Chapter 4. Affected Environment

The complex includes three refuges and 79 waterfowl production areas scattered throughout Burleigh, Emmons, and Kidder counties, located in the south-central part of the State. Long Lake NWR serves as the complex's headquarters and largest parcel of land. The refuge is situated in the partially buried valley of the ancestral Cannonball River and is part of the Missouri Coteau physiographic region and the Collapsed Glacial Outwash ecoregion.

This ecoregion's topographic variation is the result of gravel and sand deposited by glacial melt-water and precipitation runoff over stagnant ice, and it is characterized by many large, alkaline lakes. The refuge consists of gently rolling native uplands, tamegrass fields, scattered tree plantings, and numerous temporary, seasonal, and semi-permanent natural wetlands, in addition to a 16,000-acre impoundment. Refuge wildlife consists of a wide variety of wetland- and grassland-dependent species, as well as a lesser number of arboreal species. This chapter describes the complex's environmental resources that may be affected by the implementation of the CCP.

The complex's other fee-title lands are located in the Coteau Slope physiographic region (25 WPAs) and the Missouri Coteau physiographic region (two refuges, 54 WPAs). In addition to the Collapsed Glacial Outwash ecoregion (two refuges, 43 WPAs), fee-title lands are also located in the Missouri Coteau Slope (nine WPAs), Missouri Coteau (26 WPAs), and River Breaks (one WPA) ecoregions. The northeastern one-third of the complex is comprised of the Missouri Coteau ecoregion, which has a higher density of wetlands, fewer streams, and more varied topography than the Missouri Coteau Slope ecoregion that lies to the south and west. The River Breaks ecoregion makes up only the western-most portion of the complex and consists of broken terraces and uplands that descend to the Missouri River and its major tributaries. Although the frequency of occurrence and density of certain wildlife species does vary somewhat between the complex's two physiographic regions and four ecoregions, the same principal wildlife species occur across all Service lands throughout the complex.

The area included in the complex exhibits a negative precipitation:evaporation ratio and therefore, is considered semi-arid (Rau et al. 1962, Kume and Hansen 1965) and is characterized by relatively short, hot summers and relatively long, cold winters (Kantrud et al. 1989). Temperature fluctuates both seasonally and daily. Summer temperatures occasionally climb above 100 °F, while winter temperatures may drop to -30°F, with wind chills as low as -100°F. The annual average number of days with maximum and minimum temperatures of ≥90°F and ≤32°F, respectively, is 25 and 73. The growing season, defined as the long-term average number of consecutive days that the minimum temperature does not fall below 32°F, ranges from 99–47, which correlates well with an average frost-free period of 120 days reported for the central portion of the State (Winter et al. 1984). Average annual total precipitation is 16 inches, of which 73 percent occurs from May to September. During the summer, most rainfall is associated with thunderstorms (average of 25–30 days/year; Shjeflo 1968). In contrast, average monthly precipitation during winter is only 0.95 inches and occurs mostly as snow.

Geology and Soils

Surface bedrock composition in Burleigh and Kidder counties is somewhat similar, with the former having a slightly more diverse composition than the later. Surface bedrock across the two-county area includes the Late Cretaceous Pierre (marine shale), Fox Hills (marine sandstone), and Hell Creek (sandstone, mudstone, siltstone, lignite, carbonaceous shale) formations, as well as the Tertiary Paleocene Fort Union Group consisting of the Ludlow (continental sandstone, lignite, and shale), Cannonball (marine sandstone, siltstone, shale, and limestone), and Tongue river (continental sandstone, claystone, siltstone, shale, limestone, and lignite) formations (Kume and Hansen 1965).

Glacial till material that overlies the bedrock in Burleigh and Kidder counties is similar with respect to physical characteristics (Rau et al. 1962, Kume and Hansen 1965). In Kidder County, most of the till has reddish-yellow spots caused by oxidation of iron oxide and a white mottling caused by concentration of calcium carbonate (Rau et al. 1962). Burleigh County till is oxidized to depths of 20–30

feet and exhibits a mottled appearance due to calcium carbonate concentrations. Additionally, free pebbles are typically encrusted with caliche and particles of shale and lignite are common (Kume and Hansen 1965). Conversely, glaciofluvial sediments in both counties are comprised primarily of stratified sands and gravel that range in size from fine sand to pebbles, whereas glaciolacustringe sediments primarily consist of clays and silts.

The principal parent materials of soils on Long Lake NWR, Slade NWR, and Florence Lake NWR are glacial outwash, glacial till, and sediments of glaciofluvial and glaciolacustrine origin. Soils on these three refuges belong to more than 20 series and nine subgroups (Stout et al. 1974, Seelig and Gulsvig 1988). The 20 soils series form 10 associations (i.e., areas with a proportional pattern of soils that normally consist of one or more major soils and at least one minor soil) that make up the terrestrial land base of the refuges. Of these, the dominant associations on all three refuges are loams and sands derived from glacial outwash and till that are generally deep, medium to moderately coarse in texture, range in available water capacity from very low to high, and are susceptible to erosion by either water or wind (Stout et al. 1974, Seelig and Gulsvig 1988). The soils that underlie Long Lake NWR's uplands are clays and sands, compared to a sand-silt mix on Slade NWR, and sandy loam underlain by gravel on Florence Lake NWR. Nearly all soil associations found throughout the three refuges can be characterized as nearly level to rolling or gently rolling.

Water Resources

Surface Water

The Long Lake Creek watershed is the primary source of supply for Long Lake NWR. This watershed has a contributing area of approximately 460 square miles. Annual evaporation in the area is 33 to 40 inches and average annual precipitation is approximately 16 inches. This yields a negative precipitation: evaporation ratio in areas administered by the complex and a subsequent semiarid designation. Water levels in Refuge impoundments are greatly dependent on spring runoff.

A series of dikes with control structures impound approximately 15,000 acres of wetlands in three water management units when at capacity. These impoundments have a maximum depth of six feet and an average depth of less than three feet. Gaging stations operated by USGS monitored flows into the Refuge from Long Lake Creek south of the refuge boundary and out of the refuge in the overflow channel for a relatively short period of time. Because there are a number of other small tributaries that provide other surface water supplies which are ungaged, there has never been an accurate accounting of water supplies other than to determine that the Long Lake Creek Watershed contributes approximately 68 percent of the water for Long Lake.

Long Lake captures surface water from several minor tributaries and watersheds during periods of runoff in impoundments referred to as unit 2 Marsh, G-12, G-19, and G-19a. Other water management units have been developed on WPAs and satellite refuges where tributaries and watersheds allow for the capture of runoff. These impoundments function as small artificial freshwater wetlands. Overwhelmingly, surface waters occurring under the jurisdiction of the complex exist as natural, undeveloped wetland basins.

Background

Prior to being established as a refuge in 1932, Long Lake was a relatively shallow (elevation ranges from 1,710 feet–1,716 feet above MSL), alkaline lake that exhibited dynamic water level fluctuations, based on variable seasonal and annual surface water inputs (e.g., rainfall, snowmelt runoff). Although speculative, during years of low inflow, surface water likely was not discharged from the lake and was lost only by evaporation and transpiration (Laubhan et al. 2006). However, in years of high inflows, surface waters breached a natural sill and water was discharged downstream.

Although the valley encompassing Long Lake NWR retains many historic features, the area has been modified by both ongoing natural processes and anthropogenic forces. Perhaps the greatest change that has impacted the NWR is hydrologic alteration aimed at reducing the occurrence of botulism. In the mid–1930s the Civilian Conservation Corps (CCC) built three earthen dikes (denoted as A, B, and C) in order to improve the water management capability of Long Lake. At their present level (1,720ft above MSL), these dikes have raised the full pool level more than three feet above its historic elevation, creating three separate management units (denoted as unit I, unit II, and unit III) which make up the >17,000 acre

impoundment (acreage includes nonrefuge portions of Long Lake).

Groundwater
Essentially all water in this region is derived from precipitation; however, a portion of this water either enters the ground through direct or indirect percolation or is transported along the ground surface to topographically lower areas. For example, many river and stream valleys function to collect excess surface water that cannot be absorbed into soils at local scales. In general, groundwater is abundant in both Burleigh and Kidder counties (Rau et al. 1962, Kume and Hansen 1965,); however, the amount of groundwater recharge that occurs varies locally and depends on numerous factors, including topography, climatic variables (e.g., precipitation and temperature patterns), and soil characteristics (e.g., available water capacity). In general, groundwater recharge tends to be greatest during periods of major precipitation that result in large amounts of surface runoff (Randich and Hatchett 1966).

Additionally, since the mid-1990s, the acreage of planted potatoes has increased dramatically in certain parts of the State, including Kidder County. For example, in 1995, 1,300 acres of potatoes were planted in Kidder County. By 2000, this acreage had increased to 7,500 acres (USDA 2002). Along with these increases in potato production have come an equally large increase in irrigation (100 percent of all Kidder county potato fields have been irrigated since 1995; USDA 2002). Consequently, irrigation systems have been installed in the uplands directly adjacent to wetlands protected by easements. In 2001 Euliss et al. (2003) conducted a study to determine the impact of ground-water pumping on a single protected (easement) wetland in Kidder County. Although Euliss et al. (2003) were not able to observe a reduction in the length of time that the easement wetland contained water in 2001 that could be directly related to pumping of groundwater (likely due to the relatively small amount of pumping that occurred in 2001 and the difficulty in separating pumping-induced drawdowns from natural drawdowns observed in control [reference] wetlands), they did document altered wetland hydrology during irrigation events. During pumping the treatment wetland changes from a ground-water flow-through wetland to a "recharge" wetland. Pumping in the treatment wetland also altered the chemical characteristics (e.g., salinity) of the treatment wetland. In summary, Euliss et al (2003) recommend that if the goal of purchasing wetland easements is to protect the unique biotic and abiotic characteristics of these wetlands for the benefit of waterfowl and other wildlife species then actions that alter the natural hydrological characteristics (i.e., pumping for agricultural irrigation) should be avoided whenever possible.

Wetlands
Wetlands are lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface (Cowardin et al. 1979). It is estimated that the contiguous United States contained 221 million acres of wetlands just 200 years ago (Dahl1990). By the mid-1970s only 46 percent of the original acreage remained (Tiner 1984). Wetlands now cover about five percent of the landscape of the lower 48 states. Wetlands are extremely productive and important to both migratory and resident wildlife. They serve as breeding and nesting habitat for migratory birds and as wintering habitat for many species of resident wildlife. Humans also benefit from wetlands as these habitats improve water quality and quantity, reduce flooding effects, and provide areas for recreation.

Wetlands are classified using a number of attributes including vegetation, water regimes (the length of time water occupies a specific area), and water chemistry. Prairie potholes are described using the following nontidal water regime modifiers (Cowardin et al 1979):

- Temporarily flooded—surface water is present for brief periods during the growing season. The water table usually lies below the soil surface most of the season, so plants that grow in both uplands and wetlands are characteristic.
- Seasonally flooded—surface water is present for extended periods especially early in the growing season, but is absent by the end of the season in most years. When surface water is absent, the water table is often near the surface.
- Semi-permanently flooded—surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land surface.
- Permanently flooded—water covers the land throughout the year in nearly all

years. Vegetation is composed of obligate hydrophytes, such as cattails.

Even though drainage and other wetland-decimating factors have taken their toll, wetlands are still a prominent feature of the landscape within the complex. Wetlands within the complex occur in a diverse distribution of sizes, types, locations, and associations. The National Wetland Inventory (NWI) has identified 396,105 wetland acres in the wetland management district.

The chemistry of surface waters in wetlands tends to be dynamic because of complex interactions among numerous factors, including the position of the wetland in relation to groundwater flow systems, chemical composition of groundwater, surrounding land uses, and climate (LaBaugh et al. 1987, Swanson et al. 1988, Winter 2004).

The gradient from fresh to hypersaline water is a continuum, and any divisions are arbitrary (Euliss et al. 2004). In addition, salinity levels can fluctuate widely within and among seasons (Stewart and Kantrud 1972). In general, however, surface water in temporary and seasonal wetland basins is usually fresh or slightly brackish (~ <0.8 mS/cm), whereas semi-permanently flooded basins are often brackish (~ 2.0–15 mS/cm), but can range from fresh to subsaline (~ >15 mS/cm) (Stewart and Kantrud 1971).

Although the general effect of increased salinity in any zone of wetland vegetation is a decrease in species diversity, it is difficult to establish meaningful salinity tolerances for individual species in their natural habitats because of the complex interaction of abiotic factors. However, general estimates of the tolerance of many emergent and aquatic plant species to salinity are available (Kantrud et al. 1989).

Water Rights

The following section is a summary of water rights associated with complex lands:

Long Lake NWR holds water rights filed February 17, 1936, claiming 47,955 acre-feet of storage and an additional seasonal use of 51,100 acre-feet. This water right covers water stored and seasonal use to an elevation of 1713.5 feet above MSL.

Long Lake NWR also holds Perfected Water Right # 5549P priority date June 1, 1942, for an additional 21,993 acre-feet of storage and 2,410 acre-feet of annual use from surface water of Long Lake Creek a tributary of Apple Creek. This water right covers the additional water stored and seasonal use to an elevation of 1,716 feet above MSL, the elevation in which facilities were raised during construction of refuge impoundments, which occurred in 1942.

G-19 dam on Long Lake NWR holds a water right/permit # 4628 allocating 70 acre-feet, of which 53 acre-feet will be used to offset evaporative losses. The permit was granted with an exception to the one-time fill rule.

G-19a dam on Long Lake NWR holds a water right/permit # 4249 allocating 88.5 acre-feet, of which 48 acre-feet will be used to offset evaporative losses. The permit was granted with an exception to the one-time fill rule.

G-12 dam on Long Lake NWR holds water right/permit # 4505 allocating 252 acre-feet, 129 acre-feet for storage and 123 acre-feet to offset evaporative losses. The permit was granted with an exception to the one-time fill rule.

Unit 2 marsh on Long Lake NWR holds water right/permit # 3812 allocating 410 acre-feet of storage and 629 acre-feet of seasonal use.
Lake George NWR holds water right dated August 30, 1937, for 773 acre-feet of storage and 468 acre-feet of seasonal use.

Sunburst Lake NWR holds a water right dated September 25, 1964, perfected permit # 1243 for 33 acre-feet of storage and 49.5 acre-feet of storage of seasonal use for a total of 82.5 acre-feet of storage. (Horsehead Creek watershed).

Sunburst Lake NWR holds water rights dated September 1, 1934, for 65.8 acre-feet of storage with additional 47.1 acre-feet for seasonal use (Horsehead Creek watershed).

Slade NWR holds water right # 1259P dated December 21, 1942, for storage to elevation 1,724 feet above MSL with additional 291 acre-feet seasonal use (tributaries to Lake Isabel).

Slade NWR holds water right # 1260P dated December 21, 1942, for storage to normal elevation with additional 1695 acre-feet seasonal use (tributaries to Lake Isabel).

Appert Lake NWR holds water rights dated September 1, 1934, for 365 acre-feet of storage with

additional 309 acre-feet of seasonal use (Long Lake Creek/Missouri River watershed).

Springwater NWR holds water rights dated September 1, 1934, for 64 acre-feet of storage with additional 48 acre-feet of seasonal use. (Clear Creek watershed).

Canfield Lake NWR holds water rights dated September 1, 1934, for 872 acre-feet of storage with additional 654 acre-feet of seasonal use (Apple Creek/Missouri River watershed).

Hutchinson Lake NWR holds water rights dated August 30, 1937, for 90 acre-feet of storage with additional 90 acre-feet of seasonal use (Missouri River watershed).

Florence Lake NWR holds water rights dated September 1, 1934, for 300 acre-feet of storage with additional 300 acre-feet of seasonal use (Missouri River watershed).

Rath WPA holds water rights permit # 4665 dated October 28, 1992, for 157 acre-feet out of which 108.6 acre-feet is for seasonal use (Apple Creek watershed).

The Long Lake WMD holds 1,036 wetland easement contracts protecting 102,646 acres of naturally occurring wetlands.

Vegetation Communities

Wetlands and Associated Vegetative Communities

Wetlands throughout the complex provide both resting cover and food resources for migratory birds. Substantial emergent and submergent acquatic vegetation occurs in freshwater wetlands. Sago pondweed, coontail, and duckweed occur in the deeper, more permanently flooded zones, while cattail, bulrush, burreed, and smartweed grow in shallow areas that may go dry due to a drawdown. Salinity is a limiting factor for wetland plants in individual wetlands scattered throughout the complex. As salinity increases, it limits the growth of certain wetland plants as levels approach and/or exceed an individual species' tolerance level.

Most palustrine basins exhibit concentric zones of vegetation that are dominated by different plant species (Kantrud et al. 1989). The terms commonly used in reference to these zones are, in decreasing order of water permanency, deep marsh, shallow marsh, and wet meadow (Kantrud et al. 1989). The water regime in a deep marsh zone is usually semi-permanent. Dominant plants include cattail, bulrush, submersed or floating plants, and submersed vascular plants, but this zone also may be devoid of vegetation if bottom sediments are unconsolidated. Shallow marsh zones are usually dominated by emergent grasses, sedges, and some forbs, but submersed or floating vascular plants also may occur. Wet meadow zones also are typically dominated by grasses, rushes, and sedges, whereas submersed or floating plants are absent.

Management of wetlands in the complex where facilities have been developed simulates natural (i.e., historic) wet/dry cycles by raising and lowering water levels to meet specific management objectives. This encourages emergent and submergent acquatic vegetation growth, increases invertebrate biomass, improves water clarity, breaks down and cycles accumulated nutrients in bottom sediments, and augments control of common carp. Extensive mudflats are created when wetlands are in the initial drawdown phase. Mudflats provide optimal feeding opportunities for migrating shorebirds, wading birds, and other waterbirds.

The wetland easement program has provided perpetual protection for 102,646 acres of wetlands on private lands in the wetland management district. This has secured a landscape-level habitat base for migratory birds. While normal farming practices may have essentially erased some of the smaller, temporary, and seasonal wetland basins, most of the habitat that has been protected remains intact. Improved GIS technology and landscape modeling have guided the effort to protect essential wetlands to priority areas where those measures have potential to influence migratory bird resources the most (see figures 11, 12, and 13; Long Lake NWR, Florence NWR, and Slade NWR habitat maps at the end of this chapter).

Uplands and Associated Vegetative Communities

Upland vegetation is essential in order to provide nesting habitat for migratory and resident bird species. Upland habitats also provide necessary habitat requirements for resident wildlife throughout the year. The grassland easement program has provided perpetual protection for 41,181 acres of privately owned grassland in the wetland management district. The program is in its infancy and continues to expand the acreage

protected annually. While these lands are often not in optimum condition, they provide a secure landscape-level habitat base. Conversely, fee-title lands sometimes offer an opportunity to provide habitat, which is in optimal condition. The complex currently uses a variety of management techniques to maintain and enhance upland habitat conditions on fee-title uplands including the use of prescribed fire, grazing, haying, native grass seeding, and invasive species management.

During the 1930s, large fields formerly planted to crops were planted with nonnative grasses including smooth brome, crested wheatgrass, and Kentucky bluegrass species to minimize soil erosion.

In the early 1970s, habitat management techniques were developed to provide dense nesting cover for waterfowl. Several areas on the refuge were planted to grass species such as tall and intermediate wheatgrass, sweet clover, and alfalfa. These fields initially provided good cover for nesting birds; however, over time they deteriorated and were prone to invasion by Canada thistle and other problem species (e.g., smooth brome). The complex has begun the process of restoring these grasslands to native grasses and forbs. The native grass restoration process generally involves cropping the field for three or more years to eliminate exotic cool season grass seeds and rhizomes, control Canada thistle and other noxious weeds, and prepare a seed bed for planting native grass seed.

Uplands were historically comprised of warm-season grasses characteristic of the short-grass prairie to the west, and the cool- and warm-season grasses characteristic of the tall-grass prairie to the east (Samson et al. 1998); thus, the area represented a zone of ecotonal mixing that included a diversity of short-, intermediate-, and tall-grass species (Bragg and Steuter 1996). Vegetation composition at regional and local levels was determined by numerous interrelated factors, including elevation, topography, climate, soil characteristics, herbivory, and fire (Hanson and Whitman 1938, Coupland 1950). Based primarily on vegetation and topography, the mixed-grass prairie in the State has been classified into nine major types (Hanson and Whitman 1938). Species typical of the mixed-grass prairie in the State include western wheatgrass, blue grama, prairie junegrass, needle and thread, sandberg bluegrass, little bluestem, needleleaf sedge, and threadleaf sedge (Whitman 1941, Kantrud and Kologiski 1982).

However, even within a classification, local variation exists. For example, in xeric areas the blue grama-needle and thread-threadleaf sedge association also includes western wheatgrass, prairie junegrass, and needleleaf sedge as less important dominant grasses, as well as about 12 dominant forbs (e.g., lotus milkvetch, narrowleaf goosefoot, scarlet beeblossom, flatspine stickseed, stiffstem flax, spiny phlox, woolly plantain; Hanson and Whitman 1938, Coupland 1992). In contrast, more mesic areas in the same association supported more slender wheatgrass, fendler threeawn, sideoats grama, little bluestem, porcupine grass, green needlegrass, and sun sedge, whereas dominant forbs included tarragon, prairie sagewort, white sagebrush, blacksamson echinacea, and white milkwort (Sarvis 1920). Further, grasses in the genus Bouteloua, Stipa, and Carex are dominant on sandy loams and fine sandy loams that typically occur on topographically high areas. In contrast, species such as inland saltgrass, Nuttall's alkaligrass, and foxtail barley tend to occur more often in depressional areas with silt loams and silty clay loams characterized by increased soil moisture and high concentrations of carbonates and soluble salts (Hanson and Whitman 1938).

Shrub and Tree Plantings (Shelterbelts)

The complex has scattered tree rows, shelterbelts and block plantings of shrubs and trees. By Service policy, trees are no longer planted except for shelterbelts that are allowed near refuge housing, buildings and the headquarters to provide protection from the wind. As time and funding allow, current management direction targets removing the shrub and tree plantings and restoring these areas to perennial grass cover.

Native Shrubs and Trees

Buffaloberry, chokecherry, Juneberry, and other low-growing native shrubs occur sporadically in native uplands, primarily in coulees and/or drainages where aspect and relief combine to provide microclimates for these woody species to develop and thrive.

Western snowberry and silverbrush are native shrubs that sometimes dominate native grassland areas and can become management problem/considerations when fire and/or grazing are excluded or not applied at regular intervals.

Riparian areas and wetland fringes hold native trees including green ash and cottonwood. Rare landforms have allowed aspen and other low shrubs to develop and extend their range south into some areas in the northern part of the wetland management district.

Management objectives target maintaining native shrubs and trees within an acceptable composition range, where they are allowed to thrive within the microclimates and/or normal native range site, but not to expand and/or dominate range site locations where grasses would otherwise be the normal composition under historical burning/grazing regimes.

Wildlife

Mammals

Representative species for the complex include the coyote, red fox, white-tailed jackrabbit, deer mouse, badger, raccoon, mink, muskrat, white-tailed deer, thirteen-lined ground squirrel, striped skunk, long-tailed weasel, masked shrew, and meadow vole. The complex staff anticipates that 34 mammal species likely occur regularly or periodically on complex lands (Appendix G). A checklist of State mammals (Wiehe and Cassel 1978) lists 10 species (including four bats, one mouse, two voles) with a statewide distribution that have not been documented by complex staff on Service lands in the complex. Undoubtedly, the limited amount of Service-owned land in Burleigh, Kidder, and Emmons counties does not provide habitat sufficient to support some of these 10 species (i.e., bobcat, river otter, hoary bat).

In addition to this area's common mammal species, there are occasionally confirmed sightings of moose, elk, and pronghorns on, or adjacent to, Service lands in the complex. Additionally, the complex staff has received unconfirmed reports of mountain lions and gray wolves on Service lands within the complex.

In 2002, the small mammal population on Long Lake NWR was systematically inventoried. The inventory was conducted to determine the species composition and abundance of small mammals in both upland- and wetland-edge habitats. Large- and medium-sized mammals (e.g., deer, rabbits, skunks) and bats were not sampled. Live trapping was conducted at 16 different study fields throughout the refuge from late June to late September. Ten different mammal species were captured. The deer mouse was the most frequently captured species, with 38.34 captures (C) per 100 trap nights (TN), followed by the masked shrew (2.68 C/100 TN), northern short-tailed shrew (1.87 C/100 TN), and thirteen-lined ground squirrel (1.06 C/100 TN), respectively.

Reptiles and Amphibians

The complex staff expects that eight reptiles and amphibians likely occur regularly or periodically on complex lands (appendix G). Hoberg and Gause (1991) provide range distributions for all State amphibians and reptiles.

From 2001 to 2003, complex staff worked with the Service's ecological services division to capture juvenile (metamorph) northern leopard frogs on Sisco-Fallgatter and Schiermeister WPAs, in Emmons County. These frogs were examined for potential malformations. The impetus for this work stemmed from the heightened nationwide concern over amphibian malformations that began when a group of Minnesota junior high school students discovered numerous malformed frogs in a local wetland in 1995 (Meteyer 2000). In 2001, complex staff collected 180 leopard frog metamorphs from the two Emmons County WPAs. Two frogs from Schiermeister and one frog from Sisco-Fallgatter were determined to be malformed via radiology. Two of these three malformations were classified as asynchronous metamorphosis (involving the mouth and tail), whereas the third was classified as having polymelia of a forelimb (an extra forelimb). The following year, 127 leopard frog metamorphs were collected at Scheirmiester WPA, with no malformations observed. In 2003, 231 leopard frog metamorphs were collected at the two Emmons County WPAs. Two specimens from Schiermeister were considered abnormal (hind foot on both) and forwarded to the University of Wisconsin-LaCrosse for further examination. Final results are unavailable as of this writing.

Birds

More than 314 species of birds have been documented throughout the complex (appendix G). The Long Lake NWR Bird List (May 2002) contains 289 species that had been recorded on or immediately adjacent to the refuge, as of 2001. The bird list includes 18 accidentals (species seen once or only a few times because the refuge is outside of their normal range. There are 118 species that breed on Long Lake NWR. The importance of Long Lake NWR to the avian community is illustrated, in part, by the fact that it was designated both a

Globally Important Bird Area (GIBA) and as a regional shorebird site in the Western Hemisphere Shorebird Reserve Network (WHSRN) in 2002. Additionally, the diversity of birdlife in the complex has resulted in national recognition of both Kidder County (Konrad 1996a) and Long Lake NWR (Konrad 1996b) as two of the top ten birding "hot spots" in the nation.

Twenty-three species of waterfowl are considered either common or uncommon species throughout the complex, with several other waterfowl species being occasional visitors (i.e., greater scaup, American black duck, red-breasted merganser, white-winged scoter. Seventeen waterfowl species breed in the complex. The five most abundant breeding duck species are the mallard, blue-winged teal, gadwall, northern shoveler, and northern pintail. When habitat conditions are favorable, breeding duck densities exceed 100 pairs per square mile in several portions of the complex, especially in Kidder and northeastern Burleigh counties. The Service began conducting annual breeding waterfowl population surveys throughout the Dakotas and northeastern Montana in 1987, focusing on 13 duck species that are the primary breeding species in the PPR. The number of breeding pairs of these species that use both Service and private lands in the complex has ranged from 8,865 in 1990 to 544,017 in 1997, whereas recruitment rates have ranged from 0.40 in 1990 to 0.82 in 1997. A minimum recruitment rate of 0.49 is needed to maintain a duck species' population (Service 1996). Based on survey data, a strong positive relationship exists between wetland condition (i.e., wet area, number of wet ponds) and both breeding pairs and duck recruitment.

Since 2000, the complex staff has investigated upland waterfowl nesting success at both Long Lake NWR and on select WPAs in the complex. In 2001, portions of five WPAs (Wahl, Bernhardt, Basaraba, Rath, North Crimmins) that had breeding duck pair densities exceeding 80 pairs per square mile and surrounding landscapes that had a high degree (>60 percent) of perennial grass cover, were searched using the chain drag method (Klett et al. 1986). Each site was searched either two or three times and 106 nests were found across 350 acres. Nest success was 26.05 percent (Mayfield 1961) across all sites and ranged from 4.2 percent to 38.8 percent at individual sites. In 2002, the complex staff surveyed nesting activity on seven Long Lake NWR management units. Each site was searched three times and 79 nests were found across 415 acres. Nest success was 3 percent (Mayfield 1961) across all sites and ranged from 0.4 percent to 17.8 percent at individual sites. Nest success rates ranging from 15–20 percent (Mayfield 1961) are thought to be a minimum requirement for population stability of the five most abundant breeding duck species in the complex (Cowardin et al. 1985, Klett et al. 1988).

During the fall migration, the average, waterfowl numbers at Long Lake NWR peak at 25,000 ducks and 35,000 geese; however, in some years, fall refuge populations of both duck and geese exceed 100,000 each. Migrant populations of Canada geese, cackling geese, white-fronted geese, snow geese, and tundra swans are joined on the refuge by an average of 10,000 sandhill cranes. The refuge serves as a principle staging area for members of the mid-continent population of sandhill cranes, and their numbers exceed 25,000 individuals on the refuge in some years.

Long Lake NWR's designation as a WHSRN site is due to the documented abundance of shorebirds (>20,000 annually) that utilize the refuge at some time of the year, as either a migratory stopover or breeding area. Twenty-five species of shorebirds are considered either common or uncommon species throughout the complex, with several other species being occasional visitors (e.g., black-bellied plover, western sandpiper, Hudsonian godwit, buff-breasted sandpiper). Nine shorebird species are regular breeders throughout the complex.

Since 2001, shorebird surveys have been conducted on two survey routes at Long Lake NWR, following Manomet Center for Conservation Sciences International Shorebird Survey (ISS) protocol.

From 2001 to 2003, 28 shorebird species were recorded annually on the refuge during formal surveys. Based on ISS data, the most abundant spring migrants at the refuge include the Wilson's phalarope and marbled godwit; whereas the most abundant fall migrants include the Wilson's phalarope, long-billed and short-billed dowitchers, American avocets, and killdeer. Both refuge shorebird diversity and abundance has varied seasonally and annually since ISS began. Abundance has ranged from 17,685 in spring 2004 to 1,551 in spring 2003, whereas Simpson's Diversity Index (Simpson 1949; range=0.0 [low] to 1.0 [high]) values have varied from a seasonal low of 0.4978 to an annual high of 0.8218. The substantial variation in shorebird abundance likely is related to wetland

conditions at scales greater than the refuge. During years when numerous prairie wetlands are flooded and the water level in Long Lake is high (i.e., spring 2003), relatively few shorebirds use the refuge. Conversely, substantially more shorebirds use the refuge during years of minimal spring runoff (i.e., spring 2004) because preferred habitat on the surrounding landscape is mostly dry and Long Lake provides a wealth of suitable shorebird habitat. The landscape that surrounds Long Lake NWR, which includes numerous other Service lands, is also of tremendous importance to a host of shorebird species, for a multitude of reasons. For example, a portion of the Collapsed Glacial Outwash ecoregion within the complex has recently been designated as a priority fall migration staging area as part of the Marbled Godwit Conservation Plan (Melcher et al. 2005). Twenty-five WPAs and two refuges are included within the boundaries of this conservation area.

The importance of Service lands in the complex to colonial nesting waterbirds was recently investigated. In 2003, the complex staff conducted an extensive survey of waterbird colonies on fee-title lands throughout the complex to determine the distribution and estimate the abundance of breeding colonial waterbirds, and also develop a monitoring protocol that can be followed in subsequent years with reduced effort. An aerial survey of all wetland basins (n = 864) on fee title lands in the complex was completed and each wetland was assigned to one of three categories (high probability [HPC], moderate probability [MPC], and low probability [LPC], based on the likelihood that it would support one or more waterbird colonies that year. Category assignments were based on a combination of habitat conditions, including: 1) wetland cover type (Steward and Kantrud 1971); 2) hydrologic regime and basin size, and; 3) special features (e.g., islands, dead trees in wetlands). All HPC wetlands (n = 68) were ground surveyed for colonies, whereas only 50 percent of the MPC wetlands (n = 83) and 5 percent of the LPC wetlands (n=32) were ground surveyed. When a waterbird colony was located, species composition was determined, nests were tallied, the perimeter of the colony was delineated, and general habitat variables were measured. Forty colonies were located on 16 WPAs and two refuges during the survey, including 31 (77.5 percent) marsh colonies, eight (20 percent) ground/island colonies, and one (2.5 percent) tree/shrub colony. Seven WPAs and one refuge contained multiple, ranging from two to nine, colonies. Twenty-four (60.0 percent) of the 40 colonies consisted of only one species, 11 (27.5 percent) contained two species, three (7.5 percent contained three species, and two (5.0 percent) contained between five and eight species. Fourteen separate waterbird species were recorded and only the double-crested cormorant utilized multiple colony types. The number of total breeding pairs of each species detected during the survey ranged from three (snowy egret) to 310 (California gull). Thirty-eight colonies were located on HPC wetlands, whereas only two (5 percent) were located on MPC wetlands and no colonies were located on LPC wetlands. The apparent success of the wetland stratification scheme provided a breeding colonial waterbird population estimate for the complex that had a low variance and provided an accurate estimate of use of Service lands during 2003.

Service lands throughout the complex hold substantial importance for grassland-nesting passerines, especially given the current rate of grassland conversion to cropland throughout the Dakotas. From 2001 to 2004, the complex staff surveyed the relative abundance and species composition of this bird group at 50 randomly selected 328-foot (100-meter) radius points at Long Lake NWR. Relative abundance (mean number of breeding pairs/point), estimated mean pairs per 247 acres (100 hectares), and frequency of occurrence (percentage of points at which a species was detected) were calculated for all species. The number of grassland-nesting passerine species detected from 2001 to 2004 ranged from 10–14, whereas the number of breeding grassland-nesting passerine pairs ranged from 258 in 2003 to 378 in 2004. Ten grassland-nesting passerine species were detected at survey points during all 4 years (table 2), three (Baird's sparrow, Nelson's sharp-tailed sparrow, Sprague's pipit) were detected during two years, and the vesper sparrow and lark bunting were detected during only one year. The species with the four highest mean frequencies of occurrence across all four survey years were the bobolink, clay-colored sparrow, red-winged blackbird, and grasshopper sparrow, respectively.

In 2005, the diversity of grassland-nesting passerines was surveyed at Florence Lake NWR and Slade NWR, using area search methodology (Ralph et al. 1993). Surveys were conducted in three different vegetative community types (native prairie, old cropland, seeded natives) at each refuge. Each 7.4-acre (3-hectare) search plot was surveyed three separate times during the summer,

for 20 minutes per survey. Grassland passerine abundance at Florence Lake NWR was similar on the native prairie and seeded native plots, with nine breeding pairs detected in each. The grasshopper sparrow was the most abundant species at the native sod plot, whereas the bobolink was the most abundant species at the seeded native plot. Grassland passerine use of the tamegrass plot at Florence Lake NWR was considerably less that the other two plots, with only three breeding pairs (two savannah sparrow, one grasshopper sparrow) detected. Conversely, at Slade NWR, grassland passerine abundance was similar in all three plots, but was highest in the tamegrass plot (nine breeding pairs). The red-winged blackbird was the most abundant species in the tamegrass plot. Eight grassland passerine pairs were detected in the Slade NWR seeded native plot, with the bobolink, clay-colored sparrow, and grasshopper sparrow sharing the greatest abundance. In the native prairie plot, seven grassland passerine pairs were tallied; the grasshopper sparrow was the most abundant.

The sharp-tailed grouse is a native gamebird species that is abundant both on Long Lake NWR and other Service lands throughout the complex. Each spring the male of this polygamous species engages in communal breeding displays at leks, where they defend their territories. Upland areas on Long Lake NWR and more importantly, private lands immediately adjacent to Long Lake NWR that are annually grazed, serve as host sites for several leks each year. The complex staff attempts to survey sharp-tailed grouse attendance at these leks each April. The first formal sharp-tailed grouse survey at Long Lake NWR that was completed in cooperation with the NDGF was conducted in 1981, although informal refuge surveys were completed in prior years. With the exception of 1994, counts have been conducted at the refuge annually since 1981. Throughout the years, sharp-tailed grouse have been documented on as many as 25 different leks, either on, or immediately adjacent to, the refuge. From 1981 to 2005, the number of observed active leks has ranged from 6 to 17 each year and averaged 12.75 (SE±0.590). Given the presumed 1:1 sex ratio of males to females (Ammann 1957, Connelly et al. 1998) and the much more reliable lek detection rate of males, often total numbers of males only are reported. Total males in the Long Lake NWR survey area have varied widely (36–247), based on a variety of factors, but the mean total is 160.38 (SE±12.403), across all years.

Fish

The complex staff anticipates that seven species of fish occur in Service-owned wetlands in the complex (Appendix G). Although systematic fishery inventories have not been completed on Service lands within the complex, wetland habitat capable of supporting populations of certain fish species is present, at least during nondrought periods, on several tracts throughout the complex.

Great blue herons, double-crested cormorants, American bitterns, black-crowned night-herons, and grebes frequently forage for fish in Long Lake NWR waters. Additionally, several gull species take advantage of plentiful winter-killed common carp on Long Lake during ice-out in some years.

Threatened and Endangered Species

There are four federally listed threatened and endangered species that have been observed on Service lands within the complex. The endangered least tern has been documented on Long Lake NWR, but this is an anomaly, as the majority of this species' habitat use in the State centers on the Missouri River. Conversely, the threatened piping plover and bald eagle and the endangered whooping crane regularly use various WPAs and refuges in the complex.

The piping plover breeds on the shoreline of the large, alkaline lakes that are common throughout the northeastern one-third of the complex. In the summer of 2002, the Service's Ecological Services Division designated eleven different tracts of land, of which at least portions are owned by the Service and administered by the complex, as Piping Plover Critical Habitat. These Critical Habitat areas consist of Long Lake NWR, three Kidder County WPAs, and seven Burleigh County WPAs. The complex staff annually surveys Long Lake NWR and WPAs that are known piping plover breeding areas.

Additionally, since 2002, staff has erected predator exclosures (Melvin et al. 1992) over most observed piping plover nests in an effort to increase nest success. They have also conducted vegetation removal practices on portions of Long Lake NWR, to enhance traditional breeding areas.

Table 2. Relative abundance, estimated breeding pairs per 247 acres, and frequency of occurrence for 15 grassland/wetland edge-nesting passerines on Long Lake National Wildlife Refuge Complex, 2001-2004

SPECIES	*RELATIVE ABUNDANCE*[1]				*ESTIMATED PAIRS / 247ac*				*FREQUENCY OF OCCURRENCE*			
	2001	*2002*	*2003*	*2004*	*2001*	*2002*	*2003*	*2004*	*2001*	*2002*	*2003*	*2004*
Baird's sparrow	0.02 (0.020)	0.00	0.00	0.02 (0.020)	0.6	0.00	0.00	0.6	2	0	0	2
bobolink	1.72 (0.179)	1.34 (0.182)	1.26 (0.151)	1.68 (0.255)	54.8	42.7	40.1	53.5	80	66	74	66
chestnut-collared longspur	0.02 (0.020)	0.04 (0.028)	0.02 (0.020)	0.06 (0.034)	0.6	1.3	0.6	1.9	2	4	2	6
clay-colored sparrow	0.94 (0.172)	0.92 (0.169)	0.86 (0.146)	1.00 (0.185)	29.9	29.3	27.4	31.9	50	48	54	56
common yellowthroat	0.34 (0.093)	0.32 (0.088)	0.22 (0.066)	0.62 (0.117)	10.8	10.2	7.0	19.7	26	24	20	44
grasshopper sparrow	0.36 (0.109)	0.68 (0.126)	0.88 (0.136)	1.66 (0.224)	11.5	21.7	28.0	52.9	22	40	58	66
lark bunting	0.00	0.00	0.00	0.02 (0.020)	0.00	0.00	0.00	0.6	0	0	0	2
Le Conte's sparrow	0.04 (0.028)	0.12 (0.028)	0.02 (0.020)	0.02 (0.020)	1.3	3.8	0.6	0.6	4	10	2	2
Nelson's sharp-tailed sparrow	0.04 (0.028)	0.00	0.00	0.04 (0.027)	1.3	0.00	0.00	1.3	4	0	0	4
red-winged blackbird	1.06 (0.224)	1.14 (0.249)	0.78 (0.141)	1.06 (0.224)	33.8	36.3	24.8	33.8	44	46	50	46
Savannah sparrow	0.54 (0.125)	0.34 (0.084)	0.38 (0.099)	0.50 (0.132)	17.2	10.8	12.1	15.9	34	28	26	28
sedge wren	1.18 (0.203)	0.56 (0.157)	0.26 (0.114)	0.30 (0.096)	37.6	17.8	8.3	9.6	56	26	12	24
Sprague's pipit	0.02 (0.020)	0.00	0.00	0.02 (0.020)	0.6	0.00	0.00	0.6	2	0	0	2
vesper sparrow	0.00	0.00	0.04 (0.028)	0.00	0.00	0.00	1.3	0.00	0	0	4	0
western meadowlark	0.30 (0.082)	0.06 (0.034)	0.44 (0.082)	0.57 (0.100)	9.6	1.9	14.0	18.2	24	6	40	46

[1]Number in parentheses is standard error (±SE).

The bald eagle is a relatively common migrant during the spring and fall migrations. Bald eagle observations on the complex's refuges and WPAs can usually be tied to large concentrations of migrant waterfowl. The peregrine falcon, which was delisted in 1999, is not as common as the bald eagle, within the complex, but it uses Service habitats during a similar timeframe and in a similar fashion.

Long Lake NWR is a key stopover site for whooping cranes migrating through the Central Flyway to their breeding area in the Northwest Territories in the spring and their wintering area on Aransas NWR in the fall (Beyersbergen et al. 2004). Since 2000, there have been at least eight confirmed observations (all during the fall) of whooping cranes using Long Lake NWR. Additionally, during recent years, whooping cranes have been documented on WPAs in the complex (e.g., Seventh Day Adventist, spring 2003). The complex biologist serves as the Service's key whooping crane contact for State observations. Additionally, complex staff follows guidelines presented in the Whooping Crane Contingency Plan (Service 2001) to minimize risks to whooping cranes that utilize lands within the complex's boundaries during the fall.

Although there has not been confirmed documentation of federally endangered gray wolves in Burleigh, Emmons, or Kidder counties in recent history, the complex staff does occasionally receive unconfirmed gray wolf reports from the public.

The Dakota skipper is a prairie-obligate butterfly that became a candidate for listing on the federal Endangered Species List in 2002. To date, this species has not been documented in Burleigh, Emmons, or Kidder counties, but there is potential for it to occur on Service lands in these locations. The complex staff classified the degree of Dakota skipper habitat potential that presently exists on Service lands within the complex, according to guidelines in a Service Conservation Strategy for Dakota skippers in North Dakota and South Dakota (Murphy 2005). It was determined that only a single fire-management unit on one tract of land (Schiermeister WPA) presently has habitat characteristics (i.e., size, vegetative species composition) that indicate possible Dakota skipper occurrence. Upland habitat management of this WPA unit will follow guidelines presented in the Service Conservation Strategy (Murphy 2005).

The State does not have an official threatened and endangered species list. However, in 2004, the NDGF designated its 100 Species of Conservation Priority (birds, mammals, reptiles, amphibians, fish, freshwater mussels) as part of its Comprehensive Wildlife Conservation Strategy. The Species of Conservation Priority that are known to occur in the complex are listed in Appendix J.

Cultural Resources

Prehistoric Resources

On April 4, 2005, RMC Consultants, Inc. under contract with the Service completed a Cultural Resource Overview and Site Sensitivity Analysis for the complex in the south-central portion of the State. The goal of that overview was to provide a tool for the Service to assist in preparation of a CCP and EA with regards to management of cultural resources. The objective of the study was to characterize the distribution of known cultural resources in the study area, create a sensitivity model for prehistoric and historic archaeological site location in the study area, and develop recommendations for the management of cultural resources within the study area.

Four surveys have been carried out on Long Lake NWR in response to various small development projects. A cultural resources inventory of a township road in the refuge in 1981 resulted in the recording of a single prehistoric archaeological site (Peterson 1981). A cultural resources inventory of approximately six acres for a tour road in 1992 resulted in no cultural resources being recorded (Lewis 1992). Cultural resources inventories of four borrow areas and two peninsula cutoffs totaling 74 acres at Long Lake NWR in 2001 (Olson 2001) resulted in the recording of a prehistoric site lead (32KDX69) at Pintail Point. A subsequent inventory of approximately twenty-one acres for the proposed borrow area on Pintail Point recorded the lead as prehistoric archaeological site 32KD82 (Morrison 2001).

Six sites have been recorded in the WPAs lying within the Long Lake WMD during two inventories. Of the six sites recorded, five (32BL95, 32BL96, 32BL98, 32BL99, 32BL100) were recorded during a survey of the East Lost Lake WDA by the University of North Dakota in 1990 (Driscoll et al 1991). Three of the sites are prehistoric archaeological sites (32BL95, 32BL96, 32BL100). More information is needed on two of the sites (32BL95, 32BL100) before an evaluation of their

significance and management recommendations can be made. No further work is recommended on the third site (32BL96). The other two sites (32BL98, 32BL99) recorded during the inventory are historic archaeological sites at which no further work is recommended.

Five unique, Depression-era structures and a shelter have been documented and evaluated at Long Lake NWR (Speulda and Lewis 2003)

Analysis of the prehistoric and historic cultural resources within Long Lake WMD revealed a total of 407 recorded sites of which 197 were prehistoric sites and 221 were historic sites (the sum of the prehistoric and historic sites exceeds the overall site total by 11 because there are 11 sites that have both prehistoric archaeological and historical archaeological components). Two sites were located at Long Lake NWR.

Open archaeological sites are the most predominant prehistoric site type that has been recorded in both the Coteau Slope and the Missouri Coteau physiographic regions. Open camps are the second most numerous prehistoric site type followed by open lithic scatters. A few graves have been recorded in the Coteau Slope but none have been recorded in the Missouri Coteau.

Farmsteads are the most numerous historic site type on the Coteau Slope followed by cemeteries and transportation sites. The site data is heavily skewed towards sites located along the Missouri River and thus within the Coteau Slope physiographic region. In Long Lake WMD, 376 sites have been recorded in the Coteau Slope physiographic region compared to only 33 sites recorded in the Missouri Coteau.

Based on the site sensitivity analysis conducted by RMC Consultants Inc., inventories for refuges are prioritized below:

1. Canfield Lake NWR and Long Lake NWR
2. Lake George NWR
3. Florence Lake NWR
4. Slade NWR

The priority order for conducting tract inventories in the wetland management district are prioritized below:

1. Kurtz WPA
2. Wahl WPA
3. Braun WPA

Other waterfowl production areas (and one WDA) should be inventoried in order of their average site sensitivity as appears in figure 44 of the April 4, 2005, Cultural Resource Overview and Site Sensitivity Analysis, which lists each tract in order of priority.

All known sites within waterfowl production areas (and one WDA) should be documented and evaluated for eligibility to the National Register of Historic Places. Six sites have been recorded within Long Lake WMD. All but two have been evaluated as not eligible. Those two sites are on East Lost Lake WDA and both sites are prehistoric and archaeological sites. It is recommended that these sites be evaluated through a program of test excavations.

Special Management Areas

Long Lake NWR has been designated as a WHSRN site of regional significance because of its importance to shorebirds. It has also been designated as a GIBA by the American Bird Conservancy.

A number of colonial-nesting waterbird colonies are distributed throughout the complex. These areas are important for recruitment for the following migratory bird species:

- Black-crowned night-heron
- Black tern
- California gull
- Cattle egret
- Clark's grebe
- Common tern
- Double-crested cormorant
- Eared grebe
- Forster's tern
- Franklin's gull
- Red-necked grebe
- Snowy egret
- Western grebe
- White-faced ibis

Eleven tracts of land within the complex have been designated as critical habitat for piping plovers. Five unique Depression-era structures and a shelter have been documented on Long Lake NWR.

Visitor Services

The Improvement Act emphasizes the importance of compatible wildlife-dependent recreation. The Act identifies these six priority public uses: hunting, fishing, wildlife observation, wildlife

photography, environmental education, and interpretation.

Hunting
Centuries ago, Long Lake was considered a prominent landmark to the Plains Indians and early European settlers who camped and hunted waterfowl and other game species along its shores. With bison extirpated from the landscape, and Long Lake under federal ownership, certain hunting restrictions now apply.

Because the principle purpose of the complex is to provide habitat for migratory birds, hunting waterfowl and other migratory birds is prohibited. A map showing areas open to hunting and regulatory text is available for Long Lake NWR.

Most of Long Lake NWR is open to upland bird (i.e., ring-necked pheasant, sharp-tailed grouse, gray partridge) hunting. To reduce hunting-group conflicts and migratory bird disturbance, this season does not open until late November. Long Lake NWR also offers archery, rifle, and muzzleloader deer hunting. Additionally, Slade NWR is only open to deer hunting and Florence Lake NWR is closed to all hunting.

All WPAs in the wetland management district are open to hunting for a variety of game, including migratory birds. Only federally approved non toxic shot is permitted on WPAs. All other State regulations apply on WPAs.

Fishing
Nationally, refuges receive approximately seven million angling visits annually. Long Lake NWR is one of the 270 refuges where anglers can enjoy their sport.

Fishing is permitted year-round on Long Lake NWR in designated areas. Fishing is only allowed on unit 1 of Long Lake and Long Lake Creek. Available species include northern pike, black bullhead, common carp, and occasionally walleye and yellow perch. Fishing is usually best at the mouth of the creek where it enters Long Lake. The lake itself is shallow and generally does not support gamefish, except when water flows into the lake at high levels. These high flows improve water quality and potentially allow fish to survive for several years. However, decreased water quality and winter killscan rapidly erase fish populations.

Canoes and small boats are restricted to Long Lake Creek. Boats may be used on the creek from May 1 through September 30 only. Shallow depths restrict motors to small outboards (maximum of 25 horsepower) and to electric motors. No boat ramps are available, limiting boat access to "lift in, lift out."

Currently, fishing facilities include an accessible dock, and accessible rest room, table, and informational kiosk, all located just south of the refuge headquarters on Long Lake Creek.

Fishing is prohibited on both Slade NWR and Florence Lake NWR. WPAs offer marginal fishing opportunities. Certain climatic conditions (i.e., periods of deluge) create periodic fish (e.g., yellow perch, northern pike) populations and therefore, public fishing opportunities on some WPAs. On WPAs there are no fishing facilities for anglers, and vehicle access is limited to designated trails.

State regulations apply to fishing on Long Lake NWR and WPAs.

Wildlife Observation and Photography
Long Lake NWR provides outstanding opportunities for viewing wildlife. It offers optimum viewing for waterfowl, marshbirds, and shorebirds from April through early June and from late August through October. Seasonal highlights include sharp-tailed grouse and western grebe courtship dancing in the spring shorebird migration in the spring and fall, daily movements of thousands of sandhill cranes each fall, and winter activities of various bird and mammal species. Many wildlife species can be observed from public roads on the refuge. The Butte Viewing Area offers a commanding view of the surrounding countryside. Public viewing blinds are available, by reservation in the spring to observe the sharp-tailed grouse on their leks. Bird watchers and photographers can also be authorized by the refuge manager to hike in and place temporary observation blinds within the refuge.

Environmental Education and Interpretation
Currently, a small visitor center is located in the administrative headquarters at Long Lake NWR. This visitor center includes two exhibits and a variety of informational pamphlets about the Service, the Refuge System, the complex, and other natural resources-related information. These pamphlets are available in the office entry foyer during and after business hours. There is a kiosk

located in front of the headquarters that contains information about prairie wetlands and wildlife species found throughout the complex. Refuge staff provides educational talks and tours for schools and other groups, upon request. The complex's environmental education and outreach program expands beyond the boundaries of the complex. The staff is involved in local, regional, and statewide programs.

Trapping

The complex staff developed a Predator Management Plan in 1993. This plan authorized predator control, performed by personnel and their authorized agents, outside the normal trapping season. It authorized public trapping on refuges administered under the complex, through issuance of SUPs to permittees for trapping during the State trapping season. Trapping targets predator management and infrastructure maintenance objectives.

Recreational trapping is available on all WPAs in the wetland management districts in accordance with State trapping regulations.

Fire and Grazing History

Historically, grasslands in the northern Great Plains coevolved with various disturbance regimes such as fire and large-mammal grazing. Whether lightning-induced or deliberately set by Native Americans, historical fires have influenced the composition of the plant communities on complex lands. A handful of fire-tolerant shrubs such as chokecherry, American plum, and leadplant were present, while other fire-sensitive woody species were restricted to areas that were protected from fire. The plant community was dominated by a number of grass and forb species.

It is believed that the historical wildfire frequency for the mixed-grass prairie was 5–7 years although little information is available on the occurrence of wildfire during the early years of the refuge. Potential exists for fairly large wildfires to occur; however, this has generally not been the case. Local fire departments and area ranchers aggressively suppress wildfire. It is also complex policy to control all wildfires occurring on Service lands.

The complex staff now uses prescribed fire to simulate the historical influence wildfire had on the plant communities. Wildfires help manage invading cool-season grasses, open up shorelines, and provide areas of attractive green browse for migrant waterfowl.

Most prescribed fires occur in the spring through early summer period or in early fall to allow for some vegetative recovery before winter. These times of year present opportunities to complete prescribed burns necessary to manage invading cool-season grasses and to open up shorelines and provide areas of attractive green browse areas for migrant waterfowl. Historically, wildfires likely would also have occurred during the summer and fall. During the last 15 years, however, prescribed fire has been increasingly used, and refuge staff now completes 10–20 prescribed burns each year covering 1,500 to 3,000 acres.

Grazing also greatly influences the structure and composition of grassland communities. Herbivores such as bison, elk, deer, pronghorn, and black-tailed prairie dog interact with soils, plants, other animals, and other processes to produce unique successional patterns in the northern Great Plains landscape at multiple scales.

Most plant species have growing points located at or near the ground surface, which allows the plant to be clipped off without killing it. Some contain bitter or toxic substances that cause animals to avoid grazing on them. Some species have spines to cause injury to grazing animal's mouths. Small mammals and deer presently graze on plants in the complex; however, it is believed that the historic impact from large grazing mammals (e.g., bison) was significant.

It is likely that herds of bison historically spent a considerable amount of time grazing native mixed-grass prairie found throughout the complex. Their grazing, trampling, trailing, and related activities likely had a significant impact on the development and maintenance of certain plant communities.

Free-ranging bison and elk are no longer present within the complex. Instead, staff works with local ranchers to mimic natural disturbances through livestock grazing. Grazing is generally conducted during the spring and early summer and again in the fall in upland habitats to stress exotic cool-season grasses and favor native grasses and forbs. Specific timing of grazing is also used to stress invading noxious weeds and is prescribed seasonally during periods when specific plants are most palatable to livestock.

Wetland grazing reduces accumulations of organic litter at the surface. A large amount of organic litter often favors invasive species such as Canada thistle. Grazing can also be used as part of an IPM program. The complex staff has determined that cattle will actively graze Canada thistle early in the growing season. Follow-up treatments also tend to be easier to complete and are more effective after grazing. Combination prescribed burning and grazing is a practice used to reduce the accumulation of organic litter. A fire creates a "flush" growth of new vegetation, which is grazed to extend treatment of problem plants such as Kentucky bluegrass and smooth brome. Noxious weeds including Canada thistle, absinth wormwood, and leafy spurge can be managed in a similar fashion. To date, this management strategy has been employed occasionally; however, the application shows promise for more frequent use in the future.

Socioeconomics

Socioeconomics

North Dakota is an important agricultural state, especially as a producer of wheat, much of which finds its way onto the world market. Many segments of the economy are affected by agriculture; for example, a substantial wholesale trade is involved in moving grain and livestock to market. Farm numbers have continued to decline since the 1980s, posing a threat to the vitality of the State's rural lifestyle. Since 1970, 43 of the State's 53 counties have lost population, and for 23 of these the population decline accelerated in the 1990s. The exodus has been aggravated by prolonged drought conditions, which in 2002 helped reduce wheat production (representing a quarter of the State's total agricultural revenues) by 24 percent and disrupted cattle production. It was slightly affected by the national recession and slowdown of 2001 and 2002. By December 2002, State unemployment which had risen to 3.6 percent in October had fallen back to 3.0 percent.

Growth industries include petroleum and the mining of coal, chiefly lignite; It has more coal resources than any other state. Manufacturing is concentrated largely on farm products and machinery.

Its gross state product in 2001 was $19 billion, smallest among the 50 states, to which general services contributed $3.7 billion; trade, $3.5 billion; government, $3 billion; financial services, $2.8 billion; transportation and public utilities, $1.9 billion, and construction, $896 million. The public sector in 2001 constituted 15.7 percent of gross state product, the ninth-highest among the states.

The State's farm marketing totaled $2.98 billion in 2001. Typically, it is the number one producer of hard spring wheat, durum wheat, sunflowers, barley, oats, flax, all dry, edible beans, and pinto beans. In 2002, the State led the Nation in spring wheat, durum wheat, barley, dry edible beans, sunflowers, and was second in the nation in overall wheat production.

The total number of farms has declined over the years as the average size of farming operations has increased. In 2002, the State had approximately 30,000 farms and ranches occupying 39.4 million acres (16 million hectares) and producing 216.6 million bushels of wheat, 57.0 million bushels of barley, 1.71 billion pounds of sunflowers, 12.7 million bushels of oats, 10.6 hundredweight of dry edible beans, 114.4 million bushels of corn, 4.8 million tons of sugar beets, and 23.5 million hundredweight of potatoes. The average farm was 1,313 acres (531 hectares) in size.

The State's farms and ranches had an estimated 1.9 million cattle and calves, valued at $1.58 billion in 2003. During 2002, there were around 154,000 hogs and pigs, worth $11.4 million. Its farmers produced nearly 9.1 million pounds (4.1 million kilograms) of sheep and lambs, which brought in $5.8 million in gross income in 2001, and nearly 42 million pounds (19.1 million kilograms) of turkey were produced in that same year.

The value of nonfuel minerals produced in the State in 2001 was estimated at about $39 million, up about 12 percent from 2000. Construction sand and gravel accounted for more than 70 percent of the value ($27.6 million) of the State's nonfuel mineral output, from a production of 10.6 million metric tons. Recovered elemental sulfur is the second most important mineral produced in the State, in terms of value. Sulfur and other byproducts such as krypton, xenon, anhydrous ammonia, and liquid nitrogen are recovered during natural gas processing at five plants in the western part of the State. Lapidary and collectible materials such as petrified wood, agates, jasper, and flint are also found in the State.

In 1997, the State had 1,963 wholesale establishments, with sales of $9.5 billion. The

leading wholesale lines by sales volume were farm-product raw materials, machinery, equipment, and supplies (especially farm machinery), groceries and related products, and petroleum and petroleum products. The State's 4,810 retail establishments recorded $6.4 billion in sales during 1997. Exports of State origin totaled $750 million in 1998, ranked 45th of all states.

By number of employees, the leading manufacturing industries in the State in 1997 were food and food products; industrial machinery and equipment; printing and publishing; electronic and other electric equipment; transportation equipment; and fabricated metal products. Value of shipments of manufactures in 1997 were estimated at over $5.2 billion, exhibiting the 9th fastest growth in shipments between 1992 and 1997. Earnings of persons employed in the State increased from $9.1 billion in 1997 to $10.2 in 1998, an increase of 11.5 percent. The largest industries in 1998 were services, 26.2 percent of earnings; State and local government, 12.4 percent; and retail trade, 10.5 percent. Of the industries that accounted for at least 5 percent of earnings in 1998, the slowest growing from 1997 to 1998 was construction (6.9 percent of earnings in 1998), which increased 1.9 percent; the fastest was durable goods manufacturing (5.1 percent of earnings in 1998), which increased 11.9 percent.

According to Bureau of Labor Statistics (BLS) provisional estimates, in July 2003 the seasonally adjusted civilian labor force in the State numbered 350,500, with approximately 12,600 workers unemployed, yielding an unemployment rate of 3.6 percent, compared to the national average of 6.2 percent for the same period. Since the beginning of the BLS data series in 1978, the highest unemployment rate recorded was 6.7 percent in May 1986. The historical low was 2.3 percent in October 1997. In 2001, an estimated 4.7 percent of the labor force was employed in construction; 7.3 percent in manufacturing; 5.2 percent in transportation, communications, and public utilities; 20.3 percent in trade; 4.7 percent in finance, insurance, and real estate; 23.6 percent in services; 17.9 percent in government; and 8.5 percent in agriculture.

The U.S. Department of Labor reported that in 2002, 24,000 of the State's 291,000 employed wage and salary workers were members of unions. This represented 8.1 percent of those so employed, up from 7.5 percent in 2001 but down from 9.1 percent in 1998. The national average is 13.2 percent. In all, 28,000 workers (9.8 percent) were represented by unions. In addition to union members, this category includes workers who report no union affiliation but whose jobs are covered by a union contract. The State is one of 22 states with a right-to-work law. (www.city-state.com)

Refer to tables 3, 4 and 5 at the end of this chapter for more detailed information on population, demographics, employment, and income in the State and the counties outlying the refuge complex.

Air Quality

The National Ambient Air Quality Standards include maximum allowable pollution levels for particulate matter, ozone, sulfur dioxide, nitrogen dioxide, lead, and carbon dioxide. Particulate matter is a measure of microscopic liquid or solid particles in the air that is respirable in the lungs.

Air quality in the area of the complex is considered good, with no nearby manufacturing sites or major air pollution sources. Carbon from automobiles and diesel engines; prescribed fire activities throughout the complex, and dust associated with wind-blown sand and dirt from the roadways and fields contribute to particulate matter.

Table 3. Population*

	Population in 2000	*Estimated Population in 2004*	*Change in Population 2000–2004 (%)*	*Native American Population in 2000 (%)*	*African American Population in 2000 (%)*	*White Population in 2000 (%)*	*Hispanics or Latinos in 2000 (%)*	*All Other Races Combined in 2000 (%)*
United States	281,421,906	293,665,404	+4.3	0.9	12.3	75.1	12.5	9.2
North Dakota	642,200	634,366	-1.2	4.9	0.6	92.4	1.2	1.0
Burleigh County	69,416	72,585	+4.6	3.3	0.3	95.0	0.7	0.6
Emmons County	4,331	3,913	-9.7	0.1	data not available	99.1	1.2	0.7
Kidder County	2,753	2,563	-6.9	0.1	0.2	99.5	0.6	0.1

*The total percentage for the population based on racial backgrounds may appear to be more or less than 100 percent. This is due to the fact that Hispanics/Latinos may fall under different categories because their self-identity may be based on language and heritage rather than race or color alone.

Table 4. Demographics and Income

	Land Area (square miles)	*Persons per Square Mile in 2000*	*Households in 2000*	*Home Ownership Rate in 2000 (%)*	*Median Value of Owner-Occupied Housing in 2000 ($)*	*Median Household Income in 1999 ($)*	*Per Capita Money Income in 1999 ($)*	*Persons Below Poverty Line in 1999 (%)*
United States	3,537,438	79.6	105,480,101	66.2	119,600	41,994	21,587	12.4
North Dakota	68,976	9.3	257,152	66.6	74,400	34,604	17,769	11.9
Burleigh County	1,633	42.5	27,670	68.0	98,900	41,309	20,436	7.8
Emmons County	1,510	2.9	1,786	83.4	37,000	26,119	14,604	20.1
Kidder County	1,351	2.0	1,158	81.7	33,400	25,389	14,270	19.8

Table 5. Income and Employment*

County	*Per Capital Personal Income (PCPI)*	*Total Personal Income (TPI)*	*Components of Total Personal Income (TPI)*	*Earnings by Place of Work*
Burleigh County	In 2004 PCPI was $32,729. This PCPI ranked 4th in the State and was 111% of the State average ($29,494) and 99% of the national average ($33,050). The 2004 PCPI reflected an increase of 6.0% from 2003. The 2003–2004 State change was 2.3% and the national change was 5.0%. In 1994 the PCPI was $20,593 and ranked 8th in the State. The 1994–2004 average annual growth rate of PCPI was 4.7%. The average annual growth rate for the State was 4.5% and for the nation was 4.1%.	In 2004 TPI was $2,374,950. This TPI ranked 2nd in the State and accounted for 12.7% of the State total. In 1994 the TPI was $1,331,097 and ranked 3rd in the State. The 2004 TPI reflected an increase of 7.2% from 2003. The 2003–2004 State change was 2.8% and the national change was 6.0%. The 1994–2004 average annual growth rate of TPI was 6.0%. The average annual growth rate for the State was 4.4% and for the nation was 5.2%.	In 2004 net earnings accounted for 71.2% of TPI (compared with 69.5 in 1994); dividends, interest, and rent were 15.7% (compared with 17.7 in 1994); and personal current transfer receipts were 13.1% (compared with 12.9 in 1994). From 2003–2004 net earnings increased 8.1%; dividends, interest, and rent increased 4.0%; and personal current transfer receipts increased 6.5%. From 1994–2004 net earnings increased on average 6.2% each year; dividends, interest, and rent increased on average 4.7%; and personal current transfer receipts increased on average 6.1%.	Earnings of persons employed in Burleigh increased from $1,884,445 in 2003 to $2,047,484 in 2004, an increase of 8.7%. The 2003–2004 State change was 3.1% and the national change was 6.3%. The average annual growth rate from the 1994 estimate of $1,110,565 to the 2004 estimate was 6.3%. The average annual growth rate for the state was 4.7% and for the nation was 5.5%.
Emmons County	In 2004 PCPI was $24,175. This PCPI ranked 41st in the State and was 82% of the State average, $29,494, and 73% of the national average, $33,050. The 2004 PCPI reflected an increase of 0.5% from 2003. The 2003–2004 State change was 2.3% and the national change was 5.0%. In 1994 the PCPI of Emmons was $14,450 and ranked 47th in the State. The 1994–2004 average annual growth rate of PCPI was 5.3%. The average annual growth rate for the State was 4.5% and for the nation was 4.1%.	In 2004 TPI was $95,006. This TPI ranked 31st in the State and accounted for 0.5% of the State total. In 1994 the TPI of Emmons was $66,224 and ranked 33rd in the State. The 2004 TPI reflected a decrease of 1.6% from 2003. The 2003–2004 State change was 2.8% and the national change was 6.0%. The 1994–2004 average annual growth rate of TPI was 3.7%. The average annual growth rate for the State was 4.4% and for the nation was 5.2%.	In 2004 net earnings accounted for 50.3% of TPI (compared with 53.1% in 1994); dividends, interest, and rent were 26.1% (compared with 24.2% in 1994); and personal current transfer receipts were 23.6% (compared with 22.6 in 1994). From 2003–2004 net earnings decreased 5.6%; dividends, interest, and rent increased 1.0%; and personal current transfer receipts increased 4.9%. From 1994–2004 net earnings increased on average 3.1% each year; dividends, interest, and rent increased on average 4.4%; and personal current transfer receipts increased on average 4.1%.	Earnings of persons employed in Emmons decreased from $55,200 in 2003 to $52,837 in 2004, a decrease of 4.3%. The 2003–2004 State change was 3.1% and the national change was 6.3%. The average annual growth rate from the 1994 estimate of $38,479 to the 2004 estimate was 3.2%. The average annual growth rate for the State was 4.7% and for the nation was 5.5%.

Table 5. Income and Employment*

County	*Per Capital Personal Income (PCPI)*	*Total Personal Income (TPI)*	*Components of Total Personal Income (TPI)*	*Earnings by Place of Work*
Kidder County	In 2004 PCPI was $26,186. This PCPI ranked 31st in the State and was 89% of the State average, $29,494, and 79% of the national average, $33,050. The 2004 PCPI reflected an increase of 6.4% from 2003. The 2003 TPI includes net earnings by place of residence; dividends, interest, and rent; and personal current transfer receipts received by the residents of Kidder. 2004 State change was 2.3% and the national change was 5.0%. In 1994 the PCPI of Kidder was $14,697 and ranked 45th in the State. The 1994-2004 average annual growth rate of PCPI was 5.9%. The average annual growth rate for the state was 4.5% and for the nation was 4.1%.	In 2004 TPI was $67,035. This TPI ranked 39th in the State and accounted for 0.4% of the State total. In 1994 the TPI was $45,383 and ranked 45th in the State. The 2004 TPI reflected an increase of 5.0% from 2003. The 2003–2004 State change was 2.8% and the national change was 6.0%. The 1994–2004 average annual growth rate of TPI was 4.0%. The average annual growth rate for the State was 4.4% and for the nation was 5.2%.	In 2004 net earnings accounted for 58.1% of TPI (compared with 52.7% in 1994); dividends, interest, and rent were 19.9% (compared with 24.4% in 1994); and personal current transfer receipts were 22.1% (compared with 23.0% in 1994). From 2003–2004 net earnings increased 7.0%; dividends, interest, and rent increased 1.0%; and personal current transfer receipts increased 3.5%. From 1994–2004 net earnings increased on average 5.0% each year; dividends, interest, and rent increased on average 1.9%; and personal current transfer receipts increased on average 3.6%.	Earnings of persons employed in Kidder increased from $35,611 in 2003 to $38,107 in 2004, an increase of 7.0%. The 2003–2004 State change was 3.1% and the national change was 6.3%. The average annual growth rate from the 1994 estimate of $24,373 to the 2004 estimate was 4.6%. The average annual growth rate for the State was 4.7% and for the nation was 5.5%.

*All income estimates, with the exception of PCPI, are in thousands of dollars, not adjusted for inflation. Total personal income includes net earnings by place of residence; dividends, interest, and rent; and personal current transfer receipts received by the residents of that county.

U.S. Fish & Wildlife Service

Long Lake National Wildlife Refuge

Burleigh & Kidder Counties, North Dakota

Habitat 2003

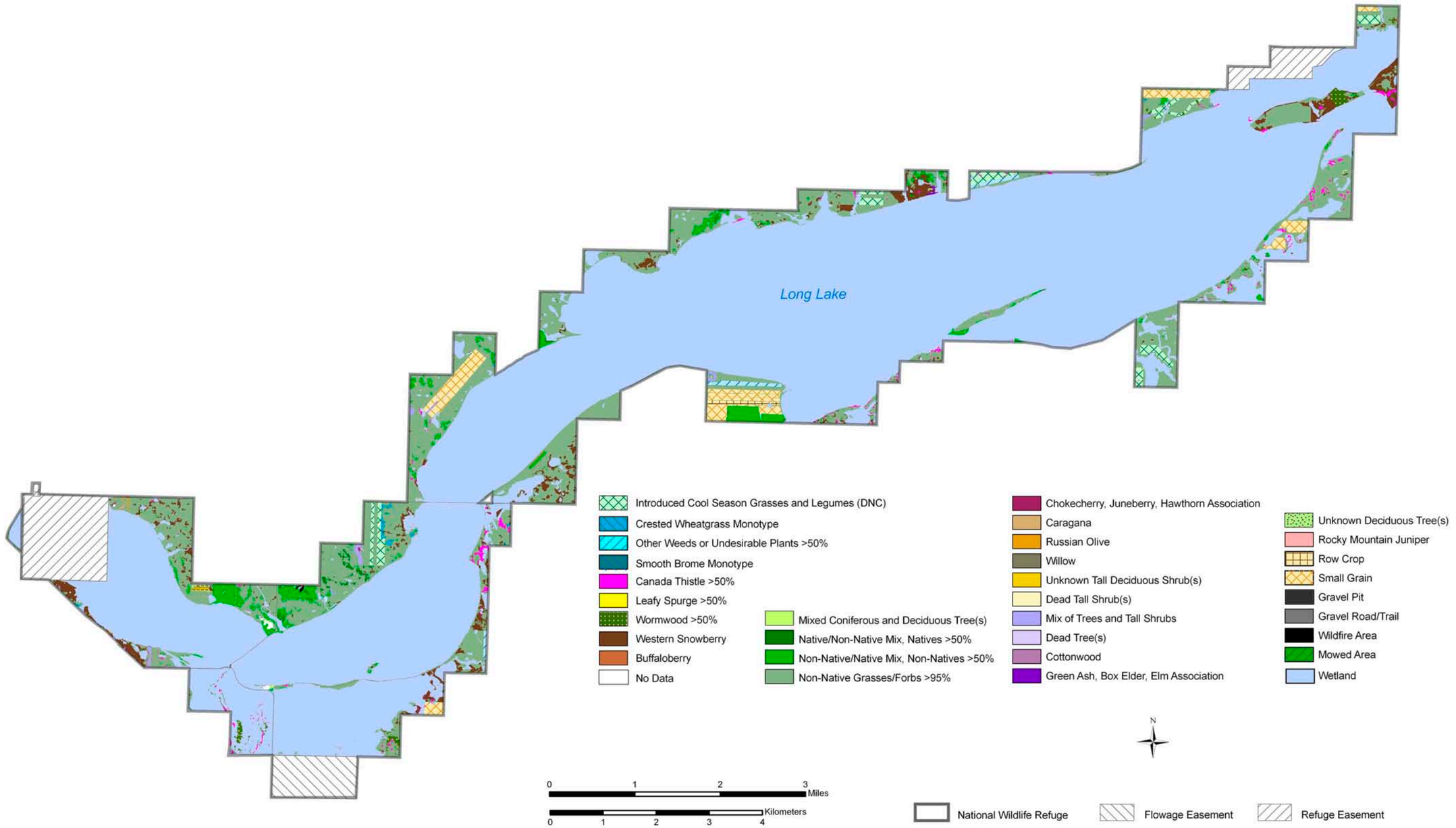

Figure 11: Long Lake National Wildlife Refuge Habitat (2003)

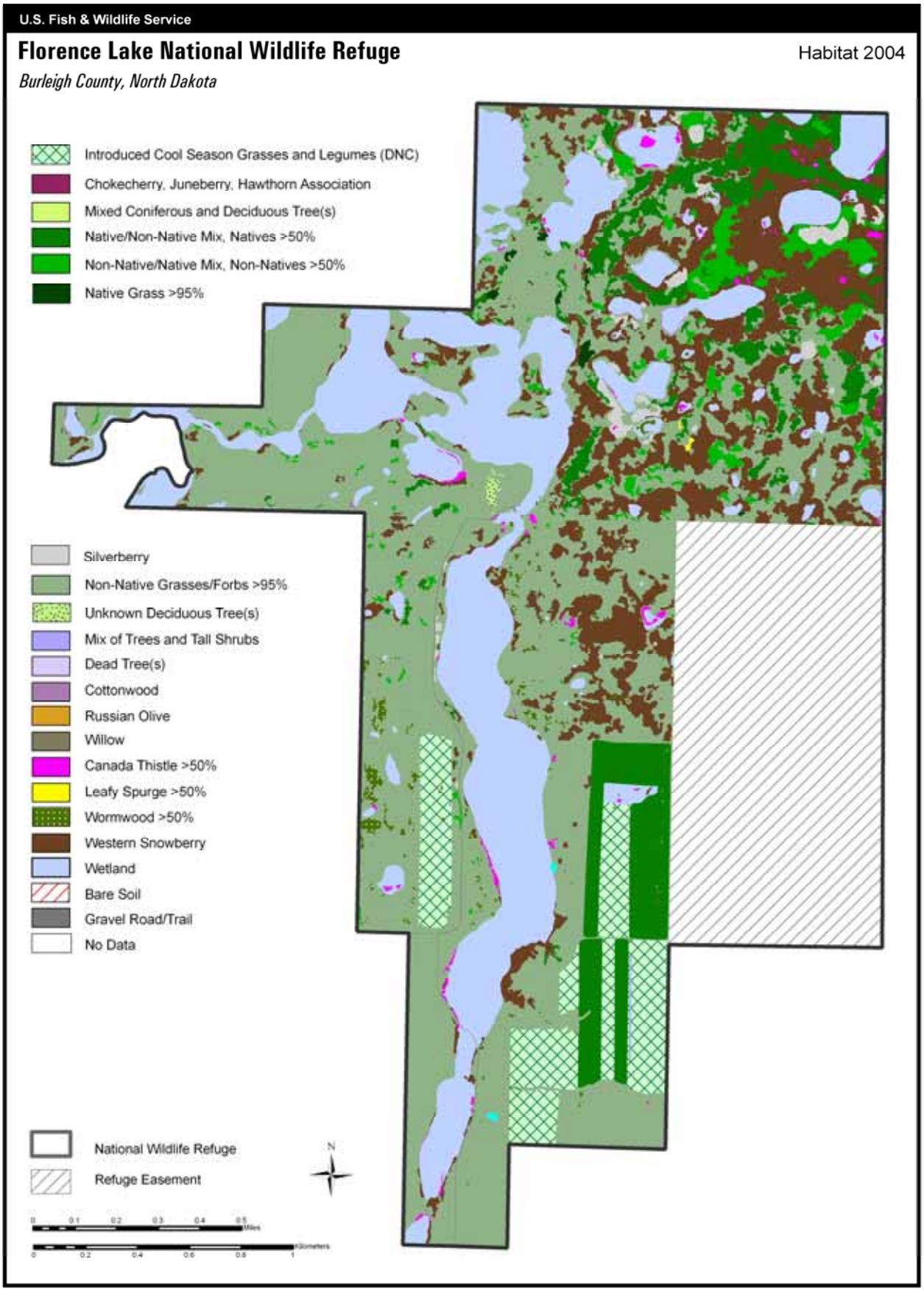

Figure 12: Florence Lake National Wildlife Refuge Habitat

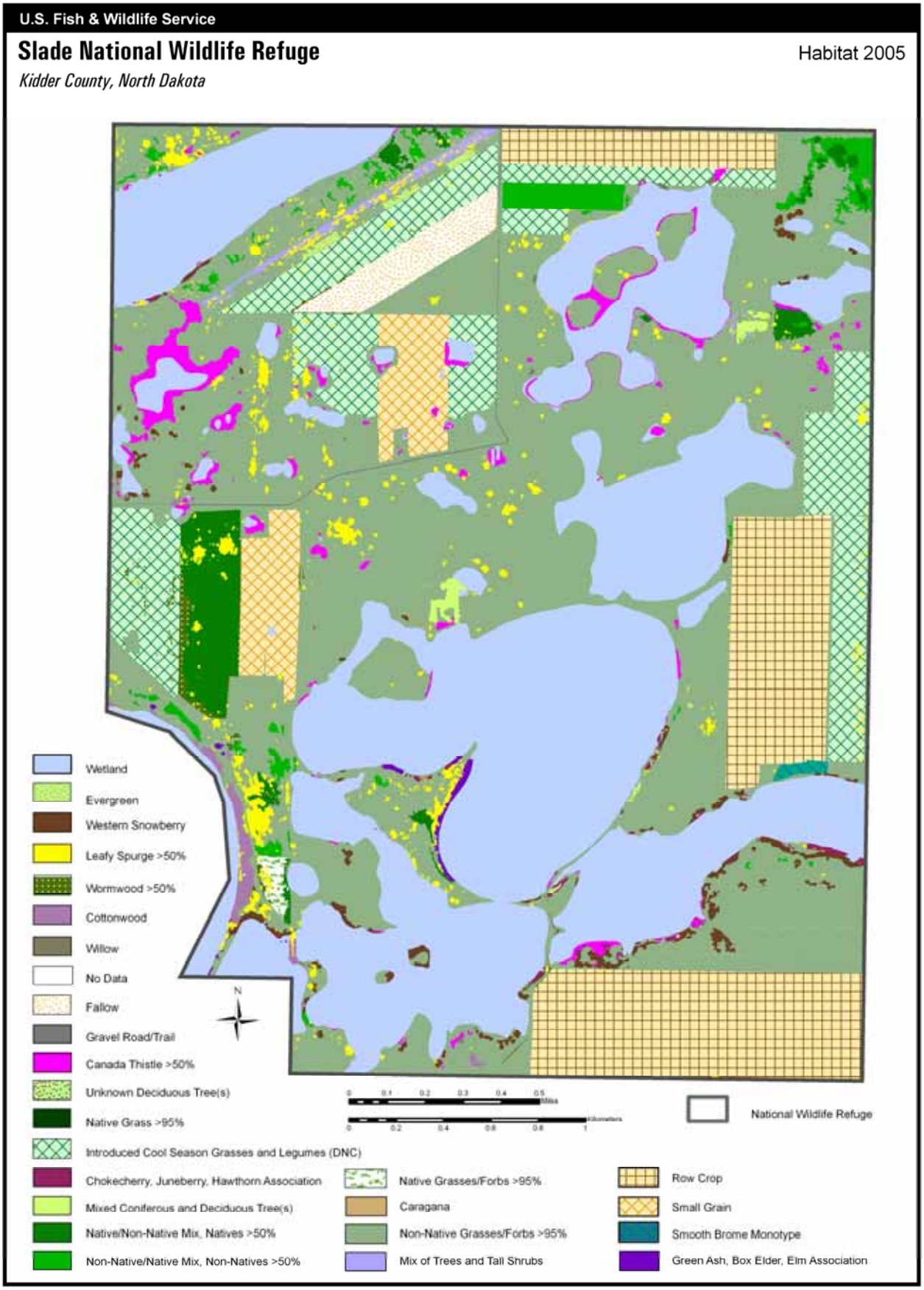

Figure 13: Slade National Wildlife Refuge Habitat