4 Affected Environment

Gary Eslinger/USFWS

The stiff sunflower is a native forb in the Rainwater Basin.

The Rainwater Basin Wetland Management District manages 61 noncontiguous tracts of federal land totaling 24,210.09 acres in south-central Nebraska. All of these lands within the Rainwater Basin are WPAs, which each typically contain one large wetland. Together, these WPAs are managed as a grassland ecosystem designed to provide optimal habitat for waterfowl and shorebirds. Uplands (nonwetlands) are managed for a high diversity of native grass species and grassland birds. The district also manages 35 conservation easements totaling 2,476 acres.

This chapter describes the physical environment and biological resources of the basin and the district. In addition, the affected environment includes the fire and grazing history, cultural resources, special management areas, visitor services, socioeconomic environment, and operations of the district.

4.1 PHYSICAL ENVIRONMENT

The Rainwater Basin is located near the center of the Great Plains. Its geographical region encompasses approximately 4,200 square miles covering portions or all of 17 counties in south-central Nebraska. The widest span is 160 miles across, extending from Gosper County to central Seward County. The northern edge parallels the central Platte River. The southern edge lies about 10 miles from the Kansas border.

Global Warming

The U.S. Department of the Interior issued Order No. 3226 in 2001 requiring federal agencies under its direction that have land management responsibilities to consider potential climate change effects as part of long-range planning endeavors.

The Department of Energy's report, "Carbon Sequestration Research and Development" (USDOE 1999), concluded that ecosystem protection is important to carbon sequestration and may reduce or prevent loss of carbon currently stored in the terrestrial biosphere. The report defines carbon sequestration as "the capture and secure storage of carbon that would otherwise be emitted to or remain in the atmosphere."

The increase of carbon dioxide (CO_2,) within the earth's atmosphere has been linked to the gradual rise in surface temperature commonly referred to as "global

warming." In relation to comprehensive conservation planning for Refuge System units, carbon sequestration constitutes the primary climate-related effect to be considered in planning.

Vegetated land is a tremendous factor in carbon sequestration. Large, naturally occurring communities of plants and animals that occupy major habitats—grasslands, forests, wetlands, tundra, and desert—are effective both in preventing carbon emission and in acting as biological "scrubbers" of atmospheric CO_2.

One Service activity in particular—prescribed burning—releases CO_2, directly to the atmosphere from the biomass consumed during combustion. However, there is no net loss of carbon because new vegetation quickly germinates and sprouts to replace the burned-up biomass. This vegetation sequesters an approximately equal amount of carbon as was lost to the air (Dai et al. 2006).

Several other effects of climate change may need to be considered in the future:

- Habitat available in lakes and streams for cold-water fish such as trout and salmon could be reduced.
- Forests may change, with some plant species shifting their range northward or dying out and other trees moving in to take their place.
- Ducks and other waterfowl could lose breeding habitat because of stronger and more frequent droughts.
- Changes in the timing of migration and nesting could put some birds out of synchronization with the life cycles of their prey.

Climate

The basin has a continental climate characteristic of extreme temperature changes through the seasons and relatively low precipitation rates. The district averages 21–28 inches (west to east) of precipitation annually. Eighty percent of the precipitation occurs between April and September. The change in precipitation amount across the district is primarily responsible for the shift from mixed-grass prairie in the west to tall-grass prairie in the east.

Winter temperatures average 27°F, while summer temperatures average 75°F. Daily minimum temperatures above 32°F occur 136–177 days. Relative humidity averages 55% at midafternoon and 80% at dawn across most of the basin. Annual evaporation in the basin exceeds rainfall accumulations. Evaporative losses in Phelps County were computed by the Thornthwaite method. These losses average more than 5.3 inches per month (June–August). Annual free-water evaporation from small bodies of water average 46 inches; about 77% of that amount is lost from May through October. Evaporative losses can significantly reduce the amount of pooled surface water.

Physiography, Geography, and Soils

The 59 WPAs found within the basin contain the same geological and soil characteristics. The Rainwater Basin lies in the flat to gently rolling, mixed-grass, loess plains of south-central Nebraska. This area is geologically new and has not developed a complete system of streams to drain surface water. It is from this characteristic that the area received its name—Rainwater Basin.

Wind-deposited Peorian Loess occurs extensively across the basin and has about 10,000 years of stability (Keech and Dreezen 1959). Upland soils that formed in wind-deposited material include Crete, Hastings, Holdrege, Hord, and Uly (Kuzila 1984). The soils are suitable for farming, with about 80% of the land being cropped.

The shallow, flat depressions formed by wind scouring are often referred to as playa wetlands because of their ephemeral (lasting for a brief time) nature. Radiocarbon dating indicates the wetlands were created near the end of the Ice Age, 20,000–25,000 years ago. Some depressions may have been enlarged and new ones created as recently as 3,000 years ago (Farrar 1996a). Over thousands of years, minute clay particles accumulated in the bottoms of the depressions, effectively sealing them off and preventing water from seeping away. The impervious clay layers are 6–72 inches thick. The wetland soils are predominantly Butler, Fillmore, Scott, and Massie (Kuzila 1994, Kuzila and Lewis 1993).

The Service and RWBJV grouped the basin's land cover into 22 categories (see table 4). Cropland covers 80% of the landscape. Grassland covers 10% and roads cover 2.6%. Nonfarmed wetlands represent 1%. Figures 20–22 show the land cover, grouped into 10 simplified categories, across the basin.

Water Resources

This section describes the relationships between the hydrology, wetlands, and water quality in the basin in relation to the district's WPAs. In addition, this section describes the water rights situation.

Hydrology

As a whole, groundwater levels throughout most of the basin have little influence on wetlands. Artificial groundwater mounds occur near irrigation delivery canals and some wetlands do benefit from this water source. Most of the basin has groundwater located more than 50 feet deep; some is 400 feet or deeper (see figure 23, groundwater map). One area east of the Tri-County canal (including Johnson WPA and Funk WPA) has groundwater levels that are less than 50 feet deep (Ekstein and Hygnstrom 1996), showing a rise of more than 50 feet from the period before development to now (see figure 23, groundwater map). Recent (2000–2006) groundwater levels have shown a decline from

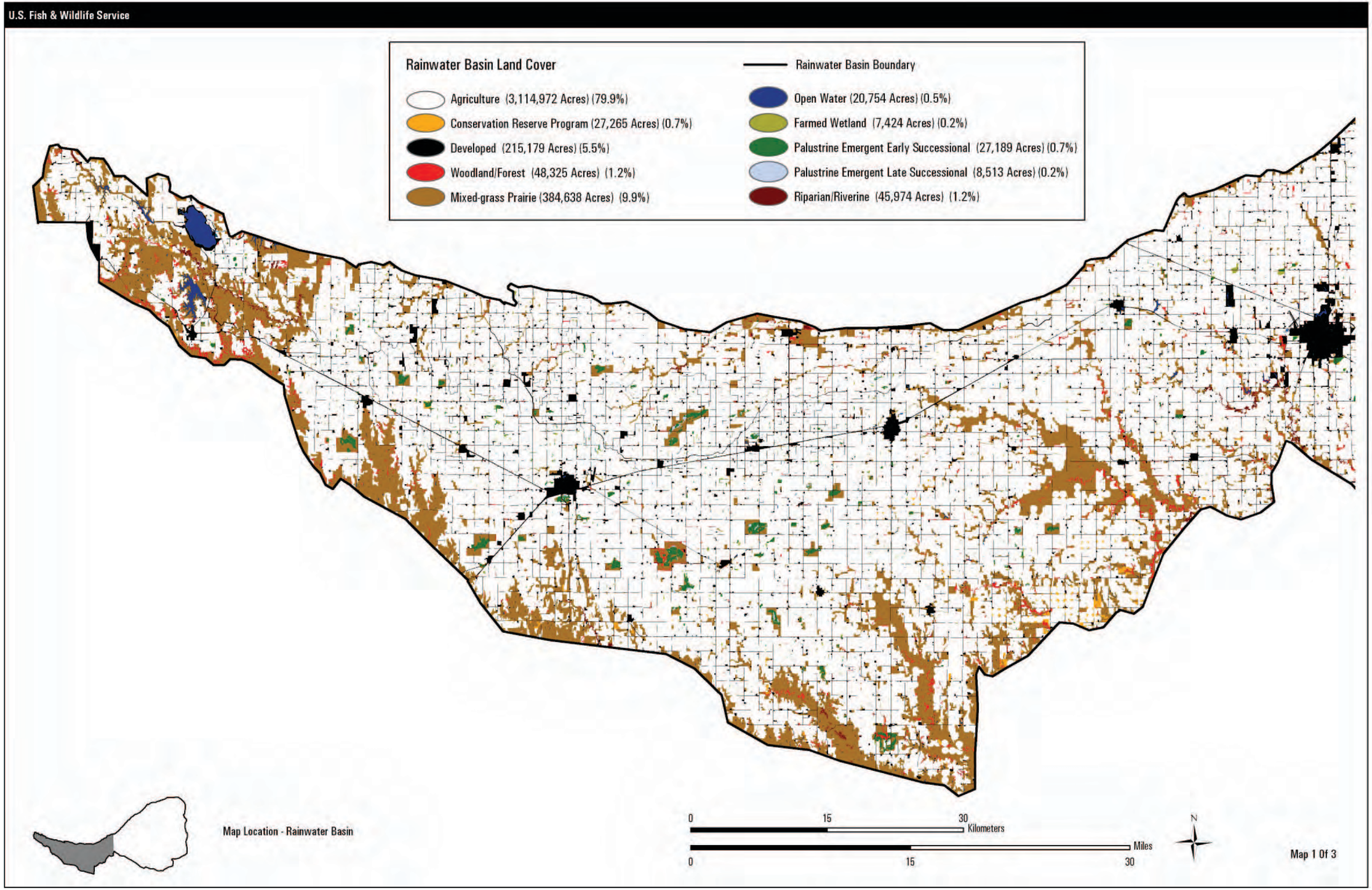

Figure 20. Land cover in the western portion of the Rainwater Basin, Nebraska.

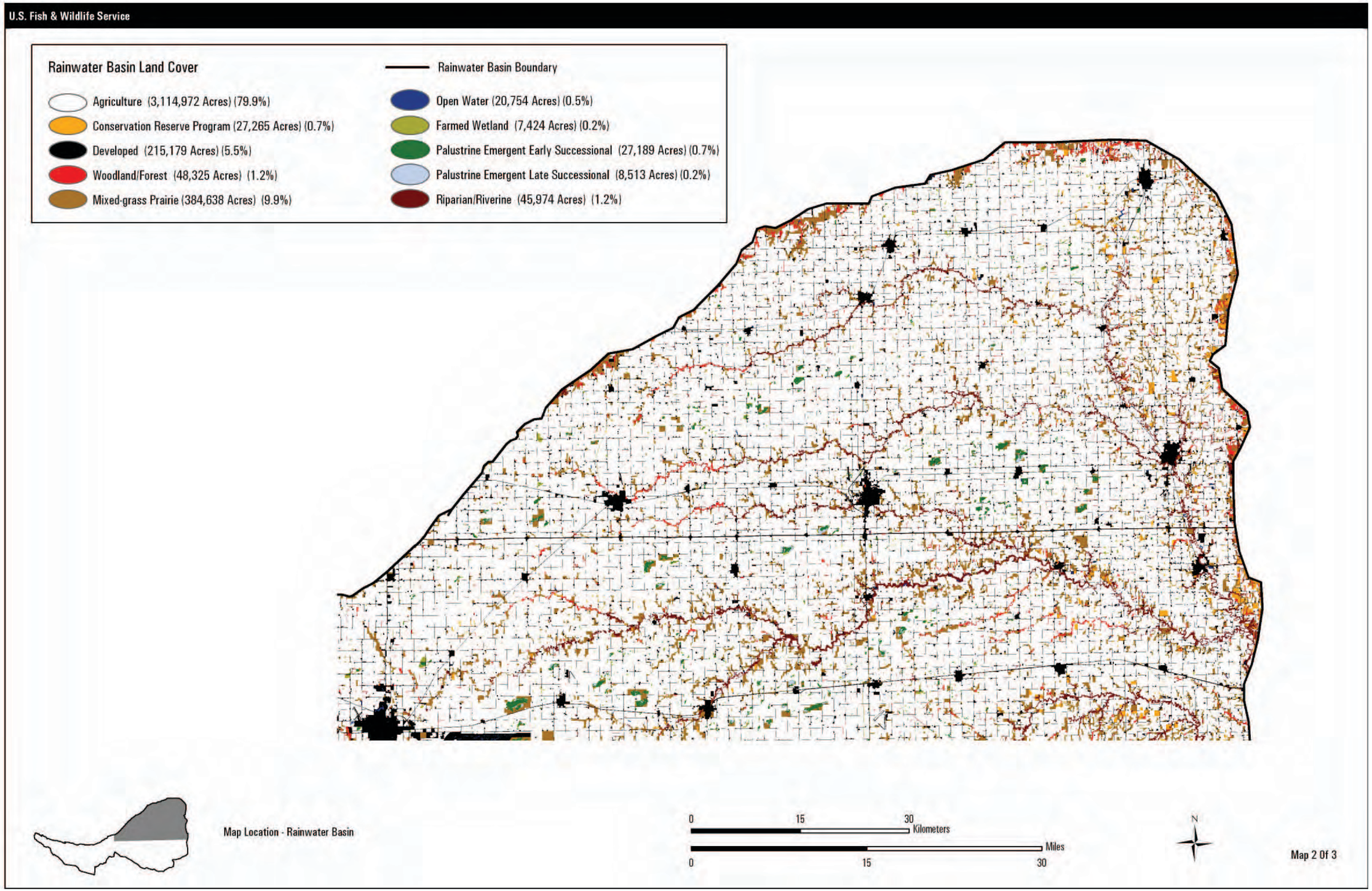

Figure 21. Land cover in the northeastern portion of the Rainwater Basin, Nebraska.

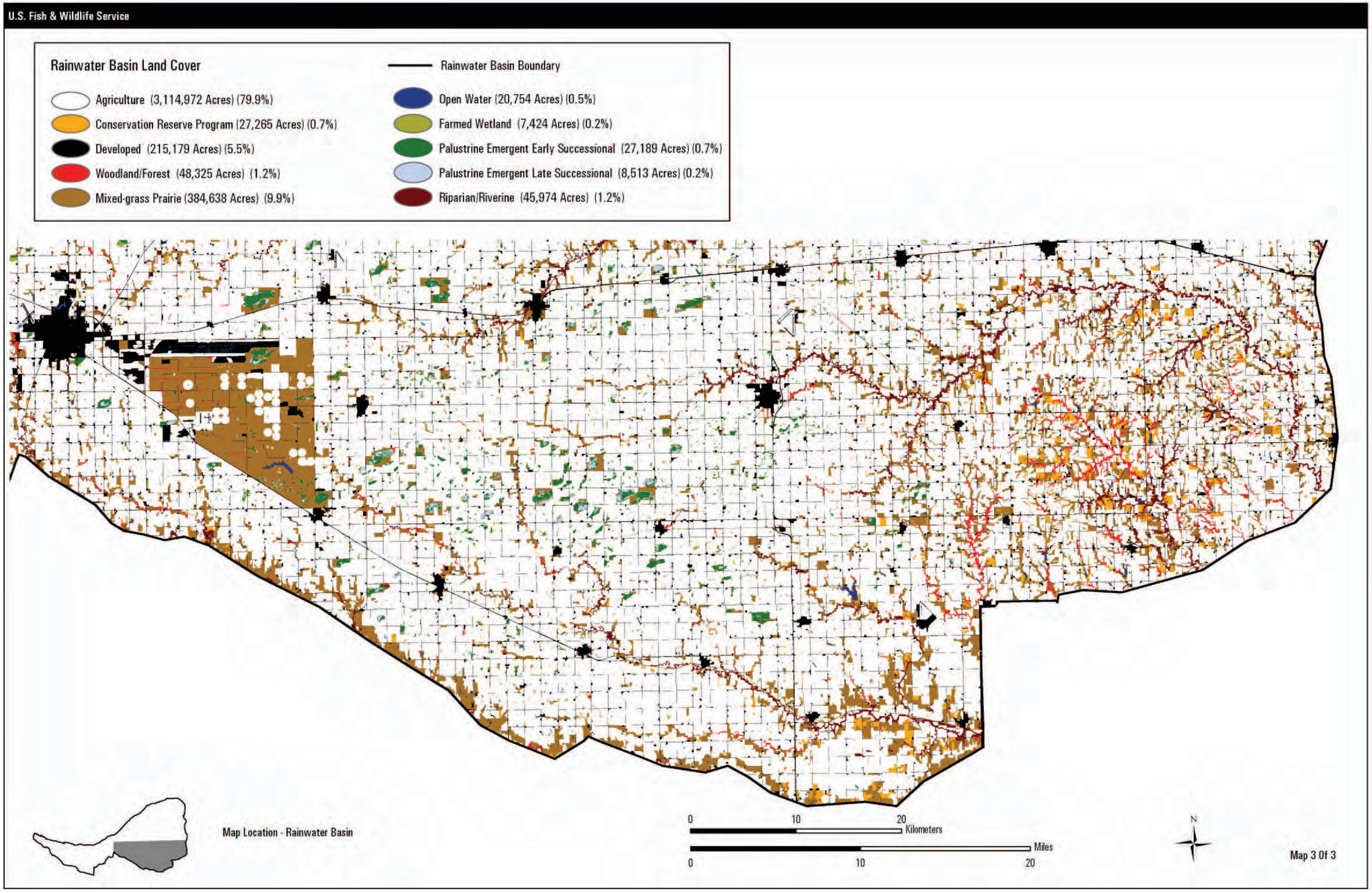

Figure 22. Land cover in the southeastern portion of the Rainwater Basin, Nebraska.

Table 4. 2004 Land cover in the Rainwater Basin.

Land Cover	*Acres*	*Percent*
agriculture (crop)	3,114,972	79.9
Conservation Reserve Program	27,265	0.7
road	102,838	2.6
developed urban area	27,969	0.7
developed rural area	80,873	2.1
other developed area	3,041	0.1
woodland forest	48,325	1.3
range/grass/pasture	384,031	9.8
sand pit	84	0.0
lagoon	486	0.0
irrigation reuse pit	5,487	0.1
reservoir	3,887	0.1
stock pond	11,298	0.3
farmed wetland	7,424	0.2
early successional hydrophytes*	27,189	0.7
late-successional hydrophytes*	8,513	0.2
riparian canopy	45,253	1.2
riparian shrubland	245	0.0
river channel	249	0.0
sandbar	46	0.0
wet meadow	971	0.0
floodplain marsh	189	0.0
Total	3,900,635	100.0

(Source: Bishop and Reker 2006.)
**A hydrophyte is a plant that is adapted to grow in water.*

5–15 feet throughout most of the basin, with a few areas decreasing more than 25 feet (UNL 2006a).

The development of center-pivot irrigation in the last third of the century has placed great demand on the groundwater underlying the basin. Irrigation, compounded by extensive drought conditions, has caused the state legislature to pass legislation to begin to control the declines in groundwater. Eleven river basins within the state have been determined to be overappropriated (that is, permitted uses for the water in the stream or river exceeds the amount of water in the stream or river). Nebraska's natural resource districts in those river basins are required to develop an integrated surface water and groundwater management plan for each river basin. Only the extreme western edge of the Rainwater Basin Wetland Management District lies within an overappropriated river basin. However, the natural resource districts within the basin have placed a moratorium on new wells and require stricter monitoring on water pumping.

There are 71 registered groundwater wells scattered over 39 of the district's WPAs. Only 26 WPAs have water-pumping capability and only 23 of these WPAs can pump water due to ownership issues relating to the "hydric footprint" (soil characteristics that indicate the existence of a wetland basin). These existing wells have the ability to deliver water to 2,230 wetland acres (approximately 20% of the total WPA wetland acres). Each well is metered and complies with state regulations for irrigation wells.

Groundwater recharge may occur in the basin and is being investigated in a 2-year research project. Research from playa lakes in Texas and New Mexico indicates that playas recharge groundwater by playa water percolating through the soils (referred to as "interstitial and macropore flow") (Wood 2000).

Wetlands and Water Quality

Mapping done in the middle part of the last century indicated that the basin contained about 100,000 acres of wetland habitat in 4,000 basins (Schildman and Hurt 1984). However, modern soil surveys indicate two to three times as many wetlands existed (Gersib et al. 1990). Ducks Unlimited inventoried the hydric soils (those characterized by considerable moisture) and computed the historical number of wetlands to be 204,436 acres (personal communication with Darin Blunk, Bismarck, ND, 2004). Figure 24 displays the historical wetlands in the basin.

In 2004, a spring habitat assessment by the Great Plains GIS office found that only 1,693 basins (14% of the historical number) contained some wetland function in the form of retained water; the area totaled 27,839 total acres. The public wetlands provided 45% of the waterfowl habitat but represented only 9% of the 1,693 wetlands. Figure 25 displays the current wetlands in the basin.

Agricultural development has been responsible for most of the wetland loss (Schildman and Hurt 1984). Modifications within the watersheds and the wetlands have caused many wetlands to become more ephemeral in nature. Land leveling and the diversion of runoff to concentration pits and road ditches are the primary causes (Raines et al. 1990). The Great Plains GIS office has identified 11,859 concentration pits totaling 7,506 acres within the basin. The pits' water storage capacity is about two-thirds of the historical storage capacity of wetlands in the basin. There are 627 pits within individual WPA watersheds. Agricultural runoff has increased siltation and deposited related chemicals, which has resulted in poor water quality and partial filling of many wetlands (Gersib 1991, Frankforter 1996).

In their natural state, the larger wetlands collected runoff from several square miles. If precipitation was adequate, the wetlands probably held water throughout most years. The most common wetlands are small—covering less than 40 acres. The larger, less common wetlands reach nearly 1,000 acres.

On average, each WPA contains one large, seasonal or semipermanent wetland. Wetlands under district ownership total 11,117 acres. The ratio of wetland to upland is 1:1. The wetlands occupy about 16% of their watershed, with the wetland receiving its runoff water from agricultural lands. Waterfowl production area

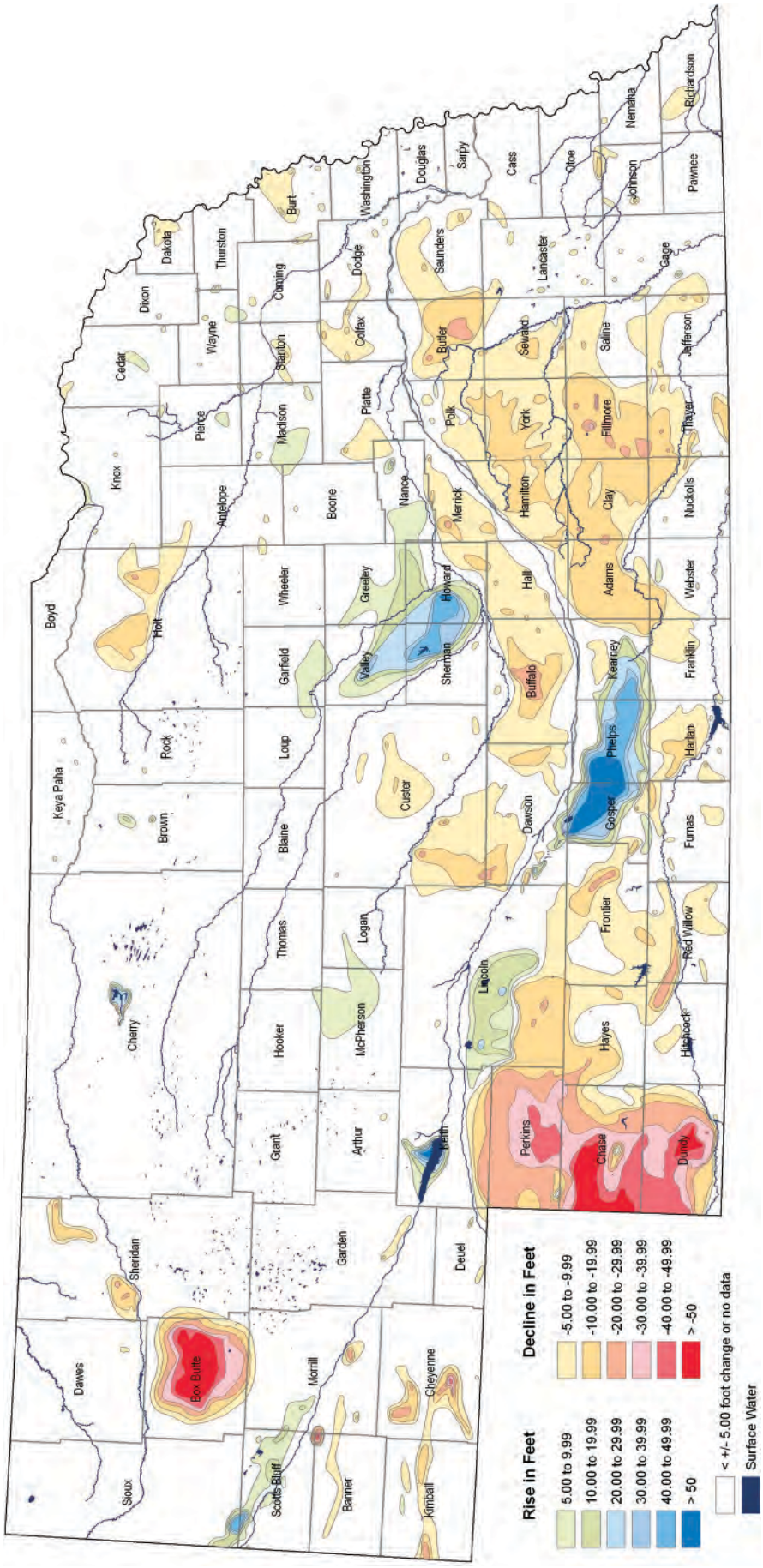

Figure 23. Groundwater-level changes in Nebraska—predevelopment to spring 2006.
(Source: University of Nebraska–Lincoln [UNL] 2006b.)

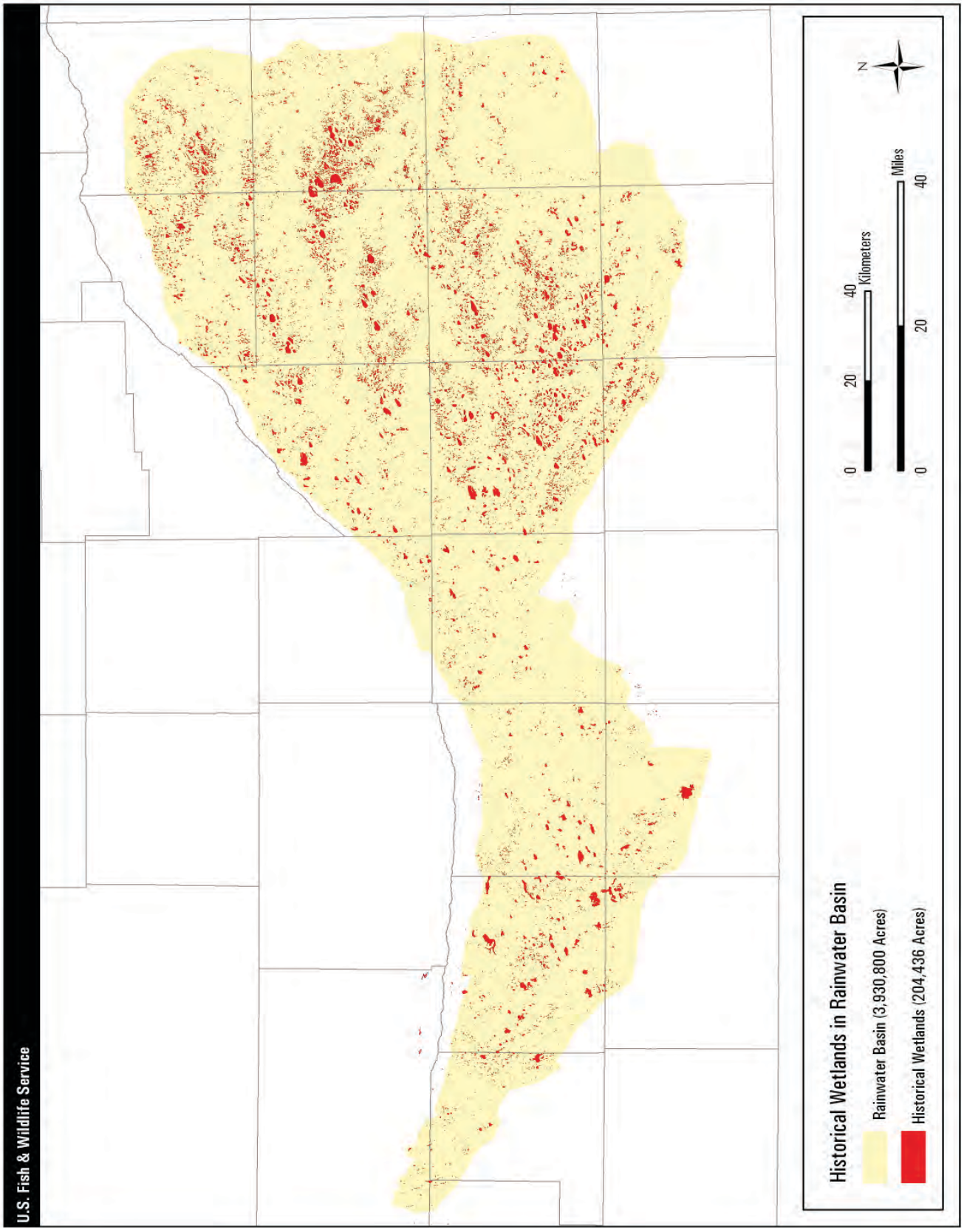

Figure 24. Historical wetlands in the Rainwater Basin, Nebraska.

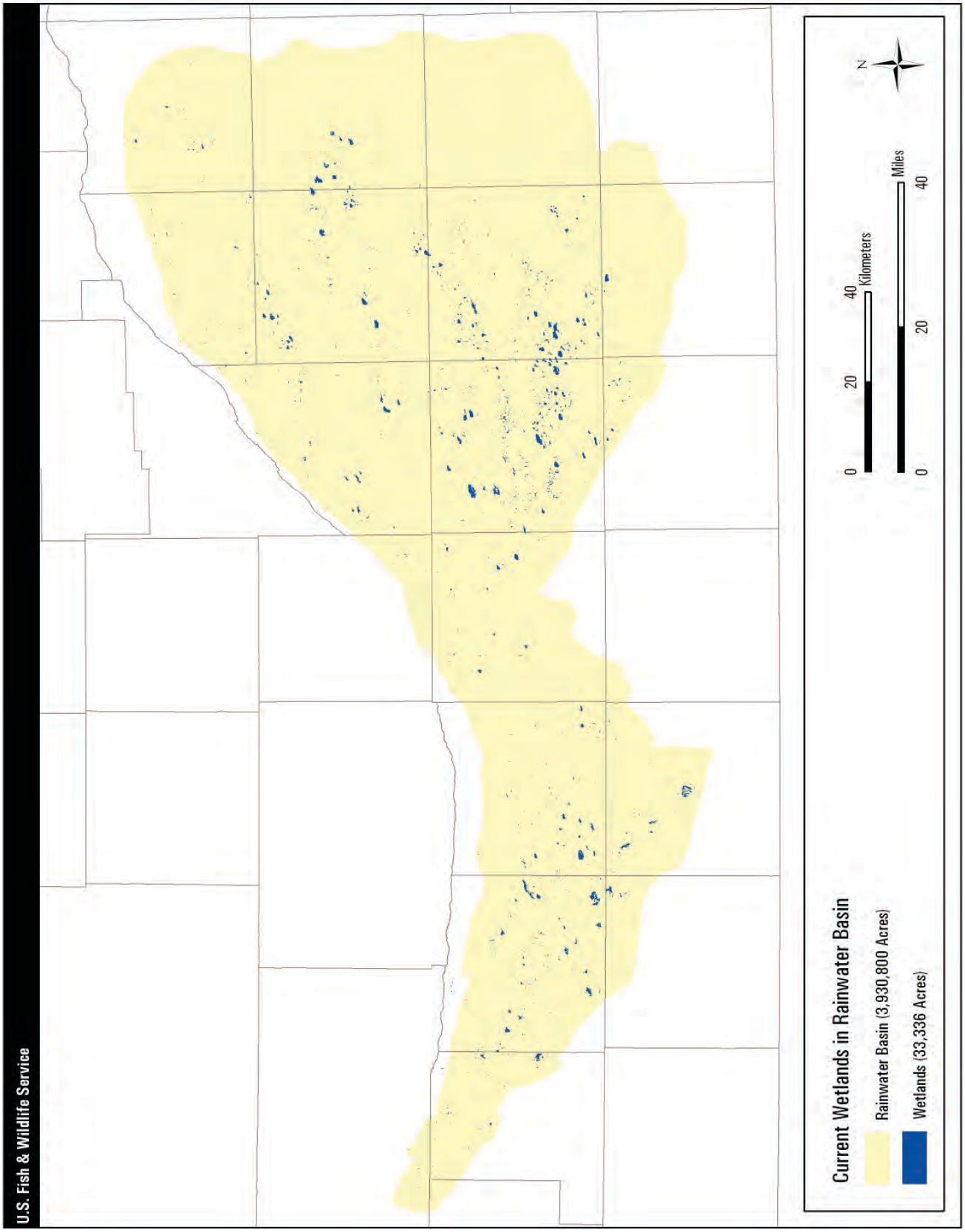

Figure 25. Current wetlands in the Rainwater Basin, Nebraska.

watersheds range in size from 153 to 15,852 acres, with an average size of 3,024 acres.

Dikes, ditches, and water control structures exist at the larger WPAs. Divided ownership of a large wetland has caused the district to try to restore its portion of the wetland to the maximum level it can. For example, surface drains occur on 13 WPA wetlands and affect the hydrology to some degree. Most of the drains only function when the wetlands are more than 80% full.

USFWS

This water control structure at Funk WPA (Phelps County) helps direct water to three different units.

In the early 1900s, counties authorized drainage districts to facilitate weltand drainage. Each district was specific to one large wetland, with drainage being done with subsurface tile drains. Five WPAs—Miller's Pond, Nelson, Springer, Troester, and Wilkins—have active tile drains. Tile drains as deep as 50 feet were tunneled though hills (Farrar 1982, 1996b). The age and structural integrity of the drains cause concern for their future. The district's desire to abandon drains is in conflict with other landowners owning a portion of the wetlands.

Water Rights

The district does not have any surface water rights because no water from streams is diverted to wetlands. However, the district has water contracts with Central Nebraska Public Power and Irrigation District for the delivery of 762 acre-feet annually to Funk WPA and Victor Lakes WPA. The water contracts transferred with the property when it was bought. The district has filed to cancel the contracts because the timing and amount of water delivered does not benefit waterfowl. These contracts are scheduled to end within 5 years.

There are no well-defined legal rights protecting surface water in wetlands. For example, where the Service owns half of a wetland, the neighboring landowner might dig a pit for irrigation re-use or for a more permanent source of livestock water or for hunting. The neighbor captures the first runoff, and the Service-owned wetland will only receive runoff water after the neighbor's pit is filled. If there is not enough runoff to overfill the pit, the Service-owned wetland will get little or no water, especially when most of the runoff comes from the neighboring land.

Nebraska's water law requires irrigators to control irrigation runoff. Infractions are difficult to enforce and the irrigator often views the runoff flowing onto public lands as a benefit to wildlife. However, the law does allow natural runoff to be diverted or used by anyone within a closed watershed. A closed watershed does not drain into a perennial or permanent stream. In an open watershed, runoff from a normal rain event runs off the land into a stream. In the future, water may become valuable enough to cause landowners to capture and use runoff before it can get to the WPAs.

Groundwater rights differ from surface water rights. Nebraska's water law only requires that irrigation wells have a permit before being drilled. After well installation, the owner is allowed "reasonable and beneficial use of the groundwater." High water demands and drought conditions are expected to cause natural resource districts to place more restrictions on groundwater use. Currently, the natural resource districts have a moratorium on new wells.

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 (PM) is a generic term for a broad class of chemically and physically diverse substances that exist as discrete particles (liquid droplets or solids) over a wide range of sizes. The smaller the size of the particle, the deeper it can penetrate into lung tissue. There are no standards for PM size in relation to prescribed fire because prescribed fires release many sizes of PM. However, there are regulations for the amount of different sizes of particles. The standards for $PM_{2.5}$ (published in the "Federal Register" on October 17, 2006) set a 24-hour standard of 35 microns/cubic meter, with an annual standard of 15 microns/cubic meter.

The Rainwater Basin in general has good air quality, with no nearby manufacturing sites or major air pollution sources. Feedlots near the WPAs produce odors and can produce particulate matter. The state of Nebraska has minimal smoke management guidelines and regulations that pertain to agricultural burning and the prevention of smoke lingering on roadways and other sensitive areas. Windblown dirt from cropland and carbon from automobiles and diesel engines contributes to particulate matter.

4.2 BIOLOGICAL RESOURCES

This section describes vegetation, wildlife, and their associated communities at the district. Species lists are found in appendix F (plants), appendix G (amphibians, reptiles, and mammals), and appendix H (birds).

Wetlands and Associated Vegetative Communities

The district manages 11,117 acres of hydrophytes (wetland plant species). During drawdown or drought, emergent vegetation dominates the wetlands. In wet years, submerged vegetation can occur. The 2004 vegetation mapping established community names and determined the acreage for each vegetative zone (see table 5). These names or categories have been cross-referenced with the National Vegetation Classification System (NVCS). Appendix I contains more explanation.

Table 5. Habitat types at the district in 2004.

Habitat Type	*Acres*	*Percent*
buildings	2.7	0.01
bull thistle	0.4	0.00
Canada thistle	67.1	0.29
cattail	656.6	2.83
leafy spurge	0.1	0.00
moist-soil plants	5,014.5	21.62
musk thistle	10.6	0.05
parking lot	0.3	0.00
reed species (*Phragmites* spp.)	1.1	0.00
reed canarygrass	1,963.8	8.47
road	3.2	0.01
bulrush species	1,145.0	4.94
trees	554.3	2.39
water or mud flat	585.0	2.52
wet meadow	1,717.8	7.41
annual weeds	99.5	0.43
cropland	478.1	2.06
introduced forbs	4.4	0.02
invasive cool-season plants	3,192.9	13.77
native grassland	232.4	1.00
newly seeded	370.7	1.60
planted native cool-season plants	409.2	1.76
planted native warm-season plants	6,668.9	28.75
prairie dog town	14.9	0.06
Total	23,193.5	100.00

Native wetland plants occur on 9,148 acres. Currently, cattail dominates 657 acres and river bulrush dominates 1,145 acres. Moist-soil plants (5,014 acres) and wet meadow (1,718 acres) are the more prevalent associations. Reed canarygrass and reeds add an additional 1,965 acres of wetland habitat but are considered introduced species and are targeted for reduction (see table 5). Other invasive plants that occur in wetlands at the WPAs include Canada thistle, purple loosestrife, and "volunteer" deciduous trees.

Upland and Associated Vegetative Communities

The district manages 12,044 acres of upland habitat at the WPAs. Vegetation includes native, cool- and warm-season grasses, forbs, planted and "volunteer" trees, and invasive plants. Native, warm-season grass stands are dominated by big bluestem, little bluestem, Indiangrass, switchgrass, Junegrass, needle and thread, and leadplant. Undesirable and invasive plant species include Canada thistle, musk thistle, leafy spurge, smooth brome, intermediate wheatgrass, and Kentucky bluegrass.

During the 1960s and '70s, the district planted native warm-season grass and dense nesting cover on many areas to promote waterfowl production. These plantings lacked vegetative diversity and frequently became dominated by one or two species, which reduced the grassland's attractiveness to a variety of wildlife species. Most of these stands have been "interseeded" with a high-diversity (more than 80 species) grassland mix.

Between 400 and 700 acres are farmed, usually with soybeans. Farming is done for 2–4 years to reduce the seed source of weed seeds in the soil and to prepare the land to reseed with native grasses and forbs.

The WPAs have undesirable woody species—green ash, cottonwood, willow, eastern red cedar, and elm. These species are continually controlled or removed throughout the district. Native tree species such as buffaloberry, mulberry, chokecherry, and American plum occur and are not targeted for removal; however, some of these native trees may be inadvertently cleared during large-scale reduction treatment of undesirable trees.

Shrub and Tree Plantings (Shelterbelts)

Shelterbelts were planted along the boundaries of many of the district's WPAs in the 1970s. The shelterbelts are mostly mature eastern red cedars that have shaded out native vegetation. Since that time, the district has realized that tree planting is not compatible with the purposes of the district.

Fire and Grazing History

Historically, grassland species in the northern Great Plains co-existed or adapted to various disturbance

regimes such as fire and large-scale grazing. Settlement and the expansion of agriculture have removed fire and high-intensity, short-duration grazing from the basin.

Fire

Whether lightning-induced or deliberately set by Native Americans, fire has influenced the grassland ecosystem of the basin. A handful of fire-tolerant shrubs such as chokecherry, American plum, and leadplant are present; other woody species that are killed by fire are now restricted to areas protected from fire.

It is estimated that presettlement (historical) fire frequency on mixed-grass prairie was 5–7 years. These fires sustained diverse and healthy grasslands. The district uses prescribed fire to simulate the historical influence wildland fires had on the plant communities. Most prescribed fire treatments are completed during late winter through green-up in spring. Spring presents opportunities to complete prescribed burns when temperatures are low, humidity is high, and the fire is easier to control. In addition, the timeframe coincides with other district management activities. During the last 10 years, district fire treatments have increased from about 6 prescribed burns to 25–35 burns each year, covering 4,000–5,500 acres. District experience has shown that prescribed burning of residual wetland vegetation helps promote annual plants during drier years.

Grazing

Similar to fire, grazing greatly influenced the structure and composition of grassland communities. Herbivores such as the bison, elk, deer, pronghorn, and black-tailed prairie dog maintained grassland vigor and created patches of varying stand height and density. Grazing influenced the soil productivity, plant diversity, animal diversity, and other processes to produce unique successional patterns in the landscape at multiple scales.

Vegetation in grassland communities has developed growth strategies that allows for grazing at or near the ground without killing the plants. Some plant species contain bitter or toxic substances that cause animals to avoid grazing on them. Some species have spines that cause injury to a grazing animal's mouth. Small mammals and deer "naturally" graze at the WPAs. Additional grazing by large herbivores such as cattle is needed, at times, to maintain wetland and upland vegetation.

The district staff works with local cattle producers to provide grazing disturbance. Upland grazing is generally conducted during spring and early summer, and again in fall, to (1) stress exotic cool-season grasses or invasive plants, and (2) increase the vigor of native warm-season grasses and forbs. Wetland grazing occurs for much of the growing season to stress and physically injure invasive or aggressive wetland species such as cattail. This grazing strategy favors early successional species that provide wildlife food, create diverse habitats, and limit the expansion of invasive plants.

Wildlife

This section describes the animals that are common at the WPAs, as well as those that are uncommon, threatened, or endangered.

Amphibians and Reptiles

Amphibians that occur in the basin include the plains spadefoot toad, Woodhouse's toad, Great Plains toad, Blanchard's cricket frog, western chorus frog, bullfrog, and plains leopard frog. Appendix G contains a list of amphibians and reptiles that occur in the basin.

Semipermanent wetlands provide habitat for the painted turtle, chorus frog, common gray treefrog, and snapping turtle. The ornate box turtle lives in grassland areas. The western garter snake, red-sided garter snake, bullsnake, and eastern yellowbelly racer are common. The western hog-nosed snake occurs less frequently and prefers dry sandy prairies. The two rare snakes that can occur are smooth green snake and red-bellied snake.

The lesser earless lizard may occur in open sandy soil with little or sparse vegetation. The six-lined racerunner can be found in both lowland and upland sites.

Mammals

The most common, larger mammals found at the WPAs are white-tailed deer, coyote, raccoon, striped skunk, eastern cottontail, American badger, and Virginia opossum. Mule deer have been seen at the western WPAs but are uncommon. During wet periods, muskrat and mink are common. The black-tailed prairie dog occurs at five WPAs: McMurtrey, Prairie Dog, Atlanta, Hultine, and Clark. Appendix G contains a list of mammals that occur in the basin.

Dave Menke/USFWS

Muskrat

Less common mammals are red fox, black-tailed jackrabbit, woodchuck, Franklin's ground squirrel, and eastern fox squirrel. Small mammals that are common include thirteen-lined ground squirrel, northern pocket gopher, plains pocket gopher, Ord's kangaroo rat, meadow jumping mouse, meadow vole, northern grasshopper mouse, and white-footed mouse.

Birds

The Rainwater Basin is internationally known for its spectacular bird migrations—not only numbers of birds but also the large proportion of the continental population of prominent species. Thirty species of shorebirds use wetlands in the basin. Of the 329 species of birds that have been observed in the basin (Sharpe et al. 2001), 96 species nest (Mullhoff 2001). Appendix H contains a list of birds that occur in the basin.

Common grassland species include grasshopper sparrow, dickcissel, western meadowlark, bobolink, northern bobwhite, ring-necked pheasant, field sparrow, and northern harrier. The greater prairie-chicken is becoming more common and is found at these WPAs: Harvard, Hultine, Funk, Quadhamer, Prairie Dog, Lindau, and Jensen.

The spring migration chronology usually starts with a buildup of Canada geese on the Platte River until the basin's wetlands begin to thaw. Numbers of snow geese, white-fronted geese, and mallards begin to peak by mid- to late-February. In early March, northern pintail numbers peak, followed by Ross's geese and green-winged teal. The numbers of other divers and puddle ducks usually peak during mid- to late-March. Cinnamon teal may be seen as far east as Harvard WPA in late March, but is more common west of Hastings.

Most shorebirds pass through the basin between April 15 and May 15. According to Jorgensen (2004), the most common, spring, shorebird migrants are the following species:

black-bellied plover
American golden-plover
semipalmated plover
greater yellowlegs
lesser yellowlegs
willet
upland sandpiper
Hudsonian godwit
dunlin
short-billed dowitcher
long-billed dowitcher
Wilson's snipe
Wilson's phalarope
semipalmated sandpiper
least sandpiper
white-rumped sandpiper
Baird's sandpiper
stilt sandpiper
buff-breasted sandpiper

Donna Dewhurst/USFWS

Greater Yellowlegs

Rainwater Basin has one of the largest concentrations of buff-breasted sandpiper during its spring migration. Common, late-summer migrants are the following: greater yellowlegs; lesser yellowlegs; Wilson's snipe; long-billed dowitcher; and sandpipers (solitary, upland, least, semipalmated, stilt, and pectoral).

The peregrine falcon frequents wetlands during peak, shorebird migration periods. In contrast, the prairie falcon is most numerous in late January when horned lark and meadowlark are common. The merlin is primarily a winter visitor and a spring migrant (Johnsgard 1997). The burrowing owl nests at Prairie Dog WPA and Atlanta WPA. The short-eared owl is common at many of the larger WPAs during the winter months.

The Harris's sparrow can be seen at the eastern WPAs that have brushy growth or American plum thickets.

Threatened and Endangered Species

In Nebraska, there are eight state- and federally listed endangered species, four state- and federally listed threatened species, six state-listed endangered species, and nine state-listed threatened species (see table 6).

The state- and federally endangered whooping crane and piping plover use wetlands at the basin. Forty-two percent of confirmed observations of whooping crane in Nebraska have been at the basin's wetlands (Richert 1999). Most of these sightings occur the first two weeks of April, or late October through mid-November. Piping plovers are rarely seen at the basin's wetlands due to their size and the number of other shorebirds that would be using mud flat habitats in late April through mid-May (Johnsgard 1997).

Table 6. Nebraska's state-listed and federally listed species.

Common Name	*Scientific Name*	*State Status*	*Federal Status*
PLANTS—7 Species			
Hayden's (blowout) penstemon	*Penstemon haydenii*	endangered	endangered
Colorado butterfly plant	*Gaura neomexicana* ssp. *coloradensis*	endangered	endangered
saltwort	*Salicornia rubra*	endangered	—
western prairie fringed orchid	*Platanthera praeclara*	threatened	threatened
Ute lady's tresses	*Spiranthes diluvialis*	threatened	threatened
ginseng	*Panax quinquefolium*	threatened	—
small white lady's slipper	*Cypripedium candidum*	threatened	—
INSECTS—2 Species			
American burying beetle	*Nicrophorus americanus*	endangered	endangered
Salt Creek tiger beetle	*Cincindela nevadica lincolniana*	endangered	—
REPTILES—1 Species			
massasauga	*Sistrurus catenatus*	threatened	—
FISH—7 Species			
pallid sturgeon	*Scaphirhyncus albus*	endangered	endangered
Topeka shiner	*Notropis topeka*	endangered	endangered
sturgeon chub	*Macrhybopsis gelida*	endangered	—
blacknose shiner	*Notropis heterolepis*	endangered	—
lake sturgeon	*Acipenser fulvescens*	threatened	—
northern redbelly dace	*Phoxinus eos*	threatened	—
finescale dace	*Phoxinus neogaeus*	threatened	—
BIRDS—6 Species			
Eskimo curlew	*Numenius borealis*	endangered	endangered
whooping crane	*Grus americana*	endangered	endangered
interior least tern	*Sterna antillarum athalassos*	endangered	endangered
bald eagle	*Haliaeetus leucocephalus*	threatened	threatened
piping plover	*Charadrius melodus*	threatened	threatened
mountain plover	*Charadrius montanus*	threatened	—
MAMMALS—4 Species			
black-footed ferret	*Mustela nigripes*	endangered	endangered
swift fox	*Vulpes velox*	endangered	—
river otter	*Lutra canadensis*	threatened	—
southern flying squirrel	*Glaucomys volans*	threatened	—

Bald eagles are most common during peak waterfowl migration.

4.3 CULTURAL RESOURCES

Archaeological and architectural remains representing 12,000 years of human occupation are potentially located in the district. There has been very limited, formal, cultural resource survey done in the area. However, sites in the surrounding areas span the time from the earliest Paleo-Indian occupation through the rural and agricultural development of the early twentieth century. Nearby sites are located in a variety of geographical settings and exhibit a wide range of artifacts and features, but definite trends in site types and changes through time are apparent.

Archaeological evidence indicates that the earliest humans, called the Paleo-Indians, migrated to the region near the close of the Ice Age approximately 12,000 years ago. These people had a highly mobile lifestyle that depended on the hunting of big game including mammoths and the huge, now-extinct bison. The hallmark of most Paleo-Indian sites are the beautiful but deadly spear points that are generally recovered from animal kill and butchering sites and small temporary camps.

There was a gradual but definite shift in the pattern of human use of the area beginning about 9,000 years ago. The changes were due to a combination of climatic fluctuations and an increasing population, coupled with tremendous social change and technological innovation. This stage is referred to as the Archaic and lasted until about 2,000 years ago. Although the Archaic stage is better represented in the archaeological record than the preceding Paleo-Indian stage, the interpretation of the remains is difficult. Evidence of a greater diversity of tools and increased use of native plants is found on many sites but the remains also suggest a more localized and less mobile population.

By 2,000 years ago, the populations of the area became increasingly influenced by the woodland cultures to the east. This period, referred to as the Plains Woodland (1,000–2,000 years ago), brought great changes and innovation including the advent of pottery, the bow and arrow, and semipermanent dwellings. Small villages began to be established and evidence of early agriculture is found along some of the waterways.

Beginning approximately 1,000 years ago until approximately 600 years ago, evidence of an increasingly sedentary population is found at many of the sites. This adaptation is referred to as the Central Plains village tradition and amplifies many of the trends began during the Plains Woodland period. Small villages of earthen structures with associated agricultural fields were more common. The increased use of pottery in conjunction with the construction of food storage pits reflect a population that was spending increasing amounts of time in one location.

Early postcontact occupation of the area (100–400 years ago) included the Pawnee and possibly the Arikara peoples. Their settlements tended to be large villages with extensive agricultural fields—often located along the major waterways. Bison hunting, fishing, and Euro-American trade were also primary components of the economy. Beginning in the early 1700s, explorers began to make incursions into the area and by the mid-1800s there was a regular stream of emigrants passing through on their way west. Many of these travelers chose to stay and settle in the area referred today as the Rainwater Basin.

4.4 SPECIAL MANAGEMENT AREAS

McMurtrey WPA, which lies adjacent to the Meat Animal Research Center, is closed to public use because no public access exists. The WPA contains 1,067 acres (513 wetland acres). Land and vegetation management is the same as for other areas managed by the district. The WPA has two wells and water is pumped during dry years to provide a refuge area for migratory birds.

The district manages two additional areas that are located outside the basin. Schwisow WPA, in Saline County (within the district's boundary), is 61 acres. Haseman WPA is located on the border of Cuming and Dodge counties, outside of the district's boundary. The Farmers Home Administration transferred both properties to the district. Schwisow WPA is primarily riparian habitat along the Little Blue River with some oak-timbered upland. Haseman WPA covers 229.11 acres, with 160 acres of riparian wetland along State Highway 275. Both areas are open to the public uses allowed at the district's other WPAs. The Service is considering these WPAs for property exchange or divestiture for the following reasons: (1) the lands do not meet the purpose of the district, (2) the distance of the WPAs is so far from the district's facilities that staff visits require overnight lodging, and (3) another agency may be able to more efficiently manage the riparian habitats.

4.5 VISITOR SERVICES

The district has 60 of the 61 WPAs it manages open to the public; McMurtrey is the only WPA closed to all public use. The Improvement Act outlines wildlife-dependent and wildlife-compatible uses. These uses include hunting, trapping, fishing, wildlife observation, photography, environmental education, and interpretation. Hunting and wildlife observation are the most popular activities, accounting for 80% of annual visitation. (BBC Research and Consulting 2006)

There are no official visitation data available for the district. All visitation figures reflect best available estimates by district staff. Visitation levels fluctuate between 60,000 and 80,000 visitor days per year, depending on the water level and habitat quality. A typical breakdown of annual visitation by use is

about 60% hunting and 40% wildlife viewing. (BBC Research and Consulting 2006)

All WPAs are marked with boundary signs. Proper signs identify four of the most prominent WPAs in the district. The other WPAs are unmarked and the only locator for these areas is a district brochure map that shows their locations within the district.

Hunting, Trapping, and Fishing

Visitors generally hunt various waterfowl, pheasant, and deer at the district. The major hunting season for all species is October through December, although there is a light goose–hunting season in the spring. (BBC Research and Consulting 2006)

Hunting, trapping, and fishing are allowed in accordance with state regulations. There is a viewing blind at Funk WPA, which is accessible to hunters with disabilities.

The WPAs, other than McMurtrey, are open to fishing. However, the physical characteristics and hydrologic conditions of the wetlands in the WPAs do not provide for a viable fishery.

Wildlife Observation and Photography

The most popular wildlife-viewing season is during spring migration, which lasts from mid-February through April (BBC Research and Consulting 2006).

Every spring and fall, thousands of tourists and locals visit the district to observe and enjoy the semiannual migration of waterfowl and other birds from the southern United States and Mexico to Canada and vice-versa. As a result, ornithologists, amateur birders, hunters, and the general population are witness to a remarkable natural phenomenon. (BBC Consulting 2006)

There are two viewing blinds, one each at Funk WPA and Massie WPA. Funk WPA has approximately 2 miles of developed trail (constructed in 2006).

USFWS

Visitors can view flocks of snow geese (seen in the distance) from this blind at Massie WPA (Clay County). An interpretive sign provides information.

Environmental Education

The district does not provide any public environmental education programs. It is only on rare occasion that district staff is available to conduct a wetland tour. One reason for that is the long distance between the office and the WPAs. The district's office is located in an industrial park in Kearney, approximately 20 miles from its closest WPA.

Interpretation

There are information kiosks at four WPAs: Mallard Haven, Massie, Funk, and Harvard. Plans for 2007 include additional interpretive signs.

4.6 PARTNERSHIPS

The district is engaged in various partnerships that allow the district to pursue the purposes for the district. While these partnerships help the district to conserve habitats, the district would benefit from expansion in the number and variety of partnerships. Current formal and informal partnerships include those with groups such as the RWBJV, Ducks Unlimited, Pheasants Forever, and The Nature Conservancy.

4.7 SOCIOECONOMIC ENVIRONMENT

A socioeconomic study prepared by BBC Consulting (2006) is the source for information in this section.

The Rainwater Basin supports hunting, trapping, photography, wildlife observation, and environmental education for the public. These recreational activities attract both visitors and dollars from outside the 17-county basin that benefits the local communities. Ancillary visitor activity—such as spending on food, gasoline, and overnight lodging in the local area—provides local businesses with supplemental income and increases the local tax base. District management decisions regarding public access, expansion of services, and other district-related operations may affect recreational traffic and thus visitor expenditure levels.

Population and Demographics

Nebraska's population in 2006 was estimated at 1,768,331, a 3.4% increase from 2000. The reported population for the basin in 1999 was 201,245. Rural emigration is a concern with 89% of Nebraska's cities having fewer than 3,000 people. Fifty-three of the 93 counties have reported declining populations between 1990 and 2000. The three major cities of Grand Island, Kearney, and Hastings contribute to 48% of basin's 2004 population (U.S. Census Bureau 2000–2007). These cities' populations totaled 157,662 in 2004 (U.S. Census Bureau 2000–2007).

The 17 counties encompassing the basin are currently neither losing nor gaining population. In comparison, the population of Nebraska has increased at a steady

pace since 1980 (see figure 26). While the population retention of the 17 counties is better than many rural Midwestern counties, the gradual loss of residents undoubtedly affects the socioeconomic conditions of the area.

Figure 27 illustrates the aging population within the 17 counties. In 1980, about 26% of the population was between 18 and 34 years old, while that same demographic constituted only 22% of the population in 2004. The median age for the 17 counties has increased by about 6 years since 1980, a trend that is found throughout the state.

Employment

The civilian workforce for the 17 counties within the basin has increased by about 250 workers per year since 2000, and it is predicted to increase by another 1,000 workers to 107,980 by the year 2009. Estimates from the year 2004 calculated the unemployment rate for the 17 counties within the basin at 3.4%. This is on par with the state of Nebraska, whose 2004 estimate calculated the statewide unemployment rate at 3.5%.

Agricultural row cropping is the main economic enterprise throughout the basin. Eighty percent of the land base is cropland. Major crops are corn and soybeans. Other crops that may occur include wheat, milo, sorghum, and alfalfa. Ranching is a secondary enterprise with 10% of the area being grassland. The number of farms per county in the basin range from 345 in Gosper County to 974 in Seward County. The average-sized farm in the basin in 1987 was 506 acres.

While agriculture has been the traditional mainstay of the state's economy, new industries such as health care and services now employ an increasing portion of the state's residents. In the 17 counties within the basin, the total number of farms has decreased at a notable rate. In 1964, the 17 counties supported over 16,500 farms. That number of farms declined to just over 9,200 in 2002 (see figure 28).

Business Concentration

The 17 counties within the basin employ a large number of white-collar workers, with over 13% of its total workforce in the office and administrative support occupations. However, the basin also contains a large manufacturing sector, with 12% of its total workforce employed in production occupations. Other high-ranking occupations include sales and related occupations, education training and library occupations, and food preparation. It should be noted that only 6% of the entire workforce is employed in the agricultural industry.

Rainwater Basin Wetland Management District Current Conditions

About 60% of district visitors live in the 17 counties within the basin. Most destination visitors come for the weekend and stay 1–2 nights, usually in Grand Island, Kearney, Hastings, or York.

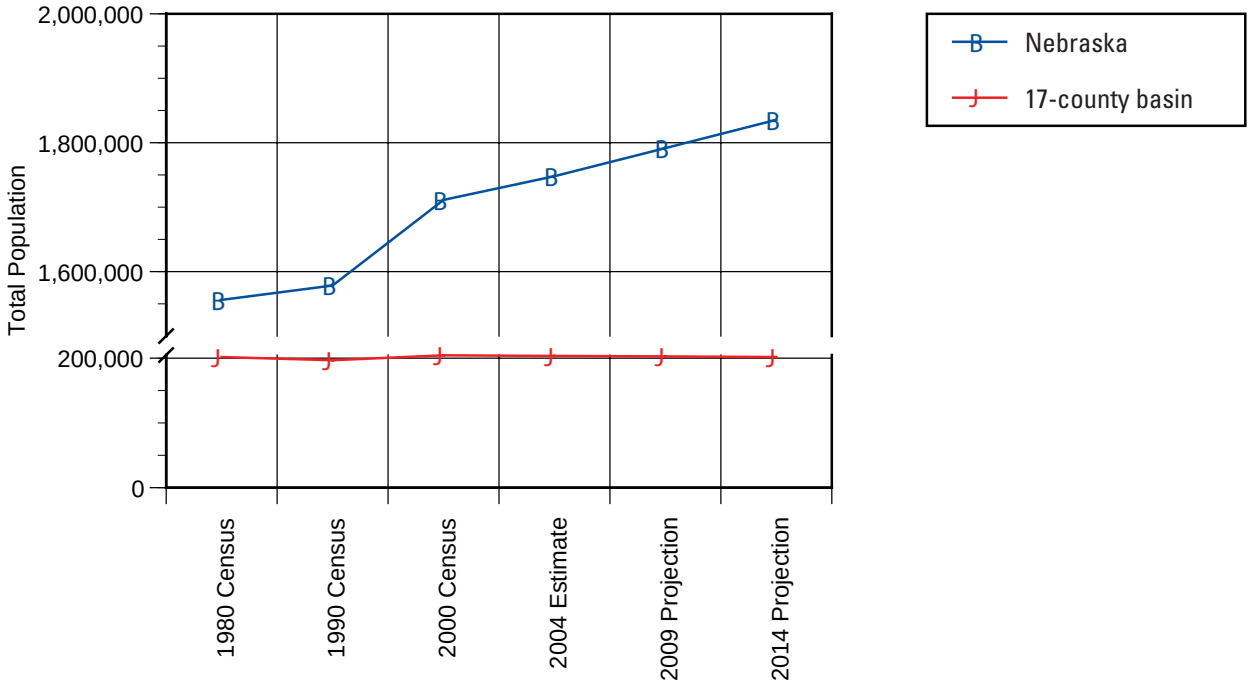

Figure 26. Populations of Nebraska and the 17 counties in the Rainwater Basin.
(Note: 2004, 2009, and 2014 populations are estimates. Source: U.S. Census Bureau, PCensus, 2006.)

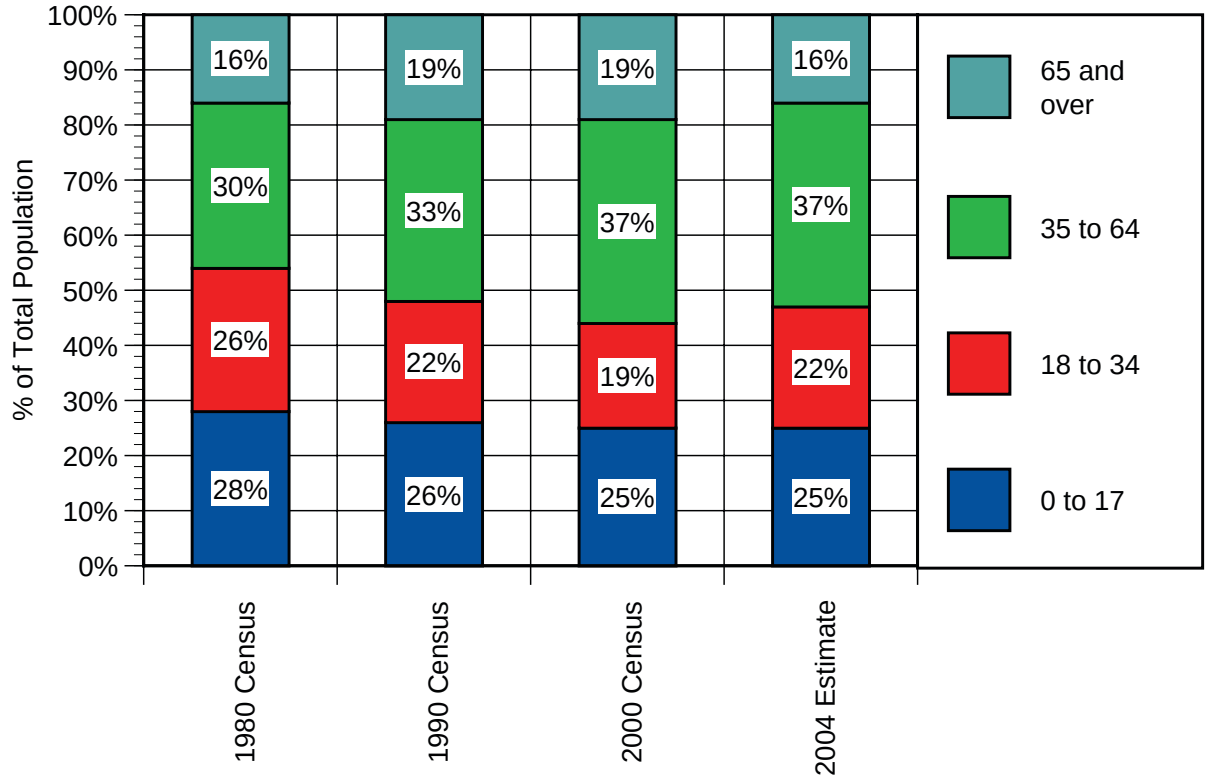

Figure 27. Age composition within the 17 counties in the Rainwater Basin.
(Source: U.S. Census Bureau, PCensus, 2006.)

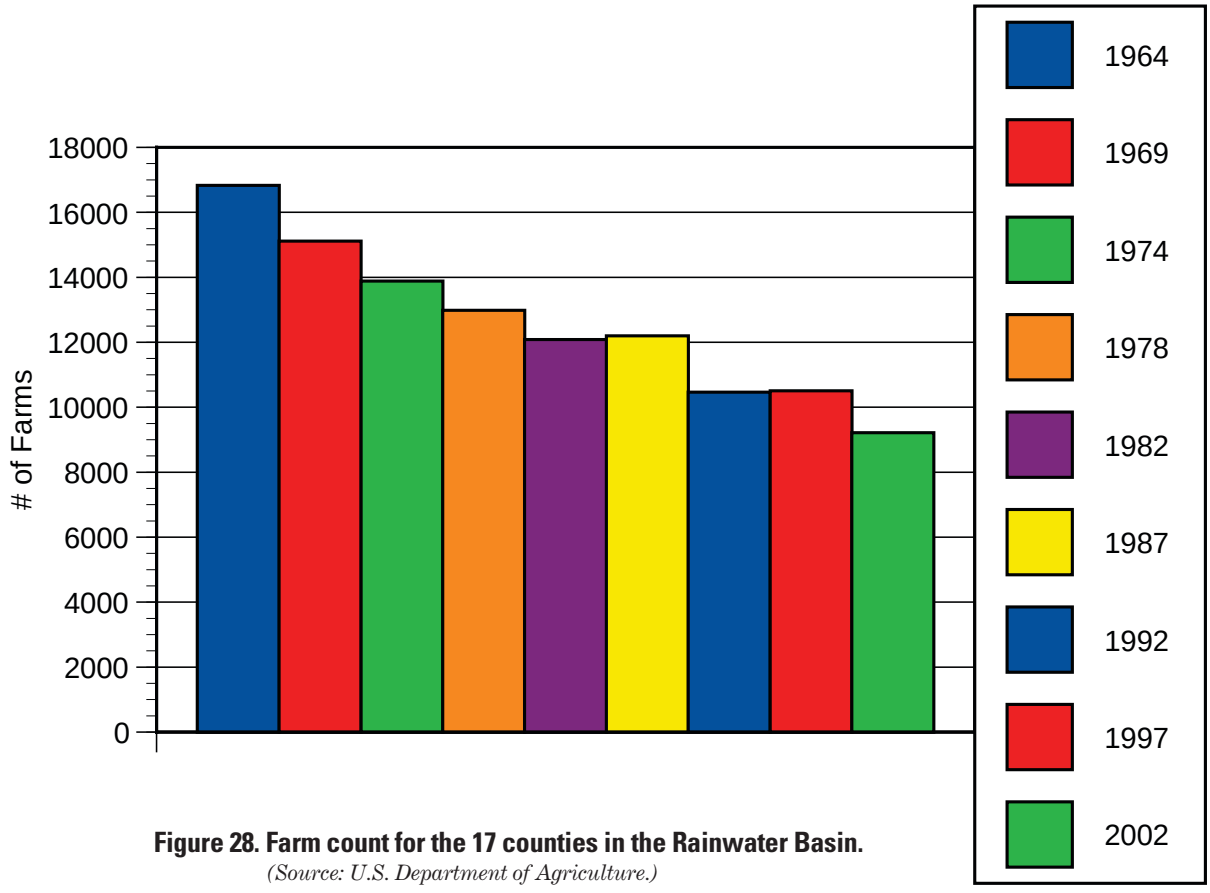

Figure 28. Farm count for the 17 counties in the Rainwater Basin.
(Source: U.S. Department of Agriculture.)

Visitor Spending

Off-site spending by visitors helps support local lodging and retail establishments in surrounding towns. Approximately 40% of the district's visitor days, or about 30,000 visitor days, are from nonlocal visitors. If 50% of these guests spend the night locally in commercial lodging or campgrounds—and, on average, nonlocal visitors spend $60 per day for lodging, food, and supplies—the district's activity spurs about $900,000 of new annual spending in the regional economy.

Other Economic Considerations

The purchase of additional farmland for conversion into wildlife habitat by the district is sometimes problematic for local governments. National legislation requires the district to receive permission from the governor before purchasing additional lands. The governor, in turn, often seeks the advice of local county commissioners. In the past, county commissioners have expressed concerns about the conversion of local farmland to wildlife habitat because the land is retired from agricultural production and local purchases for fertilizer, grain, and farming supplies are reduced. Conversion from agricultural designation to public ownership reduces tax revenue.

While county commissioners may not always wholeheartedly support public land acquisition, there has never been a formal denial of land acquisition by the Service on record. Local authorities generally balance the modest loss of business activity against the prospect of additional visitors and the business activity associated with wildlife viewing and hunting. A citizen's broader right to sell his or her personal property to whomever they choose is also a consideration.

To address the issue of lost tax revenues, Congress passed the Refuge Revenue Sharing Act (revised in 1964), which mandated ¾ of 1% of the current appraised value of land bought for use by the Service be paid to the counties in which the land was bought, a form of payments in lieu of taxes (PILT). These payments are designed to help the counties recoup lost tax revenue. The Service finances these reimbursements with revenues generated from permits sold and services rendered on Service-controlled land nationwide (such as a permit sold for the right to drill for oil on a refuge in Texas). Although land values of refuges have risen over time, the annual revenues used to reimburse the counties have not kept pace. As a result, the participants currently only receive approximately 40% of the money they are owed annually by the Service. Increased tourist spending can mitigate some of this shortfall.

4.8 OPERATIONS

The Service achieves the purposes of the district through effective use of available funding, staff, partners, and facilities.

Staff and Funding

Spring migration is the primary season of aggressive habitat management, which includes extensive water-pumping operations and shoreline habitat enhancement. Off-season management activities include (1) wetland restoration efforts on public and private agricultural lands, and (2) vegetation management using a combination of prescribed fire, grazing, haying, resting, and grassland reseeding. (BBC Research and Consulting 2006)

Current federal employment at the district is 12 permanent full-time employees and 3 seasonal employees. (BBC Research and Consulting 2006)

The district had a $1.8 million budget in fiscal year 2005. The district does not collect any fees for recreational use of its facilities and does not directly generate any basic local revenue. (BBC Research and Consulting 2006)

Law Enforcement

Refuge law enforcement officers are charged with resource protection and provision of visitor and employee safety on Service lands. Resource protection includes protection of wildlife, fish, and plants, as well as cultural resources. Common activities include (1) investigating illegal hunting, arson, theft, vandalism, dumping, and drug-related activities, and (2) answering questions and assisting visitors in the field.

The district has two dual-function refuge officers who spend 25% of their time dealing primarily with resource protection activities.

Facilities and Equipment

The district's facilities include the leased headquarters/shop building with an adjacent, fenced, equipment storage area. These facilities do not meet safety standards for personnel and do not provide adequate space to welcome visitors. The headquarters facility is difficult for visitors to find because it is located in an industrial area in the city of Kearney, which is outside the district's boundary.

The district owns and maintains two old farm sheds that serve as storage facilities. Two, surplus, mobile trailer homes provide volunteer housing. The district maintains 135 parking lots at the WPAs. The parking areas are fenced (0.2 acre) and contain native vegetation. Each fall, these parking areas are mowed to reduce the risk of wildland fire.