



Ducks Unlimited Avoided Grassland Conversion Project in the Prairie Pothole Region

Climate, Community, and Biodiversity Alliance Report

Prepared by:

Ducks Unlimited, Inc.

New Forests, Inc.

Equator, LLC

March 2009



Important Information

This submission to the Community, Climate and Biodiversity Alliance has been jointly prepared by Ducks Unlimited and The Eco Products Fund, LP (EPF), a Delaware (United States) limited partnership ("LP"). No representation or warranty, express or implied, is made in relation to the accuracy or completeness of the information. This submission has been prepared solely for validation against the Climate Community and Biodiversity Standard ("Recipient"). The submission provides information on the scientific and legal basis of the carbon credits. This submission is not a formal offer to sell the carbon credits referred to in this document.

For further information, please contact:

Randal Dell
Ducks Unlimited, Inc.
2525 River Road
Bismarck, ND 58503
rdell@ducks.org
P: +1 701-355-3593

James K. Ringelman
Ducks Unlimited, Inc.
2525 River Road
Bismarck, ND 58503
jringelman@ducks.org
P: +1 701-355-3504

Table of Contents

Table of Contents.....	3
Overview	6
G1. Original Conditions at Project Site.....	7
G1.1 Location.....	7
G1.2 Vegetation	11
G1.3 Current Carbon Stocks at the Project Site.....	12
G1.4 Communities Located in and Around the Project Area.....	15
G1.5 Current Land Use and Land Tenure at the Project Site	16
G1.6 Current Biodiversity in the Project Area	16
G1.7 IUCN Red List Threatened Species	20
G2. Baseline Projections.....	21
G2.1 Land Use Scenario (without project scenario).....	21
G2.2 Projection of Future Carbon Stock Changes (without project scenario).....	23
G2.3 Baseline Scenario – Local Communities	26
G2.4 Baseline Scenario – Biodiversity	26
G2.5 Baseline Scenario – Water and Soil Resources.....	28
G3. Project Design and Goals.....	29
G3.1 Project Scope and Summary of Goals	29
G3.2 Major Project Activities	29
G3.3 Project Map	30
G3.4 Project Timeline.....	31
G3.5 Risks.....	32
G3.6 Local Stakeholders.....	33
G3.7 Transparency and Project Information Availability	33
G4. Management Capacity	33
G4.1 Counterparty Experience, Capacity, Skills, and Finance.....	33
G4.2 Scalability	34
G4.3 Key Technical Skills and Management Team	34
G4.4 Financial Health of the Implementing Organizations	36
G5. Land Tenure.....	36

G5.1 Private Property and Land Rights	36
G5.2 Property Boundaries, Relocation, and Migration	36
G5.3 Potential “In-Migration”	37
G6. Legal Status.....	37
G6.1 & G6.2 Laws and Approvals from Authorities.....	37
G7. Adaptive Management for Sustainability.....	38
G7.1 Monitoring Programs	38
G7.2 Information Dissemination	38
G7.3 Flexibility.....	38
G7.4 Long-term Sustainability	39
G8. Knowledge Dissemination	39
G8.1 Documentation of Lessons Learned.....	39
G8.2 Knowledge Dissemination	39
CL1. Net Positive Climate Impacts	40
CL1.1 Project Scenario	40
CL1.2 Non-CO2 gases.....	41
CL1.3 Net Climate Impact	41
CL2. Offsite Climate Impacts	42
CL2.1 Leakage.....	42
CL2.2 Mitigation of Negative Offsite Impacts	44
CL3.3 Subtracting Unmitigated Negative Offsite Climate Impacts	44
CL3. Climate Impact Monitoring	44
CL4. Adapting to Climate Change & Climate Variability	45
CL4.1 Climate Change and Climate Variability	45
CL4.2 Potential Impacts	48
CL5. Carbon Benefits Withheld from Regulatory Markets.....	48
CM1. Net Positive Community Impacts	49
CM1.1 Community Benefits	49
CM1.2. Stakeholder Participation in the Project's Planning	54
CM1.3 Conflicts Resolution and Grievances Procedures	55

CM2. Offsite Community Impacts.....	55
CM2.1 Potential Offsite Community Impacts	55
CM2.2 Plans to Mitigate Potential Offsite Impacts	56
CM2.3 Unmitigated Offsite Impacts	56
CM3. Community Impact Monitoring	56
CM4. Capacity Building.....	56
CM5. Best Practices in Community Involvement.....	57
B1. Net Positive Biodiversity Impacts.....	57
B1.1 Biodiversity under the Project Scenario	57
B1.2 Native Species.....	64
B1.3 Threatened Species.....	65
B1.4 Species Used by the Project.....	66
B1.5 Genetically Modified Organisms	66
B2. Offsite Biodiversity Impacts.....	67
B2.1 Potential Negative Offsite Biodiversity Impacts	67
B2.2 Negative Offsite Biodiversity Impacts	67
B2.3 Unmitigated Negative Offsite Biodiversity Impacts	67
B3. Biodiversity Impact Monitoring.....	67
B4. Native Species Use	70
B5. Water and Soil Resource Enhancement	70
B5.1 Project Activities That Are Likely to Enhance Water and Soil Resources.....	70
B5.2 Improved Water and Soil Resources Compared to the Baseline.....	70
References and Bibliography	71
Appendices.....	79
Appendix A – Emissions Profile under the Baseline Scenario	79
Appendix B – Analysis of Project Region Leakage	80

Overview

The Ducks Unlimited Avoided Grasslands Conversion Project (“the project”) will protect threatened native grasslands in the Prairie Pothole Region (PPR) of the United States. The project will encumber 26,300 acres threatened of native grasslands with Perpetual Conservation Easements to prohibit conversion to crop-based agriculture, thereby protecting biodiversity, wildlife habitat, and community values and reducing greenhouse gas emissions. Easements purchased by Ducks Unlimited will be donated to the U.S. Fish and Wildlife Service to become a part of the National Wildlife Refuge System. Conversion of native grasslands leads to the release of carbon dioxide (CO₂) into the atmosphere through the oxidation of soil organic carbon (SOC). The project will create an immediate “carbon bank,” in effect permanently storing and protecting the carbon stocks that have been sequestered from the atmosphere over thousands of years.

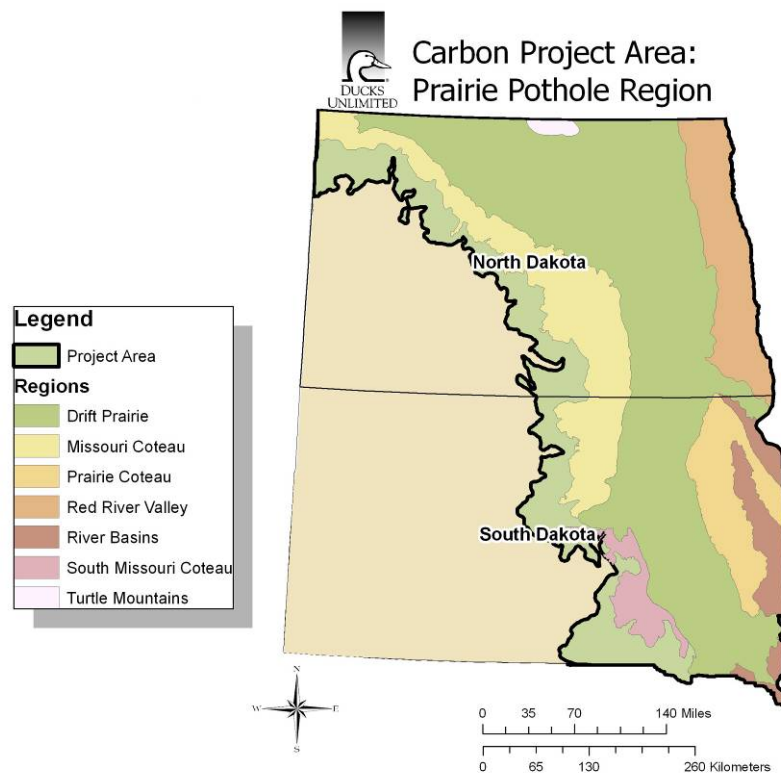
The methods described in this report indicate that the project will result in a reduction of 795,777 metric tonnes carbon dioxide emissions across the Project Area over 99 years. On average, the project will reduce carbon dioxide emissions by 8,038 metric tonnes per year.

G1. Original Conditions at Project Site

G1.1 Location

The Project Area is defined as the PPR of North Dakota and South Dakota, being that portion of North and South Dakota east of the Missouri River (Figure 1). Across the Project Area, 26,300 acres of private land will be secured under Perpetual Conservation Easements. To date, approximately 19,000 acres have been secured with the rest expected to be completed by mid-2009. Geo-referenced boundaries of the easements are not provided as part of this report due to the confidentiality of those boundaries between the landowners, Ducks Unlimited (DU), and the U.S. Fish and Wildlife Service (USFWS). The boundaries are kept on file by Ducks Unlimited and the USFWS. They can be provided to auditors at the time of project validation. A map showing the approximate location of current Project Properties is presented in section G1.3 (Figure 2) and G3.3 (Figure 7). All existing projects and upcoming projects are located within North Dakota, but future plans include expansion into South Dakota.

Figure 1: Project Region



Soils

The soils typical at the project sites are a part of six Major Land Resource Areas (MLRAs). These include MLRA 53A (Northern Dark Brown Glaciated Plains), MLRA 53B (Central Dark Brown Glaciated Plains), MLRA 53C (Southern Dark Brown Glaciated Plains), MLRA 55A (Northern Black Glaciated Plains), MLRA 55B (Central Black Glaciated Plains), and MLRA 55C (Southern Black Glaciated Plains) (USDA NRCS, 2006)

The soils of MLRAs 53A, 53B, and 53C cover 34,590 mi² (89,590 km²) and form the Missouri Coteau Region of the northern Great Plains of the U.S. These soils are well drained with medium textures and mixed mineralogy and have a frigid to mesic temperature regime. The topography is nearly level to undulating to moderately sloping. Annual precipitation within these MLRAs ranges from 11 to 19 inches (300 to 475 mm) and the frost-free growing period is 110 to 150 days.

The soils of MLRAs 55A, 55B, and 55C cover 40,520 mi² (104,960 km²). These soils are deep and are well drained to poorly drained in the north (MLRA 55A) to well drained and moderately well drained in the south (MLRA 55C) with textures ranging from sandy to loamy to clayey. They have a mixed mineralogy with a frigid to mesic temperature regime. The topography is nearly level to undulating to moderately sloping. Annual precipitation within these MLRAs ranges from 14 to 21 inches (375 to 525 mm) and the frost-free growing period is 110 to 155 days.

Within the landscapes of these MLRAs are shallow to deep depressions containing seasonal to permanent wetlands. Soils are of the Mollisol order (dark, thick, organic-rich surface horizons that developed under prairie vegetation) and belong primarily to the Boroll and Ustoll soil suborders. Some soils affected with salts or sodium occur in lower landscape positions in the vicinity of the depressions.

Based on soil survey characterization data, soil organic matter values in soils across these MLRAs generally range from 1.7 to 4.5%, total soil nitrogen ranges from 0.17 to 0.36% and the carbon to nitrogen (C:N) ratio ranges from 9 to 12. These values may

vary across the region based on soil texture, land management practice, and predominant plant species growing on the landscape (USDA NRCS, 2008).

Geology

About 7 million years ago, the subtropical climate of what is now the Dakotas began to change to a continental climate of cool winters and warm summers (Bluemle, 1977). During the Pleistocene Epoch, which followed several million years later, a succession of great ice sheets inched southward from Canada and covered most of the Dakotas and parts of Montana. These huge glaciers transported vast quantities of soil and rock. Large amounts of silty and clayey bedrock outcrops were pulverized and added to the mixture, forming glacial drift or till, and were deposited as sediment across most of the area. These deposits may be 800 feet thick in places and are dotted by shallow wetland basins formed by the scouring or shearing action of the glaciers, or by the collapse of ice blocks left to melt in the deposits after the glacier retreated. This geologically young landscape has become known as the PPR.

Climate

The project site's climate is characterized by large temperature variation across all time scales, light to moderate irregular precipitation, plentiful sunshine, low humidity, and nearly continuous wind. Its location at the geographic center of North America results in a strong continental climate, which is exacerbated by the Rocky Mountains to the west. The mountains greatly reduce the maritime effects by blocking some of the cool, moist Pacific Ocean air masses from moving eastward, or by extensively modifying the temperature and the water content of those that do. However, there are no barriers to the north or south so air masses from these directions easily overflow the area with little modification of temperature or water content. Thus, in every season and in every year, cold dry air masses originating in the far north, warm humid air masses originating in the tropical regions, or modified mild, dry air masses from the North Pacific regularly overflow the region. Movement of these air masses and their associated fronts causes near continuous wind and often results in large day-to-day temperature fluctuations in all seasons. This temperature variation is perhaps the most important feature of the climate (Enz, 2003).

Temperature

Across the project sites, January is the coldest month, with an average temperature of -13°C (9°F). July is typically the warmest month, with an average temperature of 19°C (67°F).

Temperatures form roughly south-to-north gradients in the PPR of the Dakotas. Normal annual temperature ranges from about 3°C in northern North Dakota to about 8°C in southern South Dakota. In January, temperatures average -19°C in northeastern North Dakota and -8°C in southeastern South Dakota. During July, the average is 16°C to 23°C for the two areas, respectively. Rapid plant growth begins when mean daily temperatures rise to 6.1°C. The date for this event varies from about 26 April in northeastern North Dakota to about 3 April in southeastern South Dakota, a difference of over three weeks. Conversely, vegetative growth largely ceases when mean daily temperatures fall to 1.7°C, which occurs about 20 October in northern North Dakota and about 10 November in southeastern South Dakota. The normal length of the frost-free season varies from about 110 days in northern North Dakota to about 150 days in southeastern South Dakota. The frost-free season may be slightly shorter in basin wetlands, as cold air flows downhill and can accumulate in topographic depressions.

Precipitation

Annual precipitation across the project sites ranges from 13 inches per year in the northwest to more than 24 inches in the southeast (Kantrud, 1989). About 70% of the annual precipitation falls as rain during spring and summer, with June the wettest month. Distinctly dry years, having less than 75% of normal precipitation, occur with 10% frequency in northwestern North Dakota, but only 4% in southeastern South Dakota. On average about 75% of the annual precipitation falls during the growing season, April to September. The coldest months, November through February, average only about 0.50 inch per month, mostly as snow.

Measurable precipitation occurs on an average of 65 to 100 days during the year, but over 50% of these events produce less than a 0.10 inch. Although there are fewer precipitation days in the northwest, there is no defined rain day pattern across the region. Most of the summer rainfall is produced during thunderstorms, which occur on

an average of 25 to 35 days per year. In most years at least some part of the region experiences a severe storm that brings rainfall of 2-3 inches in 24 hours, and occasionally 5-6 inches or more in one day. Often these more severe storms produce hail, damaging winds, and the occasional tornado (Enz, 2003).

Snowfall across the project sites averages less than 38 inches, much less than in areas directly to the west and east. In the dry northwestern corner of the Project Area, 25% of the normal precipitation falls as snow, whereas in southeastern South Dakota only 12% falls in this form.

G1.2 Vegetation

Native grasslands found on the project sites are dominated by diverse, endemic flora and fauna that have evolved since the glaciers retreated some 10,000 years ago. Prairie plants are adapted to grazing. Native grazers such as bison helped maintain diverse prairie habitats by altering the vegetation height and density. These animals grazed at different intensities and frequencies, creating patches of heavily to lightly grazed prairie. This patchiness provided different habitats for various plant and animal species. Currently, most native grasslands are used for annual grazing with only modest improvements for fencing and livestock water.

The composition of plant and forb species varies by site, but common grass species in the region include prairie junegrass, western wheatgrass, green needlegrass, needle-and-thread, blue grama, little bluestem, needleleaf sedge, Canada wild-rye, spike oats, mat muhly, spikemoss, plains reedgrass, and buffalo grass. Forbs include pasque flower, western wallflower, prairie smoke, Missouri milkvetch, lead plant, Indian breadroot, purple prairie clover, gaura, harebell, narrowleaf blazing star, ball cactus, purple coneflower, yarrow, and several species of goldenrods (Hagen et al., 2005). The condition of vegetation on project sites varies from fair to excellent.

G1.3 Current Carbon Stocks at the Project Site

Current carbon stocks in the Project Area were obtained from data generated by the Intergovernmental Panel on Climate Change (IPCC). In determining the data source for SOC content on the project sites, an assessment of peer reviewed literature was carried out, data were obtained from studies carried out on the project sites, and IPCC values were assessed.

IPCC Values

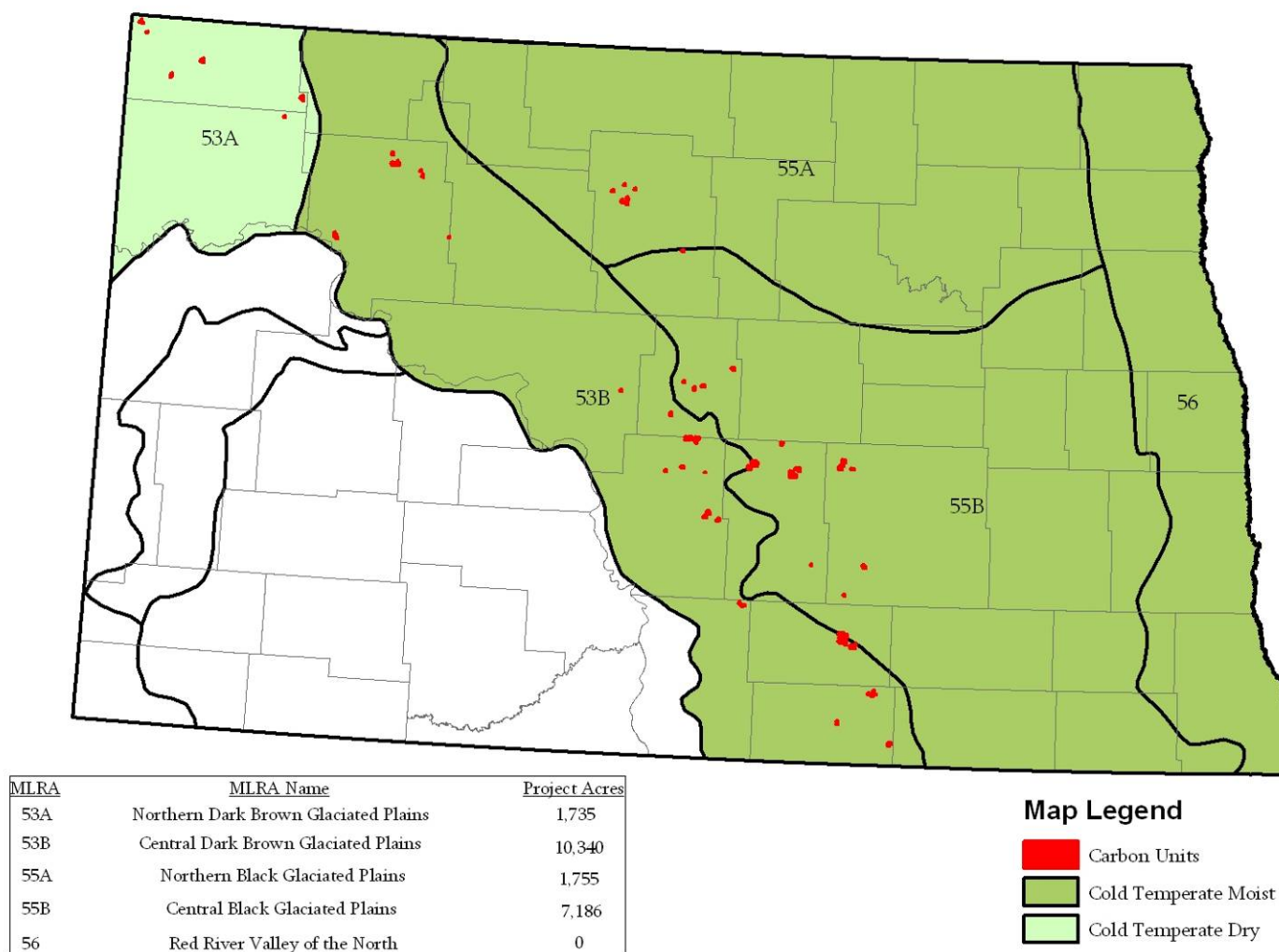
Most of the project sites will be located in the Cold Temperate Moist (CTM) climatic zone (Figure 2) as defined by the IPCC. Currently, six project sites, comprising 1,735 acres (8% of aggregated easements to date), are located in the Cold Temperate Dry (CTD) climatic zone. The climatic zones were determined by mapping the project sites over the U.S. Environmental Protection Agency's (EPA) data of the IPCC climate zones (USEPA 2003). The EPA climate zone mapping was based on the IPCC criteria for the determination of climate zone for a location (EPA, 2003) and spatial climate data were produced with the PRISM (Parameter-elevation Regressions on Independent Slopes Model) system. The PRISM system is an advanced system that uses point data and a digital elevation model to generate gridded estimates of climate parameters (Daly et al., 1994). The PRISM system applies advanced algorithms to interpolate climate data between weather stations in order to produce climate coverage for all locations in the United States.

For the CTM climatic zone, where most Project Properties will be located, the IPCC provides a value of 95 Mg/ha SOC (140.9 Mg/ac CO₂). For the CTD climatic zone, where fewer Project Properties are located, the IPCC provides a value of 50 Mg/ha SOC (74.1 Mg/ac CO₂), representative of the SOC content of native uncultivated grasslands (Penman et al., 2003, Table 3.4.4).

Figure 2: IPCC Climate Zones



Carbon Units by MLRA



Peer Reviewed Literature

In order for the peer-reviewed literature to be judged relevant, it needed to have measured soil organic carbon (SOC) down to a depth of 12 inches (30 cm), in areas where soils and climate are similar to the project site soils and climate. Frank et al., (2006), who were looking at the management effects on soil CO₂ efflux in northern semi-arid grassland and cropland, found that uncultivated native grasslands contained 84 Mg/ha SOC (125.2 Mg/ac CO₂). Liebig and Doran (1999) stated a value 106.5 Mg/ha SOC (157.8 Mg/ac CO₂) of SOC in native grasslands. No relevant literature was found in the CTD climate zone.

Field Studies

The SOC data obtained from the field were generated by Dr. Larry Cihacek (Professor of Soil Science at North Dakota State University) and a Masters student at North Dakota State University. This project was developed in collaboration with Ducks Unlimited, as part of the larger Plains CO₂ Reduction Partnership (PCOR) (see G8.2 and www.undeerc.org/pcor/). The methods used for sampling were those described in the *USDA Field Book for Describing and Sampling Soils*, Version 2.0 (Schoeneberger et al., 2002). The loss on ignition method (900–1000°C) was used to determine the total carbon content of samples, and the method of Loeppert and Suarez (1996) was applied to determine inorganic carbon. SOC was obtained as the difference between these two values. Bulk density was determined with the methods of Blake and Hartge (1986) and Doran and Mielke (1984) methods. In all, 56 soil samples were collected on six sites within the CTM climate zone in the project region. These data fell within the range of values provided by the literature and the IPCC values (Table 1).

Table 1: SOC and CO2 for the IPCC data point, as well as for other relevant sources of data

References	Geographic Region	Soil Organic Carbon	
		SOC (Mg/ha)	CO2e Mg/ac
Cold Temperate Dry			
IPCC (2006)	Cold Moist Dry	50.0	74.1
Cold Temperate Moist			
IPCC (2006)	Cold Moist Temperate	95.0	140.9
Frank et al. 2006	Mandan, ND	84.4	125.0
Liebig and Doran 1999	Stutsman county, ND	106.5	157.8
Dr. Larry Cihacek, project area 1	Project Area	85.1	126.1
Dr. Larry Cihacek, project area 2	Project Area	125.7	186.2
NDSU 2008 data project area 4	Project Area	84.1	124.5
NDSU 2008 data project area 5	Project Area	85.3	126.4
NDSU 2008 data project area 6	Project Area	92.4	136.8
NDSU 2008 data project area 7	Project Area	97.3	144.1
Mean Cold Temperate Moist*		95.1	140.9

* The mean value for cold temperate moist excludes the IPCC (2006) value

Community Information

G1.4 Communities Located in and Around the Project Area

The Project Area and sites are characterized by numerous rural farm residences in small towns, most ranging in size from under 100 to a few thousand residents. Agriculture (in various forms) is the main economic driver of these communities. Only the cities of Bismarck, Fargo, Grand Forks, Sioux Falls, and Rapid City have populations exceeding 50,000 people. Ironically, due to out-migration of people from the small towns to the larger cities, the Dakotas are considered urban states because most of the populace resides in the few urban centers. Rural depopulation is an important societal issue that leads to school closings, loss of businesses, and decay of rural infrastructure. Some counties have lost so many people that demographers have reclassified them as “frontier counties.”

There are many reasons for rural depopulation, including out-migration of young people seeking better employment opportunities and social life, older citizens moving to town to be closer to medical facilities and family, and increasingly high expense and low return on investment from traditional agribusiness (Johnson and Rathge, 2006). An important driver of rural depopulation is modern agronomy, which operates on thin profit margins

but requires increasingly large investments in equipment and inputs such as seed, fertilizer, and pesticides. Crop producers must farm large acreages to achieve adequate financial returns, so farm size is constantly expanding (Vias and Nelson, 2006). As farmers purchase their neighbors' land in order to expand, then fewer people live on the land and in small towns. Larger equipment can farm more acres, so fewer farm hands are needed. Finally, many farmers are discovering that they need not be year-round residents in the area in which they farm, and increasing numbers opt to spend their winter months in warmer climates. In contrast, most ranchers run cow-calf operations and must tend their livestock year-round. For that reason, ranchers tend to be year-long residents in the Project Area.

The average farm size in North Dakota (as an example for the Project Area) is 1,309 acres. Net farm income was \$19,996 in 2006, down from \$41,046 in 2005, and the average debt-to-asset ratio is 17:3. The average age of North Dakota farmers was 54.4 years in 2002, trending increasingly older every year. The average in 1992 was 50.0, which means much of the rural land will be conveyed to younger generations in the not-too-distant future (USDA NASS, 2004, 2008a).

G1.5 Current Land Use and Land Tenure at the Project Site

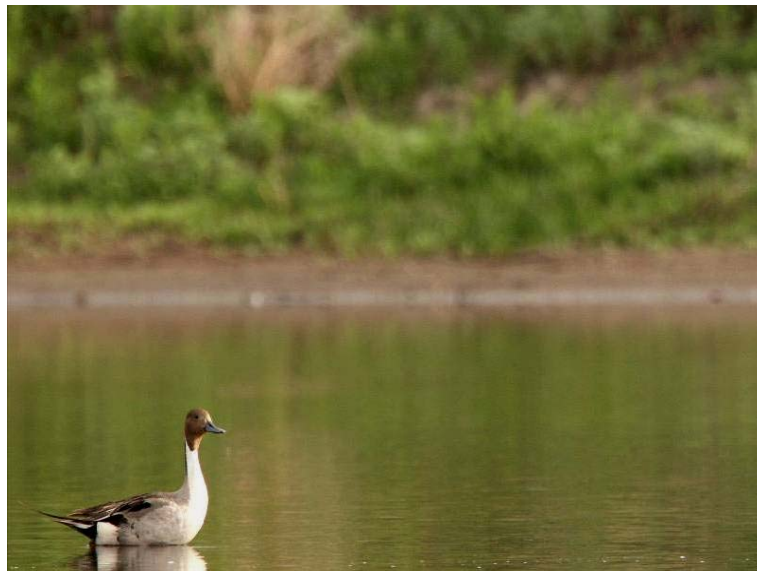
Project sites will be in use predominantly as seasonal pasture for livestock production. Owner-operators are estimated to be the most common form of landownership arrangement as North Dakota state law prohibits land ownership by corporations or non-governmental agencies.

G1.6 Current Biodiversity in the Project Area

The remaining PPR wetlands, commonly referred to as “the duck factory” of North America, support about 4.2 million breeding duck pairs (USFWS, 2008). These breeding ducks concentrate in extremely high densities in portions of the PPR. In some years the eastern Dakotas make up only 7% of the surveyed portion of the North American May Waterfowl Breeding Population and Habitat Survey but have accommodated 21% of the ducks observed in the survey (ibid.).

The Project Sites and surrounding areas offer unique resources for shorebirds, including breeding and migration stopover habitat for 37 of the 50 species that regularly occur in the U.S.; breeding habitat for 13 of 20 that breed in the lower 48 states; and important stopover habitat for most (30 of 37) species of Arctic breeders. During spring migration, shorebirds must refuel on protein-rich foods available in superabundance in small, shallow PPR wetlands. More than 98% of shorebirds migrating through this central flyway utilize these small wetlands, often doubling their body weight in a few days (Skagen, 1997).

Wetlands in the PPR provide habitat for 40 species of breeding waterbirds such as American white pelicans, rails, and herons. The largest breeding colonies in the world of Franklin's gulls and American white pelicans are found here, and PPR wetlands provide habitat for significant numbers of black terns (Sauer et al., 2004).



Source: Jim Ringelman, Ducks Unlimited

Populations of grassland birds are declining more steeply than any other guild of North American bird species (Knopf, 1994). Of the three grassland ecosystems that exist in the PPR, the tall grass prairie ecosystem has suffered the greatest losses followed by mixed-grass and shortgrass systems. In general, the magnitude of grassland bird decline mirrors the differential grassland loss rates observed in the project area.

Some grassland bird species are “area sensitive” and therefore require large tracts of contiguous native prairie for successful breeding. Others seek out suitable patches of grassland within a matrix of cropland and other land uses. In some cases, fragmentation and loss of grassland creates unsuitable habitat or causes nesting success and nestling survival to decline below the level needed for population maintenance (Johnson et al., 1998).

The Project Area also supports a wide variety of other animal life. The total number of insect and other invertebrate species is not currently known, but current information suggests a wide diversity. A survey of just five wetlands found over 50 species of insects. Three butterfly species known to occur in the PPR are considered likely to become candidates for listing under the Endangered Species Act without additional conservation of native prairie and wetlands. These are the regal fritillary, the tawny crescent butterfly, and Dakota skipper (USFWS, 1995). Snails, shrimp, and amphipods are common invertebrates found in prairie wetlands (Kantrud et al., 1989) and are important food resources for migrating and breeding waterfowl, shorebirds, and other waterbirds.

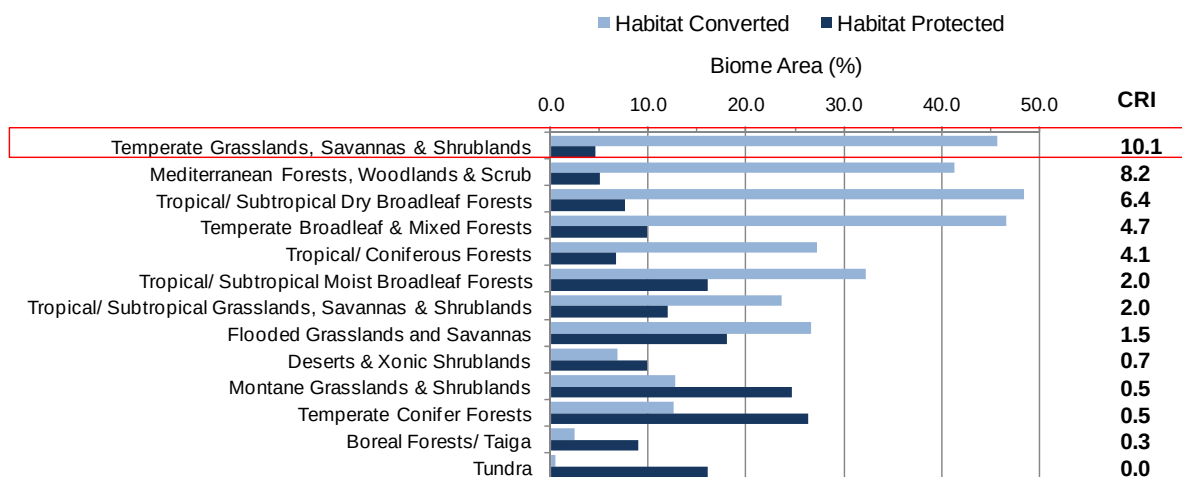
Turtles, snakes, toads, frogs, and salamanders can all be found in the PPR. The western hognose snake and the Great Plains toad are typical of the grasslands, whereas the northern leopard frog, western chorus frog, and tiger salamander are closely associated with prairie wetlands. Tiger salamander larvae and adults are particularly important food items for wetland birds (Kantrud et al., 1989).

The Project Area includes the ranges of approximately 50 mammal species. The grasslands provide habitat for many small mammals including shrews, mice, voles, and ground squirrels. These small mammals, in turn, provide critical food resources for prairie raptors (Berkey et al., 1993). Coyotes, red foxes, badgers, skunk, and weasels are examples of carnivores that are widespread throughout the region. Ungulates such as white-tailed and mule deer and pronghorns also utilize the grassland habitat.

The Project Area is an extremely diverse ecosystem facing many challenges from agriculture due to the pressures to convert grasslands and wetlands for cereal and row crops. Once the native prairie is converted it is lost forever, along with biotic resources it provides. Prairie restoration cannot fully restore the values for wildlife and society, thus highlighting the need to conserve native habitats.

Recently, by quantifying both the amount of habitat converted and the amount of habitat protected within a biome, researchers have developed a “Conversion Risk Index” (CRI) that identifies the biomes at greatest risk (Figure 3). Of the 13 terrestrial biomes and 810 ecoregions examined in the study, temperate grasslands, such as those in the Project Area, had the highest CRI at 10.1. The root cause of concern: only 4.6% of this biome has been protected, but 45.8% has already been destroyed (Hoekstra et al., 2005).

Figure 3: Conversion Risk Index



Habitat conversion and protection in the world's 13 terrestrial biomes. Biomes are ordered by their Conversion Risk Index (CRI). CRI was calculated as the ratio of per cent area converted to per cent area protected as an index of relative risk of biome-wide biodiversity loss.

Adapted from Hoekstra, J.M., Boucher, T.M., Ricketts, T.H. & Roberts, C., (2005) 'Confronting a biome crisis: global disparities of habitat loss and protection', *Ecology Letters*, 8: 23-29

G1.7 IUCN Red List Threatened Species

The data were collected from two sources, the U.S. Fish and Wildlife Service (USFWS) and the International Union for Conservation of Nature (IUCN). The IUCN had a much broader approach to listing endangered and threatened species because it was on a global scale and as a result many of the endangered species listed by the USFWS were listed as “least concern” individuals by the IUCN. The table below shows the threatened and endangered plant and animal species listed by the USFWS in North Dakota and South Dakota. The last column shows the rating given by IUCN for each species.

Table 2: IUCN Red List threatened species in the Project Area

Common Name	Species Name	State(s)	US Federal Rating	IUCN Rating
American Burying Beetle	<i>Nicrophorus americanus</i>	ND, SD	Endangered	Critically Endangered
Dakota Skipper	<i>Hesperia dacotae</i>	ND	Classified	Vulnerable
Scaleshell Mussel	<i>Leptodea leptodon</i>	SD	Endangered	Near Threatened
Topeka Shiner	<i>Notropis topeka</i>	SD	Endangered	Not listed
Brewer's Sparrow	<i>Spizella breweri</i>	ND	Not listed	Near Threatened
Ferruginous Hawk	<i>Buteo regalis</i>	ND, SD	Not listed	Near Threatened
Greater Prairie Chicken	<i>Tympanuchus cupido</i>	ND	Not listed	Vulnerable
Least Tern	<i>Sterna antillarum</i>	ND, SD	Endangered	Least Concern
Long-billed Curlew	<i>Numenius americanus</i>	ND, SD	Not listed	Near Threatened
Pallid Sturgeon	<i>Scaphirhynchus albus</i>	ND, SD	Endangered	Endangered
Piping Plover	<i>Charadrius melodus</i>	ND, SD	Threatened	Near Threatened
Sprague's Pipit	<i>Anthus spragueii</i>	ND	Not listed	Vulnerable
Whooping Crane	<i>Grus americana</i>	ND, SD	Endangered	Endangered
Franklin's Ground Squirrel	<i>Spermophilus franklinii</i>	ND	Not listed	Vulnerable
Gray Wolf	<i>Canis lupus</i>	ND, SD	Endangered	Least Concern
Western Prairie Fringed Orchid	<i>Platanthera praeclara</i>	ND, SD	Threatened	Not listed

Sources: http://ecos.fws.gov/tess_public/StateListing.do?state=all; <http://www.iucnredlist.org>

G2. Baseline Projections

G2.1 Land Use Scenario (without project scenario)

Public policies and global demand for food and fiber are the primary economic drivers that make it increasingly attractive for landowners in the Project Area to cultivate native grasslands. New federal policy promotes the use of biofuels (corn ethanol in the short-term, cellulosic ethanol and biodiesel in the longer-term). The recently released “Billion Ton Study” identifies the conversion of millions of acres to cropland as one component of meeting the demand for feedstock (Perlack et al., 2005). Federal legislation has been introduced that would boost production of ethanol and other biofuels to 60 billion gallons by 2030.



Land converted from native grassland to cropland in the project area. Source: Ducks Unlimited

The U.S. Federal Government's strong push for biofuels policies is a driver of grassland conversion into cropland. There is evidence that this is already happening. The 2007 and 2008 planting seasons saw a 1.27% and 1.26% annual increase in the number of acres in cropland production over the previous year, totaling an additional 8.07 million acres of cropland in the two year period. Cropland acreage increased at an even greater

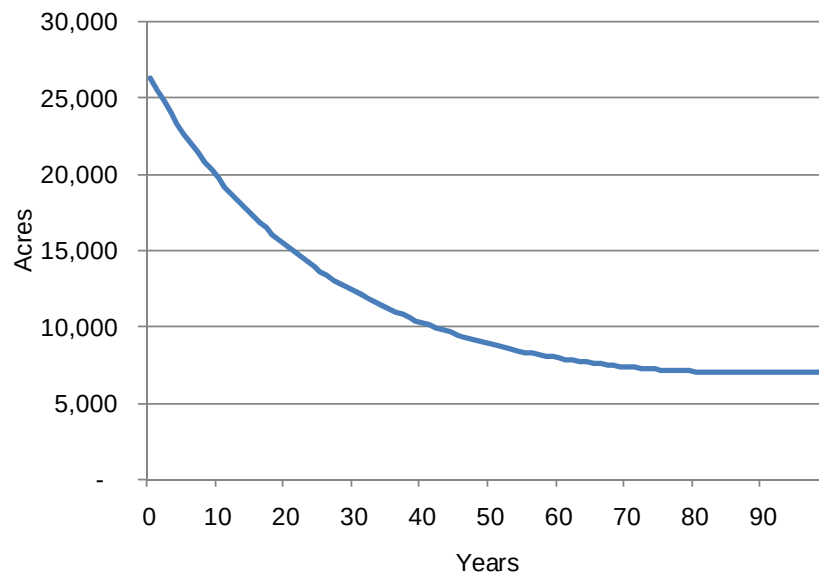
rate in North Dakota, 2.78% and 1.72% annually for 2007 and 2008 respectively, totaling 0.97 million additional cropland acres during the two year period (USDA 2008). High commodity prices and increasing land rental rates are placing enormous pressure on landowners to convert native grasslands to cropland.

The baseline scenario incorporates the probability of conversion of native grasslands in the Project Area to cultivation-based farming activities. DU's research indicates that the annual loss rate of the remaining native prairie grasslands will begin at 3% starting in 2008, and then gradually decline to 2% annually over the course of three decades as the biofuels initiatives mature and most potential ethanol production plants come online (Ducks Unlimited, 2008). Thereafter, DU's modeling of land use change assumes that loss rates will further decline as all suitable land is gradually converted.

Under the baseline scenario, this model predicts that 73.1% of the native prairie grassland in existence today will be lost in the next 99 years (Ringelman, 2007). The risk of conversion to cropland is based on spatial and economic risk assessment models (Ringelman, 2007). When the annual loss rate is applied to the Project Properties, it is projected that 19,225 of the 26,300 acres—73.1%—of native grasslands in this Project will be converted over 99 years (Figure 4).



Figure 4: Risk of Project Property Conversion under the Baseline Scenario



The graph shows the acreage of Project Properties remaining in native grasslands over the next 99 years, under the baseline scenario of no protection.

G2.2 Projection of Future Carbon Stock Changes (without project scenario)

Using the IPCC methods from the IPCC 2006 guidelines, the loss of SOC from mineral soil was quantified. The method allows the calculation of carbon stocks after 20 years of cultivation; after this initial 20-year cultivation period, the IPCC 2006 guidelines assume that carbon stocks stabilize, reaching a new depleted equilibrium. The IPCC 2006 guidelines assume that the loss of SOC is linear over time (IPCC 2006). Only SOC loss from mineral soil is considered, because there are no organic soils on the project site. Changes in carbon stocks due to liming were omitted in order to be conservative. SOC stocks on a per acre basis were calculated from the following equation (equation 2.25 in Chapters 2 and 5, in IPCC Eggleston, 2006):

$$\text{SOC}_{20} = \text{SOC}_{\text{ref}} * F_{\text{LU}} * F_{\text{MG}} * F_{\text{I}}$$

where SOC_{20} is the carbon stock after 20 years of cultivation,
 SOC_{ref} is the quantity of SOC in an undisturbed grassland soil,
 F_{LU} is the scaling factor for the effect of land use change over 20 years,

F_{MG} is the scaling factor for the effect of management practices, and
 F_I is the scaling factor for the application of inputs over a period of 20 years.

The value of SOC_{ref} (cold temperate moist: 95 Mg/ha C and cold temperate dry: 50 Mg/ha C) was drawn from IPCC 2006 guidelines, Table 2.3, as described in section G1.3. The values of F_{LU} (long-term cultivated, temperate, moist: 0.69, temperate, dry: 0.80), F_{MG} (full tillage: 1), and F_I (medium inputs: 1) were drawn from the IPCC 2006 guidelines, Table 5.5. The SOC content for cultivated soils after 20 years is thus equal to 65.5 Mg/ha C (97.2 Mg/ac CO₂) in the Cold Temperate Moist regions and 40.0 Mg/ha C (59.3 Mg/ac CO₂) in the Cold Temperate Dry regions.

Baseline Assessment Summary

Based on the data and methods described above, the project assumes the native grassland Project Properties (26,300 acres) contain 95.0 Mg/ha SOC and 50.0 Mg/ha SOC depending on the site location (section G1.3, Figure 2). The rate at which land is converted under the baseline scenario is taken into account (section G2.1). Utilizing IPCC guidelines, the project assumes that cultivated soils contain 65.5 Mg/ha SOC or 40.0 Mg/ha SOC, having lost 29.5 Mg/ha SOC or 10.0 Mg/ha SOC respectively over 20 years (section G2.2). Therefore, under the baseline scenario, 217,028 Mg SOC would be depleted from the soil on Project Properties over 99 years, equating to 795,777 metric tonnes of carbon dioxide. SOC stocks across the Project Properties under the baseline scenario are depicted in Figure 5.

Figure 5: SOC Stocks in the Project Properties under the Baseline Scenario

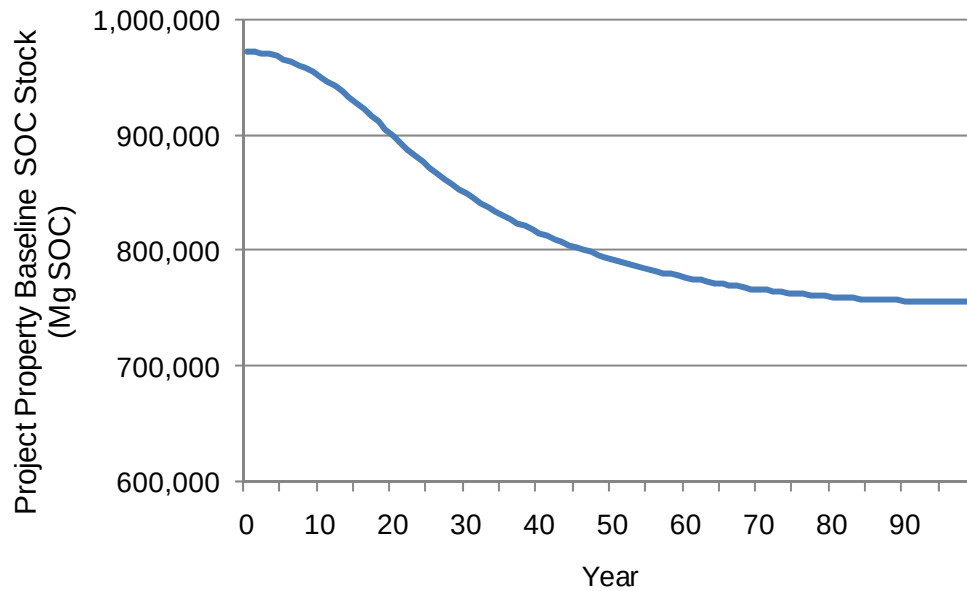
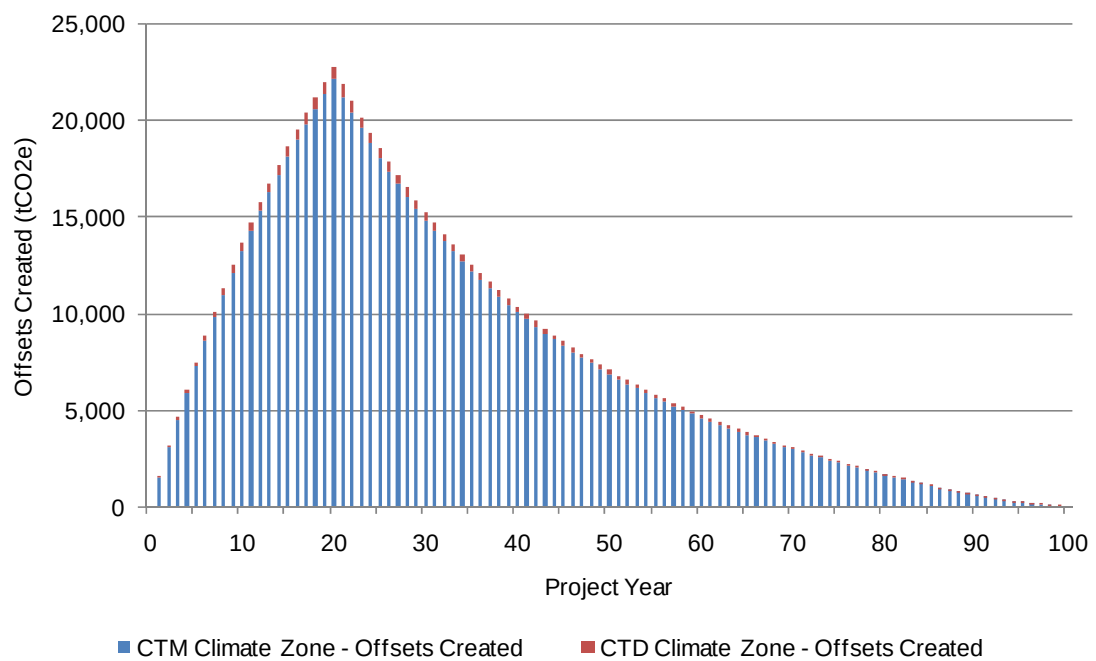


Figure 6 shows the emissions profile of Project Properties under the baseline scenario. The annual numerical data set is provided in Appendix A.

Figure 6: Annual CO2 Emissions from Cultivation under the Baseline Scenario



It is critical to note that the 26,300 acres in this Project will be immediately protected once the Perpetual Conservation Easement is placed on the land. The Perpetual Conservation Easement, which has a low risk of violation and is enforceable, creates an immediate “carbon bank.” Moreover, the biodiversity and community benefits of the project are immediately recognized. To account for the assumptions of land conversion rates, the accounting of the carbon offsets is shown (Appendix A) as a schedule of annual accrual of carbon credits created from the project.

G2.3 Baseline Scenario – Local Communities

Without this project, native grasslands in the Project Area would continue to be converted to cropland consistent with the economic drivers and societal trends assumed in this report. The expansion of cropland will lead to the continued increase of average farm size with fewer people living in farmsteads and small communities. This will fuel rural depopulation and accelerate the decay of rural infrastructure. Eventually, insufficient grass will exist to sustain a ranching industry, and this lifestyle and economic base will disappear. When ranchers disappear, so do the reasons to live year-round in the community. Troubles for rural schools and businesses will be compounded and the countryside will “empty out” as people migrate toward cities and states with more opportunity. Perpetual Conservation Easements, funded by the sale of carbon offsets, provide an alternative revenue stream to these landowners.

G2.4 Baseline Scenario – Biodiversity

Without this project, the cultivation of Project Properties would reduce a biodiversity-rich grassland-wetland ecosystem to crop monocultures. Cultivation and conversion to crop monocultures has a significant negative effect on native species in the Project Area and on the specific Project Properties. Many grassland bird species, such as the endangered sage grouse, Sprague’s pipit and Baird’s sparrow, will not use cropland since they are unable to find necessary habitat structures in cultivated fields. Those that do attempt nesting are typically unsuccessful, creating “population sinks” where mortality exceeds reproduction success leading to decreased populations (Johnson 2005). A

survey of bird densities in North Dakota between grasslands and croplands found a higher species richness and density for grassland bird species on grassland (Johnson and Igl, 1995). Only one generalist species, the horned lark, had a higher density in cropland. The temperate grassland biome, already considered at high risk, will be placed in further jeopardy (Hoeskstra et al., 2005).

Flora

Modern cropping practices are highly efficient in controlling plant communities (“weeds”) in planted fields through tillage and chemical treatments. In the baseline scenario, floristic diversity would be limited to crop monocultures in a 3-4 year rotation sequence. Species included in the rotation will mostly be genetically engineered, non-endemic, and found in many parts of the world. Acres converted to cropland will also act as pathways for invasive species into remaining grassland, such as the leafy spurge, further jeopardizing remaining flora diversity of the mixed-grass prairie. Once the native prairie is cultivated, the grass and forb species are entirely eliminated and the full compliment of species and associated web of life can never be fully restored.

Birds

An extensive study of bird use of conventional, minimum tilled, and organically managed croplands in wheat, sunflower, and fallow fields in North Dakota found great seasonal variation of species use and densities amongst fields (Lokemoen and Bieser 1997). Summer bird use demonstrated a significant year-crop interaction with fallow fields receiving the highest density, primarily by nesting species. However, fallowing during the growing season is a rare practice in the project area. In total, 70 species were observed in cropland at densities of 6-23 birds/ 10 ha. Fall and winter exhibited large variation in bird densities by field crop or management with little use in winter. Across all seasons and fields, Horned Larks were the most common species, but Red-Wing Blackbirds the most abundant. Minimum tillage and organic fields contained a wider variety of nest species than conventionally tilled and managed fields. Overall, Lokemoen and Bieser (1997) found 16 species made use of fallow fields for nesting, 12 in wheat fields, and 10 in sunflower fields. Nest successes were low with unsuccessful clutches predominately

attributed to predation and farming activities. Four of the 9 most numerous nesting species (killdeer, mourning dove, horned lark, and vesper sparrow) in cropland were responsible for 69% of all nests.

The conversion of grassland to cropland has many detrimental impacts on waterfowl. Cropland is the most available habitat type on the landscape of the Prairie Pothole Region, yet is the least preferred cover type for nesting waterfowl (Klett et al. 1988). Where preferred cover is available, i.e. grassland-wetland catchments and upland grasslands, it affords no benefit to nest success and recruitment rates if isolated in small pockets in a predominantly cropland landscape (Greenwood et al. 1995, Sargeant et al. 1993, Beauchamp et al. 1996). A multi-year study of landscape habitat composition estimated nest success and recruitment rates 46% and 30% higher, respectively, in landscapes with grass cover relative to simulated landscapes where cropland replaced grass cover (Reynolds et al. 2001).

Invertebrates

Cropland activities contribute to sedimentation of prairie wetlands, further exacerbated by cultivation during dry periods. The impacts of these activities on invertebrate and plant communities are detrimental. Amplified sedimentation buries seeds banks and suffocates invertebrate larvae and eggs, prohibiting emergence during wet periods. Sediment-load experiments have found that burial depths of 0.5 cm cause a 91.7% reduction in total seedling emergence and a 99.7% reduction in total invertebrate emergence in prairie wetland catchments (Gleason et al 2003). Observed sedimentation rates for wetland in cultivated catchments range from 0.4-0.8 cm. Invertebrate and seed emergence are essential components of nearly all wetland functions, providing food support for wetland dependent species.

G2.5 Baseline Scenario – Water and Soil Resources

Without this project, increased soil erosion from the Project Properties will result from alluvial and fluvial deposition of soils from upland crop areas into wetland basins. These deposits will alter natural wetland hydrology and suffocate benthic invertebrates, causing a dramatic decline in the biodiversity and functioning of wetlands (Gleason et al., 2008).

Wetlands that recharge aquifers and sustain plants and animals will transition from becoming assets in a grass-based agricultural system to liabilities in a cropland system, thus providing an incentive to drain or fill wetlands. Increased inputs of fertilizers, herbicides, and pesticides associated with cropland agriculture will increase the nutrient and contaminant loads in surface and underground water supplies (ibid).

G3. Project Design and Goals

G3.1 Project Scope and Summary of Goals

The project's scope is to avert the destruction of 26,300 acres of native grasslands in the PPR and thereby protect an internationally significant migratory waterfowl breeding habitat, non-migratory wildlife, biodiversity, and ranching communities. The project will encumber threatened native grasslands with Perpetual Conservation Easements in order to prohibit conversion to crop-based agriculture, thereby protecting biodiversity and wildlife habitat, ensuring permanent storage of soil organic carbon, and providing alternative revenue source to landowners besides cropping. The Perpetual Conservation Easements purchased by Ducks Unlimited are donated to the U.S. Fish and Wildlife Service and incorporated into the National Wildlife Refuge System

G3.2 Major Project Activities

Ducks Unlimited has sold the Greenhouse Gas Rights from the native grasslands of the Project Properties to finance the Perpetual Conservation Easements. Ducks Unlimited has responsibilities associated with the science of the carbon program, easement aggregation, easement assignment, and landowner communication.

- Science – DU scientists build and interpret the scientific foundation for the PPR carbon programs.
- Land aggregation – The easement process is initiated with a DU biologist sending letters to prospective landowners in the Project Area that own grasslands in areas of high threat and high wetland densities. The letter inquires if the landowner is interested in the easement program and is followed up by phone calls to generate interest. If a landowner is interested, a biological evaluation and site inspection is performed on the property. If all the criteria are

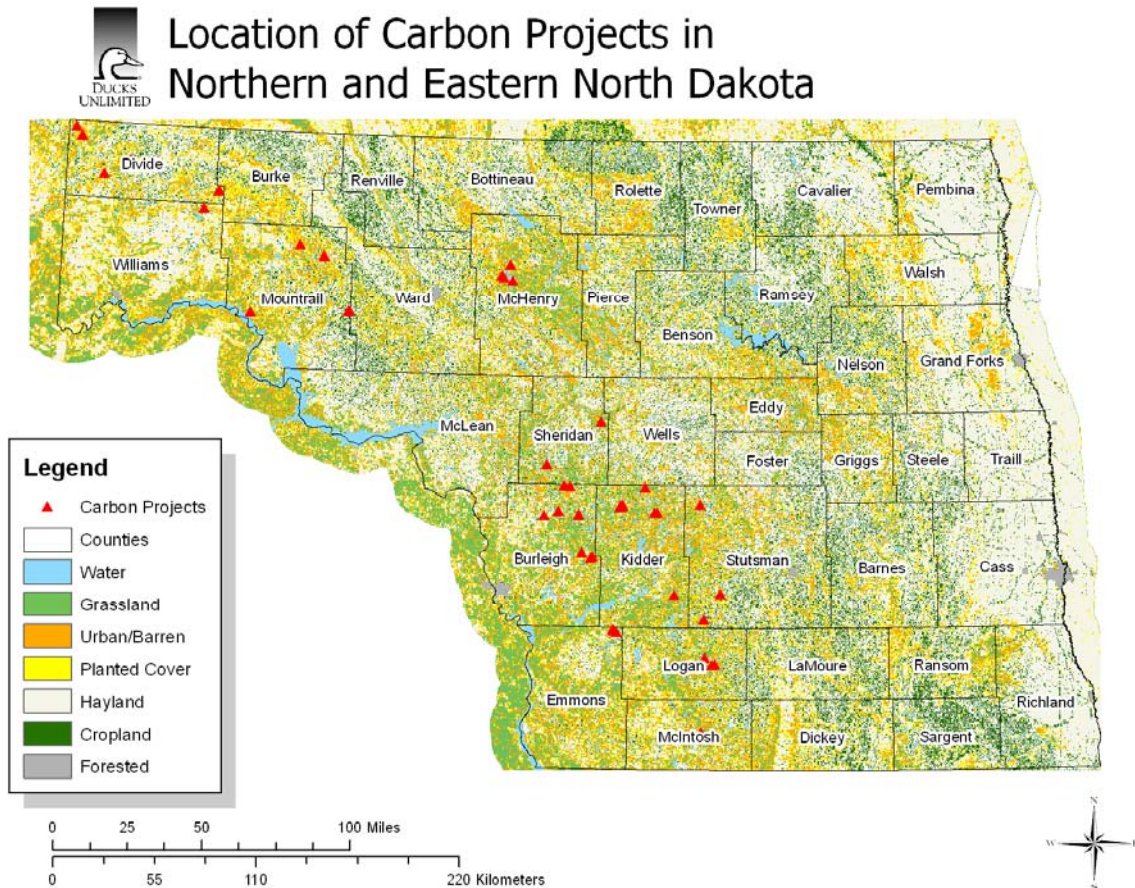
met, the evaluation is passed on to a realty specialist at USFWS or Ducks Unlimited to make the landowner an offer for the easement. A DU realty specialist also contacts the landowner regarding the purchase of the greenhouse gas rights. The realty specialist inspects the property, does a Phase I contaminants survey, and prepares the initial courthouse work. The realty specialist then develops the easement and GHG rights offer and presents it to the landowner. After the landowner accepts the offers, the easement is sent to the Regional Office of the U.S. Fish and Wildlife Service and to the U.S. Justice Department for review. The GHG conveyance document is sent to Ducks Unlimited and logged into its system. After the review is satisfactorily completed, a closing is set up to present the checks to the landowner and the easement and notice of conveyance of greenhouse gas rights are recorded in the county courthouse.

- Easement assignments – Per agreement between Ducks Unlimited and the USFWS, easements may be facilitated and purchased by Ducks Unlimited but are held, monitored, and enforced by the USFWS. These easements do not “flow” through Ducks Unlimited; rather, DU real estate specialists use USFWS easement protocols and documents throughout the process from evaluation to closure.
- Land-owner communication – Ducks Unlimited staff make initial contact with landowners to explain terms of the easement and the greenhouse gas (GHG) conveyance agreements. They address questions from the landowner and present the documents for signature.

G3.3 Project Map

Figure 7 shows the approximate location of the Project Properties. Geo-referenced boundaries of the easements are not provided due to the confidentiality of those boundaries between the landowner, Ducks Unlimited, and the U.S. Government. The boundaries are kept on file by Ducks Unlimited and the USFWS. They can be provided to auditors at the time of project validation.

Figure 7: Project Property Location Map



G3.4 Project Timeline

The length of the project is perpetual because the conservation easement used by Ducks Unlimited and managed by the USFWS is perpetual. A 99-year project length, based on 99 years being a reasonable assumption of perpetuity, is used for projected grassland conversions. Project design, securing the Perpetual Conservation Easement, and the vast majority of other project undertakings will occur within the first two years of the project (Table 3).

Table 3. Project timeline		
Task	Date	Status
Procedure, project justification, and collection of data for GHG quantification	2006/2007	Complete
Completion of project design	Sep 2007	Complete
Financial commitment to undertake the project	Oct 2007	Complete
Aggregation of Perpetual Conservation Easements (project start)	Nov 2007	Ongoing
Perpetual Conservation Easement monitoring		Ongoing

G3.5 Risks

The two risks identified that would affect the climate, biodiversity, and community benefits associated with the project are natural disaster and violation of Perpetual Conservation Easements. These risks are assumed to be minimal for the following reasons.

Natural disasters – After approximately 10,000 years, since the receding of glaciers at the end of the last ice age, the carbon in native grassland soils is at long-term equilibrium with the environment (Frank et al. 2002). Periodic drought may cause a relatively minor loss of soil carbon, whereas periods of deluge (wet) will result in an incremental sequestration of carbon. These are considered normal fluctuations around a steady-state average (Schlesinger, 1995). Events, such as wildfire, that may be disastrous to carbon stores in other ecosystems have little or no effect on grassland carbon because nearly all of the carbon reserve is belowground and not affected by aboveground events like fire.

Violation of Perpetual Conservation Easements – In the past, Perpetual Conservation Easements in North Dakota have had a high rate of compliance by landowners. For example, there has never been a grassland easement violation in North Dakota since the program began in 1992 (Lloyd Jones, Refuge Manager North and South Dakota,

USFWS. November 17, 2008, personal communication). The Perpetual Conservation Easement itself is a standardized, four-page legal document. The Perpetual Conservation Easement is perpetual in duration, runs with the land, forever prohibits plowing or other disturbance to the grassland, requires that haying and seed harvesting be delayed until after July 15th of each year (to prevent damage to nests), but otherwise allows other uses including grazing and recreation. Any easement violation will result in the grassland's being restored at the violator's expense and under supervision of U.S. Fish and Wildlife Service, or the landowner will be taken to court by the U.S. Department of Justice.

G3.6 Local Stakeholders

Local stakeholders are identified as the legal landowners of the Project Properties, members of the local business communities of the project region, those with an interest in grassland conservation, community leaders in the project area, or representatives of farm and ranch organizations.

G3.7 Transparency and Project Information Availability

Ducks Unlimited has its Great Plains Regional Office located in Bismarck, North Dakota, and most of the staff members who work in this office are known and live in the local community. The following documentation on the project will be available at the Ducks Unlimited office and online.

- CCB Project Design Document – Ducks Unlimited Avoided Grassland Conversion Project in the Prairie Pothole Region

G4. Management Capacity

G4.1 Counterparty Experience, Capacity, Skills, and Finance

For over 70 years Ducks Unlimited has been working to protect and conserve waterfowl and wetlands. Ducks Unlimited is the world's largest waterfowl and wetlands conservation organization and has identified the PPR as its top priority in the United States. DU's work in the PPR began in 1984, and since that time it has protected

wetlands and grasslands, and restored or enhanced 558,000 acres of wetlands and other habitats. Aggregation of easements is a key skill for the implementation of this project.

G4.2 Scalability

Ducks Unlimited staff (e.g. biologists and real estate specialists) has successful track records in land aggregation and field-tested experience in placing easements—skills that are critical to terrestrial carbon project development. In addition, Ducks Unlimited works closely with the oversight of the U.S. Fish and Wildlife Service when conducting due diligence activities regarding clear title and other legalities including Greenhouse Gas Rights and carbon agreements. Ducks Unlimited is a highly visible public organization with a more than 70-year-old history.

G4.3 Key Technical Skills and Management Team

Successful project implementation will require a strong knowledge of the landscape, landowner and community attitudes; transparent database capabilities to track easements and carbon units; a strong relationship with regional stakeholders; and staff numbers sufficient to enroll easements, educate community members and address all other project tasks. Many of Ducks Unlimited's conservation activities provide a strong basis and skill sets for these tasks.

A key staff member involved in project organization and implementation is Dr. Jim Ringelman (Ph.D. Wildlife Ecology, University of Maine). Dr. Ringelman is DU's Director of Conservation Programs for the Dakotas and Montana, working out of the Great Plains Regional Office in Bismarck, North Dakota. Dr. Ringelman has published extensively on waterfowl and grassland bird ecology and has been deeply involved in the development of the North American Waterfowl Management Plan (NAWMP), recently chairing the technical committee that plans conservation programs for the U.S. PPR. As part of the technical committee, Dr. Ringelman worked closely with employees from Federal and State agencies, and other non-governmental organizations. At DU, Dr. Ringelman has also overseen the Grasslands for Tomorrow program, an initiative that has protected

over 750,000 acres to date and has been in a management capacity of several other DU conservation initiatives.

A key staff member involved in landowner enrollment and securing of Perpetual Conservation Easements is Mr. Randy Renner, Manager of Conservation Programs–Acquired Easements at the DU's Great Plains Regional Office in Bismarck, North Dakota. For the last several years, Mr. Renner has managed the acquisition of grassland and wetland easements through a partnership with the USFWS Small Wetlands Acquisition Program, and recently as part of DU's Carbon Program. As part of these duties, Mr. Renner oversees the DU realty staff that work directly with area landowners. Mr. Renner (B.S., Fisheries and Wildlife Management, University of North Dakota)) has been with DU since 1990. Mr. Renner's duties have included evaluating the effects of the Conservation Reserve Program and haying on duck production, and managing habitat restoration programs in Montana and North Dakota. Recently, Mr. Renner has also managed the terrestrial portion of the Plains CO2 Reduction (PCOR) partnership, a large grant from the Department of Energy to the University of North Dakota Energy and Environment Research Center to study ways to sequester carbon in the northern Great Plains. This has included coordinating field sampling with PCOR partners.

Database development of carbon project tracking is overseen by Ms. Dawn Browne, DU's Manager of Conservation Programs. Ms. Browne successfully integrated a new carbon module into DU's existing Oracle-based conservation project tracking system (CONSERV) to allow detailed tracking of carbon offsets associated with habitat restoration projects. The database has the ability to track the location and spatial extent of carbon project boundaries linked to tabular records in a geo-database environment.

Ms. Browne will also be involved in the implementation of the project and will assist with key issues relating to negotiating carbon agreements with landowners, legal contracts, and database and administrative tracking of carbon sequestration projects. Ms. Browne (M.S. University College London) works on the development of selected additional lines of new business for Ducks Unlimited that relate to future marketing opportunities of ecological goods and services. She previously oversaw Geographic Information Systems (GIS) and remote sensing applications in support of DU's national and

international programs. Ms. Browne has been involved in habitat-related data development, spatial analysis, and modeling. She is also overseeing ongoing carbon sequestration research and business development tasks relating to the U.S. Department of Energy's Plains CO2 Reduction Partnership grant.

G4.4 Financial Health of the Implementing Organizations

Ducks Unlimited is an established conservation organization with over 70 years of experience. Part of DU's longevity can be attributed to its efficient management and diversified funding sources. A copy of DU's annual financial report and 990 IRS audit for non-profit status can be found at: http://www.ducks.org/About_DU/AboutDucksUnlimitedHome/2359/FinancialInformation.html

The project is also supported by the Eco Products Fund (EPF), which purchased the Greenhouse Gas Rights associated with the native grasslands on Project Properties. For a host of reasons, funding availability has diminished and the economics of grassland preservation have become less attractive to private landowners, requiring financial packages to landowners that typically exceed offers provided by state or federal programs. The sale of carbon credits created from this project contributes to native grassland conservation.

G5. Land Tenure

G5.1 Private Property and Land Rights

The United States has established stringent property rights that delineate property boundaries, prohibiting uninvited encroachment of other privately or publicly owned properties. Project activities will be limited to private properties that voluntarily enroll in the project.

G5.2 Property Boundaries, Relocation, and Migration

See section G3.3 for location of Project Properties. The project will be implemented on privately owned properties but will not require the relocation and/or migration of any

people. Sometimes, landowners may be living on the Project Properties but the Perpetual Conservation Easements allows them to live on the property and use it for recreational and other activities that do not affect the SOC stocks.

G5.3 Potential “In-Migration”

Not relevant to project.

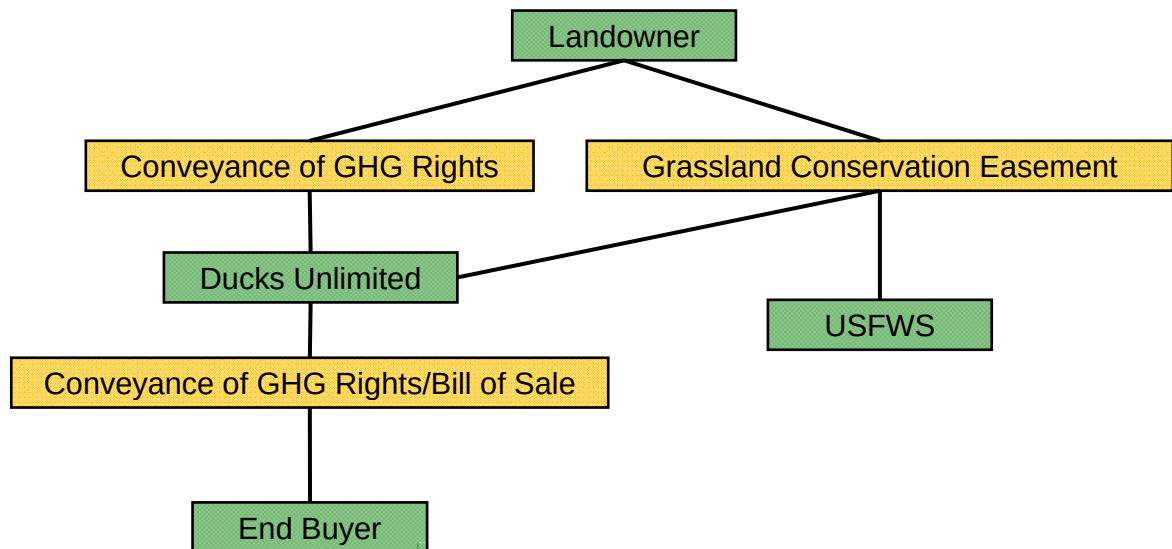
G6. Legal Status

G6.1 & G6.2 Laws and Approvals from Authorities

The project is based on a solid legal framework (Figure 8) and the project satisfies applicable planning and regulatory requirements. Perpetual Conservation Easements are a standard, four-page contract between the landowners of the Project Properties and the U.S. Fish and Wildlife Service in which the landowner relinquishes the right to cultivate the land for a single payment.

Ownership of the Greenhouse Gas Rights is proven in legal documents that convey full and unencumbered title of the Greenhouse Gas Rights from the landowner(s) of the Project Properties.

Figure 8: Legal Agreements between Project Partners



G7. Adaptive Management for Sustainability

G7.1 Monitoring Programs

See section G8.1 (below)

G7.2 Information Dissemination

See sections G8.1 and G8.2 (below)

G7.3 Flexibility

If aspects of the project design were to change, the CONSERV database could be adjusted accordingly to include any new requirements or any methodological updates. Further, Ducks Unlimited and the USFWS are evolving organizations and have developed flexible corporate systems that were designed to adapt to change.

G7.4 Long-term Sustainability

As described above, the Perpetual Conservation Easements are enforced by law, so the U.S. Fish and Wildlife Service will continue to monitor the project lands as required by law and at their own cost. Ducks Unlimited or project property owners will not have ongoing financial costs associated with the project, helping to ensure long-term sustainability.

G8. Knowledge Dissemination

G8.1 Documentation of Lessons Learned

Ducks Unlimited will not formally document the relevant or applicable lessons learned from this project, although it is expected that DU staff will draw on relevant or applicable lessons learned in the future to help create and adjust other payments for ecosystem services projects and programs. Many of the lessons learned about carbon project delivery for grassland offsets in the northern Great Plains are documented in a Topical Report prepared by Ducks Unlimited through its participation in the Plains CO₂ Reduction Partnership (PCOR) sponsored by the U.S. Department of Energy. Details of the PCOR partnership and a link to partnership documents are presented in the next subsection.

G8.2 Knowledge Dissemination

The information contained in this document will be made available to establish other avoided grassland conversion projects and a framework so that these types of projects can be included in future voluntary carbon markets.

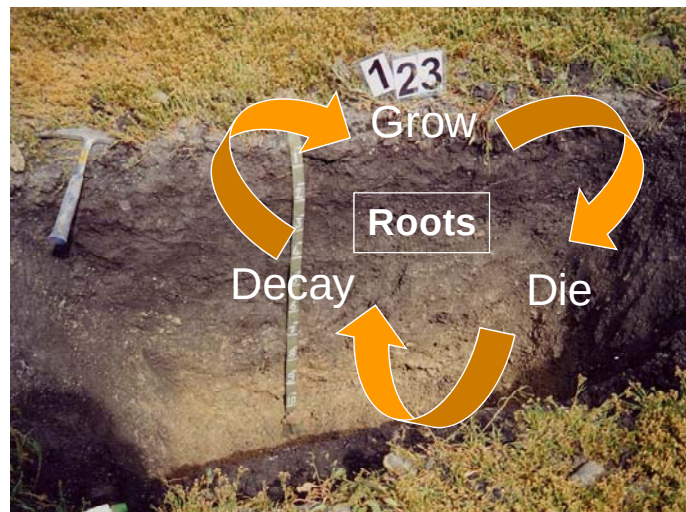
Further, the development of many DU program materials (outreach to landowners, research on carbon sequestration rates) was created through participation in PCOR. Many of these materials are available to the public at <http://www.undeerc.org/pcor/>. The administrative body of PCOR, the Energy & Environmental Research Center at the University of North Dakota, also distributes these materials at relevant public events, highlighting many of these findings in documentaries that have appeared on the local

public broadcast station, Prairie Public TV, and in other regional media outlets such as newspapers and radio programs.

CL1. Net Positive Climate Impacts

CL1.1 Project Scenario

Via the implementation of the project, the SOC stocks will stay constant because they are in equilibrium, meaning that they are constantly losing SOC and sequestering CO₂ but not actually emitting or sequestering additional CO₂ (Figure 9, “Project SOC”).

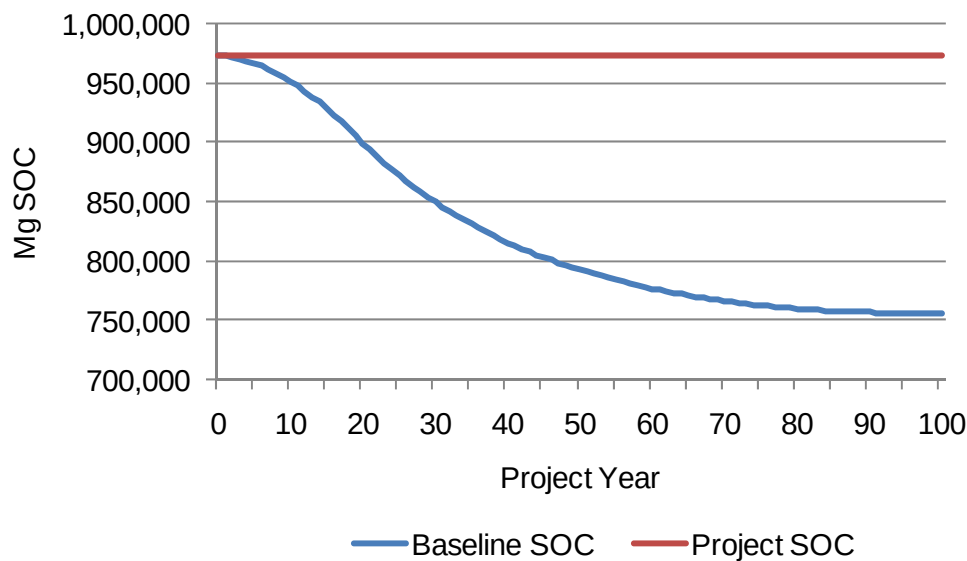


Source: Ducks Unlimited

As a result of implementing the Ducks Unlimited Avoided Grassland Conversion Project, 795,777 metric tonnes of CO₂ will not be released into the atmosphere (see section G2.2).

It is important to note that not all of the Perpetual Conservation Easements have been aggregated to date. All easements are expected to be aggregated by mid-2009. As Perpetual Conservation Easements are aggregated, the amount of carbon credits will be adjusting according to the IPCC climate region in which they are located.

Figure 9: SOC Stock Comparison on Project Properties



CL1.2 Non-CO2 gases

There are no additional non-CO2 gases that occur as a result of this project. Methane emissions from cattle grazing were considered; however, the emissions from cattle grazing are not included because under the baseline scenario, the cattle would be taken off the land and placed elsewhere (e.g. other grasslands or feedlots). The emissions from these cattle would continue to exist.

CL1.3 Net Climate Impact

Additionality demonstrates that greenhouse gas emission reductions achieved by a project would not have occurred in the absence of the project. In this instance, additionality is demonstrated by describing the high degree of threat to the grasslands in the Project Area from cultivation driven by the growth in demand for cropland and feedstock for biofuel production (see sections G2.2. and G4.4). Consequently, it is increasingly economically attractive for landowners in the Project Area to cultivate native grasslands. If it were not for the purchase of Perpetual Conservation Easements on the Project Properties, analyses conducted for this project show that 73.1% of native grasslands would be converted to crop-based farming activities. In addition to the argument presented above, the Ducks Unlimited Avoided Grasslands Conversion

Project was tested against “additionality” criteria (test 1) outlined in the Voluntary Carbon Standard 2007 edition.

- *Regulatory Surplus* – The project is not mandated by any law, statute, or other regulatory framework.
- *Implementation Barriers* – The project faces constraints on capital and investment return that can be overcome by the additional revenues associated with the generation of carbon credits. Absent the potential to sell carbon credits from the project, the Eco Products Fund LP would not have contributed to the financing of Perpetual Conservation Easements on the Project Sites.
- *Common Practice* – The project type is not common practice in the project area.

CL2. Offsite Climate Impacts

CL2.1 Leakage

An Empirical Assessment of Leakage

If the process of placing native grasslands under easement (or multiple easements) induces behavior to destroy other grassland, one would expect greater conversion of grassland to cropland in the Project Area where easements are sold, the leakage belt. To test for this relationship, DU researchers acquired data on the acres of easements purchased in 11 North Dakota counties during 2004–2006, as well as statistics on the number of “new breakings” acres brought into crop production according to the records maintained by the USDA’s Farm Services Agency (FSA). County-level data were used because the field offices and data collection protocols of the FSA are organized by county. The term “new breakings” refers to native grassland that was converted to cropland and added to a landowner’s agricultural (cropland) base. If there was a positive statistical relationship between either (1) easement acres acquired in a county and new breaking acres for that county in the same year, or (2) easement acres acquired in a county and new breaking acres for that county in the following year, this was assumed to be evidence of leakage. If there was no statistical relationship, the assertion that leakage is occurring is not supported.

The data set was analyzed in two ways. The first analysis examined acres of new breakings versus acres of easements within a set of counties where easements were

purchased. The second analysis examined acres of new breakings expressed as a percentage of the county area, versus acres of new easements expressed as a percentage of the county area. This scaling by percentage was done to reduce any bias introduced as a function of county size. Additionally, for this second analysis, we removed three outliers (i.e., greater than 0.8% of county area in new easements) to avoid the possibility of extreme data points driving the slope of the regression line and correlation.

In analysis one, the slope of the regression line between easement acres acquired and new breakings acres was not significantly different from zero, and correlation coefficients approached zero (Appendix B Figures 1 and 2). In analysis two, when the associations were expressed as the percentage of the county area, the slopes of both regression lines were also not different from zero (R^2 values of 0.0011 and 0.0014; Appendix B Figures 3 and 4). Taken collectively, these results are interpreted as lending no support to the hypothesis that there is a relationship between the acquisition of easements in a county and new breakings, and therefore there is no evidence of “leakage” of carbon emissions as a result of this project.

It was estimated that there will be no negative offsite impacts attributable to the project. Because there is no planting activity, there are no production and transportation emissions. The above-mentioned analysis indicates that leakage within counties containing easements has historically been zero. The greatest barrier to native grassland preservation is the economic landscape of the region. The principal use of native grasslands is as grazing land, which has an economic return far less than cropland. Easement payments are meant to compensate landowners for the difference in value between the current value as pasture and the potential value as cropland. However, in the recent climate of high commodity prices, the easement payment falls short of being enough incentive to retain the native prairie grasslands. Accordingly, the additional payment for carbon rights is critical to the landowner's decision to retain the land as native grassland.

A Qualitative Assessment of Leakage

As land is taken out of production in the Project Area via Perpetual Conservation Easement, the amount of land available for conversion is reduced, thus ultimately reducing the total amount of conversion in the PPR. Because the Project Area is small relative to the total PPR area of 64 million acres, the project should not have any significant impact in terms of leakage. When the project places a value on the SOC via the sale of carbon credits, it does so because the project displaces activities that heretofore externalized the cost of soil carbon release.

CL2.2 Mitigation of Negative Offsite Impacts

Because no offsite impacts attributable to project leakage are anticipated, no direct actions will be necessary to mitigate their effect.

CL3.3 Subtracting Unmitigated Negative Offsite Climate Impacts

There were no unmitigated negative climate impacts

CL3. Climate Impact Monitoring

Ducks Unlimited has expanded its CONSERV database to include tracking of carbon sequestration projects. Tracked information pertaining to carbon projects includes carbon rates and volumes, buffer reserves, vintages, serial numbers, sales transactions, contracts, and agreements. The database provides accurate tracking of carbon offset sales and protects against the possibility of double counting or double issuing of credits. The database is able to track each carbon transaction as the carbon is sold and provides a full accounting of the tons transacted on each carbon unit as well as those available for the market in the future. The database also tracks buffer reserves of tons as required by certain carbon projects with tons destined for particular registries or verification schemes.

The U.S. Fish and Wildlife Service provides Ducks Unlimited with a recorded copy of each grassland easement along with the digital, vectorized boundary geometry of those

easements. Once an easement is closed it is logged into DU's projects database. The CONSERV database is a full accounting of the finances and habitat delivered by each project. If the easement is associated with the purchase of Greenhouse Gas Rights it is tracked as an Eco-asset with a Carbon modifier attached to it. The CONSERV projects database is directly linked to a Geo-database, which stores the spatial data associated with each carbon project and the associated easement. Also included is a scanned image of the easement documents and maps. The Conveyance of Greenhouse Gas Rights and Credits document is also uploaded and attached to the appropriate projects record in the database.

Easement Monitoring

The USFWS monitors each easement following the procedures in its easement manual. The manual stipulates that each easement be inspected from the air, and if a possible violation is noted, that a ground inspection occurs soon afterwards. The North Dakota Refuge Zone Law Enforcement Officer will provide Ducks Unlimited with a report by January 30 of each calendar year certifying that grassland easements in which a Conveyance of Greenhouse Gas Rights and Credits was purchased have been monitored for compliance. The report will also tabulate cases not in compliance and cases that are under investigation for non-compliance. Any easement not in compliance will be tracked in the CONSERV database by Ducks Unlimited.

Ducks Unlimited will hold a buffer reserve (equal to 10% of marketable carbon credits) commensurate with the risk related to replacing carbon credits in the event there is an easement violation.

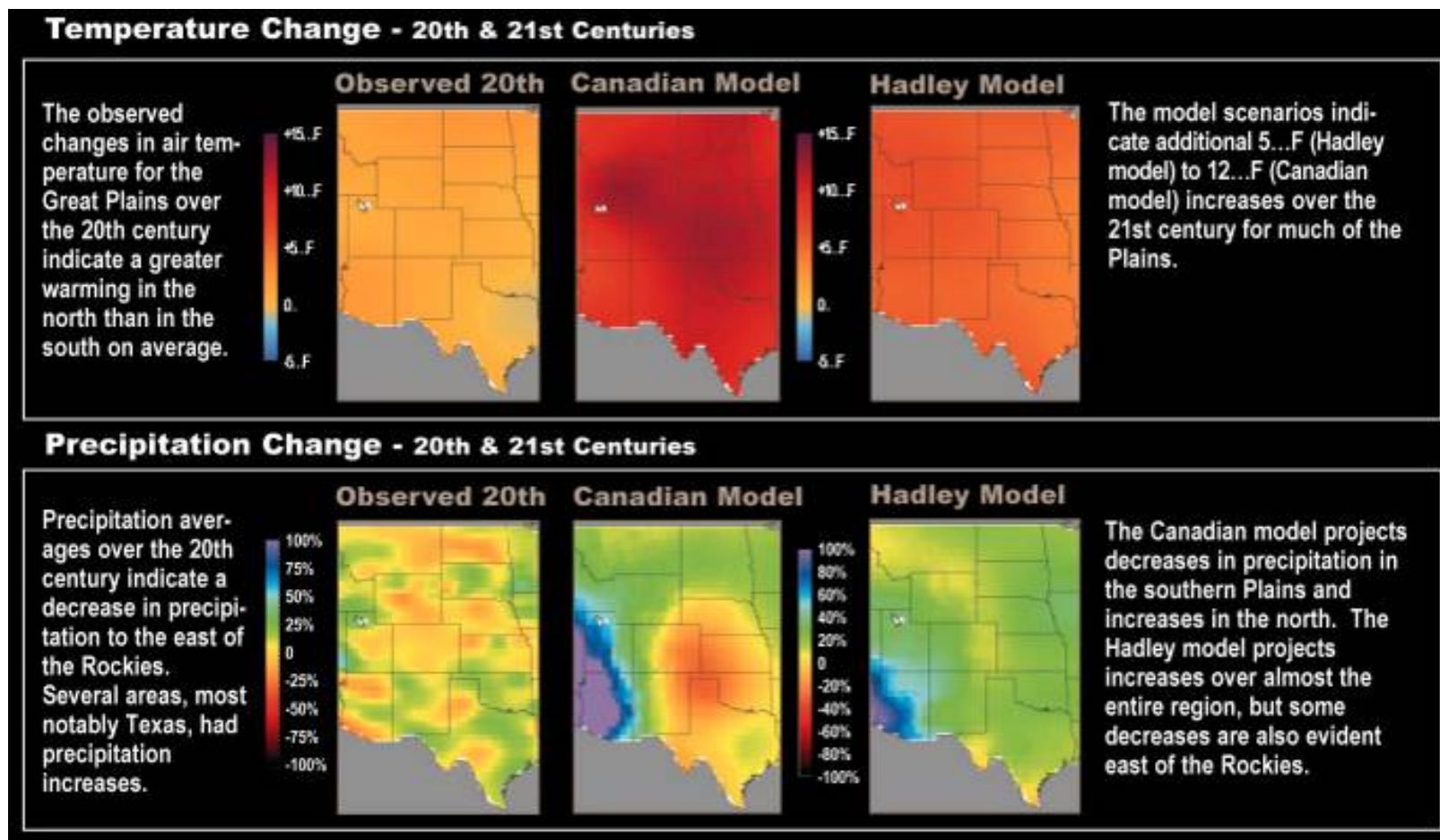
CL4. Adapting to Climate Change & Climate Variability

CL4.1 Climate Change and Climate Variability

The following section is derived largely from information developed by the Hadley Centre for Climate Prediction and Research, as reported by the US Global Climate Research Program (Joyce et al., 2000). The variability of weather in the Project Area is a characterizing feature. Consistent yearly tend to be rare and extreme years are most often the norm as reported by the USGCRP. Blizzards, floods, droughts, tornadoes, hail

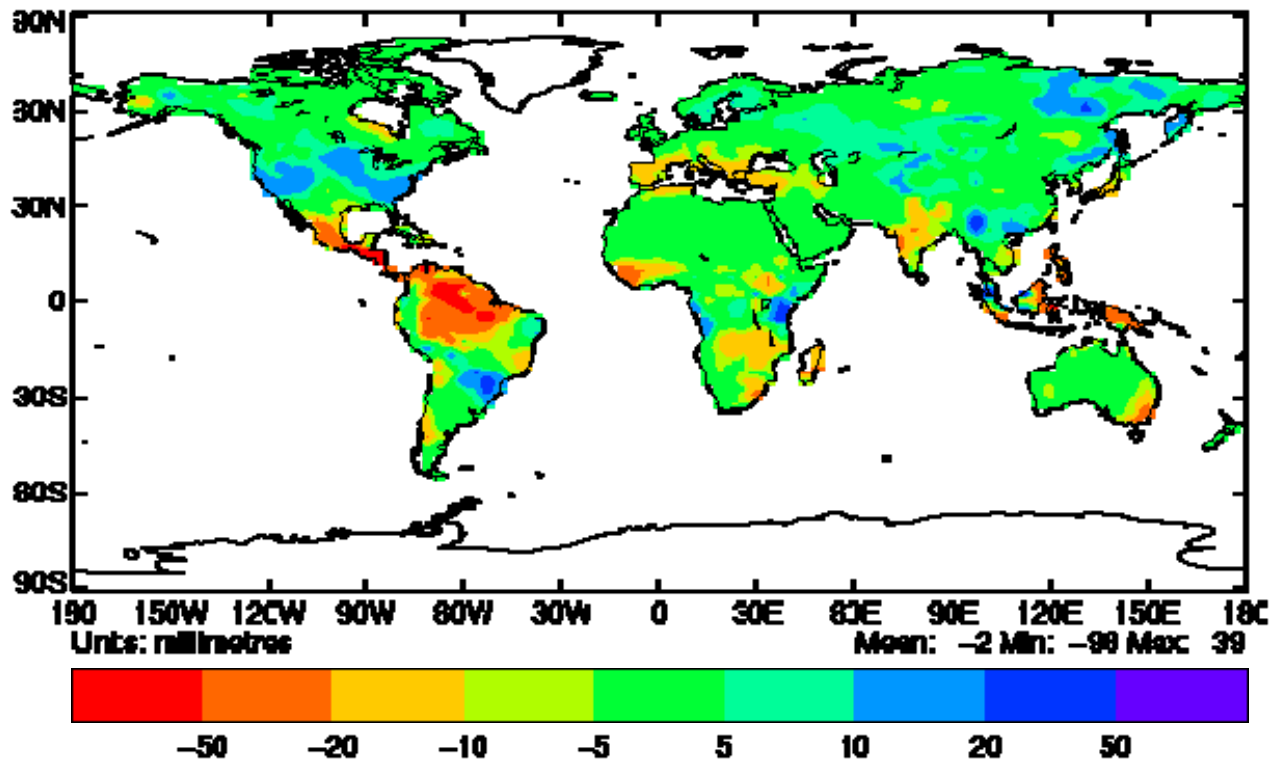
storms, thunderstorms, high winds, severe cold, and extreme heat often arrive suddenly. Over the next century, air temperatures will likely rise throughout the Project Area (Figure 10), with the largest increases in the northern and western parts of the Great Plains. More warming is projected to occur in winter and spring than in summer and fall. The Project Area is also predicated to receive increased rainfall over the 21st century as a result of climate change (Figure 10). The Hadley Centre for Climate Prediction and Research also predicts an increase in annual average soil moisture content over the next century (Figure 11).

Figure 10: Temperature Change – 20th and 21st Centuries



Adapted from Joyce et al., 2000, p. 191-217

Figure 11: Change in Annual Average Soil Moisture Content from 1960-1990 to 2070-2100



Source: Met Office, Hadley Centre for Climate Prediction and Research

CL4.2 Potential Impacts

Climate change is expected to have a minimal effect on SOC stocks in native grasslands over the project period. The Central Great Plains Steering Committee and Assessment Team of the U.S. Global Climate Research Program estimates a decrease of 0.05 short tons (0.045 metric tonnes) SOC per acre from 1990 to 2035 (Ojima, et al., 2002). This equates to a change of 0.2 metric tonnes of CO₂ per acre during the 45 years.

CL5. Carbon Benefits Withheld from Regulatory Markets

The carbon offsets generated from this project will be sold only into the voluntary carbon market. They are currently not eligible for sale under any regulated markets.

CM1. Net Positive Community Impacts

CM1.1 Community Benefits

Native prairie provides a reminder of the United States' rural and pioneer heritage; it provides recreational activities such as hunting, hiking, and bird watching; and it offers living laboratories for scientific research. Prairie also provides economic benefits through cattle grazing, haying, and native seed harvesting. When the U.S. loses prairie, the country loses part of its natural heritage.

Project activities provide the means for landowners to maintain grassland-based economic activities, primarily cow-calf cattle operations. The day-to-day rigors and year-round demands of these operations require that ranchers and their families reside in close proximity to their livestock, either living on individual farmsteads or in one of the small rural communities within the project region. Crop producers, however, due to the size and efficiency of modern equipment and the sporadic nature of planting, spraying, and harvesting, can and often do manage their operations remotely. Increasingly, crop producers and their families are choosing to live in larger cities so that they can take advantage of the amenities found in the city. The expansion of average farm size and the conversion of grass-based economies to crop-based economies is expected to be a primary factor in the rural out-migration of the region (Wood 2006). Project activities aim to reverse this trend by maintaining the grass base necessary to sustain grass-based economic activities, therefore sustaining rural communities.

No Action Alternative

Baseline

Grassland retention in the absence of the project is a potential land use scenario. Based on the estimates of G2.1, grassland retention is estimated to represent 7,074 project acres. Grassland acres not converted and not enrolled in the program, the 'no action alternative', provide the same societal economic benefits in terms of wildlife habitat, increased recreation opportunities and provision of other ecosystem services as easement protected acres in the project scenario. The landowner, however, will incur the entire cost of the provision of these numerous societal benefits.

Project Benefits

Annual returns from grass-based economic activities will be materially similar in the project and no-action alternative scenarios. County tax receipts and the ability to provide public services will be identical in both scenarios. The net difference between the no action alternative and the project is the opportunity cost of the forgone easement and GHG payment and by extension multiplier effects as the additional income is cycled in the community. Direct payments from project activities will range from \$5.1-12.4 million, depending on regional variations in easement values, benefits that will not be realized in the no-action baseline scenario.

Cropland Alternative

Baseline

Historically, cropland returns per acre are greater than grass-based economic activities as evidenced by the discrepancy in land prices suitable for each activity. For example, in Kidder county in the project area, cropland rented an average of \$25.10/acre for 2003-2007, increasing to \$30.50 in 2008 (NASS 2008b). Pasture (grassland) in the same area rented for \$13.50 and \$16.50 for the same time periods. Before crop returns can be realized, project properties would first need to be “broken” or converted to tillable land. Initial costs to break grassland are estimated conservatively to be \$54/acre based on estimations for conversion of CRP grasslands (NDSU 2008a).

Acres previously under crop production are also eligible for federal support payments under the U.S. Farm Bill. Crop producers are eligible for direct payments in any given year, regardless of whether a crop is planted. Averaged across the project region and crops types, direct payments are \$6.50 per acre in 2009 (NDSU 2008b). Additional support payments include counter-cyclical payments- price support if commodity prices fall below a predetermined threshold and disaster payments if natural conditions prevent harvesting. Collectively, federal support programs remove production risk for the cropland producer, encouraging production expansion into disaster prone areas, and further exacerbating grassland conversion. Grasslands are not eligible for these payments.

Conservatively using 2008 rental prices in addition to direct payments, per acre returns are estimated at \$37.00/acre for the cropland scenario. However, returns per acre provide an incomplete picture of societal and regional benefits. The mechanization of most farm labor has allowed single operators with modern equipment to efficiently displace an entire team of cropland agriculture labor (Wood 2006). In North Dakota, the number of operating farms in the state has continuously declined, average farm size increased, and total acres in production remained relatively constant over the last several decades. For example, from 1993 to 2007 the number of farms decreased 10% while the average farm size increased from 1,221 acres to 1,309 (NASS 2009). Consequently, rural communities across the project region have and continue to experience a massive out-migration of population, particularly acute among 18-30 year olds (Wood 2006). The population that remains is disproportionately elderly, placing a greater strain on public services at a time of declining tax receipts.

The efficiency of modern equipment also allows owner/operators to live outside of the community in which they farm. Anecdotally, many of these operators opt to live in the amenity-filled metropolitan areas of the region, and/or further migrating to warmer regions during the bitterly cold winters of the project area. Benefits from the land are therefore concentrated into an ever smaller proportion of the project region's population while being transferred out of the immediate community to metropolitan areas or out-of-state. Input-output analysis of North Dakota's 17 primary economic sectors affirms this trend as grass-based agriculture receipts are circulated 4.49 times in-state relative to the 3.69 times crop-based agriculture receipts are circulated (Liestritz et al 2002).

Project Benefits

Based solely on personal farm income, grass-based properties of the project scenario could receive \$16.50 per acre. The easement and carbon payment provide a sufficient incentive to retain grass, allowing landowners to realize financial gain from their land assets without the need to exploit them in an ecologically negative fashion. Because project lands are taxed the same way whether or not an easement is in place, local governments do not experience a decline in tax revenues or services provided as a result of the project.

Economic values of associated wildlife benefits provided from grasslands in the Great Plains region have been estimated at approximately \$63/acre (Hellerstein, 2005). Consumptive outdoor recreation activities, e.g., hunting and fishing, are estimated to generate \$6.04-11.89/acre of in-state expenditures for North Dakota, varying by region, averaging \$10.07/acre for the portions of the state in the PPR (Bangsund et al., 2004). Industries developed to support the associated outdoor recreation opportunities, working farm and ranch activities, and related cottage industries (guiding services, lodging, food services, and other hunting-related services) provide secondary economic growth opportunities for rural inhabitants from program participation. These operations are characterized as small, having short operating seasons (less than 65 customer days) and less than \$15,000 in gross revenue, providing their operators supplemental income, and diversifying rural development. Income generated from these activities is primarily an influx as 39% of expenditures are made by non-resident hunters and 60% of resident expenditures are made by urban residents (Bangsund et al., 2004). State-wide, hunting retail expenditures totaled \$132,694,072 in 2006, generating a total of \$211,087,266 through regional multiplier effects (Southwick Associates, 2007).

Net Benefits

Once grasslands are converted, outdoor recreation opportunities and natural amenities are greatly diminished. Any outdoor recreation opportunities afforded in the baseline scenario, e.g. hunting would most likely remain restricted to the private landowner.

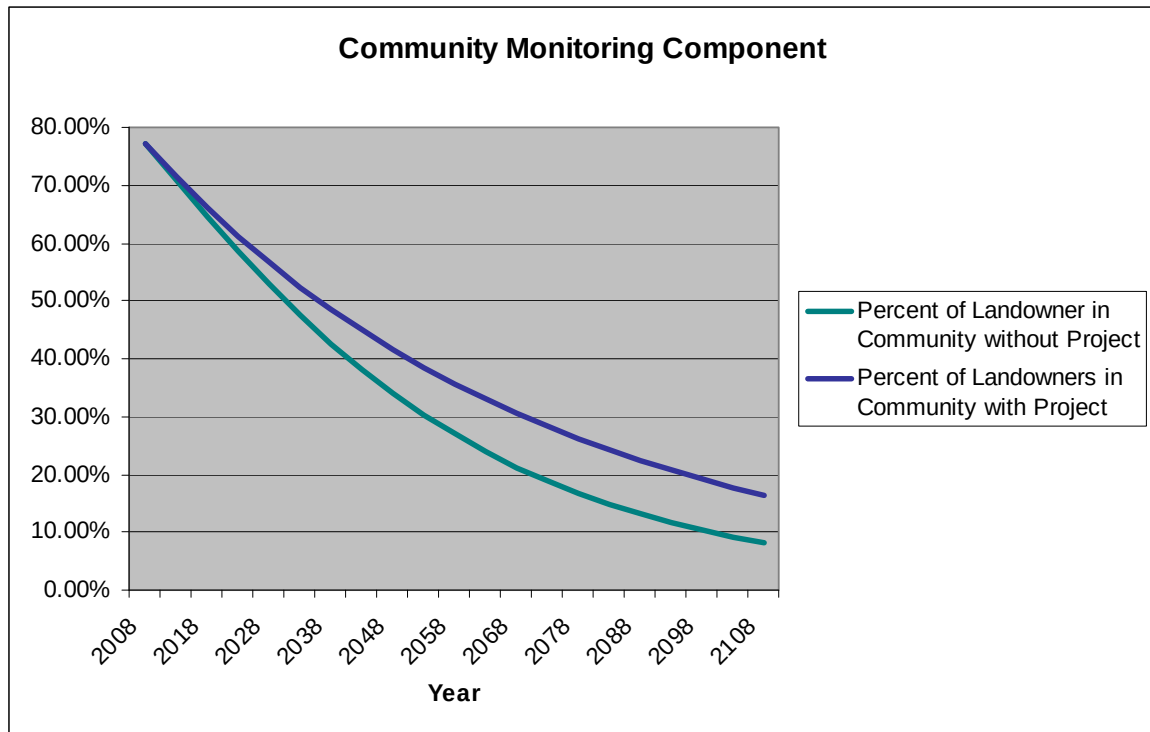
In the immediate future, project participation will help keep 60-70 ranching families on the landscape and a part of their rural communities. Because ranch and crop operations require different capital investments and skill sets, the conversion of 19,225 acres in the with-out project baseline scenario would imply new operators. Modern cropping practices and technologies will afford the new operators the freedom to live away from the farm for most or all of the year, a primary factor in the erosion of rural communities in the project region.

By retaining the Project sites in grass, we expect that landowners participating in the Project will continue to reside in their current counties at a greater rate than if the land had been converted to cropland. We present a model reflecting “with” and “without”

Project scenarios consistent with this hypothesis. We developed this model using U.S. Census population estimates for 6 pair-wise samples of rural townships for 1990, 2000, and 2007 (US Census Bureau, 2009). Each pair-wise observation by county included one township that was predominantly cropland and one that was predominantly grassland. Data on population change by township type were aggregated and used to build regression models that estimated average, annual loss rates of residents. Cropland townships lost an average of 2.71% of their residents annually, whereas grassland townships had an annual loss rate of 1.54%. We assumed these differential loss rates would occur in the future, and projected accordingly. We then examined the database of landowners participating in our project, and determined that 77.3% resided either in the county where the easement was acquired, or in the adjacent county. This percentage was therefore used as the starting point from which we estimated the future percentage of residents expected to remain county residents under “with” and “without” scenarios (Figure 12).

At five-year intervals we will examine public records to determine the owners of the project sites and their counties of residence, then compare our findings for concurrence with our “with project” curve and numeric projections. This periodic evaluation will serve as the analysis that compares the socio-economic benefit of the Project to baseline conditions.

Figure 12: Community Monitoring Component: Landowners Remaining in Community



CM1.2. Stakeholder Participation in the Project's Planning

The primary stakeholders in this project are the landowners who elect to participate in the program. By virtue of their participation, they are signaling their support for grassland conservation. Those who have concerns about perceived or real negative impacts need not participate.

Ducks Unlimited staff held a meeting with key USFWS realty and field staff along with representatives the North Dakota Game and Fish Department, and other NGOs in October 2007. Discussion was also held with a representative of the local farmers union to explain project design and address questions and concerns.

CM1.3 Conflicts Resolution and Grievances Procedures

All transactions occur in accordance with U.S. federal, state, and local law. Such laws also provide mechanisms to resolve or mitigate any potential grievances.

All legal agreements among the involved parties (landowners, Ducks Unlimited, buyers of carbon offsets, U.S. Fish and Wildlife Service, and end-buyers) identify the responsibilities and performance requirements of each party, and also the conflict and grievance resolution measures should any grievances arise. These documents are also available to the public during a public comment period, affording local stakeholders an opportunity to raise and address any grievances.

In the event that any grievances are raised by project stakeholders, including but not limited to those with project easements, DU will respond within 30 days of receipt. DU has developed an internal process for fielding, documenting, and working towards a grievance resolution with any aggrieved stakeholder. Project stakeholders interested in filing a grievance may request a copy of DU's grievance process document at rdell@ducks.org, by phone at 701-355-3593, or in-person at DU's Great Plains Regional Office in Bismarck, North Dakota.

CM2. Offsite Community Impacts

CM2.1 Potential Offsite Community Impacts

The Project is not expected to create any negative offsite community impacts. The surrounding landowners and wider community in the Project Area would most likely not have been able to use the land under the baseline scenario, crop-based agriculture. With the implementation of the project surrounding landowners and community members have the opportunity to enjoy the visual aesthetics it provides and the wildlife habitat that it will harbor.

CM2.2 Plans to Mitigate Potential Offsite Impacts

There are no offsite community impacts associated with this project, so there are no mitigation plans.

CM2.3 Unmitigated Offsite Impacts

No offsite community impacts were identified.

CM3. Community Impact Monitoring

The U.S. Census Bureau and regional governments undertake accurate socio-economic surveys and data collection in the region. These data are publicly available and were used frequently in this project.

Given the developed nature of the economies and community infrastructure of the Project Area, this project is expected to help sustain, but likely will not increase, wider community variables such as income, health, roads, schools, food security, and education.

CM4. Capacity Building

The project is offered to the community that occupies native grasslands that the project aims to protect. The project does not target particular groups within the Project Area, but it aims to increase community participation in conservation education and awareness. Ducks Unlimited is a community-orientated organization and works across the entire community to deliver conservation outcomes and benefits.

CM5. Best Practices in Community Involvement

Ducks Unlimited has been working in the local community since 1984 when they established the Great Plains Regional Office. Since then, the organization has developed a link with local communities throughout the region.

The grassland preservation project was developed to support both rural landowners interested in maintaining grassland ranching operations and wildlife. Defining characteristics of the Project Area include a strong agricultural tradition as “America’s bread basket,” an abundance of wildlife, especially as North America’s “Duck Factory,” and the related nature-based recreation opportunities provided by both. Project activities maintain facets supportive of both traditions, and do not negatively infringe upon any other local customs.

B1. Net Positive Biodiversity Impacts

B1.1 Biodiversity under the Project Scenario

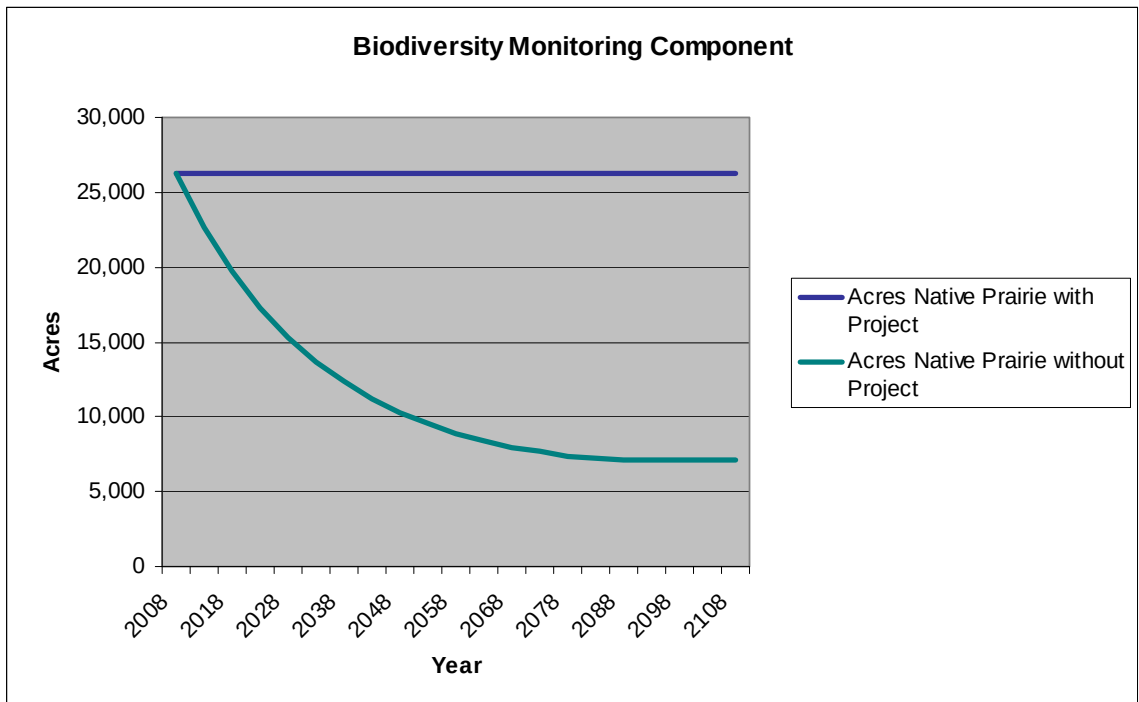
Net biodiversity impacts resulting from the project will be positive at the field and landscape level. The Prairie Pothole Region of today is a fragmented, cropland-dominated ecosystem that requires a landscape-scale approach towards conservation of biodiversity. Project properties are selectively chosen using empirical, model-based projections of waterfowl breeding densities based on the distribution and abundance of grassland, wetland and cropland features. Research on waterfowl has provided insights on the ecology of other wetland- and grassland-dependent birds, because waterfowl utilize both aquatic and upland habitats. Therefore, models and conservation efforts targeted towards waterfowl are also believed to benefit non-waterfowl species (Naugle et al. 2001). Biodiversity will therefore be enhanced on each individual project property over the baseline scenario, while improving landscape dynamics beneficial to biodiversity across the prairie pothole region.

The Project will enhance biodiversity compared to the baseline scenario by protecting native prairie grassland, the key habitat type known to support a rich assemblage of endemic plant and wildlife species (described in detail below). Project sites are selected

for the quality of native prairie and associated wetland communities using spatial databases and geographic information systems. Although species abundance and wildlife populations in Project sites may wax and wane in response to normal wet and dry cycles, the long-term biodiversity on the native prairie Project sites is sustained so long as the grassland is not plowed. Once it is plowed and converted to cropland agriculture, biodiversity plummets. This loss is permanent.

Therefore, maintenance of native prairie – the key habitat – on Project sites, indicates biodiversity is being sustained. Accordingly, our model for the “with” and “without” Project scenarios compares the baseline scenario of expected grassland conversion rate in the absence of the project to the “with project” scenario wherein all native prairie grassland is preserved (Figure 13, below). At five year intervals we will determine the percentage of grassland on Project sites as well as the percentage loss on comparable, non-project sites to gauge concurrence with our projections. This periodic evaluation will serve as the analysis that compares the biodiversity benefit of the Project to baseline conditions.

Figure 13: Biodiversity in Project and Baseline Scenarios



The presence of native prairie is indicative of a wide range of biodiversity. The net biodiversity resulting from native prairie preservation on floral, avian, invertebrate, insect, mammal, amphibian, and reptile communities is described below.

Net Flora Benefits

The diversity of the flora is vast, with more than 100 grass species in addition to many hundreds of native forb species (Great Plains Flora Association, 1986). The result of this diversity is a richness of prairie wildlife potentially greater than anywhere else in the Northern Great Plains. The project will directly help restore the integrity of the native northern mixed-grass prairie community of the region because a broad, ecosystem approach is inherent as its foundation. Grazing occurs on all the project sites. Maintaining grazing in grasslands historically impacted by large herbivores retains the natural diversity of the plant species and species richness of the grassland community (Collins et al. 1998). In net, several hundred unique species will be replaced by 10-12, primarily genetically engineered crop varieties grown in monotypic fields over 19,225 acres.

Net Avian Benefits

Avian species richness, densities, nesting densities, nesting success, and recruitment rates are considerably lower in cropland than grasslands in the project area (Lokemoen and Bieser 1997). Bird nesting densities in CRP grass fields were observed at 8 nests/10ha in the same general area during Lokemoen and Bieser's study period, 6 times higher than minimum-tillage stubble and organic fallow and 11 times larger than densities in all other field and crop types. Even though bird populations were higher in minimum-tillage and organic fields, recruitment rates were low due to predation and mechanical activities.

Grassland-dependent biota includes numerous avian groups such as Neotropical migratory birds, shorebirds, waterfowl, and others. Because many of these species are migratory, both national and international bio-diversity will benefit as a result of the project. The proposed actions will positively impact flora and fauna found only in the U.S. as well as many landbirds that winter in Neotropical countries. Birds that winter south of the U.S. but that breed on the Project Area—and would benefit significantly from the

proposed actions—include Swainson's hawk, upland sandpiper, western and eastern kingbirds, common yellowthroat, sedge wren, Sprague's pipit, lark bunting, bobolink, yellow-headed blackbird, and clay-colored, Baird's, and grasshopper sparrows (Finch, 1991).

The project's benefits to bird conservation address the concerns and support the initiatives identified by a variety of prominent bird conservation plans, as described in detail below.

Partners in Flight (PIF) identifies the Project Area as in the heart of the Northern Mixed-grass Prairie Area, Physiographic Area 37 (Rich et al., 2004), the continent's most important production area for waterfowl and the heart of the breeding range for some of its rarest species of grassland birds. This area harbors more than 40% of the world's population of Baird's sparrows, 30% of Nelson's sharp-tailed sparrows, and 25% of Sprague's pipits during the breeding season. Many priority grassland species have relatively large area requirements. PIF's conservation strategies include securing existing landscapes where native prairie exists. Many wetland birds, such as willet and marbled godwit, also require large tracts of grassland for nesting and cover during brood cover. Some species requiring large blocks of habitat have shown recent population declines, such as northern harrier and willet, and one species, the greater prairie-chicken, has declined dramatically. Other species, such as Sprague's pipit and chestnut-collared longspur, are endemic to the Project Area and if they are to survive, it is critical that large expanses of native grassland be protected in perpetuity. This proposal addresses these concerns by securing grassland conservation easements that would allow large tracts of native prairie to be preserved.

At least 148 species of birds breed in the Northern Mixed-grass Prairie physiographic area. Nearly two-thirds of those species use the wetland-grassland habitats. The project proposal will protect most landscape types found in the Project Area, thus affording protection to the variety of birds dependent on the wetland-grassland habitats. Once accomplished, this project will aid in meeting PIF objectives in maintaining populations of priority species found in this area. Conservation easements on the breeding grounds will contribute to long-term population stability by ensuring that

suitable breeding habitat remains extant and that nesting success remains high enough to compensate for annual mortality.

Another concern for wetland protection is livestock management. Overgrazing and trampling affect marsh structure by altering the density and height of wetland vegetation. This project's protection of private grasslands allows managers the opportunity to install managed grazing systems that will more closely mimic historical ungulate grazing and enhance wetland conditions by decreasing monotypic stands of emergent vegetation, creating openings to allow biological diversity within shallow-water zones, and enhance and increasing the diversity of native vegetation.

The North American Waterfowl Management Plan (NAWMP) identifies the prairie pothole breeding habitat as its top priority for protection (USDOI and EC, 1986). It also recognizes that important treatments are necessary for protecting and restoring grasslands for uplands nesting waterfowl. While this proposal specifically targets the protection and securement of wetland and grassland habitat, it also recognizes the importance of preserving adjacent uplands, not only for nesting waterfowl habitat, but also for their role in protecting wetlands. This proposal will use model-based planning to locate and target projects by using the empirical model-based predictions of nesting hen access to upland habitats as outlined in NAWMP's strategic guidelines.

The U.S. Shorebird Conservation Plan identifies 13 species of shorebirds that breed in, and 36 species that either breed or migrate through, the Northern Plains/Prairie Pothole (NP/PPR), in which the Project Areas lies (Brown et al., 2001; Skagen and Thompson, 2000). The 13 species of shorebirds that breed within the NP/PPR require a landscape of grassland and wetland habitats for nesting and brood rearing. The NP/PPR lies along one of the major migration routes for Western Hemispheric shorebirds, and migrating shorebirds stop to forage in the abundant prairie pothole wetlands. These wetlands are particularly important stopovers for long-distance shorebird migrants. In addition, more than one-quarter of small shorebirds migrating through the mid-continent in spring pass through the NP/PPR. In fall about one-quarter of the medium-sized shorebirds of the mid-continent migrate through the region. Three major shorebird issues have been identified for the NP/PPR. These are (1) endangered

and threatened species, declining species, and species of special concern; (2) habitat loss, including fragmentation and degradation; and (3) the need for additional information to evaluate potential threats, such as contaminants, predation, and invasion of exotic plants, to migrating and breeding shorebirds. This proposal addresses all three issues. The project's conservation and wetland easements, leases, and habitat restoration specifically address the issues of habitat loss, fragmentation, and degradation.

The **Western Hemisphere Shorebird Reserve Network** has recognized the PPR as important breeding and stopover sites for tens of thousands of shorebirds. Because shorebirds spread out in a broad front throughout the region, extensive habitat conservation efforts are needed. This project will provide a mosaic of potholes of different depths, as well as associated grassland habitats to provide sufficient food, cover, and nesting habitat for 30 species of shorebirds.

The North American Waterbird Conservation Plan (Kushlan et al., 2002) identifies the Project Area in the Northern Prairie and Parkland Region, which encompasses the PPR (Kushlan et al., 2002). The Northern Prairie and Parkland Waterbird Conservation Plan includes 39 breeding species of waterbirds and the whooping crane. Because waterbird habitat in the Region is often widely dispersed in numerous small wetlands, the plan takes a landscape approach, rather than focusing solely on conservation of a few key sites. It calls for conservation for waterbirds in this region to focus on habitat preservation while considering and incorporating use of surrounding uplands. The Project's multispecies habitat conservation approach is therefore compatible because it, too, works on a landscape scale. This proposal will serve to address a landscape approach and incorporate both the wetlands and associated adjacent uplands with its diversity of projects aimed at protection and management of uplands and wetlands.

Net Invertebrate Benefits

Wetland densities in many parts of the project area exceed 50 per square kilometer. Nearly all project properties include at least one wetland catchment. Wetland acres protected by project activities are estimated to be approximately 2,600 acres. The invertebrate, amphibian, and plant communities supported by these activities would

decline in the baseline scenario as would food availability for species further up the food chain. Population numbers are therefore reasonably assumed to be higher in the project grassland scenario relative to the cropland baseline. Given the significance of the area as nesting and stop-over habitat for much of the continent's bird life, biodiversity impacts would reverberate beyond the project region. Baseline sedimentation rates would be dependent upon crop management practices, distance from cultivation, and climatic factors but can be reasonably estimated to greatly exceed those of the project condition. In net, 2,600 acres of wetlands will contain approximately 91% more flora and the ability to sustain invertebrate communities that otherwise would not be present in the baseline scenario.

Net Insect Benefits

Differences in species and taxa richness and diversity between different land uses appear minimal in the greater Prairie Pothole Region (Anderson and Vondracek 1999). Anderson and Vondracek's survey of insects in the prairie biome did find a negative relationship between species abundance and grasslands but weather, ecoregion and stage of land use nutrient cycle appear to account for the greatest amount of variation in insect abundance and composition. The net difference in biodiversity of insect life is estimated to be unnoticeable between project and baseline activities, although further research is needed.

Net Amphibian, Reptile and Mammal Benefits

Detailed surveys on amphibian, reptile and mammals in the project region are not well developed. Amphibians and reptiles will undoubtedly benefit from project activities compared to the increased sedimentation and management impacts on wetlands of the cropland baseline scenario. A state-wide analysis of North Dakota vertebrate biodiversity using GIS technologies found considerably higher species richness values in prairie and wetland ecotypes compared to cropland (Table 4). Mesic Tall and Mixed grass and Needlegrass prairies are the land cover categories in Table 4 protected with project activities. Based on this analysis, project activities would be expected to support 23-26 more bird species, 11-21 mammal species, 2-4 reptile species, and 3-4 amphibian species than the cropland baseline (USGS 2005).

Table 4. Vertebrate Species Richness in North Dakota				
Land Cover Category	Bird	Mammal	Reptile	Amphibian
Cropland	37	22	2	1
Prairie (all types)	82	50	11	10
Mesic Tall and Mixed grass Prairie	63	33	4	5
Needlegrass Prairie	60	43	6	4
Wetland (all types)	76	22	9	11
Lacustrine Wetland	60	10	5	10
Palustrine Temporary Wetland	35	18	6	10
Palustrine Seasonal Wetland	50	16	6	9
Palustrine Semi-permanent Wetland	59	14	7	9

Source: http://www.npwrc.usgs.gov/projects/ndgap/NDGAP_FinalReport_text.pdf

Net Difference in Biodiversity

Ecological systems are highly dynamic and stochastic. Spatial interactions of land uses, habitat connectivity, species interaction, and varying climatic factors make extrapolation of a few studies to the 26,300 project acres difficult. This difficulty notwithstanding, published studies support the conclusion that species richness in prairie grasslands is higher than the cropland baseline. Based on the literature reviewed, bird species richness is estimated to increase 2-11 times over the baseline scenario. Mammal, reptiles, and amphibians species richness would be expected to be 2-5 greater on project properties than the baseline scenario as well. Species densities, nesting attempts and success would improve for grassland-nesting, shorebirds, passerines and other waterbirds dependent upon the mixed-grass prairie ecosystem. Species unable to utilize cropland as nesting habitat such as the Sprague's Pipit and others will realize the greatest net gain in population numbers due to the project.

B1.2 Native Species

No non-native species will be used for the implementation of the project. The terms of the easement will provide management guidance in the use of best practices to encourage healthy landscapes resilient to invasive non-native plant and animal species.

B1.3 Threatened Species

There are at least four endangered or threatened species of wildlife that will benefit from projects properties in this proposal: the piping plover, whooping crane, Dakota Skipper butterfly, and bald eagle. North Dakota is home to the Great Plains population of piping plovers, and some of the highest breeding densities in the world occur in the PPR. Piping plovers utilize the barren sand and gravel shorelines of many larger, alkaline prairie wetlands. The projects outlined in this proposal will have a direct impact on USFWS-designated Critical Habitat Areas for breeding, nesting, and brood rearing for the piping plover (USFWS, 2002). The Project Area contains 61,066 of grassland and wetland designated as critical habitat. In 1991, 496 nesting pairs were surveyed in North Dakota and in 1996, 399 nesting pairs were surveyed. A large percentage of these nests are found within the Project Area. Loss of wetland habitat and increased predation are some of the causes attributed to the decline of piping plover populations. Grassland easements when secured on the adjacent uplands next to wetlands used by nesting piping plovers will serve to perpetually protect this threatened species' wetland habitat.

Historically, whooping cranes nested in North Dakota. However, today, the Project Area lies within the heart of their annual migration route and pairs or individuals are observed on an annual basis, with more frequent sightings occurring during the spring migration. Perpetual protection of prairie wetlands and native tracts of northern mixed-grass prairie through wetland and grassland easements will ensure that migratory habitat for recovering populations of whooping cranes is always available.

Dakota Skipper butterflies can survive only in undisturbed tracts of mixed-grass prairie. Perpetual protection of large tracts of mixed-grass prairie and wetlands as outlined in this proposal will help slow the decline of this important wildlife species.

Bald eagles are regular visitors to the Project Area during the spring and fall waterfowl migrations. Wetland and grassland protection and enhancement projects within this proposal will benefit breeding and migratory populations of waterfowl and will ultimately provide benefits for migratory bald eagles by providing them with an abundant food source.

Other species of management concern within the Project Area include the Baird's sparrow, loggerhead shrike, black tern, and ferruginous hawk. Most of these species are prairie dependent and primarily associated with northern mixed-grass prairie-wetland complexes. This ecosystem is declining in both quantity and quality. Nearly all of these species are listed as species of concern because of continuing losses of wetland and grassland habitat, largely due to agricultural production. Baird's sparrows, Loggerhead Shrikes and Ferruginous Hawks all prefer vast expanses of mixed-grass prairie to carry out their social, breeding and foraging activities, and black terns breed in palustrine emergent wetlands. Perpetual protection of large tracts of mixed-grass prairie and wetlands as outlined in this proposal will help slow the decline of these important wildlife species.

B1.4 Species Used by the Project

No additional plantings will be performed by the project, only the protection of native existing native plant species. See section G1.2 for a list of the of grass and forb species common in the project area.

Project activities will support cattle ranching; although cattle are non-native to the region they do perform important grassland management functions once performed by native bison herds, which, except for some that have been reintroduced by ranchers, were largely extirpated from the project region.

B1.5 Genetically Modified Organisms

Only native grassland and wetland plant species will be protected by the project with no additional plantings performed as a result of the project and therefore no genetically modified organisms will be utilized by the project.

B2. Offsite Biodiversity Impacts

B2.1 Potential Negative Offsite Biodiversity Impacts

There are no potential negative offsite biodiversity impacts identified.

B2.2 Negative Offsite Biodiversity Impacts

Not applicable.

B2.3 Unmitigated Negative Offsite Biodiversity Impacts

Not applicable.

B3. Biodiversity Impact Monitoring

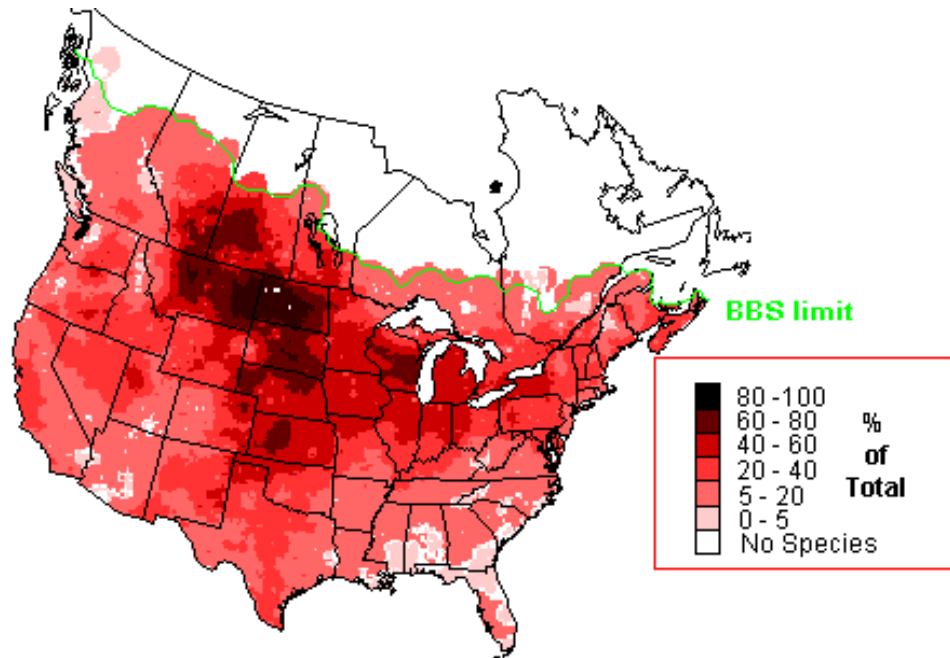
In 1987, the U.S. Fish and Wildlife initiated a survey to annually assess the size and productivity of waterfowl populations and measure wetland habitat conditions in the PPR of North Dakota, South Dakota, and northeastern Montana. The survey, called the Four Square Mile Survey, was developed by personnel of the Northern Prairie Wildlife Research Center and relies on ground pair counts in combination with aerial videography to collect specific data. In addition to annual assessments of the status of waterfowl and wetlands, upland characteristics of each sample block are mapped and updated at five year intervals (Wangler and Reynolds, 2003).

Since 2000, Ducks Unlimited has been conducting evaluations and monitoring work focused on refining our understanding of the important landscape and habitat factors that influence nesting success for waterfowl, shorebirds, and raptors. To date, this monitoring has been conducted across 55 individual study sites scattered across the Coteau region of North Dakota in the primary areas where grassland easement work is targeted. Over 15,957 waterfowl nests, 803 shorebird nests and 321 raptor nests have been located and monitored since this work began. The results of this work to date have

confirmed some important landscape characteristics that influence nesting success. For waterfowl, the key variables that were identified to influence nesting success included the amount of grassland at a 16-mi² scale and the amount of edge between grassland and cropland. For shorebirds, the presence of native grassland habitats, the amount of grassland at a 16-mi² scale, and the wetland area at a 4-mi² scale were the key factors influencing nesting success. Important factors influencing the nesting success of raptors, e.g., northern harriers and short-eared owls, included both native and planted-cover habitat types, and the wetland area at a 4-mi² scale. The results of this monitoring information reinforce the importance of protecting native grassland. Additionally, this information is currently being used to refine and improve targeting of grassland easements.

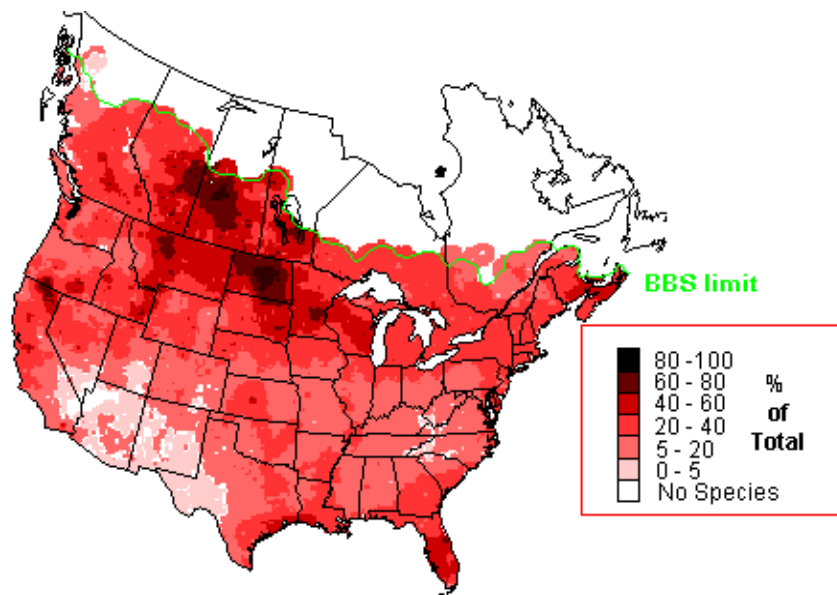
The Breeding Bird Survey (BBS) is a long-term, large-scale, international avian monitoring program initiated in 1966 to track the status and trends of North American bird populations. Each year during the height of the breeding season, June for most of the U.S. and Canada, participants skilled in avian identification collect bird population data along roadside survey routes. Each survey route is 24.5 miles long with stops at 0.5-mile intervals. At each stop, a three-minute point count is conducted. During the count, every bird seen within a 0.25-mile radius or heard is recorded. Surveys start one-half hour before local sunrise and take about five hours to complete. Over 4,100 survey routes are located across the continental U.S. and Canada. Once analyzed, BBS data provide an index of population abundance that can be used to estimate population trends and relative abundances at various geographic scales. Trend estimates for more than 420 bird species and all raw data are currently available via the BBS web site: <http://www.pwrc.usgs.gov/BBS/>.

Figure 14: Grassland Bird Abundance BBS Map



Source: <http://www.mbr-pwrc.usgs.gov/bbs/guild/ra9001.gif>

Figure 15: Wetland Bird Species Richness Map



Source: <http://www.mbr-pwrc.usgs.gov/bbs/guild/ra9002.gif>

B4. Native Species Use

The project will be protecting already established pristine native grasslands and does not require any planting of native species or otherwise.

B5. Water and Soil Resource Enhancement

B5.1 Project Activities That Are Likely to Enhance Water and Soil Resources

Sediment is a major pollutant of wetlands, lakes, estuaries, and reservoirs in the United States (USEPA 2009). Although soil erosion and sedimentation occur naturally, agricultural activities often accelerate soil erosion above normal baselines and result in excessive sedimentation of aquatic habitats. This process is especially true of depressional wetlands in the PPR, where most native grasslands that once mitigated soil erosion and surface runoff have been converted to cropland (Gleason et. al., 2008). Water and wind erosion causes increased sediment loads in wetlands located adjacent to cropland agriculture. Pesticides and herbicides flow into wetlands from cultivated hillsides and degrade the aquatic plant and invertebrate communities, thus, impacting the entire wetland ecosystem.

Most of the remaining grassland habitats in the Project Area are native prairie. These grassland habitats are critically important components of the prairie pothole ecosystem and are largely responsible for maintaining the functions and values of adjacent prairie wetlands. Once lost, the ecological functionality of native prairie habitats is nearly impossible to restore. Perpetual wetland and grassland easements purchased under this project, will prove to be an effective and attractive approach to conserving wetland and wetland-associated grassland habitat.

B5.2 Improved Water and Soil Resources Compared to the Baseline

See B5.1

References and Bibliography

- Anderson, D.J., and B. Vondracek. 1999. Insects as Indicators of Land Use in Three Ecoregions in the Prairie Pothole Region. *Wetlands* 19(3): 648-664.
- Bangsund, D.A., N.M. Hodur, and F.L. Leistritz. 2004. Agricultural and recreational impacts of the conservation reserve program in rural North Dakota, USA. *Journal of Environmental Management* 71: 293-303.
- Beauchamp, W. D., R. R. Koford, T. D. Nudds, R. G. Clark, and D. H. Johnson. 1996. Long-term declines in nest success of prairie ducks. *Journal of Wildlife Management* 60:247-257.
- Berkey, G., R. Crawford, S. Galipeau, D. Johnson, D. Lambeth, and R. Kreil. 1993. A review of wildlife management practices in North Dakota: effects on nongame bird populations and habitats. Report submitted to Region 6, U.S. Fish and Wildlife Service, Denver, CO.
- Blake, G. R., and K. H. Hartge. 1986. Bulk density. In A. Klute (ed.) *Methods of Soil Analysis, Part 1. Physical and Mineralogical Methods*. Agronomy Monograph 9 (2nd edition), pp. 363-382. American Society of Agronomy, Madison, WI.
- Bluemle, J. P. 1977. *The Face of North Dakota: The Geologic Story*. Educational Series 11. North Dakota Geological Survey, Grand Forks.
- Brown, S., C. Hickey, B. Harrington, and R. Gill, eds. 2001. *The United States Shorebird Conservation Plan* (2nd edition). Manomet Center for Conservation Sciences, Manomet, MA.
- Campbell, C.A., and W. Souster. 1982. Loss of organic matter and potentially mineralizable N from Saskatchewan soils due to cropping. *Canadian Journal of Soil Science* 62: 651-656.
- Collins, S.L., A.K. Knapp, J.M Briggs, J.M. Blair, and E.M. Steinauer. 1998. Modulation of Diversity by Grazing and Mowing of Native Tallgrass Prairie. *Science*. 280(5364):745-747.
- Daly, C., R.P. Neilson, and D. Phillips. 1994. A statistical-topographic model for mapping climatological precipitation over mountainous terrain. *Journal of Applied Meteorology*. 33: 140-158.
- Davidson, E.A., and I.L. Ackerman. 1993. Changes in soil carbon inventories following cultivation of previously untilled soils. *Biogeochemistry* 20: 161-193.

De La Torre Ugarte, D.G., B.C. English, and K. Jensen. 2007. Sixty billion gallons by 2030: economic and agricultural impacts of ethanol and biodiesel expansion. *American Journal of Agricultural Economics* 89(5): 1290-1295.

Doran, J. W., and L. N. Mielke. 1984. A rapid, low-cost method for determination of soil bulk density. *Soil Science Society of America Journal* 48: 717-719.

Ducks Unlimited. 2008. Unpublished Analysis of land-use conversion in the Prairie Pothole Region.

Eggleston H.S., L. Buendia, K. Miwa, T. Ngara, and K. Tanabe, eds. 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Prepared by the National Greenhouse Gas Inventories Programme. Institute for Global Environmental Strategies (for the IPCC), Kanagawa, Japan.

Enz, J.W. 2003. North Dakota topographic, climate and agricultural overview. North Dakota State University, Fargo.

Finch, D.M. 1991. Population ecology, habitat requirements, and conservation of neotropical migratory birds. General technical report RM-GTR-205. U.S. Forest Service, Fort Collins, Colorado.

Frank, A.B., M.A. Liebig, and D.L. Tanaka. 2006. Management effects on soil CO₂ efflux in northern semi-arid grassland and cropland. *Soil Tillage and Research* 89: 78-85.

Frank, A.B., M.A. Liebig, and J.D. Hanson. 2002. Soil carbon dioxide fluxes in northern semiarid grasslands. *Soil Biology & Biochemistry* 34:1235-1241.

Gleason, R.A., M.K. Laubhan, and N.H. Euliss Jr., eds. 2008. Ecosystem services derived from wetland conservation practices in the United States Prairie Pothole Region with an emphasis on the U.S. Department of Agriculture Conservation Reserve and Wetlands Reserve Programs. U.S. Geological Survey Professional Paper 1745.

Gleason, R.A., N.H. Euliss, D.E. Hubbard, and W.G. Duffy. 2003. Effects of Sediment Load on Emergence of Aquatic Invertebrates and Plants from Wetland Soil Egg and Seed Banks. *Wetlands* 23(1):26-34

Great Plains Flora Association. 1986. *Flora of the Great Plains*. University Press of Kansas. Lawrence.

Greenwood, R. J., A. B. Sargeant, D. H. Johnson, L. M. Cowardin, and T. L. Shaffer. 1995. Factors associated with duck nest success in the Prairie Pothole Region of Canada. *Wildlife Monographs* 128: 1-57.

Hagen, S. K., P.T. Isakson, and S.R. Dyke. 2005. North Dakota Comprehensive Wildlife Conservation Strategy. North Dakota Game and Fish Department, Bismarck. Available online: <http://www.gf.nd.gov/conservation/cwcs.html>

Hellerstein, D. 2005. USDA land retirement programs. Pp. 234 *in* K. Weibe and N. Gollehan (eds.), *Agricultural Resources and Environmental Indicators*. Economic Information Bulletin 16, July 2006.

Hoekstra, J.M., T.M. Boucher, T.H. Ricketts, and C. Roberts. 2005. Confronting a biome crisis: global disparities of habitat loss and protection. *Ecology Letters* 8(1): 23-29.

Houghton, R.A. 1995. Changes in storage of terrestrial carbon since 1850. Pp. 45-65 *in* R. Lal, J. Kimble, E. Levine, and B.A Stewart (eds.), *Soils and Global Change*. CRC/Lewis Publishers, Boca Raton, FL.

Johnson, D.H. 2005. Grassland bird use of Conservation Reserve Program fields in the Great Plains: 2000–2005 update. Pp. 17-32 *in* J.B. Haufler (ed.), *Fish and Wildlife Benefits of Farm Bill Programs: 2000–2005 Update*. Wildlife Society Technical Review; 05-2. Wildlife Society, Bethesda, MD. Available online: <http://www.npwrc.usgs.gov/resource/birds/glbuse2/index.htm> (24 August 2006).

Johnson, D.H., and L.D. Igl. 1995. Contributions of the conservation reserve program to populations of breeding birds in North Dakota. *Wilson Bulletin*. 107(4):709-718.

Johnson, D.H., L.D. Igl, J.A. Deschant, M.L. Sondreal, C.M. Goldade, M.P Nenneman, and B.R. Euliss. 1998. Effects of management practices on grassland birds. Northern Prairie Wildlife Research Center, Jamestown, ND.

Johnson, K.M., and R.W. Rathge. 2006. Agricultural dependence and change in population in the Great Plains. Pp 197-217 *in* W.A. Kendel and D.L. Brown (eds.), *Population Change and Rural Society*. Springer. Dordrecht.

Johnson, M.G., and J.S. Kern. 1991. Sequestering C in soils: a workshop to explore the potential for mitigating global climate change. USEPA Report 600/3-91-031. USEPA Environmental Research Laboratory, Corvallis, OR.

Jones, Lloyd. 2008. Personal Communication.

Joyce, L. A., D. Ojima, G.A. Seielstad, R. Harriss, and J. Lockett. 2000. Potential consequences of climate variability and change for the Great Plains. Pp. 191-217 *in* National Assessment Synthesis Team (compilers). *Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change*. Cambridge University Press, Cambridge, UK.

Kantrud, H. A., G.L. Krapu, and G.A. Swanson. 1989. Prairie basin wetlands of the Dakotas: a community profile. U.S. Fish and Wildlife Service Biological Report 85(7.28). <http://data.bls.gov/cgi-bin/cpicalc.pl>

Klett A. T, T. L. Shaffer, and D. H. Johnson. 1988. Duck nest success in the Prairie Pothole Region. *Journal of Wildlife Management* 52:431-440.

Knopf, F. L. 1994. Avian assemblages on altered grasslands. Pp. 247-257 in J.R. Jehl Jr. and N.K. Johnson (eds.), *A Century of Avifaunal Change in Western North America*. Studies in Avian Biology 15. Cooper Ornithological Society, Lawrence KS.

Kushlan, J.A., M.J. Steinkamp, K.C. Parsons, J. Capp, M. Acosta Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliot, R. M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J. E. Saliva, B. Sydeman, J. Trapp, J. Wheeler, and K. Wohl. 2002. *Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1*. Waterbird Conservation for the Americas, Washington, DC.

Leistritz, F.L., D.K. Lambert, and R.C. Coon. 2002. The Role of Agriculture in the North Dakota Economy. *Agribusiness & Applied Economics Statistical Series Report No. 57*. Department of Agribusiness & Applied Economics. North Dakota State University. October 2002.

Liebig, M.A., and J.W. Doran. 1999. Impact of Organic Production Practices on Soil Quality Indicators. *Journal of Environmental Quality* 28(5):1601-1609

Loeppert, R.H. and D.L. Suarez. 1996. Carbonate and Gypsum. Chapter 15 in *Methods of Soil Analysis, Part 3: Chemical Methods*. Soil Science Society of America, Madison, WI.

Lokemoen, J.T., J.A. Beiser. 1997. Bird Use and Nesting in Conventional, Minimum-Tillage, and Organic Cropland. *Journal of Wildlife Management* 61(3): 644-655.

Mann, L.K. 1985. A regional comparison of C in cultivated and uncultivated Alfisols and Mollisols in central United States. *Geoderma* 36: 241-253.

Mann, L.K. 1986. Changes in soil C storage after cultivation. *Soil Science* 142: 279-288.

Naugle, D.E., R.R. Johnson, M.E. Estey, and K.F. Higgins. 2001. A Landscape Approach to Conserving Wetland Bird Habitat in the Prairie Pothole Region of Eastern South Dakota. *Wetlands* 21(1):1-17

NDSU (North Dakota State University Extension Service). 2008a. Bringing Land in the

Conservation Reserve Program Back Into Crop Production or Grazing. Extension report A-1364. Available on-line at <http://www.ag.ndsu.edu/pubs/plantsci/crops/a1364.pdf> (verified 5 Feb. 2008).

NDSU (North Dakota State University Extension Service). 2008b. Projected 2009 Crop Budgets South Central North Dakota. Farm Management Planning Guide. Available on-line at <http://www.ag.ndsu.edu/pubs/agecon/ecguides/sc2009.pdf> (verified 5 February 2009).

Ogle, S.M., F.J. Breidt, and K. Paustian. 2005. Agricultural management impacts on soil organic carbon storage under moist and dry climatic conditions of temperate and tropical regions. *Biogeochemistry* 72: 87-121.

Ojima, D.S., J.M. Lockett, and the Central Great Plains Steering Committee and Assessment Team. 2002. Preparing for a changing climate: the potential consequences of climate variability and change – central Great Plains. Report for the US Global Change Research Program. Colorado State University, Fort Collins.

Penman, J., M. Gytarsky, T. Hiraishi, T. Krug, D. Kruger, R. Pipatti, L. Buendia, K. Miwa, T. Ngara, K. Tanabe, and F. Wagner, eds. 2003. Good Practice Guidance for Land Use, Land-use Change and Forestry. Institute for Global Environmental Strategies (for the IPCC), Kanagawa, Japan.

Perlack, R.D., L.L. Wright, A.F. Turhollow, R.L. Graham, B.J. Stokes, and D.C. Erbach. 2005. Biomass as feedstock for a bioenergy and bioproducts industry: the technical feasibility of a billion-ton annual supply DOE/GO-102005-2135 and ORNL/TM-2005/66. NTIS, Springfield, VA. Available online: http://feedstockreview.ornl.gov/pdf/billion_ton_vision.pdf (27 Jul. 2007).

Phettlplace, H.W., D.E. Johnson, and A.F. Seidl. 2001. Greenhouse gas emissions from simulated beef and dairy livestock systems in the United States. *Nutrient Cycling in Agroecosystems*. 60:99-102.

Rasmussen, P.E., and H.P. Collins. 1991. Long-term impacts of tillage, fertilizer and crop residue on soil organic matter in temperate semi-arid regions. *Advances in Agronomy* 45: 93-134.

Rasmussen, P.E., and W.J. Parton. 1994. Long-term effects of residue management in wheat- fallow: I. Inputs, yield and soil organic matter. *Soil Science Society of America Journal* 58: 523-530.

Reynolds, R.E., T.L. Shaffer, R.W. Renner, W.E. Newton, B.D.J. Batt. 2001. Impact of the Conservation Reserve Program on duck recruitment in the U.S. Prairie Pothole Region. *Journal of Wildlife Management*. 65(4): 765-780.

Rich, T.D., C.J. Beardmore, H. Berlanga, P.J. Blancher, M.S.W. Bradstreet, G.S. Butcher, D.W. Demarest, E.H. Dunn, W. C. Hunter, E.E. Inigo-Elias, J. A. Kennedy, A.M. Martell, A.O. Panjabi, D.N. Pashley, K.V. Rosenberg, C.M. Rustay, J.S. Wendt, and T.C. Will. 2004. Partners in Flight North American Landbird Conservation Plan. Cornell Laboratory of Ornithology, Ithaca, NY.

Ringelman, J. K. 2007. Simulation of constant loss rates. Unpublished data (Excel spreadsheet), Ducks Unlimited, Inc.

Sauer, J.R., J.E. Hines, and J. Fallon. 2004. The North American Breeding Bird Survey, Results and Analysis 1966-2003. Version 2004.1. USGS Patuxent Wildlife Research Center, Laurel, MD.

Schimel, D.S. 1986. Carbon and N turnover in adjacent grassland and cropland ecosystems. *Biogeochemistry* 2: 345-357.

Schlesinger, W.H. 1995. An overview of the carbon cycle. Pp. 9-25 *in* R. Lal, J. Kimble, E. Levine, and B.A. Stewart (eds.), *Soil and Global Change*. CRC-Lewis Press, Boca Raton, FL.

Schoeneberger, P.J., D.A. Wysocki, E.C. Benham, and W.D. Broderson, eds. 2002. Field book for describing and sampling soils, Version 2.0. Natural Resources Conservation Service, National Soil Survey Center, Lincoln, NE.

Sargeant, A.B., R.J. Greenwood, M.A. Sovada, and T.L. Shaffer. 1993. Distribution and Abundance of Predators that Affect Duck Production-Prairie Pothole Region. U.S. Fish and Wildlife Service, Resource Publication 194. 96pp.

Skagen, S.K. 1997. Stopover ecology of transitory populations: the case of migrant shorebirds. *Ecological Studies* 125: 244-269.

Skagen, S.K., and G. Thompson. 2000. Northern plains/prairie potholes regional shorebird conservation plan, Version 1.0
<http://shorebirdplan.fws.gov/regionalshorebird/regionalplans.htm> (revised 2008)

Southwick Associates. 2007. Hunting in America: An Economic Engine and Conservation Powerhouse. Produced for the Association of Fish and Wildlife Agencies with funding from Multistate Conservation Grant Program.

Stewart, R.E. 1975. Breeding Birds of North Dakota. Tri-College Center for Environmental Studies, Fargo, ND. Northern Prairie Wildlife Research Center

Online. Available online: <http://www.npwrc.usgs.gov/resource/birds/bbofnd/index.htm> (Version 06JUL2000).

Tiessen, H., J.W.B. Stewart, and J.R. Betany. 1982. Cultivation effects on the amounts and concentration of C, N and P in grassland soils. *Agronomy Journal* 74: 831-835.

U.S. Census Bureau. 2009. American Fact Finder. March 2009. Available at: http://factfinder.census.gov/home/saff/main.html?_lang=en (13 March 2009).

USDA NASS (U.S. Department of Agriculture National Agricultural Statistics Service) 2004. North Dakota at a Glance, November 2004. Available at: <http://www.nass.usda.gov/nd/atglnc04.pdf> (3 October 2008).

USDA NASS (U.S. Department of Agriculture National Agricultural Statistics Service) 2008a. *North Dakota Annual Statistical Bulletin 2008*. June 2008. Available at: http://www.nass.usda.gov/Statistics_by_State/North_Dakota/Publications/Annual_Statistical_Bulletin/index.asp (3 October 2008).

USDA NASS (U.S. Department of Agriculture National Agricultural Statistics Service) 2008b. North Dakota 2008 County Rents and Values. Available on-line at: http://www.nass.usda.gov/Statistics_by_State/North_Dakota/Publications/Land_Values_and_Farm_Numbers/pub/crents08.pdf (verified 5 Feb. 2009).

USDA NASS (U.S. Department of Agriculture National Agricultural Statistics Service). 2009. Quick Stats-North Dakota- Farm Numbers Available at http://www.nass.usda.gov/QuickStats/PullData_US.jsp (verified 2 February 2009).

USDA NRCS (U.S. Department of Agriculture Natural Resources Conservation Service). 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. *Agriculture Handbook 296*. Available online: <http://soils.usda.gov/survey/geography/mlra/> (29 September 2008).

USDA NRCS (U.S. Department of Agriculture Natural Resources Conservation Service). 2008. NSSC soil survey laboratory soil characterization database. Available online: <http://ssldata.nrcs.usda.gov/> (29 September 2008).

USDA SCS (U.S. Department of Agriculture Soil Conservation Service). 1981. Land resource regions and major land resource areas of the United States. *Agriculture Handbook no. 296*. U.S. Government Printing Office, Washington DC

USDOI and EC (U.S. Department of the Interior and Environment Canada). 1986. The North American Waterfowl Management Plan. U.S. Department of the Interior. Washington, DC.

USEPA (U.S. Environmental Protection Agency). 2003. Annex P *in* Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2001. USEPA. Washington, DC.
[http://yosemite.epa.gov/oar/GlobalWarming.nsf/UniqueKeyLookup/LHOD5MJTBF/\\$File/2003-final-inventory_annex_p.pdf](http://yosemite.epa.gov/oar/GlobalWarming.nsf/UniqueKeyLookup/LHOD5MJTBF/$File/2003-final-inventory_annex_p.pdf)

USEPA (U.S. Environmental Protection Agency). 2009. National Water Quality Inventory: Report to Congress 2004 Reporting Cycle. Available online:
http://www.epa.gov/owow/305b/2004report/2004_305Breport.pdf (16 March 2009).

USFWS (U.S. Fish and Wildlife Service). 2002. Endangered and threatened wildlife and plants; designation of critical habitat for the Northern Great Plains breeding population of the piping plover. USFWS, Federal Register, 50 CFR Part 17.

USFWS (U.S. Fish and Wildlife Service). 2008. Waterfowl Population Status, 2008. U.S. Department of the Interior, Washington, DC.

U.S. Fish and Wildlife Service. 1995. North Dakota's federally listed endangered, threatened, and candidate species - 1995. U.S. Fish and Wildlife Service, Bismarck, ND. Jamestown, ND: Northern Prairie Wildlife Research Center Online.
<http://www.npwrc.usgs.gov/resource/wildlife/nddanger/index.htm> (Version 16JUL97).

U.S. Geological Survey. 2005. A GAP Analysis of North Dakota. Available online at http://www.npwrc.usgs.gov/projects/ndgap/NDGAP_FinalReport_text.pdf (Verified 5 Feb. 2009)

Vias, A.C., and P.B. Nelson. 2006. Changing livelihoods in rural America. Pp. 197-217 *in* W.A. Kendel and D.L. Brown (eds.), Population Change and Rural Society. Springer, Dordrecht.

Wacker, Stephen A. 2007. Field Director U.S. Fish and Wildlife Service. Bismarck Office. Personal communication.

Wangler, B., and R.A. Reynolds. 2003. Results of the Four Square Mile Waterfowl Population Survey in the Prairie Pothole Joint Venture Area of North Dakota, South Dakota, and Montana. U.S. Fish and Wildlife Service, Bismarck.

Wood, R.S., 2006. Examining the Quiet Crisis of Rural America: A Study of Local Economic Development in North Dakota¹. Presentation at Midwest Political Science Association April 20, 2006 Chicago, IL. Available on-line at:
http://www.allacademic.com/meta/p140207_index.html (verified 5 Feb. 2009).

Appendices

Appendix A – Emissions Profile under the Baseline Scenario

Year	2008	2009	2010	2011	2012	2013	2014	2015
Avoided Emissions (t CO ₂)	1,633	3,198	4,699	6,139	7,520	8,845	10,117	11,338

2016	2017	2018	2019	2020	2021	2022	2023
12,510	13,635	14,716	15,755	16,753	17,711	18,633	19,519

2024	2025	2026	2027	2028	2029	2030	2031
20,371	21,190	21,978	22,735	21,831	20,967	20,141	19,351

2032	2033	2034	2035	2036	2037	2038	2039
18,595	17,871	17,179	16,516	15,880	15,272	14,688	14,129

2040	2041	2042	2043	2044	2045	2046	2047
13,593	13,078	12,585	12,111	11,656	11,218	10,798	10,395

2048	2049	2050	2051	2052	2053	2054	2055
10,006	9,633	9,274	8,928	8,595	8,275	7,966	7,668

2056	2057	2058	2059	2060	2061	2062	2063
7,380	7,103	6,836	6,578	6,328	6,087	5,854	5,629

2064	2065	2066	2067	2068	2069	2070	2071
5,411	5,199	4,995	4,797	4,604	4,418	4,237	4,061

2072	2073	2074	2075	2076	2077	2078	2079
3,890	3,724	3,562	3,404	3,251	3,101	2,955	2,813

2080	2081	2082	2083	2084	2085	2086	2087
2,674	2,537	2,404	2,274	2,146	2,020	1,897	1,776

2088	2089	2090	2091	2092	2093	2094	2095
1,657	1,540	1,424	1,310	1,198	1,087	978	876

2096	2097	2098	2099	2100	2101	2102	2103
780	690	606	527	454	387	326	270

2104	2105	2106	2107
219	174	134	-

Appendix B – Analysis of Project Region Leakage

Figure 1: Acres of New Breakings as a Function of Acres of Easements Purchased in the Same Year.

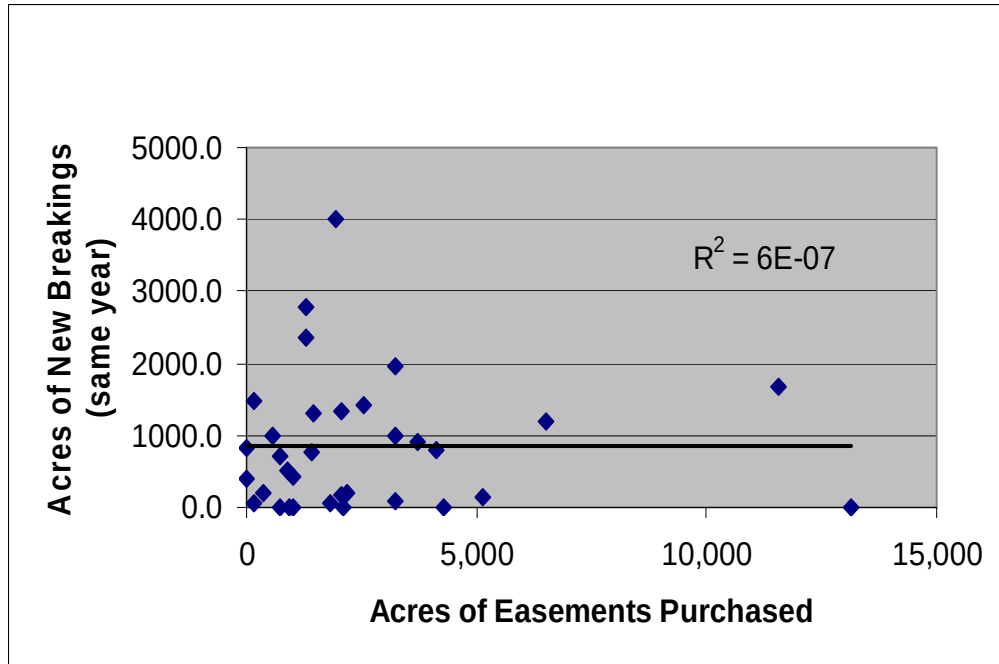


Figure 2: Acres of New Breakings as a Function of Acres of Easements Purchased the Following Year.

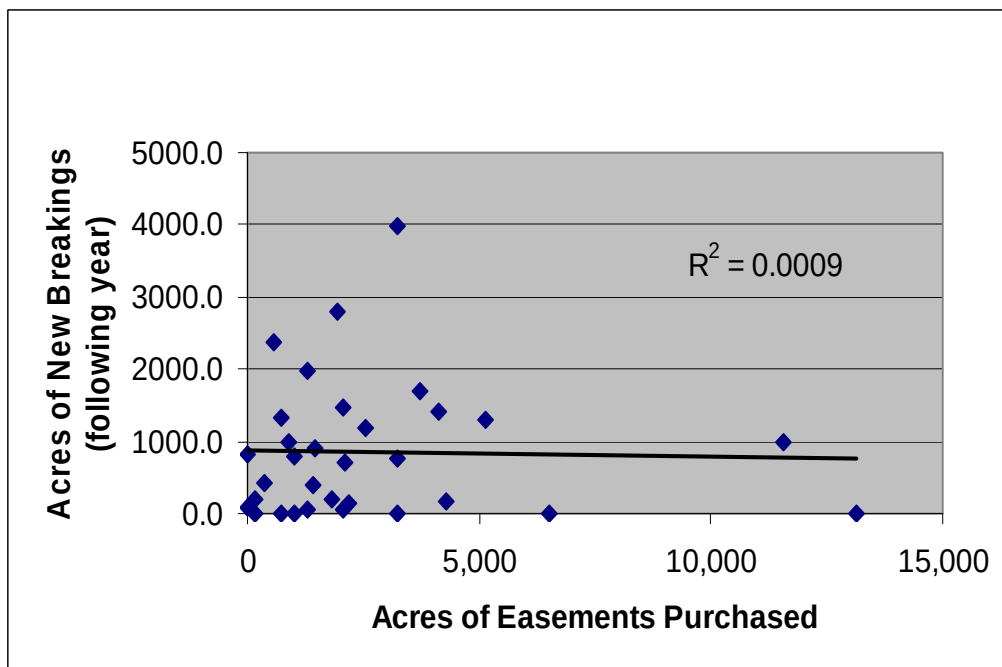


Figure 3: Percentage of a County with New Breakings as a Function of the Percentage of a County with New Easements Acquired During the Same Year.

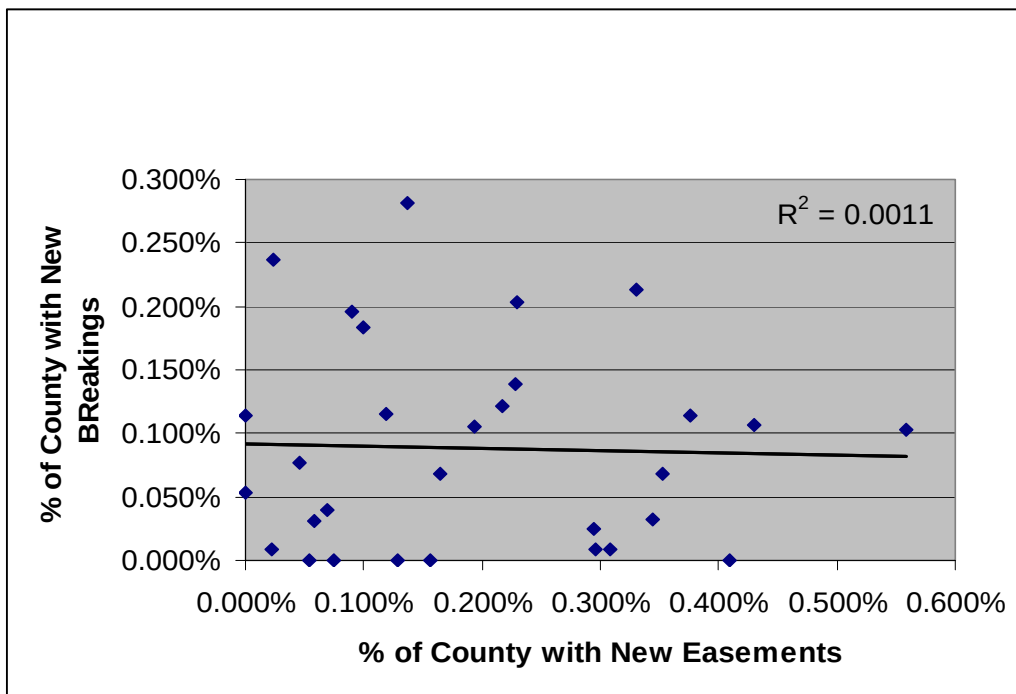


Figure 4: Percentage of a County with New Breakings as a Function of the Percentage of a County with New Easements Acquired During the Subsequent Year.

