassland-dependent species. Haying and grazing would be used to maintain grassland health and vital habitat components for grassland-dependent species and other wildlife. Grazing would also be used to slow the growth of cattails and woody vegetation around natural depressional wetland habitats (U.S. Fish and Wildlife Service, 2012b; 2022).

Haying

Haying could be used as a habitat management tool to extend the interval in between needed upland management treatments like prescribed burning or grazing. Haying in grasslands could be used to reduce litter depth, control small diameter trees and shrubs, reduce shading of forbs by grass in newly established grass stands or to create structural diversity in the landscape for specific species needs.

Historically, hay units on the refuge have ranged from 10-200 acres and would be 500 acres or less annually. Typically, haying occurs in uplands, though wetland areas may be hayed during long drought periods. Haying is not suitable in areas with steep terrain, large rocks, scattered large trees or excessive rodent mounds. Formerly ploughed areas are most often hayed; remnant prairies are seldom suitable for haying. The U.S. Army Corps of Engineers unit on the east side of the refuge is regularly hayed to prevent tree growth on the levee.

Grazing

Grazing could be used as a habitat management tool in remnant prairie and planted grasslands to reduce litter layer, introduce disturbance, increase habitat diversity, prepare sites for seeding and control woody invasive species regrowth near seed sources. Grazing along seasonal, temporary and semi-permanent wetlands could be used to remove dense vegetation and enhance diversity. As opportunities arise, grazing could be applied to forests to remove invasive species (U.S. Fish and Wildlife Service, 2022).

Access to water and limited internal fence infrastructure have been limiting factors to livestock grazing. Grazing livestock on entire management units (>200 acres) for 1-3 years at a time have been effective means to entice grazers while achieving management goals. Most grazing occurs in grassland units, especially in high priority units with remnant prairie. Up to 3,000 acres could be grazed annually, though this is highly dependent on cooperator ability and environmental conditions. Total acres grazed depends on stocking rates and management goals.

When would the use be conducted?

Haying

Haying operations would generally occur from July 15 through October 1, but timing could vary depending on weather and management needs. For example, haying used to establish and maintain fire breaks could occur anytime from July 15 through October 1. However, haying to control noxious weeds such as sweet clover, remove competition of early cool season invasive grasses, prepare areas for grazing and reduce residual grass height could be permitted earlier. The benefits of early haying should be weighed against the consequences to breeding grassland birds. Hay bales would be removed by October 10 to limit interference with upland game hunting seasons. Haying would generally occur during refuge open hours, though may occur outside of these hours as well.

Grazing

Livestock grazing operations would generally occur between May 15 and October 10, but timing could vary depending on weather and management needs. For example, grazing used to suppress cool season grasses could occur May 15 to mid-June or mid-September to October. However, grazing to suppress warm season grasses and to promote forbs could occur mid-June to mid-September. Grazers typically are removed from the refuge by October 10 to limit interference with upland hunting seasons.

Native ungulate grazing would occur throughout the year. Annually (September-November), surplus animals would be removed from the herd and general health checks performed. Periodically and throughout any given year, individual(s) may need to be removed or added to the herd to meet goals for maintaining genetic diversity.

How would the use be conducted?

Haying and grazing would be used to achieve habitat management objectives as described in the comprehensive conservation plan and habitat management plan (U.S. Fish and Wildlife Service, 2012a; 2022). These uses would be implemented to remove invasive grasses and forbs, remove accumulated plant biomass (i.e., thatch layer), remove or reduce woody vegetation, provide a desired vegetative condition such as short grass browse, reduce vegetation fuel levels where wildfires could be a concern, prepare sites for establishment of desirable vegetation or stimulate growth of native grasses. The specific details and restrictions governing haying and grazing (e.g., locations, timing, treatment type, authorized equipment, etc.) would be outlined in each special use permit to ensure the activity remained consistent with the goals and objectives of the comprehensive conservation and habitat management plans, appropriate and compatible with the refuge's mission and purpose and compliant with all applicable policies and regulations.

Permittee selection and associated cost estimates would follow relevant national wildlife refuge policy for haying and livestock grazing (620 FW 2; U.S. Fish and Wildlife Service, 2017). Contractors would be selected using a competitive bid process that examined bid price, experience and other factors. Re-establishment of native grazers would be conducted through partnerships (e.g., Minnesota Department of Natural Resources, tribes) or from existing U.S. Department of the Interior (department) herds. Both uses would be overseen by the refuge manager and their designee, usually the refuge biologist or assistant refuge manager. The number of people participating in either activity would vary from year to year depending on the need and local conditions. Refuge managers would have the discretion to deny or reevaluate the appropriateness and compatibility of haying and grazing at any time (603 FW 2.11 H.(2); U.S. Fish and Wildlife Service, 2000).

Haying

The refuge would allow haying by private individuals (e.g., cooperative haying) for the purpose of habitat management. Haying would include the cutting and processing (e.g., baling) of grass and forbs, with subsequent removal to an off-refuge location. Haying could be conducted annually, or every third year depending on vegetation height goal and would usually be conducted as a single event during any given year but could be repeated periodically. Cutting would generally be delayed until after August 1 but could be adjusted on a case-by-case basis depending on management goals (e.g., controlling invasive species). In most years, mowing would be done by early September for cool-season grasses and early August for warm-season grasses (U.S. Fish and Wildlife Service, 2022).

Haying would generally include multiple passes with a tractor to cut standing grasses and forbs to be used as windrows. The process would typically require 2-4 visits to each site using conventional farming equipment over a period of 7-14 days. After cutting, the hay would cure for an average of 3-7 days to reduce moisture content and would be turned at least once with a tractor-drawn rake to facilitate quick and even drying. Once cured, a tractor-drawn baler would be used to package the windrows into hay bales, balage or ensilage. A tractor-drawn wagon would be used to collect bales and remove them from the site. Sites may be accessed by existing public and refuge maintenance roads, approaches over ditches and various refuge access gates. Some areas may not be accessible by heavy equipment for all or part of the year. Heavy equipment could include tractors, mowers, rakes or swathers.

Hay units are put out for sealed bid with objective ranking criteria (620 FW 2; U.S. Fish and Wildlife Service, 2017). Hay fees would typically be assessed using cost per acre. Fees could include market rate deductions for special circumstances such as factors limiting economic return for permittees (e.g., unexpected weather event) or based on services rendered to the refuge by the hayer (e.g., parking lots mowed).

The refuge would issue approximately 10 special use permits a year. Special use permit stipulations would include descriptions and maps of hay location, dates (earliest/latest start, bale by, remove bales by, etc.), confirmation that the hayer has liability insurance, permissible equipment, permittee and refuge responsibilities, payment requirements and other specific guidelines.

All contractors would be required to follow permit stipulations and best practices to ensure equipment is clean and free of plant material and soil before starting work. Additional best management practices could be found in the refuge habitat management plan (U.S. Fish and Wildlife Service, 2022).

Grazing

The refuge would allow grazing by private individuals (e.g., cooperative grazing) for the purpose of habitat management. Grazing would be conducted using the temporary placement of privately owned domestic livestock. Domestic cattle would be most common, however, other livestock such as sheep, goats and native grazers (e.g., elk, bison) could be used. Most cooperators who graze refuge lands own pasture adjacent to management units (U.S. Fish and Wildlife Service, 2022).

Grazing frequency and type would be based on site-specific evaluation of the grassland or wetland area being managed. The timing and duration of grazing would depend on the grassland type and condition. Spring flash grazing would commonly be used in native prairie, which would include grazing at a relatively high stocking rate for a short duration (4-6 weeks or less). Typically, flash grazing would occur in two consecutive springs but would sometimes be followed by a fall grazing when warm-season native grasses would be less palatable. Summer grazing would most commonly be used in low diversity, seeded grasslands dominated by warm season or cool season grasses. The duration and intensity would be similar to spring grazing, but a more moderate stocking rate and longer duration (10-12 weeks) could be used depending on cooperator herd size (e.g., stocking rates) and need for season-long grazing (Ahlering et al., 2020; Gannon et al., 2010; 2013)

The refuge would typically issue three special use permits a year. Special use permit stipulations would include descriptions and maps of graze location, animal unit month, start/stop dates, confirmation that the grazer has liability insurance, permissible equipment, permittee and refuge responsibilities, payment requirements and other specific guidelines. The animal unit month per grazed area would be dependent on management unit size, animal type, type of forage available, management goals and environmental conditions.

Cooperating permittees would be responsible for adequately confining or constraining (e.g., fences, gates) livestock to identified units. Grazer would be responsible for locating and removing livestock that had strayed from fenced pastures within 24 hours notification by refuge staff. If water resources would not be available to livestock, watering facilities could be installed, or water could be delivered daily. Mineral blocks could be used to supplement and distribute animals throughout the unit to facilitate even grazing. Fence construction and maintenance, adequate watering and control and rotation of livestock would be the responsibility of the permittee (U.S. Fish and Wildlife Service, 2022).

Grazing units are put out for sealed bid with objective ranking criteria (620 FW 2; U.S. Fish and Wildlife Service, 2017). Grazing fees would typically be assessed using the animal unit month method. Grazing fees could include market rate deductions for special circumstances such as additional livestock movements as requested by agency staff, other factors limiting economic return for permittees or based on services rendered to the refuge by the grazer (e.g., tree or debris removal).

All contractors would be required to follow permit stipulations and best practices to ensure equipment is clean and free of plant material and soil before starting work. Additional best management practices could be found in the refuge habitat management plan (U.S. Fish and Wildlife Service, 2022).

Use of native grazers with partner (e.g., Minnesota Department of Natural Resources) or department herds would be allowed to support Secretarial Order 3410: Restoration of American Bison and the Prairie Grasslands (SO 3410; U.S. Department of the Interior, 2023). The purpose of this order is to restore wild and healthy populations of native prairie grassland grazers through "collaboration among the Department's Bureaus and partners...". Under this use, grazing would be year-round. Yearly stocking goals for herd size and make-up (e.g., totals by sex and age) would be determined with partners and/or the Department of Interior's Bison Working Group and the refuge biologist. Use of native grazers would only be permitted in areas with perimeter fence designed to contain the desired native grazer. Perimeter fence maintenance for containment of native grazers would be the responsibility of the refuge. Native grazers may be moved around the grazing area using the concept of pyric herbivory. Excess animals would be removed in accordance with established agreements and agency policy during yearly round-ups. At this time, herd managers would also take necessary samples and provide any necessary health exams and immunizations.

Why is this use being proposed or reevaluated?

These uses are being reevaluated because the 10-year renewal period for the 2012 haying and grazing compatibility determinations ended in 2022, as described in agency policy (603 FW2.11 H; U.S. Fish and Wildlife Service, 2000). This document renews and combines the 2012 haying and grazing compatibility determinations (U.S. Fish and Wildlife Service, 2012). No changes would occur regarding how these uses have previously been conducted on the refuge with the exception of year-round grazing by native grazers, which would entail use of partner (e.g., Minnesota Department of Natural Resources) or department herds without the use of the bid process.

As outlined in the comprehensive conservation plan, habitat management on Big Stone National Wildlife Refuge is three-fold:

- Habitat: The refuge will restore, manage and protect diverse native communities of tallgrass prairie, wetland, forest and shrub and granite outcrop habitats to enhance the vitality and health of the natural environment.
- Wildlife: The refuge will enhance and maintain habitats for biologically diverse and abundant populations of native fish and wildlife associated with healthy refuge environments.
- People: The refuge will provide a variety of wildlife-dependent recreational and educational opportunities for visitors to experience and treasure native tallgrass prairie heritage, ecological processes and cultural resources (U.S. Fish and Wildlife Service, 2012a).

Haying and grazing would occur on the refuge to restore and manage diverse native communities of tallgrass prairie and wetland habitats as outlined in the comprehensive conservation plan habitat goal (U.S. Fish and Wildlife Service, 2012a). Historically, the structure, function and composition of prairie habitats were maintained by periodic drought, fires and grazing by large herds of herbivores (Krisch et al., 1978). With many of those natural disturbances having been removed from the landscape, the refuge relies on haying and grazing to manage for early successional stages as well as limit the encroachment of invasive plant species (U.S. Fish and Wildlife Service, 2012a).

Habitat management on the refuge using haying and grazing would be administered in accordance with wildlife and ecosystem management principles, on-going research and land management demonstrations. These activities would only occur where the agency has determined that a management need exists to use haying and grazing practices to restore native vegetation and habitats and provide wildlife-dependent recreation opportunities to the public (U.S. Fish and Wildlife Service, 2012a; 2022).

The use of native grazers on the landscape would entail the effective reintroduction of species that that were effectively extirpated from the tallgrass prairie landscape over 100 years ago. Reintroduction of native grazers also would meet department species and prairie grassland restoration goals and promote nature-based solutions for prairie grassland resiliency (White House Council on Environmental Quality et al., 2022).

Availability of Resources

Annual administration costs: Administration of haying and grazing would typically require developing approximately 1-10 special use permits each year costing an estimated $350 per permit for a total annual administrative cost of $3,500. These costs would include staff time and office resources needed to develop, review and approve permits. The costs to administer haying and grazing would be considered minor relative to the value of the services gained.

Administrative costs to the refuge for native grazers would be limited to participation in annual planning meetings when stocking numbers and meta-population goals are discussed with partners and/or the department herd manager ($1,000 per year).

Monitoring: Monitoring would occur under the existing grassland monitoring program. Given current staffing levels, haying and grazing could be monitored every year at an estimated $500 per hay or graze unit. If staff capacity were to change over the ten-year period of this compatibility determination, the number of permits would be adjusted appropriately given refuge management priorities and the ability to support priority wildlife-dependent recreational opportunities.

Maintenance, special equipment, facilities and infrastructure: All repairs, maintenance and other costs of facilities, special equipment, facilities, and infrastructure used by permittees would be identified in the special use permit and would be the sole responsibility of the permittee.

For the establishment of native grazers, other refuges (e.g., Neal Smith National Wildlife Refuge) have had one-time costs for fencing around $50,000-$100,000 per mile, depending on the type of fence installed. Other reported annual costs were minimal and include staff time to assist with the yearly round up, grazing effects monitoring and fence maintenance.

Haying would be supported by existing refuge facilities and infrastructure (e.g., roads, levees, parking areas). No costs would be incurred for facilities, equipment, improvements or maintenance.

Grazing facilities costs largely reflect what is needed for fence maintenance and construction. While fence maintenance is part of the grazing contract, unexpected maintenance needs could arise. For example, a vehicular accident destroys a fence when a unit is not being grazed and repairs are needed to avoid public scrutiny at the state of fence disrepair. New fence would be constructed on units to facilitate expanded grazing efforts.

Offsetting revenue: Haying and grazing on the refuge would generate revenue for the U.S. Fish and Wildlife Service. Revenue generated by each permittee would be determined via bids and the funds would be managed by the agency. In accordance with federal law (16 USC 715s: Participation of Local Governments in Revenue from Areas Administered by the U.S. Fish and Wildlife Service), all income would be deposited into the refuge revenue sharing fund. The refuge would have a percentage of the revenue placed in a contributed fund account to help offset the costs of administering the program. Annual revenue generated by haying has averaged $3,000 and $5,000 for grazing.

Anticipated Impacts of the Use

The effects and impacts of the proposed use on refuge resources, whether adverse or beneficial, would be those that are reasonably foreseeable and have a close causal relationship to the proposed use. This compatibility determination includes the written analyses of the environmental consequences on a resource only when the impacts to that resource could be more than negligible and would therefore be considered an “affected resource.” Wilderness areas do not occur within refuge boundaries and have been dismissed from further analyses.

Haying and grazing would assist in restoring native habitat on the landscape, and the impacts from management activities would be beneficial or mitigated through careful planning and implementation. These uses would be conducted in a manner that avoids or mitigates short- and long-term impacts that adversely affect the purpose or mission of the refuge and the National Wildlife Refuge System. Restrictions imposed by the refuge manager and special use permits would reduce any anticipated negative impacts to refuge resources.

Potential impacts of a proposed use on the refuge's purpose(s) and the Refuge System mission

Haying and grazing provide important tools for habitat restoration and conservation, which benefits wildlife and furthers the mission of the National Wildlife Refuge System and the U.S. Fish and Wildlife Service. Haying and grazing were evaluated in the 2012 comprehensive conservation plan environmental assessment and are consistent with the comprehensive conservation and plan (U.S. Fish and Wildlife Service, 2012a; 2012b). The 2012 environmental assessment determined that haying and grazing would not significantly impact the human environment and a finding of no significant impact was issued (U.S. Fish and Wildlife Service, 2012a). The analyses below are supplemental to the environmental effects described in those documents and where applicable, are incorporated by summary and reference. This compatibility determination was developed using the most recent district biological information and data, scientific literature and habitat restoration principles. Hayed and grazed units on the refuge would be managed, enhanced and restored for native fish, wildlife and plants.

Potential positive impacts of haying and grazing would include restoration, maintenance and enhancement of prairie and wetland habitats and increased habitat diversity and connectivity. Haying and grazing would also improve recreational opportunities, mainly waterfowl hunting and bird watching conditions. The re-introduction of native grazers would also have significant cultural implications for indigenous peoples and would likely increase overall visitation to the refuge as has been seen at several other conservation sites with such introductions. This use would have an overall positive outcome in working towards the goal of restoring the refuge back to its original state by encouraging the growth and establishment of native species.

Mitigation: Restrictions and conditions identified in special use permits would be implemented to minimize and mitigate impacts to refuge resources. The refuge would follow guidance and best management practices established by the comprehensive conservation plan and environmental assessment (U.S. Fish and Wildlife Service, 2012a; 2012b), the habitat management plan (U.S. Fish and Wildlife Service, 2022), the Region 3 haying and grazing program guidance (U.S. Fish and Wildlife Service, 2014) and other agency guidance and policies. In addition, accepted principles of habitat management and restoration would be used when implementing haying and grazing on refuge lands.

Short-term impacts

Wildlife Species

Terrestrial Species

Over 250 species of birds have been recorded on the refuge including 46 species of waterfowl and waterbirds, 46 species of shorebirds, 23 species of raptors and 50 species of passerines. The refuge provides habitat for several species of non-migratory birds such as ring-necked pheasants and eastern wild turkeys (U.S. Fish and Wildlife Service, 2012a; 2022).

Of the refuge's 45 species of mammals, some of the most frequently observed include white-tailed deer, coyotes, rabbits, squirrels and chipmunks. Prairie habitats support the greatest diversity of species, particularly small mammals and rodents (U.S. Fish and Wildlife Service, 2012a; 2022).

Refuge habitats are managed for the benefit of migratory bird species The prairie pothole region is considered the largest breeding ground for waterfowl in the continental United States, and waterfowl are the most abundant group of birds that use the refuge. Grasslands provide breeding, nesting and foraging habitat for grassland-dependent waterfowl and other bird species (U.S. Fish and Wildlife Service, 2012a; 2022).

Areas of high floral diversity provide habitat for specialist and generalist pollinator species including different bumblebees, butterflies and other insects that require an abundance of vegetative cover and flowering nectar resources throughout the growing season (U.S. Fish and Wildlife Service, 2022). Surveys through the year 2000 have documented 46 species of butterflies on the refuge (U.S. Fish and Wildlife Service, 2012a; 2022). Diverse grasslands provide the full life cycle requirements, feeding, reproduction and larval development of native invertebrate pollinators, which serve as an important food source, especially for birds. Almost all beneficial insects require food in the form of nectar and/or pollen from flowers for optimal survival and high levels of reproduction (Klein et al., 2006; Pywell et al., 2005).

Impacts: The response of wildlife to haying and grazing would be variable, and activities associated with this use could have a positive impact on some species and a negative effect on others (Jones-Farrand et al., 2007). Depending on the nature of the use, activities could disturb wildlife, which would include both direct and indirect effects (Cline et al., 2007; Knight and Cole, 1991; Miller et al., 1998; Gill et al., 1996; Gill et al., 2001). Human induced disturbance would be defined as any encounter in which human activities lead animals to behave differently than they would in the absence of these activities (Smit and Visser, 1993). Disturbance would vary in magnitude, frequency, predictability, distribution and duration (Cayford, 1993).

Wildlife responses to disturbance could vary between species, between individuals of the same species and between different periods of time for a single individual (HaySmith and Hunt, 1995; Knight and Temple, 1995). The impact of grassland management on wildlife species would depend on within field factors (e.g., vegetation composition, structure and succession, soil moisture), practice-level factors (e.g., size, shape), spatial and temporal factors (e.g., seasonality, location), the landscape context of activities (e.g., to what extent additional grassland habitats are available), lifecycle stages of species using grasslands and how areas would be managed over the life of the permit (Jones-Farrand et al., 2007; Lawrence and Johnson, 2016).

Direct impacts to wildlife would be those that cause direct physiological effects (e.g., energetic costs, altered fitness), behavioral modifications (e.g., avoidance of otherwise suitable habitat, nest abandonment) or death (Cline et al., 2007). Haying and grazing could cause temporary disturbance and displacement of wildlife due to an increase in motion (e.g., people, livestock, equipment, vehicles, etc.), noise and ground disturbing activities (e.g., mowing). Individuals could be directly impacted via displacement to adjacent areas, nest abandonment, injury or mortality from equipment, vehicle strikes or trampling by livestock.

Grassland dependent species could be particularly susceptible to disturbance. In grasslands, vegetation structure and cover would be most important for mammals, birds and reptiles (Schieltz and Rubenstein, 2016). Haying and grazing could alter the amount and composition of vegetation available for nesting and foraging birds (Kirsch et al., 1978). The response of breeding birds to haying and grazing would be influenced by bird breeding ranges, breeding bird habitat preferences, environmental conditions and the timing of disturbance (Jones-Farrand et al., 2007).

Indirect effects on wildlife would be incidentally caused by haying and grazing and would generally occur later in time. Indirect effects on wildlife could include increased predation pressure on surviving adults and young (Bollinger et al., 1990), dispersal of breeding adults to other areas (Frawley and Best, 1991; Igl, 1991, Ingold et al., 2010), alteration of social and genetic mating patterns (Perlut et al., 2008) and changes to the structure and composition of vegetative cover (Frawley and Best, 1991; Luttschwager et al., 1994).

Most of the impacts to wildlife would be temporary and short-term, lasting approximately the amount of time it takes to treat a site. However, grassland species require a diversity of different habitats, with some species requiring long periods between disturbance events and other requiring shorter disturbance intervals. This requires punctuated disturbances with short-term negative impacts to individuals that ultimately allow populations to persist. Ensuring that a diversity of disturbances and disturbance intervals are available on the landscape is key to maintaining high species diversity at larger scales (Fulendorf and Engle, 2001). Disturbance to wildlife or the potential for mortality would be minimized and mitigated by the stipulations outlined in the special use permit.

Haying

When haying occurs in the breeding season, mowers could cause injury or mortality to ground-nesting birds or chicks (Braun et al., 1978; Calverley and Sankowski, 1995; Rodenhouse et al., 1992). Peak-nesting season disturbances could lead to nest destruction or abandonment of active nests (Dale et al., 1997; Frawley and Best, 1991; Giuliano and Daves, 2002; Luscier and Thompson, 2009; McMaster et al., 2005). Residual cover needed to nest the following spring could be reduced for ground-nesting waterfowl and upland birds (Creston Valley Wildlife Management Authority, 1974). Defoliation by mowing could cause high direct arthropod mortality (Humbert et al., 2010), and vegetation cutting height could have a strong influence on amphibian and reptile mortality (Oppermann, 2007; Saumure et al., 2007). Mowing after August 1 may minimize direct impacts to breeding birds but may not result in the desired impacts on undesirable plant species.

The removal of standing grasses would result in short-term changes to vegetation height. Annual haying would provide habitat for species that prefer short, sparse grasslands (e.g., grasshopper sparrow), while mowing every third year or more, would benefit species that prefer tall grasslands (e.g., Henslow’s sparrow; U.S. Fish and Wildlife Service, 2022).

Grazing

Grazing impacts could be complex and depend upon the species under consideration, grazing regime (i.e., grazing intensity, timing, frequency, and the livestock species) and other biotic and abiotic factors (Ryan et al. 2002; Kirsch et al., 1978). Providing quantitative generalizations on populations could be challenging because the effects of grazing on wildlife would differ depending on local habitat characteristics (Strassman, 1987). At the community level, there could be a shift in species diversity and at the individual (i.e., species) level, changes in wildlife such as area use or diet selectivity could lead to demographic changes in age structure, sex ratios, survival or fecundity. Altered prey abundance could have food chain-level effects on higher trophic levels (Schieltz and Rubenstein, 2016).

Wildlife could be directly impacted by grazing through interference competition, which would occur when wildlife and livestock coexist in a shared area, or indirectly through vegetation changes (Schieltz and Rubenstein, 2016). Livestock and native grazers could change vegetation composition (Augustine and McNaughton, 1998) and could shift relative proportions of grasses, forbs and browse available to wildlife (Schieltz and Rubenstein, 2016). Vegetation changes caused by livestock could affect food quality and quantity, cover from predators or available nesting sites (Schieltz and Rubenstein, 2016).

The effects of vegetation changes would differ across wildlife species depending on fundamental properties like body size, diet and habitat requirements (Schieltz and Rubenstein, 2016). Wild herbivores of differing body sizes would respond differently to changes in forage quantity, quality and predation (Hopcraft et al., 2010; 2012). For example, competition for food and space could drive ungulate (e.g., deer) responses (Schieltz and Rubenstein, 2016). Cattle could exclude deer from available habitats and potentially reduce fawn survival (Mackie, 1978). Birds could also experience changes in preferred vegetation types, food resources and predation pressure (Fuller and Gough, 1999). For nesting birds, the removal and trampling of residual cover by livestock could reduce nesting success and the likelihood and success of renesting attempts (Bue et al., 1952; Capel, 1965; Creston Valley Wildlife Management Authority, 1974; Jahn and Hunt, 1964; Kirsch, 1969; Kirsch et al., 1978; Slayer, 1962; Weller et al., 1958). Although short-term impacts to grassland bird species are possible, over the long-term these species would benefit from improved habitat (see Long-term Impacts Section for more information).

Large herbivores could directly affect arthropod diversity through unintentional ingestions, trampling or by supplying resources for specialized groups (e.g., dung feeders, scavengers). The presence of livestock could indirectly negatively affect arthropod populations and diversity through changes in soil, litter or plant characteristics, which form the base of arthropod food webs. Loss of vegetative cover could lead to an increase in arthropod predation (van Klink et al., 2015).

In contrast, some wildlife could experience beneficial effects of grazing under certain conditions (Fuhlendorf and Engle, 2001). Reduced structure could prompt some birds to avoid grazed pastures but attract other species (Ryan et al., 2002). Species adapted to more open habitats would likely be positively affected by livestock grazing (Bock et al., 1984). For example, grazing in goose feeding areas could increase food abundance by stimulating growth of edible green shoots (Greenwalt, 1978). Large herbivores could have positive impacts on arthropods by supplying resources in the form of dung, carcasses, blood and living tissue (van Klink et al., 2015). Short-grazed vegetation could provide nutrient-rich regrowth to herbivorous insects as young leaves often have higher nutrient contents than older plant parts (McNaughton, 1976; Ydenberg and Prins, 1981).

Mitigation: To limit impacts to wildlife, haying and grazing would follow all applicable agency guidance and policies. Mitigation measures to reduce and minimize negative impacts to wildlife and land use related disturbance would be outlined in a special use permit. Restrictions could include limiting the timing and duration of haying and grazing, equipment type, or the number of livestock or individuals participating in an activity at one time or annually.

Haying and grazing would occur on relatively small sections (e.g., multiple units unlikely to represent >30% of any habitat type on the refuge), providing sufficient refugia for dispersed wildlife in areas adjacent to the disturbance. For grazing, livestock would generally occur in a given area for approximately one week, which limits the possibility of disturbing grassland birds and their nests during the nesting season. Retention of idle fields would ensure undisturbed nesting cover (Lawrence and Johnson, 2016). Land use practices (e.g., plowing, tilling, crops, cover crops, broadcast spraying with certain herbicides) would only occur on previously altered tracts, which would protect established plants and associated insects on remnant sites. All motor vehicle and equipment would be subject to inspection to limit the transfer of non-native seeds. Permittees would be required to consider all land use conservation practices as practical.

Haying and grazing would be implemented using the best available science and peer-reviewed guidance. These uses would be accomplished in the shortest time possible to minimize disruptive effects on nesting birds and other wildlife (Jones-Farrand et al., 2007; Kirsch et al., 1978). Treatment frequency would be applied at a rate that maintained mean height and density of residual grassland vegetation at or near maximum levels for the site and would occur before or after the nesting season.

Haying and grazing would be carefully controlled and tailored to fulfill wildlife habitat objectives (U.S. Fish and Wildlife Service, 2012a; 2022). When deciding how, when and where to allow haying and grazing, a variety of wildlife needs and habitat characteristics would be considered to minimize potential negative impacts. Decisions regarding the frequency of management on grasslands would consider habitat objectives, field location, wildlife communities, weather, soil conditions and livestock forage needs (Jones-Farrand et al., 2007; U.S. Fish and Wildlife Service, 2012a; 2022). Annual haying and grazing would be avoided when possible and would be conducted only with clear goals in mind (Kirsch et al., 1978).

Haying

To the extent practicable, haying would not be permitted during primary nesting and brood-rearing seasons for grassland bird species (Jones-Farrand et al., 2007), fawning or other sensitive time periods for wildlife (Farm Service Agency, 2003). Haying would generally be delayed until August or the latest date possible after bulk nesting activities had ceased and birds had fledged (Braun et al., 1978; Jones-Farrand et al., 2007; U.S. Fish and Wildlife Service, 2022). Postponing haying until after August 1 would allow most ground-nesting birds to raise at least one brood prior to cutting. If more than one mowing would be required after the breeding season, the last mowing of the year would generally be early enough to promote some fall re-growth, which would provide residual vegetative cover the following spring (U.S. Fish and Wildlife Service, 2022).

Grazing

Grazing goals should be clearly outlined prior to sending out bids. Permits will make it clear that grazing practices (e.g., start/stop date, animal unit months targeted) are subject to change based on changing weather and resource conditions. To limit the potential for the introduction of non-native species, supplemental forage is not permitted. Mineral supplements are allowed, but these should be moved frequently to avoid excessive disturbance. Livestock should not be administered insecticides within two weeks of being released on refuge lands to limit the impacts of these chemicals on native species from fecal material. Supplemental watering would be allowed with approval from the Refuge Manager.

Threatened and Endangered Species and Critical Habitat

Federally threatened, endangered, candidate and proposed species occur on the refuge, but this use would not be expected to conflict with the recovery or protection of these species.

Listed species:

- Northern long-eared bat (endangered)
- Tricolored bat (proposed endangered)
- Red knot (threatened)
- Dakota skipper (threatened)
- Poweshiek skipperling (endangered)
- Monarch butterfly (candidate)

Critical habitat:

- Poweshiek skipperling

Northern long-eared bats roost under the peeling bark of dead and dying trees during the summer months and overwinter in large colonies in caves (U.S. Fish and Wildlife Service, 2015). They eat a variety of flying insects and typically forage in the understory of forested areas (U.S. Fish and Wildlife Service, 2015). Most refuge lands could be considered treeless with a scattering of invasive tree species. No known hibernacula or maternity roost trees occur on or near the refuge.

Tricolored bats roosts in dead leaves suspended in the canopies of deciduous trees, dead pine needles suspended in branches, in boles of large pine trees and within lichens suspended in tree canopies. Roosts may be found in man-made structures in summer months such as abandoned mines, old houses, sheds, barns, wells, road culverts and dams as well as caves (Taylor et al., 2020). Tricolored bats feed in open areas with abundant water adjacent to forested roost habitats. They forage along roads, lakes and ponds, transitional edges, forested corridors and buffer strips (Taylor et al., 2020).

The refuge contains little suitable habitat for listed or proposed bat species and any use would likely be limited to incidental foraging in upland areas. Historically, only a few oak trees would have been found within the current refuge boundary. As these bat populations are contracting, not expanding, it is unlikely that they are moving into marginal habitats on the refuge.

Impacts: Foraging bats could be temporarily disturbed by haying and grazing. The impact would likely be minimal since most activities would occur during daylight hours, and bats feed mostly at night on flying insects. Trees may be removed by grazers or hayers as in kind services, but this would be limited. Most trees removed by grazers or hayers would likely be too small to serve as reliable roost habitat and are scattered on open grasslands, not within or near forested areas.

Mitigation: Trees will largely be removed within grassland areas, not in or near standing forests. Any removal of trees with diameter at breast height greater than 3 inches and located in or near mature forest will be removed outside of the June 1-August 15 breeding window.

Red knots may use refuge mudflats as stopover habitat in spring or fall. They do not breed in Minnesota.

Impacts: Haying and grazing would have no impact on red knot breeding because they do not nest on the refuge. Removal and/or trampling of vegetation in or along wetlands would likely create more suitable red knot habitat than in the absence of these disturbances.

Mitigation: We do not see the need for any mitigation measures for this species in this location at this time.

Dakota skipper survival is dependent on the presence of native, remnant upland prairie. In Minnesota, Dakota skipper prefer native dry-mesic to dry prairie habitats where mid-height grasses such as little bluestem, prairie dropseed and side-oats gramma are abundant. Females lay eggs on grasses and forbs. Larvae feed on grasses and adults consume nectar, especially on cone flowers (Dana, 2018). Dakota skipper may be extirpated from the refuge as the most recent surveys in 2018 and 2019 did not find any occurrence of this species (U.S. Fish and Wildlife Service, 2022).

Monarch butterflies can be found in a variety of habitats including rangelands, farms, riparian areas, deserts, prairies, meadows, open forests, woodlands, cities, gardens and roadsides (Jepsen et al., 2015). Larvae feed exclusively on milkweed, and previous studies have identified the importance of nectar plants for adult monarch habitat (Kinkead et al., 2019; Stenoien et al., 2016; Thogmartin et al., 2017a; b). Conservation grasslands represent an important source of existing and potential monarch habitat (Thogmartin et al., 2017a) because they provide an abundance of milkweed (Lukens, et al., 2020). The remnant and restored prairie habitat on refuge uplands provides ideal habitat for monarchs, and they are a common species throughout the refuge.

Poweshiek skipperling habitat includes wet to dry native prairie, fens, moist and sedge meadows, and grassy lake and stream margins. Prairie dropseed is an important larval host plant. Smooth ox-eye and coneflowers are important nectar sources. This species is likely extirpated from the refuge as the most recent surveys in 2018 and 2019 did not find any specimens (U.S. Fish and Wildlife Service, 2022).

Impacts: Pollinator plant food sources could be removed during haying and grazing. Impacts of vegetation removal and livestock grazing could temporarily disturb and displace butterflies, disrupt feeding or mating behaviors or cause injury or death to immobile life stages (e.g., eggs, larvae).

Mitigation: Haying and grazing would occur in small patches within contiguous suitable habitat for these species. Refugia would be left within potential habitat to ensure that not all adults or larvae within the population might be negatively impacted by the action. Forbs that provide nectar sources tend to do produce more flower heads, and native grasses respond positively to appropriately timed disturbances that negatively impact non-native competitors (e.g., spring grazing to reduce smooth brome). Conservation efforts would align with sustainable farming practices to address habitat, water quality and erosion, through changes like vegetated field buffers, which also provide food for migrating pollinators (Gustafsson et al., 2017). The resulting restored habitat would contain a vast array of native grasses and forbs, nectar plants and milkweeds, which would be beneficial to Dakota skippers and monarchs.

The refuge would continue to reference Dakota Skipper Conservation Guidelines (U.S. Fish and Wildlife Service, 2016) when habitat management actions on the refuge occur in suitable skipper habitat (U.S. Fish and Wildlife Service, 2022). Staff would continue to monitor for the presence of this obligate grassland butterfly species including Dakota skipper and Poweshiek skipperling (U.S. Fish and Wildlife Service, 2022).

Impacts to all species: Direct and indirect impacts to listed species would be site-specific and short-term, lasting only the amount of time it takes for haying and grazing to occur. Impacts would vary depending on the scope and intensity of the management actions. Due to the low occurrence of listed species on the refuge, adverse impacts would be unlikely or minimal.

Haying and grazing activities could temporarily displace individual animals and possibly crush vegetation or habitat. Any disruption to behavior would be limited to the time it takes to operate equipment. Normal behavior (i.e., in the absence of disturbance) would resume and vegetation would recover once activities had stopped. Prairies and grasslands occurring elsewhere on the refuge would provide sufficient refugia and feeding areas outside of hayed and grazed lands.

Mitigation for all species: Haying and grazing would only occur in areas requiring habitat management or those that have been previously disturbed. Extremely sensitive wildlife habitat (e.g., fens) would be avoided unless restrictions in the special use permit would provide sufficient protection.

Special use permit stipulations (e.g., timing) would be used to reduce potential impacts to listed species. All lifecycle and habitat requirements of listed species would be considered when planning and permitting haying and grazing. Haying and grazing would not be approved if they would jeopardize or disproportionately affect threatened and endangered species.

Consultation with the Ecological Services Field Office would be re-initiated if there could be additional impacts to listed species that were not fully considered during the original consultation.

Other Special Status Species

Although no longer threatened or endangered, bald eagles are referenced here due to their protection under the Bald and Golden Eagle Protection Act. Several bald eagle pairs nest on the refuge and have commonly been observed from February through November each year. Bald eagle nests are monitored during the breeding season to evaluate eaglet production. Nest trees are protected on the refuge, and no other active management for eagles occurs (U.S. Fish and Wildlife Service, 2012a).

Impacts: Haying and grazing would not be expected to affect bald and golden eagles or other special status species and the Service will follow the Bald and Golden Eagle Protection Act guidelines.

Mitigation: We do not see the need for any mitigation measures at this time.

Habitat and Vegetation

The midwestern landscape is one of the most highly altered and intensively managed ecosystems in the country (Moore et al., 2019). Prior to European settlement, vegetation in Big Stone National Wildlife Refuge was primarily dry mixed-grass and mesic tallgrass prairie interspersed with islands of wet prairie also known as prairie potholes (Kratz and Jensen, 1983; Marschner, 1974; Stewart and Kantrud, 1971; U.S. Fish and Wildlife Service 2012b; 2022).

These areas provide essential migratory and summer breeding habitat to thousands of waterfowl as well as shorebirds, songbirds and gamebirds (U.S. Fish and Wildlife Service, 2012a). The current or potential set of species inhabiting remnant or restored wetlands and uplands is a function of the quantity and quality of requisite habitat patches available and the interconnectedness of those patches (Santelmann et al., 2006).

Despite its historical propensity for abundant prairie and wetland habitat, this area has undergone considerable change with most of the land surrounding the refuge dominated by agriculture production. Less than 1% of native tallgrass prairie remains in scattered fragments across the region (Samson and Knopf, 1994; Noss et al., 1995), and in some parts of the Prairie Pothole Region up to 89% of wetlands have been lost to agricultural drainage (Dahl, 1990).

Haying and grazing could alter habitat and vegetation on the refuge to achieve habitat management objectives as outlined in the habitat management plan (U.S. Fish and Wildlife Service, 2022). The following objectives describe how habitats would be manipulated and expected to change over the next 15 years.

- Objective 4.3.2.1 remnant prairie: Annually assess, maintain and enhance the floristic diversity and structure of 1,237 acres.
- Objective 4.3.2.2 planted grasslands: Annually maintain and enhance the floristic diversity and structure of approximately 30% of the 3,262 acres of planted grasslands.
- Objective 4.3.3.1 granite outcrops: Maintain approximately 82 acres of barrens on exposed granite outcrops to sustain the biological integrity of these unique communities.
- Objective 4.3.4.1 permanent and semi-permanent wetlands: Annually sustain and enhance approximately 20% of the 4,563 acres of permanent and semi-permanent wetlands across the refuge.
- Objective 4.3.4.2 seasonal and temporarily flooded wetlands: Assess habitat conditions annually and manage approximately 20% of the 1,294 acres of seasonal and temporarily flooded wetlands across the refuge.
- Objective 4.3.5.2 forest and shrub: Annually provide 960 acres of forest and shrub riparian habitat along the Minnesota and Yellow Bank Rivers.

Impacts: Haying and grazing would be implemented primarily to prepare a quality seed bed for the establishment of native tallgrass prairie species to accomplish habitat restoration objectives, and to recreate historic processes (i.e., grazing by large herds of native ungulates like bison and elk) that are no longer present on the landscape (U.S. Fish and Wildlife Service, 2012a; 2022). Haying and grazing by domestic livestock have been widely used to manage plant communities in upland habitats (Krisch et al., 1978) and to restore natural processes on North American prairies (Sanderson et al., 2008). Disturbances have been fundamental elements in the ecology and maintenance of native and seeded grasslands (Duebbert et al., 1981; Fuhlendorf and Engle 2001; Kantrud, 1981; Kirsch et al., 1978). Typically, the purpose of grassland conservation management would be to stop or slow the natural succession of scrub and woodland vegetation. Grazing and haying have been commonly used to slow the spread of fast-growing competitive plant species and to remove biomass to maintain low system fertility (Swengel, 2001; Watkinson and Ormerod, 2001). These management actions could be adjusted to promote diversity by varying their intensity, frequency, duration and seasonality in addition to using different species or breeds of domestic herbivores for grazing (Watkinson and Ormerod, 2001). A period of restoration management could be required before maintenance management could be practiced (Kirsch et al., 1978).

The operation of vehicles, tractors and other farming implements could crush vegetation in the management area. Disturbance would be limited in scope by only occurring during active haying and grazing and vegetation would likely recover once the disturbance had ended.

Haying

The impact of haying on vegetation would depend on habitat management objectives. Haying would maintain an open canopy for plant establishment in restoration fields and create a short structure, vegetative state in tall, dense grasses that is required by some grassland-obligate species (U.S. Fish and Wildlife Service, 2022).

The timing of haying would affect changes to plant species composition. Mid-summer mowing would suppress native, warm-season grasses and foster and maintain native forbs, especially spring flowering species and cool-season grasses. Conversely, other native forbs would be reduced by mid-summer mowing and thrive under management during early spring or late fall (U.S. Fish and Wildlife Service, 2022).

On the refuge, the immediate impact of haying would be a reduction or removal of vegetation biomass through cutting or mowing. Vegetation would immediately begin to regrow once activities had stopped.

Grazing

The effects of grazing on vegetation structure would vary across spatial scales (Adler et al., 2001; Wallis De Vries et al., 1999). For example, grazing could lead to a more homogenous vegetation structure at a small scale, while simultaneously leading to heterogeneity at a larger scale (Adler et al., 2001). In general, effects of herbivores on plant diversity would generally be positive in wet, productive systems and negative in dry, infertile ones (Bakker et al., 2006; Lezama et al., 2014; Olff and Ritchie, 1998; Proulx and Mazumder, 1998). In temperate systems, both intensive grazing and cessation of grazing could cause an increase in the relative cover of grasses (McNaughton, 1986; Milchunas and Lauenroth, 1993).

Plant diversity would be increased by grazing through a decrease in light competition and an increase in colonization by new species (Olff and Ritchie, 1998). Grazing could reduce vegetation quantity but could improve quality by removing old forage and stimulating new growth (Georgiadis et al., 1989). For some plant species, grazing could stimulate net primary productivity with maximum growth occurring at intermediate grazing intensities (McNaughton, 1983; 1985).

During grazing, large herbivores or livestock could cause direct disturbance such as trampling of living vegetation, litter and soil (Cumming and Cumming, 2003; Hobbs, 2006). Repeated defoliation and trampling without recovery can lead to changes in vegetation structure, productivity or composition (Kauffman and Pyke, 2001; van Klink et al., 2015).

Intensively managed grazing could be used as a tool to enhance vegetation heterogeneity and structural diversity by creating patches of short and tall vegetation, (van Klink et al., 2015), reduce litter build-up, stimulate growth of desired plant species, control invasive species and reduce vegetation height and density. Livestock could also disperse native seeds, creating patches of improved habitat (Archer and Pyke, 1991; U.S. Fish and Wildlife Service, 2022). Along wetlands, livestock could consume early growing cattail and break down residual vegetation through hoof action, which reduces dense vegetation and enhances diversity (U.S. Fish and Wildlife Service, 2022).

Currently, the refuge relies on occasional livestock grazing to manage grasslands, remove woody vegetation and control the spread of invasive plants (U.S. Fish and Wildlife Service, 2022). On the refuge the most likely impacts of grazing would be the removal of standing vegetation, trampling of other vegetation and reduction of pioneering woody plants. Native plants have often survived periodic intensive trampling and defoliation through various adaptations such as dwarf growth, vegetative spread and belowground storage of resources (Kauffman and Pyke, 2001; van Klink et al., 2015) and would be anticipated to recover during rest periods.

Mitigation: Current species composition, site-specific conditions, site history and conservation goals would be considered when applying management strategies. In addition, conditions identified in special use permits would be implemented to minimize and reduce the potential for adverse impacts. Incorporating buffer zones around sensitive areas and using or improving existing infrastructure would be applied. Activities would be spread across several areas so as not to overstress or overuse any one resource.

In remnant prairies, management actions would be limited to those that maintain soil structure, prevent negative impacts to plant-microbe or -invertebrate interactions and prevent the loss of organisms with specific habitat needs. Management actions for remnant prairies would be determined by vegetation quality, structure and composition. The refuge would annually assess units to determine the percent of native species present, identify new or increasing threats of invasive species and make informed management decisions. Planted grasslands would allow for more flexibility regarding management actions, and as such, there could be management strategies applied to planted grassland that would not be appropriate for remnant prairies (U.S. Fish and Wildlife Service, 2022).

Special use stipulations for grazing would include timing, duration, intensity and species of livestock (U.S. Fish and Wildlife Service, 2022). Rotational grazing or other systems would be used to avoid over-grazing treatments site. This would create periods in which the temporary negative effects of grazing (e.g., direct mortality and resource competition) would be absent (Morris, 1967), while still providing opportunities for high plant diversity and an open vegetation structure (van Klinke et al., 2015). As needed specific areas would be avoided through fencing or other means.

The refuge would protect habitat health by preventing, where possible, the introduction of invasive species and disease. Equipment used for haying and grazing would be required to be free of vegetation from previous work sites before entering the refuge. Permittees would be restricted to specific areas (i.e., established transportation routes) when using equipment.

Aquatic Species and Water Quality

Watershed land use practices, stream alterations and dam construction strongly influence hydrology and water quality within the refuge. The combined drainage area of the refuge covers 1,356 square miles and receives input from the Minnesota River, Little Minnesota River, Whetstone River and Yellow Bank River. Water entering the refuge through the Minnesota River is controlled by the Big Stone Lake Dam and the water exiting the refuge is controlled by the Highway 75 Dam. The purpose of the Big Stone Lake Dam is to regulate the level of Big Stone Lake within a relatively narrow range of water levels to meet the recreational, industrial and residential water use needs of the local area (U.S. Fish and Wildlife Service, 2012b; 2022).

Numerous dikes, levees and roads have been constructed perpendicular to the river corridor for the purpose of impounding water on the refuge. Most of the wetlands on the refuge occur within the floodplain of the Minnesota River. Several dikes and water control structures allow water level manipulations on about 3,500 acres of wetlands. The two primary impoundments are West Pool and East Pool and total 3,200 acres. The other five impoundments are smaller and collectively encompass approximately 285 acres of emergent marsh habitat. Temporary or seasonally flooded wetland depressions total 260 acres (U.S. Fish and Wildlife Service, 2012b; 2022).

Seventeen species of amphibians and reptiles have been documented on the refuge, and over 30 species of fish and 15 species of freshwater mussels have been identified (U.S. Fish and Wildlife Service, 2012b; 2022). Macroinvertebrates, such as amphipods and chironomids, are a critical food source for a wide variety of wetland dependent birds, especially during the breeding, nesting and brood-rearing periods (Krapu, 1979; Murkin and Wrubleski; 1988). Wetlands are managed to create quality habitat for waterfowl, marshbirds, shorebirds, wetland dependent passerines and raptors.

Impacts: Haying and grazing could impact both water quantity and quality. Potentially impacted aquatic ecosystems could include water bodies adjacent to or downstream from hayed or grazed areas including ponds, lakes, streams, rivers, moist soil units, marshes and wetlands. Eroded soil often enters surface water where it causes sedimentation and increases turbidity (Moore et al., 2019). Eroded sediments carry soil bound chemical contaminants, such as phosphorus and certain agricultural chemicals, to receiving water bodies (Moore et al., 2019).

Run-off from hayed or grazed areas carrying excess soil nutrients and sediments could adversely affect water quality and aquatic wildlife such as freshwater fish, invertebrates and amphibians. Research has shown that <0.2 inches of sediment could render aquatic macroinvertebrate egg banks non-viable (Gleason et al., 2003) and that as little as 0.1 inch of sediment could negatively affect the emergence of important wetland plant seedlings, such as sedges and rushes (Jurik et al., 1994). Conversely, sediment deposition could enhance the growth of certain problematic plant species. For example, the vegetation communities of silted-in wetlands often transition towards monotypic stands of non-native narrow-leaved and hybrid cattail (Kantrud, 1986).

Water flow across the ground is a naturally occurring process. Well-established vegetation helps slow water movement across the soil surface, which reduces soil erosion, runoff and impacts to water quality. Vegetation removal by haying or grazing could cause increased localized turbidity or erosion. Particulates would settle out of the water column, and water quality would improve once the disturbance had stopped. Haying and grazing would be managed as to not negatively decrease water quality more than existing runoff conditions. Any adverse impacts to aquatic resources would be temporary and site-specific.

Haying

Haying is unlikely to have any negative impacts on water quality. Plant material is removed a few inches above ground level and soil and roots remain undisturbed, limiting potential for runoff. Driving haying equipment through wet areas could result in rutting and soil disturbance. Haying typically occurs in drier areas because cooperators want to avoid getting their machinery stuck in mud. It may occur in wetlands to remove cattail dry matter (especially non-native/hybrid *Typha glauca*), but typically only in drought years.

Grazing

Grazing could have a variety of direct and indirect effects on water resources. Livestock directly impact shoreline or riparian habitat through vegetation removal and trampling, which could lead to changes in water quality. When vegetation adjacent to water bodies is removed, the reduction in shade could lead to an increase in water temperature and a decrease in dissolved oxygen (Platts, 1981; Rickard and Cushing, 1982). The loss of vegetative cover could reduce wildlife habitat and make banks more susceptible to erosion.

Trampling by livestock, especially cattle, which tend to congregate in flat areas near water (van Vuren, 1982), also contributes to erosion, soil compaction, bank sloughing and rutting (Strassman, 1987). These impacts to stream banks or lake margins could increase water turbidity and siltation (Strassman, 1987), which could decrease the amount of aquatic plant and animal food available to wildlife (Bue et al., 1964).

Mitigation: Conditions identified in special use permits would be implemented to minimize and mitigate impacts to aquatic species, their habitats and water quality. Review of special use permits would assess the amount of plant residue or grazing height that should be left to protect land soils from wind and water erosion, provide for plant health and regrowth and maintain appropriate riparian vegetation height to effectively trap sediment or other pollutants (U.S. Environmental Protection Agency, N/A).

Appropriate grazing management would maintain or improve the quality, quantity and age distribution of desirable vegetation. If necessary, livestock access to riparian zones, impoundments or lakes, wetlands and streambanks would be limited to protect these areas from physical disturbance. Livestock would be concentrated in specific areas to protect sensitive habitats from excessive use. Other riparian grazing management practices could include fencing, animal trails and walkways through or around sensitive areas and stabilized stream crossings. Providing water and salt supplements away from water resources would help keep livestock away from streambanks and riparian zones. Streambank restoration, exclusion fencing, stream buffer establishment and restoration of native vegetation would be used to reduce grazing-related impacts to stream banks, erosion, sedimentation and water pollution (U.S. Environmental Protection Agency, N/A).

Review of special use permits would assess the amount of plant residue or grazing height that should be left to protect land soils from wind and water erosion, provide for plant health and regrowth and maintain appropriate riparian vegetation height to effectively trap sediment or other pollutants.

Geology and Soils

The highly fertile soils in western Minnesota are a result of glacial till, glacial windblown sediment, and centuries of decomposed, deep rooted, tallgrass prairie plants. The refuge has 37 identified soil series, but most soils are loams formed from calcareous glacial drift. Extensive erosion exposed granite bedrock in several areas making “granite outcrops” a unique geological feature of the refuge (U.S. Fish and Wildlife Service, 2012a; 2022).

Impacts: Equipment used for haying and grazing could cause soil compaction, rutting and erosion. As objects move over the soil (e.g., tractors or animals), it becomes compacted by the weight, which decreases porosity and increases bulk density (Dormaar et al., 1989; Donkor et al., 2002; Douglas et al., 1992; Ford and Grace, 1998; Naeth et al., 1990; Villamil et al., 2001). The amount of compaction is dependent, in part, on soil water content at the time of contact with more compaction occurring under wetter conditions (Donkor et al., 2002; Dormaar et al., 1989; Naeth et al. 1990).

Plant species and the density of vegetative cover could alter soil processes directly via traits relating to litter production and chemistry, and indirectly via traits that influence microclimate (e.g., water usage, above ground biomass production; Mahaney et al., 2014). Land use practices that alter vegetation structure and composition, such as haying or grazing, could lead to changes in soil properties.

Haying and grazing would reduce vegetative cover, which could cause an increase in soil detachment through wind or water erosion. Most of the impacts would be short-term and limited to the time it takes to complete haying and grazing activities.

Haying

Haying is not known to affect the geology or soils when completed on an infrequent basis. There is potential that a large precipitation event immediately following the haying could dislodge soil and cause minor amounts of erosion. This would be small scale and very localized events. Haying is generally not completed on steep slopes as it is not safe for equipment.

Grazing

Large herbivores could have a substantial impact on soil properties such as altered levels of soil nutrients, pH values, water availability (Bakker et al., 2006; Milchunas and Lauenroth, 1993) and increased soil compaction (Murphy et al., 2004; Trimble and Mendel, 1995). Grazing could exert a greater pressure onto soils through animal hooves than tractor wheel pressure, creating higher bulk densities (Proffitt et al., 1993). Repeated trampling by livestock could also cause soil erosion and rutting (Strassman, 1987). Grazing would remove the amount of vegetation available to cushion rainfall (Ford and Grace, 1998; Naeth et al., 1990), intercept sediment flow (Lee et al., 2000; Martínez et al., 2006; Van Dijk et al., 1996) or protect against wind events, which could increase the impact on or remove topsoil (Murphy et al., 2004).

Changes in soil conditions could lead to changes in plant communities and microhabitats (Liddle, 1997). For example, when vegetation is permanently grazed short and bare soil is exposed, which often leads to a warmer microclimate in the vegetation and higher soil temperatures (van Klink et al., 2015).

Mitigation: Erosion would be reduced to tolerable rates through proper management. Tolerable soil loss would be the maximum rate of soil erosion that would permit indefinite maintenance of soil productivity (i.e., erosion less than or equal to the rate of soil development). Vegetation cover and managing for greatest species richness would protect against erosion by increasing water absorption capacity (Rixen and Mulder, 2005), improving soil structure and reducing runoff (Rey, 2003; Puigdefabregas, 2005; Durán et al., 2006a; 2007; Wainwright et al., 2002; Ziegler and Giambelluca, 1998). Any soil management practice that reduces soil disturbance and leaves more surface residue cover reduces the risk of soil erosion and transport and offers an opportunity for improved soil and water quality (Dinnes, 2004).

Best management practices would minimize soil detachment, erosion and sediment transport (U.S. Environmental Protection Agency, N/A). Soil detachment would be reduced by maintaining sufficient vegetative cover. Living vegetative cover (e.g., grasses) protects against soil detachment by creating a physical barrier which intercepts and dissipates the energy of falling raindrops (Bochet et al., 1998; Durán et al., 2007), creates a thick layer of still air next to the soil to buffer against wind erosion (U.S. Environmental Protection Agency, N/A) and reduces sediment flow and runoff.

Plants shelter and fix the soil with their roots, (Gyssels et al., 2005; de Baets et al., 2007a; b) reduce the energy of raindrops with their canopy. Also, vegetation could act as a physical barrier, altering sediment flow at the soil surface.

In the short term, vegetation influences erosion mainly by intercepting rainfall and protecting the soil surface against the impact of rainfall drops and by intercepting runoff.

__Air Quality__

Impacts:

Haying

Exhaust emissions from tractors and other farm equipment could temporarily decrease air quality. Due to the infrequency, limited duration and localized area of haying on the refuge, negative effects to air quality through slight increases in atmospheric pollution would be minimal and temporary. Air quality would improve once the emission-emitting equipment stopped operating. These effects would be negligible given the intensive agriculture surrounding refuge lands.

Grazing

Methane is produced in the digestive tract of ruminant livestock (e.g., cattle; Lassey, 2008) and native grazers (e.g., bison). Grazing could increase methane production on the refuge, which could decrease air quality. Due to the small herd size and long-term benefits to vegetation and soil structure, negative effects to air quality through slight increases in atmospheric pollution would be unlikely in the long-term. Large herds of native grazers (e.g., bison) used to number in the millions across the tallgrass prairie region. Today, methane concerns due to livestock are largely a result of over grazed landscapes, crowded free-stall barns and the expansion of cattle into areas that were not formerly grassland (e.g., Amazon rainforest). Grass-fed cattle are on the decline in western Minnesota as a result of land conversion to cropland. Air quality impacts would be negligible.

Mitigation: Haying and grazing stimulate grass growth, with primary productivity accumulating in root matter, which takes potential pollutants out of the air and stores them permanently underground.

Visitor Use and Experience

Big Stone National Wildlife Refuge conducts a broad array of wildlife and habitat management activities while also providing for a variety of visitor services. The refuge maintains hunting programs for small, upland and big game species in accordance with state seasons and regulations. No migratory game bird hunting is allowed on the refuge. The entire refuge is open to fishing wherever foot access is possible. Wildlife observation activities account for the majority of visitation that occurs on the refuge each year. Auto tour routes, drives and hiking trails are the primary infrastructure associated with this use (U.S. Fish and Wildlife Service, 2012a).

Impacts: Haying and grazing or the presence of livestock could interrupt some visitor uses in or near actively managed areas. These activities could temporarily disrupt visitor experiences but would be limited to the time it takes for haying and grazing to occur. Interruptions would be infrequent and minimal but could include temporary closures to areas generally open to the public, increased vehicle traffic, increased noise from machinery, equipment or livestock and disruption to wildlife dependent recreation (e.g., displacing wildlife for observation and photography). This disturbance would temporarily displace visitors to other parts of the refuge until operations were completed. Haying and grazing could temporarily detract from the aesthetics of an area but would improve once revegetation begins and livestock are removed. Alternatively, the presence of native grazers would likely enhance the prairie aesthetic and could provide a unique viewing opportunity for visitors. Roads would be shared by the public and farming equipment during haying and grazing operations.

Mitigation: This use would take place in a controlled area of the refuge as haying and grazing would occur on no more than 30% of the refuge at any one time. Enough locations would remain open to visitors to minimize the impact to recreational opportunities. The limited acreage and scattered nature of the haying and grazing would mitigate most natural resources and visitor conflicts.

Cultural Resources

Much of what is known about the prehistoric human occupations or visitations of the Refuge and surrounding area is drawn from a 1987 cultural resources survey report (Roetzel et al., 1987). To date, few archeological sites and artifacts have been discovered on the refuge (U.S. Fish and Wildlife Service, 2012a). A handful of petroglyphs have been found on granite outcrops, but these are not likely to be impacted by these activities

Impacts: No impacts to cultural resources would be expected through haying and grazing.

Mitigation: Planning for haying and grazing and issuance of special use permits would include clearance from the Regional Historic Preservation Officer for any ground disturbing activities and communication and/or consultation with the regional tribal coordinator.

All management actions would stop immediately if unknown or unanticipated cultural resources were discovered. The Regional Historic Preservation Officer would be contacted as soon as possible to ensure compliance with the National Historic Preservation Act.

Refuge Management, Operations and Administration

Haying and grazing would not be expected to interrupt refuge management activities. The staff time needed to develop and administer a farming program would have already been committed and available. The work would be completed as part of the routine management duties of district personnel. No special equipment, facilities or improvements would be necessary to support the use.

Socioeconomics

According to the 2009 U.S. Census, the population of the seven counties overlapping with or near the refuge was 58,574 (U.S. Census Bureau, 2010). From 2005-2009 educational services, health care and social assistance accounted for 21.7% of employment. Agriculture, forestry, fishing, hunting and mining accounted for about 12% of jobs in the area. Retail trade, manufacturing and construction were also important employers and contributors to the local economy (U.S. Census Bureau, N/A)

Impacts: Haying would result in a direct economic benefit to the cooperator through revenue generated by crop sales. Grazing would provide an indirect economic benefit to the cooperator through forage provided by refuge lands. Haying and grazing would have a modest economic return on local communities within the district from the purchase of seed, herbicide and other farming-related costs.

Environmental Justice

Haying and grazing would not disproportionately place any adverse environmental, economic, social or health affects onto minority and low-income populations. Cooperators would be selected using a competitive bid process (620 FW 2; U.S. Fish and Wildlife Service), which would provide equal access to farming opportunities across all demographics. The percentage of minorities in west-central Minnesota counties is lower than greater Minnesota, and average incomes and poverty rates within the counties are comparable to other rural counties in the state (U.S. Fish and Wildlife Service, 2012a).

Flood Plains

Haying and grazing would occur in a floodplain, but associated activities would not contribute to flood damage or negative impacts. Mitigation and avoidance measures outlined in this document and the comprehensive conservation and habitat management plans would be followed to reduce potential impacts.

Long-term impacts

This compatibility determination includes the written analyses of the environmental consequences on a resource only when long-term impacts on that resource could be more than negligible and therefore considered an “affected resource.” Threatened and endangered species, special status species, aquatic species, visitor use and experience, refuge management, operations and administration, socioeconomics, environmental justice and floodplains would not be more than negligibly impacted by the action and have been dismissed from further analyses. Mitigation measures would limit potential negative long-term impacts.

The use of haying and grazing as a habitat management tool provides long-term benefits across Big Stone National Wildlife Refuge such as:

1. The restoration, management and protection of diverse native communities of tallgrass prairie, wetland, riparian and granite outcrop habitat to enhance the vitality and health of the natural environment;
2. The enhancement and maintenance of habitats for biologically diverse and abundant populations of native fish and wildlife; and
3. Wildlife-dependent recreational and educational opportunities for visitors to experience native tallgrass prairie heritage, ecological processes and cultural resources (U.S. Fish and Wildlife Service, 2012a).

Wildlife Species

Positive long-term (i.e., more than two years) impacts could compensate for potentially adverse, short-term (e.g., one year) impacts (described in the Short-Term Impacts Section; Lawrence and Johnson, 2016). For example, periodic treatments to remove cover on designated areas through haying and grazing would maintain ideal long-term ecological conditions for upland nesting birds. Upland nesting ducks prefer tall, dense residual vegetation, which could be maintained through haying or grazing. Short-term haying or grazing disrupts vegetative succession and restores vigor to management areas by establishing preferred vegetation height, diverse plant structure and large tracts of habitat (Kirsch et al., 1978; U.S. Fish and Wildlife Service, 2022). If these practices occur in a patchy distribution within a field, across the landscape and through time, a mosaic of grassland successional stages could sustain a wider array of species. Irregular management will result in a greater variety of grassland successional stages and provide for a wider array of species (Jones-Farrand et al., 2007).

Carefully controlled grazing and haying could be beneficial to a variety of grassland-dependent species (Holechek et al., 1982). Periodic treatments to remove cover on designated areas through haying and grazing would maintain ideal long-term ecological conditions for upland nesting birds. Upland nesting ducks prefer tall, dense residual vegetation, which could be maintained through haying or grazing (Jones-Farrand et al., 2007). Woody vegetation in prairie habitats could negatively affect grassland birds (Bakker, 2006) and removing invasive and planted trees through haying and grazing would improve habitat long-term (U.S. Fish and Wildlife Service, 2022).

Habitat and Vegetation

The primary goal for remnant prairies would be to conserve a core area of native grassland to maintain and increase the ecological integrity of the habitat. The main goals for planted grasslands would be to increase grassland patch size, increase the composition of native plants, reduce invasion of non-native species and provide a buffer between remnant prairies and the surrounding landscape. The refuge would focus on enhancing all planted grasslands to exhibit conditions similar to those of remnant prairies. Planted grasslands could provide breeding, nesting or foraging habitat requirements for grassland dependent species, such as bobolink and grasshopper sparrow (U.S. Fish and Wildlife Service, 2022).

Evidence suggests that habitats could not be maintained in long-term high vegetative condition without periodic disturbance (Dixon et al., 2019). Grazing by domestic livestock has desirable long-term impacts on grassland communities by reducing unwanted invasive grasses and woody vegetation as well as promoting diverse forb diversity (U.S. Fish and Wildlife Service, 2022). Grazed lands could serve as an important conservation tool by providing habitat for wildlife outside of formally protected areas and preserving open space and connectivity in ecosystems (Food and Agriculture Organization, 2009; du Toit et al., 2010). Managed grazing at light to moderate levels could positively impact rangeland vegetation compared to grazing exclusion (Holechek et al., 2006).

Water Quality, Geology and Soils

Managing and restoring grassland habitats through haying and grazing would develop healthy soils and improve water resources long-term. An increase in vegetation diversity and complexity would improve soil-aggregate stability and cohesion and improve water filtration (Zuazo et al., 2008), which would reduce the susceptibility of these areas to erosion and runoff.

Cultural Resources

Efforts to restore native grazers (e.g., bison) to the native landscapes have received growing national and international attention due to the intimate connection between bison and the native communities that relied upon them for their sustenance, shelter, and cultural and religious practices. Additionally, bison are recognized as an iconic species of the American West and the United States as a whole (U.S. Department of the Interior, 2023; S.O. 3410).

Public Review and Comment

The draft compatibility determination will be available for public review and comment for 30 days (June 10, 2024) to (July 15, 2024). The public will be made aware of this comment opportunity through newspapers, radio, postings at local libraries, letters to potentially interested people such as adjacent landowners, states and tribes, public meetings, federal register, or other places and media outlets. State and Tribes have been asked to review and comment onthe draft compatibility determination. A copy of this document will be posted at the Refuge Headquarters or Visitor Center (44843 County Hwy 19, Odessa, MN 56276). It will be made available electronically on the refuge website (https://www.fws.gov/refuge/big-stone). Please let us know if you need the documents in an alternative format. Concerns expressed during the public comment period will be addressed in the final Compatibility Determination.

Determination

Is the use compatible?

Yes

Stipulations Necessary to Ensure Compatibility

To ensure compatibility with the National Wildlife Refuge System Improvement Act and refuge establishing purposes, goals and objectives, haying and grazing could only occur under the following stipulations:

General

1. Permission to hay or graze refuge lands will be authorized through the issuance of a special use permit.
2. Haying and grazing activities must meet specific habitat and wildlife objectives and contribute to the purposes of the Big Stone National Wildlife Refuge.
3. Haying and grazing activities will follow best management practices and conditions of the special use permit and/or cooperative agriculture agreement as established by the refuge.
4. Cooperative agreements administered through special use permits will be limited to five years or less.
5. Special use permits will address unique local conditions and restrictions as applicable.
6. All cooperators and special use permits will adhere to Region 3 haying and grazing guidance and U.S. Fish and Wildlife Service policy.
7. Haying and grazing activities will be restricted to minimize wildlife disturbance.
8. Cooperator equipment must be cleaned prior to entering the refuge to prevent the spread of invasive plant species and will be subject to inspection.
9. Cooperator vehicles and equipment will be limited to existing trails, roads or identified access points to protect soils and vegetation unless otherwise approved by the refuge manager on a temporary or emergency need.

Haying

1. Haying of a single area will occur no more than once per year to allow for pollinator populations, other wildlife and vegetation to recover unless there is a specific management objective identified in a refuge plan or a written justification by the project leader is attached to the current compatibility determination.
2. Most haying will begin after July 15 to minimize disturbance to ground-nesting birds. In some years it may be necessary for haying to occur before July 15 to prevent seed dispersal of undesirable plant species.
3. Windrowed grass left lying to dry prior to baling must be raked and moved every two days if left on newly seeded native grass.
4. Bales must be removed from the Refuge within 7 days of baling.

Grazing

1. Grazing will occur no more than three out of five years on any tract unless there is a specific management objective identified in a refuge plan or a written justification by the project leader is attached to the current compatibility determination.
2. Control and maintenance of livestock will be the responsibility of the permittee.
3. All livestock grazing will be conducted under strict control of a special use permit.
4. All fencing, water supply and other livestock management infrastructure needs will be the responsibility of the permittee and outlined in a special use permit.

5. No insecticides will be applied to refuge lands.
6. No supplemental feeding of livestock will be allowed.
7. The needs of pollinators and other wildlife will be considered when placing grazing infrastructure on the landscape such as salt/mineral blocks, watering tanks and holding corals.

Justification

The stipulations outlined above would help ensure that the use is compatible at Big Stone National Wildlife Refuge. Haying or Grazing, as outlined in this compatibility determination, would not conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge. Based on available science and best professional judgement, the Service has determined that grazing and haying at Big Stone National Wildlife Refuge, in accordance with the stipulations provided here, would not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission, or the purpose of the Big Stone National Wildlife Refuge. Rather, appropriate and compatible Grazing and Haying would be the use of the Big Stone National Wildlife Refuge through which the public could develop an appreciation for wildlife and wild lands.

Signature of Determination

Refuge Manager Signature and Date

Signature of Concurrence

Assistant Regional Director Signature and Date

Mandatory Reevaluation Date

2034

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Figure(s)

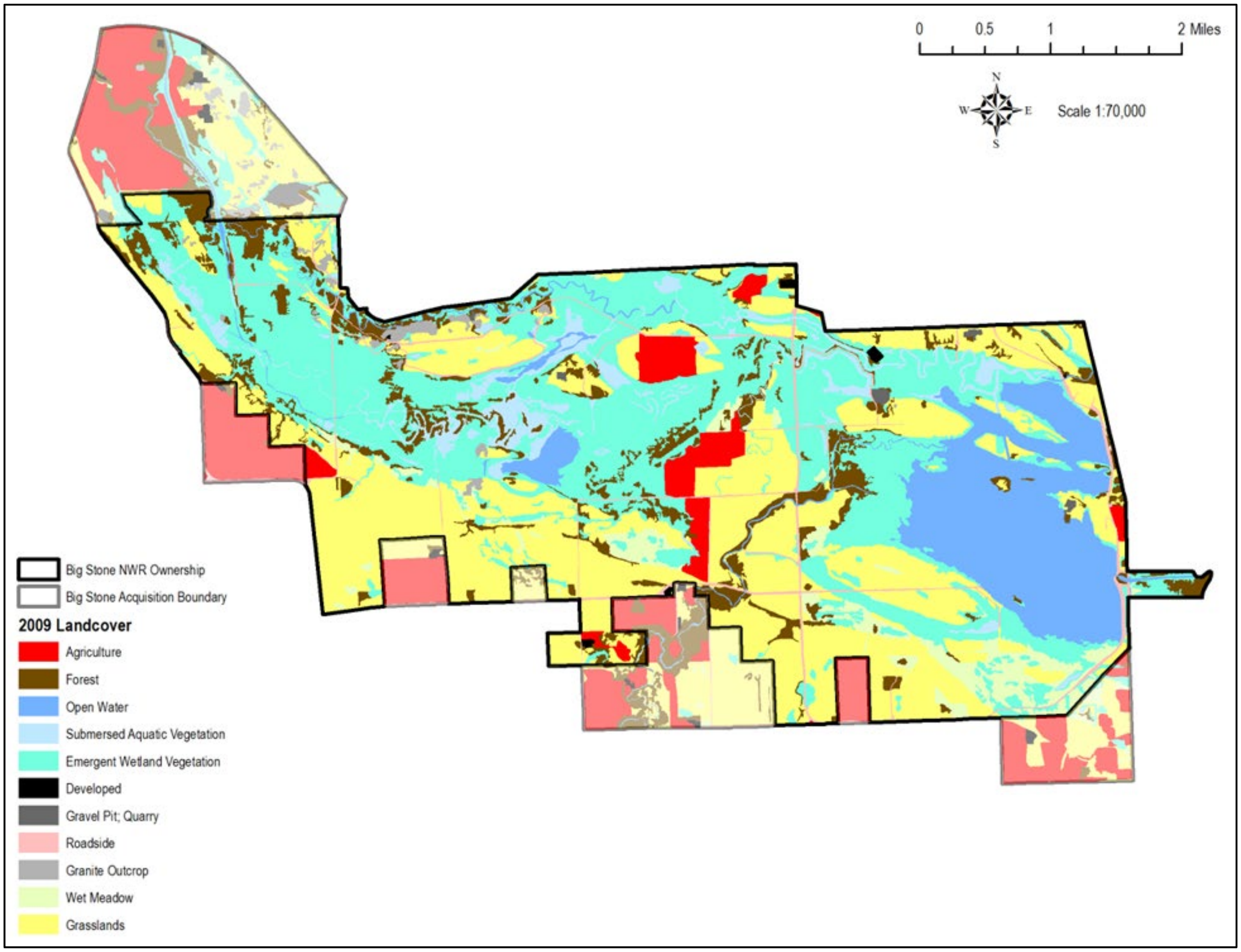

Figure 1. The above image provides a breakout of the different land cover types found on Big Stone National Wildlife Refuge.