# GRASSLANDS MANAGEMENT AND PLANNING PROJECT

**Seg. 4 Amendment**

**July 2, 2013- July 31, 2017**

# SECTION 319 GRANT APPLICATION

# OCTOBER 2014

**SPONSORED BY**

**SOUTH DAKOTA GRASSLAND COALITION**

**SUBMITTED TO:**

**South Dakota Department of Environment and Natural Resources**

**AWARD FISCAL YEAR:** 2014

**PROJECT TITLE:** Grassland Management and Planning Project Segment 4

**NAME, ADDRESS, PHONE AND E-MAIL OF LEAD PROJECT SPONSOR:**

South Dakota Grassland Coalition
Jim Faulstich, Chairman
33795 186th St
Highmore, SD 57345 Phone: (605) 852-2622

Primary Contact: Justin Jessop Phone: 605-280-0127

**PROJECT TYPE:** Watershed

**PROJECT LOCATION:** State wide

**WATERSHED NAME:** State wide

**HYDROLOGIC UNIT CODE (HUC):** State wide

**HIGH PRIORITY WATERSHED:** Yes **POLLUTANT TYPE:** Nutrients, Sediment, and Fecal Coliform Bacteria

**UWA CATEGORY:**

**TMDL DEVELOPMENT:** See Table 3 **TMDL IMPLEMENTATION:** See Table 3

**TMDL PRIORITY (High, Medium, Low):** High

**WATERBODY TYPES:** Lakes, Streams, and Wetlands

**ECOREGION:** State wide

**PROJECT CATEGORY:** Agricultural

**PROJECT FUNCTIONAL CATEGORY:** BMP Implementation/Design

**GROUNDWATER PROTECTION:** No

**Total 319 Funds: $201,000 ($ 462,077) Local and State Match: $431,500 ($ 316,500)**

**Nonmatching Federal funds: $232,375 ($175,000)**

**319 Funded Full Time Personnel: 1.6 Total Project Cost: $ 864,875 ($953,577)**

**GOALS:**

The goals of the Grassland Management and Planning Project are:

1. Reduce sediment, nutrients and fecal coliform bacteria loading of surface waters in South Dakota by improving range condition on grasslands.
2. Develop standardized and repeatable methodology to assess South Dakotas remaining native grasslands that can be adapted to other regions of the Great Plains in order to measure impacts of grassland conversion on conservation of ranching, habitat, and watersheds.

By attaining these goals, water quality and wildlife habitat will be improved, biodiversity increased, and grassland manager economic sustainability improved.

The goals will be attained by providing technical assistance to grassland managers for the planning and implementation of grassland management systems, the completion of an information and education program on grassland management, a GIS layer of remaining native grasslands of South Dakota, and watershed modeling of "what if" scenarios of grassland-to-cropland conversion in hopes of identifying and applying grassland protection in key areas of the state.

**PROJECT DESCRIPTION:**

The project is a two year continuation of the current statewide Grassland Management and Planning project. During this project segment the sponsor and its partners will:

1. Provide grassland managers with accelerated technical assistance to plan an additional:
    a. 160,000 acres of intensive grassland management systems implement and
    b. 120,000 acres of intensive grassland management systems.
2. Transfer grassland management information gained from on-ranch demonstration projects and systems implemented to ranchers, researchers, agency specialists and the public.
3. Assess native grassland in South Dakota and Minnesota through a five-phased project
    a. Evaluate and map untilled sod in portions of 17 counties comprising the Prairie Coteau region of South Dakota (completed June 2014)
    b. Evaluate and map native grassland in portions of 11 counties comprising the Prairie Coteau region of Minnesota
    c. Evaluate and map native grassland in portions of 9 counties comprising the Missouri Coteau region of South Dakota
    d. Evaluate and map native grassland sod in the remaining 44 counties of eastern South Dakota
    e. Evaluate and map untilled sod in the 22 counties of western South Dakota
4. Inform the public and grassland managers about environmental impacts of grassland depletion.
5. Assess hydrologic and water quality impacts of grassland losses.

Planning and implementation assistance will be provided using the following priority and estimated allocation of resources that follow:

1. Grassland managers in TMDL implementation project areas where additional technical assistance to plan and implement improved grassland and riparian management are critical to implementing the TMDL - 50 percent.

2. Belle Fourche River Watershed TMDL Implementation Project - 40 percent.
3. Central SD where grassland conversion to cropland is occurring at an accelerating rate and areas of the state, i.e. eastern and southeast SD, where managed grazing has a history of limited implementation by landowners – 10 percent.
4. Mapping of native grassland will occur in sequence as described in section 3 above, beginning with completion of the Prairie Coteau and Missouri Coteau landscapes and ending with SD west river counties. As areas of native grassland are completed and mapped, the watershed modeling portion of the project will ensue based on the native grassland data.
5. Watershed modeling will describe "what if" scenarios based on converting the native grassland to crop production with varying degrees of conservation practices applied.

**2.1 Statement of Need - Objective 1:** Reduce sediment, nutrients and fecal coliform bacteria loading of surface waters in South Dakota by improving range condition on grasslands.

This project segment will continue the South Dakota Grassland Coalition's (SDGLC) leadership in providing South Dakota livestock producers with practices that reduce nonpoint source (NPS) pollution from grasslands and promote sustainable agricultural.

Nearly fifty percent (23 million acres) of South Dakota's of 48,614,000 acres of land are grasslands. According to the Census of Agriculture, approximately 75 percent of the state's (= 23,000) farm/ranch operations graze livestock. The stock raised is the primary source of income for approximately 12,000 of the operations.

The sustainability of a farm/ranch enterprise based on grazing is directly related to the stocking rates its pastures can support without reducing forage production capability. Whether forage production decreases, is maintained or improved is dependent on the management practices employed by the producer.

Resource managers categorize grasslands using similarity index that compares forage production at a site to what the potential plant community could produce at its historic climax. The comparison values range from 0 – 100 percent with 100 percent being the most similar to climax production According to data provided by the USDA Natural Resources Conservation Service's (NRCS) National Resource Inventory (NRI) of South Dakota rangelands, approximately:

- 60 percent are at 50 percent or less potential
- 28 percent at 75 - 50 percent of potential and
- 12 percent at potential.

Continuous or season-long grazing, coupled with stocking rates greater than the forage produced can support, has been linked to degraded riparian areas and low ecological status. Conversely, management systems that include proper stocking rates and rotational grazing promote functioning riparian systems and higher range ecological status.

In contrast to rangelands with lower ecological status, high ecological status rangelands:

- provide greater biodiversity,
- produce more and better quality forage,
- raise more pounds of marketable livestock/animal unit, which translates to increased economic stability for the operation,
- provide better wildlife habit,
- yield 25 percent of the precipitation received as runoff (Welch et.al, 1991) versus 45 percent for low condition sites dominated by sod forming grasses, and 75 percent for bare ground,
- have sediment peaks at least 20 percent lower than those from low condition grasslands,
- characteristically have less prominent gullies, headcuts and streambank erosion and
- contribute up to four times less nitrogen and phosphorus to the watershed.

Based the findings of Russell (2004, Iowa Beef Center) and Thelen (1996, Bad River Phase II Water Quality Project), reducing NPS pollution from grasslands may be accomplished by maintaining or improving rangelands to a higher ecological status.

Russell reported that sediment and phosphorus loads in pasture runoff can be reduced using rotational stocking to maintain adequate grass height, and/or maintaining buffer strips along pasture streams. This being particularly important in pastures with high soil phosphorus levels.

Thelen's study of the impact of grassland management on sediment transfer from clay soils found that:

- as grass production, percent canopy cover, vegetation height, and litter increase, runoff and sediment transfer decrease,
- sediment peaks were six to eight times higher for poor condition (low ecological status) grasslands than good and
- gullies and headcuts are accelerated in poor condition grasslands dominated by short grasses.

Practices implemented during previous (2001-2013) and the current two year project segment have provided livestock producers with management alternatives that implement practices Russell and Thelen found to be effective NPS reduction best management practices (BMPs).

The activities completed during previous project segments have met, exceeded or are on schedule to meet milestones established to monitor project success (Table 1). The benchmarks include planning and implementing managed grazing systems using USDA Natural Resource Conservation Service (NRCS) practices and information transfer activities selected to reach the project's primary targeted stakeholders - livestock grazers and grassland management professionals

**Table 1. Grassland Management and Planning Project Milestone Comparison (2001-2014).**

| Project Activity/Products | Planned | Accomplished[1] |
|---|---|---|
| Management Systems Planned/Total Acres | 205 Systems / 515,000 acres | 173 systems /589,644 acres |
| Management Systems Installed/Total Acres | 202 /720,000 acres | 166 / 768,470 acres[2] |
| *Practices Installed:* | | |
| Fencing | 425,000 lf | 506,330 lf |
| Pipeline | 335,000 lf | 468,430 lf |
| Wells | 14 | 5 |
| Tanks | 120 | 183 |
| Pasture Pumps | 5 | 0 |
| Dugouts/Dams | 20 | 6 |
| Stream Crossing | 1 | 1 |
| Grass Seeding | 950 acres | 985 acres |
| *Information and Education* | | |
| Demonstrations Sites | 9 | 12 |
| Web Site | 280,000 hits | 355,931 Hits |
| Tours/Attendants | 25/1,680 | 60/1,903 |
| News/Media Events | 29/942,800 | 100/3,444,106 |
| 5 program series aired on Today's Ag Series segments merged into a video. | 1 | 1 |
| Workshops/Attendance | 27/1,230 | 78/15,181 |
| Grazing Schools/Attendance | 10/260 | 13/400 |
| Administration and Oversight | 4 | 4 |

[1] Accomplished through 8/31/2013 [2] Includes acres planned by project partners.

The practices installed have improved the ecological status of an estimated one million acres (4 percent) of the state's grasslands. It is also estimated that the information and education activities have lead to improved ecological status of an equal number of acres.

In addition, information included in the 2008 and 2012 *SD Integrated Report for Surface W*aters indicate that during the four year time period, the river and stream miles identified as impaired by grazing in riparian or shoreline zones decreased from 561 to 475 miles. During this same period, the river and stream miles impaired from pollutants originating from livestock grazing and feeding operations decreased from 1,750 to 1,350 miles. Information in the 2002, 2008 and 2012 reports indicate river and stream miles impaired by pollutants associated with grazing in riparian and upland areas decreased from 2,151 to 562 miles.

A comparison of data available in the 2012 report to that in the 2014 indicates that impairments attributed to livestock grazing and feeding operations was reduced from 1,912 to 1,684 miles and the number of lake/reservoir acres impaired by NPS' was reduced from 4,517 to 4,411 acres.

NPS load reductions realized from the practices installed to improve and maintain higher levels of range potential during previous and the current (Segment 4) projects, calculated using the Spreadsheet Tool for Estimating for Pollutant Loads (STEPL) developed by EPA Region 5, equal:

- Nitrogen 637,741 lbs
- Phosphorous 114,912 lbs
- Sediment 71,329 tons

Practices employed to realize the reductions were installed on a total of nearly one million acres located:

- in more than 90 drainages
- on land managed by more than 200 producers
- located in more than 40 counties.

The size of the managed grazing systems implemented ranged from 30 to more than 31,500 acres.

Previous project accomplishments demonstrate the ability of the SD Grassland Coalition to partner and coordinate activities with grassland stakeholders that provide effective, efficient services that reduce NPS pollution and have positive economic and environmental benefit. In addition, it is suggested that the partnerships developed can serve as the basis for implementing the recommendations outlined in the SD Governor's Pheasant Habitat Work Group final report. The report is available by accessing:

http://gfp.sd.gov/pheasantsummit/docs/PHWG%20Final%20Report.pdf

Requests for planning and implementation assistance that are on hand and continue to be received indicate continued interest in using planned grazing systems to increase environmental stewardship and improve or stabilize a farm/ranch operation's economic viability.

The types of systems most commonly identified to accomplish these objectives are rotational systems that vary in management intensity - from simple two pasture switchback systems, to complicated multi-pasture rapid rotations. The water quality improvements realized from riparian buffers, shoreline stabilization, and livestock management (livestock exclusion, animal feeding areas) installed as the systems are developed are dependent on proper grazing management in the pasture, subwatershed area, and/or watershed associated with the site of BMP installation.

Implementation of new or improving current grazing management systems will be delayed in South Dakota without the availability of the grassland specialists employed by this project and its partner's to continue providing the information and technical assistance needed to plan, implement, and operate managed grazing systems.

The South Dakota NPS Pollution Program priority funding areas include staffing, information transfer, animal nutrient management systems, riparian buffers, shoreline stabilization, and practices to exclude livestock from riparian areas. This project segment will continue to provide the grassland planning, implementation, and education activities necessary to effectively implement these funding priorities as part of the need for a landscape planning approach to reduces NPS pollution in South Dakota.

The project addresses a key watershed BMP, grassland management. It provides existing watershed projects with technical assistance and information that can be used to make targeted, measurable water quality improvements through improved grassland management. The planning, design, and implementation of grassland management systems will be based on whole farm/ranch plans that incorporate the goals of the individual producers. Factors addressed in the plans include family, production, natural resources, and finances.

This project is designed to meet the clean water, economic and wildlife goals of grassland managers and the citizens of South Dakota on a statewide basis, by accelerating the implementation of grassland management practices that improve plant diversity, net primary production and forage quality. These practices will lead to attaining the project goal by:

1. Reducing soil erosion and sediment transfer in runoff through:
   a. increased water intake - reduced runoff reduces stream and river peak flow volumes and velocities, which in turn reduces stream bank erosion and abnormally long periods of flooding that damage wildlife habitat and
   b. rainfall interception - soil anchoring and ground protection by vegetation decreases the dislodging of soil and subsequent transport in runoff.
2. Providing a buffer adjacent to wetlands, lakes, waterways and drainages to intercept sediment and nutrients transported by water.
3. Increasing vegetation production on grasslands, which will increase the sequestration of carbon in the grassland ecosystem.
4. Providing producers with additional profits from increased livestock or wildlife production, and/or decreased production costs.
5. Assist producers and agencies in improving information related to the occurrence of native grasslands and their function in regard to: biological diversity, resiliency, economics, and water quality.

Completing activities that result in attaining the project goal will also support attaining the goal of the South Dakota NPS Management Plan. Management plan tasks supported include 4, 5, 8, 10 12 and 14.

A copy of the SD NPS Management Plan is available by accessing;

http://denr.sd.gov/dfta/wp/NPSMgmtPlan07.pdf

Information describing how previous Grassland Management and Planning Project segments have supported attaining the state's NPS management plan is available by accessing;

http://denr.sd.gov/dfta/wp/wqprojects/grasslands.pdf

**Statement of Need - Objective 2:** Develop standardized and repeatable methodology to assess South Dakotas remaining native grasslands that can be adapted to other regions of the Great Plains in order to measure impacts of grassland conversion on conservation of ranching, habitat, and watersheds.

South Dakota is losing its perennial grassland cover at a rate that is concerning to many individuals and organizations. The statewide rate of grassland loss, while likely measurable, has not been quantified in regard to actual loss of *native* grasslands.

Currently, there exists no singular accurate source of data or maps that indicate the location or land area of truly native sod in South Dakota or western Minnesota. This region of the upper plains has experienced some of the highest rates of conversion to row crop agriculture over the last decade. While several recent studies have addressed the issue conversion of grassland habitats to cropland based on

known data sets (such as NASS data), there exists no data on the portion of grassland conversion that is truly native sod.

Most studies attempting to quantify land use change have utilized some type of GIS remote sensing or other technology to derive at a conversion rate. Most typically, studies rely on the National Agricultural Statistics Service's (NASS) Cropland Data Layer (CDL) to report total acres 'lost' or a percent change over a period of time (Wright and Wimberly 2013; Johnston 2013, 2014; Faber et al. 2012, Decision Innovation Solutions 2013). This type of analysis can be very powerful in reporting land use trends, but because researchers have not been able to accurately and consistently separate native grasslands from other types of planted grasslands (such as CRP), grass-like crops (such as hayfields), or other grassy habitats using NASS CDL data, it becomes nearly impossible to accurately map vegetation type at a meaningful scale.

Decision Innovation Solutions (2013) addressed the issue of error in land covers reported by NASS CDL data, especially in relation to those that are "more grassy in nature". Typically, analysts group most or all of the following NASS CDL cover categories together under a 'grass' or 'grass-like' label for analysis: 36-alfalfa, 37-other hay/non-alfalfa, 62-pasture/grass, 87-wetlands, 171-grassland herbaceous, 181-pasture/hay, and 195-herbaceous wetlands. However, Johnston (2013) also found that NASS CDL data even confused corn crops with cattail sloughs. These issues with interpretation of NASS CDL data render it impossible to quantify acreage and location of undisturbed land or native sod with any confidence. Reitsma et al (2014) attempted to quantify conversion using aerial imagery to verify NASS data, and concluded that roughly 1.8 million acres of grasslands were converted in South Dakota between 2006-2012. While promising in relation to providing accuracy in conversion rates, this study did not attempt to quantify the impacts of conversion on native grasslands.

The objective of our work is to develop a simple, systematic, repeatable, and cost-effective approach to estimating location and total area of land tracts that are likely undisturbed (i.e. native) grasslands and woodlands. The central component to our analysis was the utilization of the 2012 South Dakota Farm Service Agency's (FSA) Common Land Unit (CLU) cropland data layer.

Our recent pilot project in the Prairie Coteau region of eastern South Dakota suggests that nearly 50% of the existing remaining native grassland is not included in regional estimates while those tracts that are included are themselves only likely about 50% accurate. Our system of analysis will result in the most comprehensive and accurate analysis to date and will likely serve as an important tool for conservation and agricultural programs and policies.

With our methods, we estimated there are approximately 1,102,271 acres of undisturbed grasslands and woodlands remaining representing (20.3%) of the 5,434,508 total acres within the South Dakota Prairie Coteau Boundary. Of these 1,102,271 remnant undisturbed acres, 1,065,262 acres (96.6%) are classified as 'undisturbed grasslands' and 37,009 acres (3.4%) are 'undisturbed woodlands'. Approximately 276,184 acres (25.1%) of undisturbed grasslands and woodlands are permanently protected from conversion through conservation ownership or permanent conservation easements, representing 5.1% of the 5,434,508 total SD Prairie Coteau Acres.

Going forward, we propose to continue this project in phases, with each phase focused on a certain landscape our block of counties in South Dakota and Minnesota until we have completed mapping all 66

South Dakota counties and the 11 counties comprising the remainder of the Prairie Coteau landscape in western Minnesota. Further, we intend to incorporate landscape-level watershed modeling on at least three watersheds to determine the environmental impacts of continued grassland loss in relation to runoff, soil erosion, and water quality. Watersheds will be selected based on the results from the grassland mapping project and will likely include one cross-border watershed in the Prairie Coteau region of eastern South Dakota and western Minnesota, one in the Missouri Coteau region of northcentral South Dakota, and one in northwestern South Dakota's range country. (For a full description of the methods that will be employed in the mapping project, see the project report ***Quantifying Undisturbed Land on South Dakota's Prairie Coteau*** attached).

There is a scarcity of scientific information that documents how grassland losses affect hydrology and water quality in South Dakota. This study is proposed to help provide understanding of hydrologic implications of accelerating grassland conversion.

**2.4 General Watershed and Grassland Information**

Except for two small areas in the northeastern corner of the state which are in the Red River and Minnesota River Watersheds, South Dakota is in the Missouri River watershed.

Western South Dakota is drained by six major rivers - Bad, Cheyenne, Belle Fourche, White, Moreau, and Grand - which flow west to east to the Missouri River. The area, which was not glaciated during the last ice age, is dominated by rolling, native grasslands with as little as 10–30 percent of many areas converted to crop production. While the traditional crops planted were forage crops, hay and wheat; the production of row crops has increased during recent years as no till practices have become the production system of choice and commodity prices risen to what may be historic highs.

The major rivers in eastern South Dakota - James, Vermillion, and Big Sioux - generally flow north to south to the Missouri River. Unlike the west, the topography was influenced by glacial activity. Eastern SD has less defined drainage patterns with numerous natural wetlands and lakes. Much of the native prairie has been converted to cropland which is mostly cropped using a corn – soybean rotation.
Moving east from the Missouri River and toward the southeast corner of the state, row crop production increases from 20 to 80 percent of land use. Likewise, grasslands decrease in prevalence and become increasingly concentrated along streams, creeks, rivers, and wetlands.

Grasslands commonly occupy 70-90 percent of the land in western South Dakota watersheds. In eastern SD, grasslands cover from 20 to 80 percent a watershed with lower values being the norm. While lesser in extent in eastern SD, grasslands commonly occupy the environmentally sensitive lands adjacent to streams, wetlands, lakes, and rivers, where they cover riparian areas and sloping drainages, hills and/or breaks. Regardless of extent by region, grasslands in all parts of SD impact runoff volume and are the buffers that intercept pollutants carried by runoff and protect stream banks. Grasslands also provide habitat (nesting, winter cover, food, and reproductive range, etc.) for South Dakota's wildlife.

Central SD, essentially west of highway 281 to the Missouri River, was traditionally dominated by diversified agriculture with producers involved with livestock production to an increasing degree with closer proximity to the $100^{th}$ meridian. During recent years there has been an increasing shift toward row crop production. For example, during 2005 – 2006, 101,571 acres of grasslands in 16 counties in

the area were converted to crop production (GAO-07-1054, September 2007). Visual observations and information relative to payment for lost production provided by the livestock producers and resource managers and the crop insurance industry, respectively, indicate the rate has accelerated since that time with a concern that claims filed/paid are disproportionate to other areas in the state and region.

Data presented to the SD Governor's Pheasant Habitat Work Group by South Dakota State University showed the acres of grassland converted to cropland, inundated by water or lost to urban development the 2006 – 2012 time period totals 1.8 million acres.

The river and stream miles and acres of lakes identified as having impaired water quality and the source of impairment are shown in the Table 2. As discussed previously (Project Description information included in the 2008 and 2012 *SD Integrated Report for Surface W*aters indicate that during the four year time period, the river and stream miles identified as impaired by grazing in riparian or shoreline zones decreased from 561 to 475. During this same period, the river and stream miles impaired from pollutants originating from livestock grazing and feeding operations decreased from 1,750 to 1,350. Information in the 2002, 2008 and 2012 reports indicate river and stream miles impaired by pollutants associated with grazing in riparian and upland areas decreased from 2,151 to 562.

A comparison of data available in the 2012 report to that in the 2014, the impairments attributed to livestock grazing and feeding operations was reduced from 1,912 to 1,684 miles and the number of lake/reservoir acres impaired by nonpoint sources was reduced from 4,517 to 4,411 acres. A comparison of the 2012 to 2014 data also indicates the proportion of river/stream miles impaired by livestock related nonpoint source pollutants declined an additional three percent, from approximately the 40 percent to 37. The primary pollutants identified as the cause of impairment were total suspended solids (TSS) and fecal coliform bacteria.

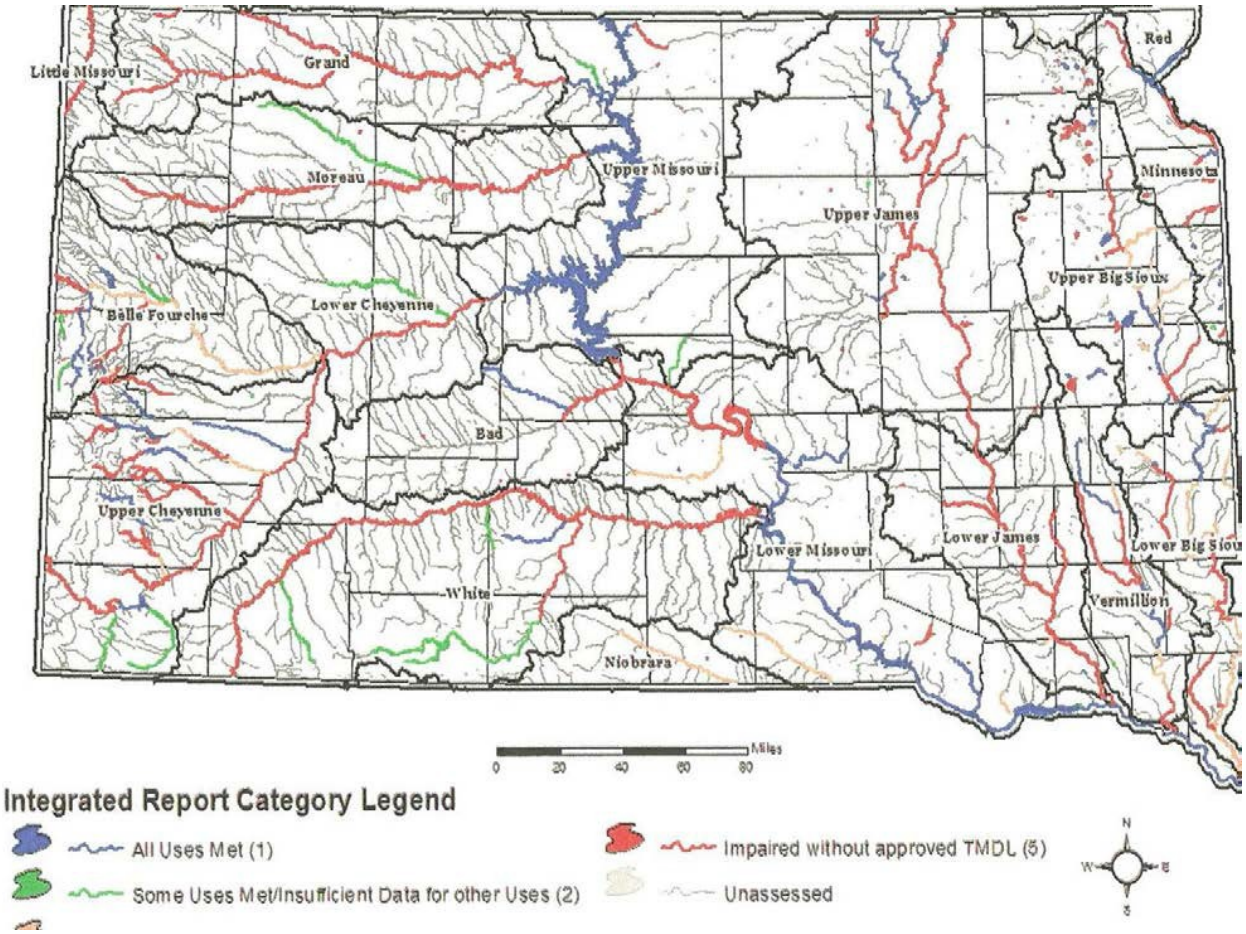
The map that follows (Figure 1) shows the river segments and/or lakes that require development of and/or implementation of Total Maximum Daily Loads (TMDLs). Grasslands, because of their extent and critical location in relation to the listed water bodies, are commonly targeted for BMP installation in South Dakota watershed implementation projects (Figure 2). The location of grazing systems installed during the previous and current project segments are shown in Figure 3.

Table 2: Total Sizes of Waters Impaired by Various Source Categories in SD[1]

| Rivers/Streams | Miles[2] |
|---|---|
| Impacts from Abandoned Mines | 2 |
| Drought-related Impacts | 25 |
| Streambank Modifications/destabilization | 77 |
| Municipal Area or Urban Runoff | 117 |
| Unknown Sources | 127 |
| Wildlife | 508 |
| Agricultural Crop Production | 865 |
| Natural Sources | 1,110 |
| Livestock -Grazing or Feeding | 1,684 |
| **Lakes/Reservoirs** | **Acres** |
| Unknown Sources | 3,073 |
| Nonpoint Sources | 4,411 |
| Natural Sources | 5,125 |

[1] 2014 SD Integrated Report for Surface Water

[2] Mileage values rounded to the nearest whole number.



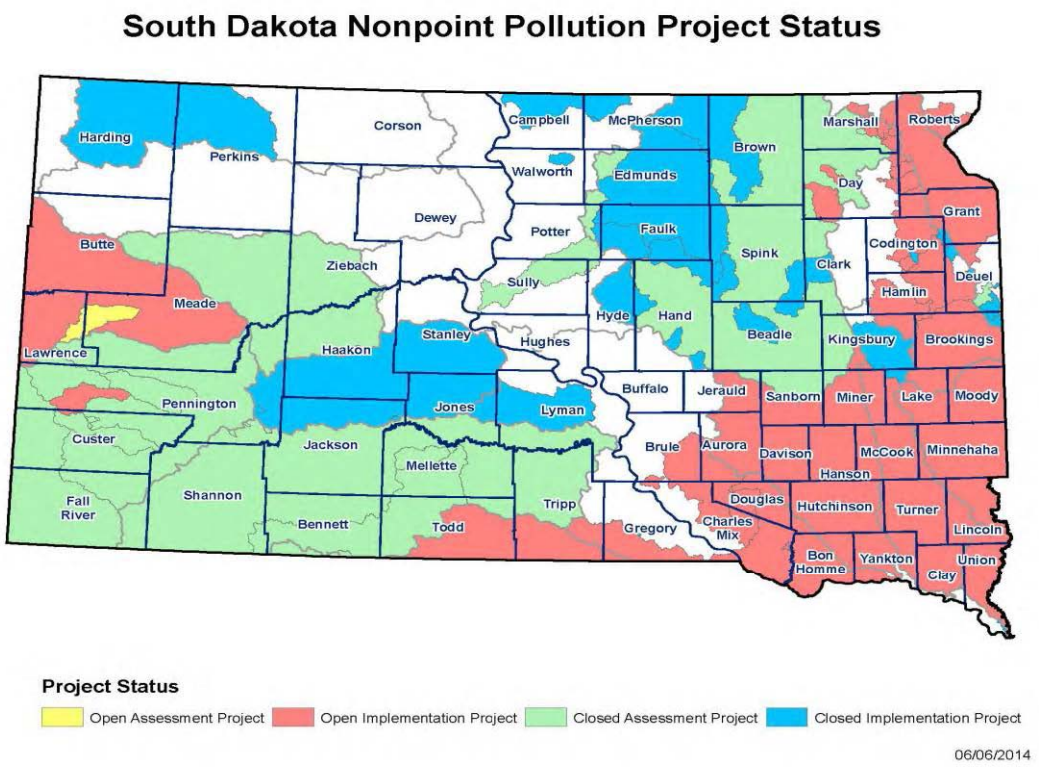



**Figure 2. South Dakota TMDL Development and Implementation Status.**

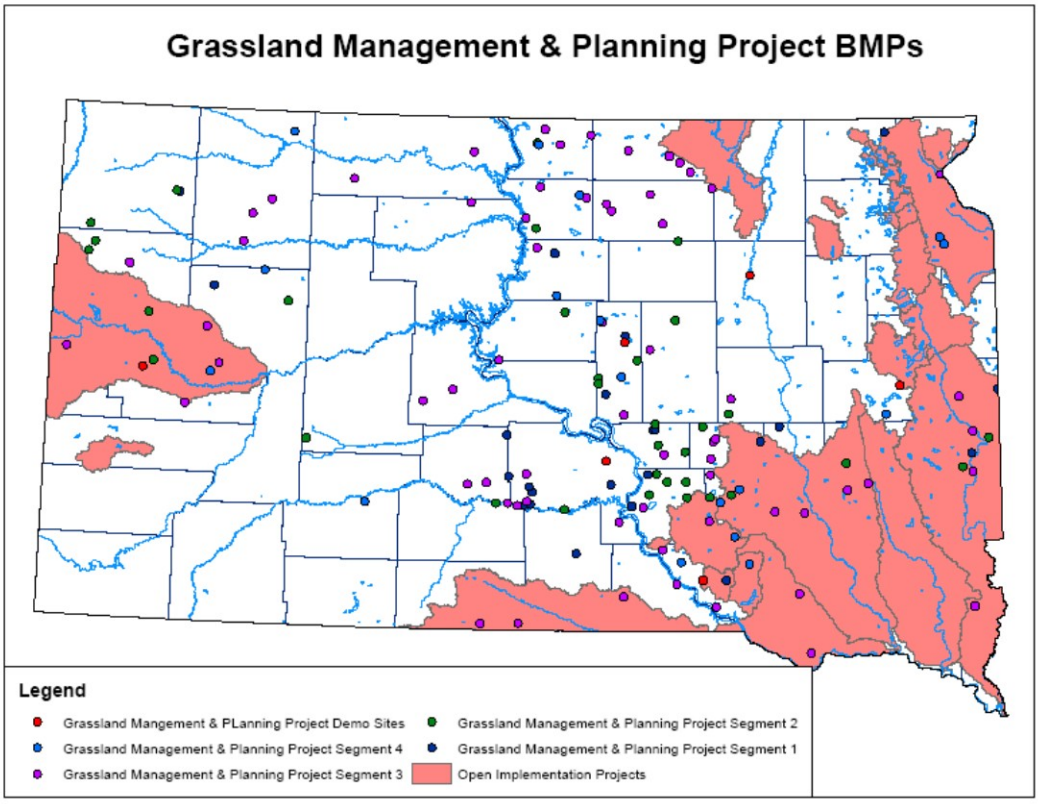



**Figure 3. Location of Grazing systems Grazing Systems installed.**

### 3.1. Project Description

The proposed project is a two year continuation of the current Grassland Management and Planning Project. Activities planned for this project segment will:

1. Provide grassland managers with assistance to plan 160,000 acres and implement 120,000 acres of managed grazing systems.
2. Transfer information gained from on-ranch demonstration sites and systems implemented that managed grazing offers producers a viable option for developing a sustainable agricultural enterprise using practices that promote resource conservation and environmental protection.
3. Determine the area and location of all potential native grassland remaining in South Dakota and western Minnesota through a five-phased analysis and mapping project.
4. Evaluate changes in hydrology and water quality associated with changes in the extent of South Dakota's grassland by simulating "what if" cases of grassland losses in three watersheds to illustrate the hydrologic implications for converting grass to crop lands using a watershed model.

As project sponsor, the South Dakota Grassland Coalition is responsible for completion of tasks selected to attain the project goal. The coalition will continue its management agreement with the South Dakota Association of Conservation Districts (SDACD) for implementation, evaluation and reporting service. . The services and personnel employed by SDACD to carry out the services include:

1. Administrative and management staff
   Accounting services, progress reports, hiring, training and supervising project staff and procure and maintain equipment, supplies, and vehicles.

2. Project Coordinator/Range Specialist
   Provide leadership, coordination, and technical assistance for all project activities; assist livestock producers with planning and installing managed grazing systems on approximately 60,000 acres.

3. Project Range Specialist
   Planning and implementation technical assistance to landowners for 120,000 acres of managed grazing.

4. Range Consultants, other agencies and TSPs
   Technical assistance providers contracted to provide planning and implementation technical assistance to landowners for 50,000 acres of grazing management.

5. Outreach Coordinator/Information Specialist.
   This position is 0.10 FTE of a South Dakota State University (SDSU) Department of Natural Resource Management staff person assigned to provide leadership to the Grassland Coalition and project staff for planning, and coordination of information transfer and outreach activities.

The project will continue funding technical assistance for the development of managed grazing system plans, and complete information transfer and outreach activities. Conservation practices considered

when planning grazing system are anticipated to include, are but not limited to, those associated with water development, building cross and riparian exclusion fences, stream crossings and seeding grasses.

Sources of financial assistance to implement the plans will be identified and arranged as part of the planning process. Programs that provided implementation funds during previous project segments and, are anticipated to continue doing so include:

- DENR Watershed Protection Program – US Environmental Protection Agency (EPA) Clean Water Act Section 319 Grant to South Dakota,
- USDA Farm Service Agency (FAS) - Conservation Reserve Program Continuous Signup (CCRP) and Marginal Pastureland Practice (CP30),
- USDA Natural Resource Conservation Service (NRCS) - Environmental Quality Incentives Program (EQIP) and Farm Bill Implementation Technical Assistance funds,
- SD Department of Agriculture (SDDA) - SD Soil and Water Conservation Grants awarded through the SD Conservation Commission,
- SD Game, Fish, and Parks (GFP) – Private Lands Habitat and Access Program,
- US Fish & Wildlife (FWS) - Annual appropriation for habitat development,
- Ducks Unlimited (DU) - BMP installation and sponsorship of Coalition activities,
- Pheasants Forever and
- World Wildlife fund.

In addition to the continuation of the management agreement with the South Dakota Association of Conservation Districts, the SD Grassland Coalition will expand the scope of its focus to include additional partnerships aimed at assessing the location and area of native grasslands while assessing the potential impacts of the loss of those grasslands on water quality. This additional focus will be administered through a partnership with South Dakota State University (SDSU) while employing funding from government and non-government organizations. The services and personnel that will be employed by SDSU to carry out the services include:

1. SDSU Extension Range Field Specialist

   The SDSU Extension Range Field Specialist position currently supports the South Dakota Grassland Coalition through a mutual partnership that includes roughly 20% time in organization and promotion of SDGC events, as well as other priorities. This expense is currently funded through SDSU. Under this grant, the Field Specialist will be additionally responsible for overall coordination of native grassland mapping and analysis project, including coordination of partner data, data management, supervision of two GIS technicians, and project deliverables. These additional duties will comprise 10% of this positions total time allocation will be dedicated to mapping project and funded through the grant request.

2. SDSU Senior Agricultural Research Technician

   This is a full time, term position that is responsible for daily project coordination, information gathering, mapping, and which serves as the lead technician for the project. 100% of this position’s total time allocation is dedicated to the mapping project, and the position will be expanded to include the west river project area should the grant be awarded

3. SDSU Assistant Agricultural Research Technician

   This is a full time, term position that is responsible for project mapping and analysis and which serves as the assistant technician for the project. 100% of this position's total time allocation is dedicated to the mapping project, and the position will be expanded to include the west river project area should the grant be awarded

4. SDSU Grassland Hydrologist

   Responsible for the day to day administration and supervision of the modeling component of the proposed project. Will supervise a graduate research assistant, who will assist with the completion of modeling tasks. The value of this time investment will be recorded as match to the grant.

5. SDSU Graduate Student

   This position is the only 'new' position funded solely through this grant and will provide assistance to the Grassland Hydrologist for the completion of modeling tasks.

The grassland mapping and modeling projects will focus on new data and products developed through this grant. Partner organizations and sources of financial, in-kind, and data assistance are identified as follows:

- SD Grassland Coalition
- South Dakota State University Extension
- South Dakota State University College of Agriculture and Biological Sciences, Department of Natural Resource Management
- South Dakota State University Geographic Information Science Center of Excellence
- The Nature Conservancy
- Minnesota Department of Natural Resources
- Natural Resources Conservation Service (SD)
- Farm Services Agency (SD and MN)
- South Dakota Department of Game, Fish, and Parks
- Pheasants Forever
- US Fish and Wildlife Service
- National Fish and Wildlife Foundation funds (phase I – complete)

Information transfer and outreach activities planned include:

- grassland web site,
- SD Grazing Schools,
- grassland workshops,
- grassland birding workshops,

- Leopold Conservation Award recipient ranch tours and
- news releases/media events.

Requests for technical assistance will be accepted by referral from TMDL implementation project coordinators, landowners, conservation districts SDSU Cooperative Extension Service and NRCS field offices. The application for assistance procedure and forms are available by accessing:

http://www.sdconservation.org/grassland/managing/gmd/

Technical assistance will be delivered using the priority system adopted during previous project segments. The priorities and estimated allocation of project resources to each category are:

1. Grassland managers in TMDL implementation project areas where additional technical assistance to plan and implement improved grassland and riparian management are critical to implementing the TMDL - 50 percent.
2. Belle Fourche River Watershed TMDL Implementation Project - 40 percent.
3. Central SD where grassland conversion to cropland is occurring at an accelerating rate and areas of the state, i.e. eastern and southeast SD, where managed grazing has a history of limited implementation by landowners – 10 percent.

The GIS layer of native grasslands will be incorporated to better prioritize areas of assistance once data is available. Project staff will increase efforts to identifying and assisting historically underserved farmers and ranchers in the priority areas. Historically underserved farmer/rancher include:

- beginning farmer and/or rancher
- limited resource farmer and/or rancher
- socially disadvantaged farmer and/or rancher

Additionally, the native grasslands data layer will be made available to all public and private partners for program/project analysis and modifications including but not limited to USDA Conservation programs, SD Game, Fish, and Parks, US Fish and Wildlife Service, and others.

Partnerships with conservation districts, Section 319 projects and NRCS will:

- provide support services and guidance to project staff,
- identify and assist producers with requesting assistance and
- provide maps, soils data and existing farm plans.

NRCS will provide project staff with access to the *SD Field Office Technical Guide*. The guide may be accessed at:

http://www.sd.nrcs.usda.gov/technical/ConsPract.html

A report that includes load reductions as indicator of the impact of the project on nonpoint source pollution in South Dakota will be filed at the end of the project period.

Three watersheds will be used for the watershed analysis (**Figure 4**). Following mapping of native grasslands, the three watersheds will be selected in the Prairie Coteau (eastern South Dakota), Missouri

Coteau (north-central South Dakota), and Great Plains of western South Dakota, respectively. These locations are identified for the selection of the study watersheds not only because of the abundance of native grassland in these areas; but also these areas are representative of grass landscape in South Dakota, North Dakota, Minnesota, and the Corn Belt States.

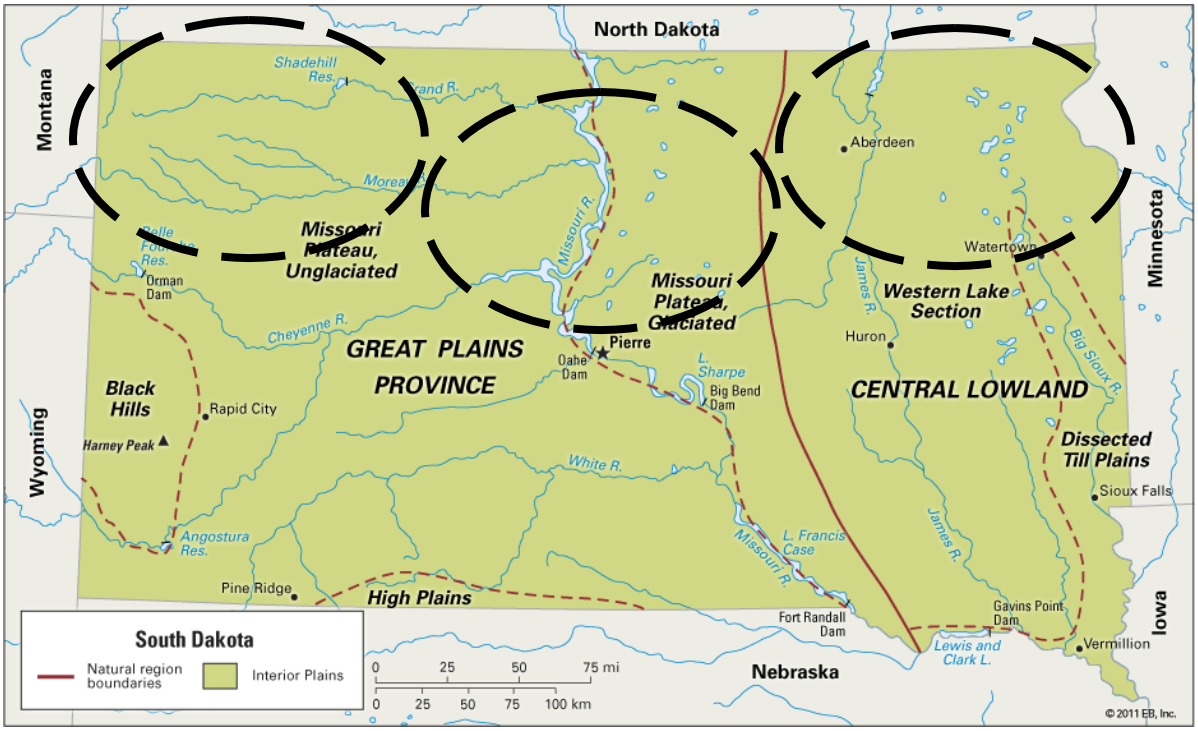



**Figure 4. Map (Britannica.com) showing potential locations of the three watersheds selected for study. Locations are circled.**

### 3.1 Project Goal

The first project goal is:

> Reduce sediment, nutrients and fecal coliform bacteria loading of surface waters in South Dakota by improving range condition on grasslands.

By attaining the goal, water quality and wildlife habitat will be improved, biodiversity increased, and grassland manager economic sustainability improved.

The goal will be attained by providing technical assistance to grassland managers for the planning and implementation of grassland management systems, the completion of an information and education program on grassland management, a GIS layer of remaining native grasslands of South Dakota, and watershed modeling of scenarios of grassland-to-cropland conversion to identify and better provide grassland protection strategies to key areas of the state.

## 3.2 Objectives and Tasks

**Objective 1:** Provide grassland managers with the technical assistance needed to plan 160,000 (160,000) acres of managed grazing systems, and complete the implementation of systems on an additional 120,000 (120,000) acres of grasslands by July 31, 2017.

**Task 1:** Provide livestock producers with the technical assistance needed to plan and operate grazing systems.

**Product 1:** Grazing Management Plans - 160,000 (160,000) grassland acres.

Project staff, and range consultants will plan 60,000 (60,000) acres of managed grazing systems (Prescribed Grazing – Practice Code 528). Of the remaining 100,000 (100,000) acres, 50,000 (50,000) acres will be planned by Belle Fourche River project staff and consultants and 50,000 (50,000) by other agency specialists and NRCS certified technical service providers (TSPs) respectively.

The planning process:

- begins with a resource inventory of the land that will be included in the system and determination of the producer's management philosophy and capabilities.
- uses methods and practices outlined in the *NRCS National Planning Procedures Handbook, National Range and Pasture Handbook, and the South Dakota Field Office Technical Guide*,
- includes development of alternative water sources to facilitate excluding grazing in riparian area and
- considers rural water hook up as the preferred alternative water source.

See Product 2 for the practices which are expected to be included in the plans developed.

Milestones:

- 15 grassland grazing system plans/year @ 2000 acres/plan x 2 (2) years = 60,000 (60,000) acres.
- 25 plans/year @ 2,000 acres/plan x 2 (2) years = 100,000 (100,000) acres.

**Cost:** The technical assistance costs are included in the project personnel costs. Costs include salaries, travel and consulting contracts.

**Product 2**: Install grassland management systems on 120,000 (120,000) acres of grasslands. The total includes

60,000 (60,000) acres planned by the project and 60,000 (60,000) acres planned project partners.

Financial assistance to install the practices will be provided by the SDGLC's project partners. As indicated previously, programs from which funds are anticipated include:

- TMDL Implementation Projects,
- FSA - CRP Program,
- NRCS - EQIP and Farm Bill Implementation Technical Assistance Programs,
- SDDA – SD Soil and Water Conservation Grant Program,
- SD GFP – Partners for Wildlife,
- US FWS – Annual Appropriation for SD,
- Ducks Unlimited,
- Pheasants Forever and
- World Wildlife Fund.

The practices and quantity of each and estimated cost to implement 120,000 (120,000) acres of managed grazing
systems are summarized in Table3.

Milestones: 60,000 (60,000) acres planned by project staff installed.
60,000 (60,000) acres planned by project partners installed.

**Total Cost: Task 1, Product 2: $ 330,000 ($330,000) 319 Cost: $0 ($0.00)**

**Table 3. Conservation Practices Used to Install Managed Grazing Systems.**

| Practice | Practice Code | Units | Unit Cost ($) | Total ($) |
|---|---|---|---|---|
| Marginal Pastureland CRP | CP 30 | 250 acres | $50.00/acre | 12,500 |
| Fence - Cross & Riparian Exclusion | 382 Cross Fence<br>390 Riparian Exclusion | 80,000 feet<br>40,000 feet | $ 0.80/foot<br>$1.10/foot | 64,000<br>44,000 |
| Pipeline | 516 Pipeline | 125,000 feet | 1.60/foot | 200,000 |
| Rural Water Hook-ups | 516 pipeline | 2 | 4,000.00 each | 8.000 |
| Tanks | 614 Watering Facility | 40 | 1,200.00 each | 8,000 |
| Wells | 642 Water Well | 4 | Large diameter - $76.00 - $91.00/ft.<br>Artesian copper casement - $31.00 - $37.00/foot<br>Artesian PVC casement - $16.00 - $19.00/foot<br>Deep aquifer well > 6" diameter - $44.00 - $53.00/foot<br>Plastic casement well > 100' - $22.00 - $27.00/ft.<br>Shallow well < 100' -$3,000.00 - $3,600.00/well<br>J 55 steel well - $27.00 - $32.00/well | 150,000 |
| Dams/Dugouts | 378 Pond | 6 | $10,000.00 each | 60,000 |
| Stream Crossings | 578 | 1 | Concrete $61 – $73.00/foot<br>Rock – $24 – $28.00/foot | 3,500 |
| Grass Seeding | 512 Introduced Species<br>550-Native Species | 500 acres | $40.00/acre<br>$60.00/acre | 25,000 |
| Total | | | | 385,000 |

**RESPONSIBLE AGENCIES (Products 1 and 2)**

**Technical Assistance Coordination:**
Project Coordinator
South Dakota Association of Conservation Districts

**Planning Assistance:**
Project Coordinator/Range Consultant/Range Specialist
South Dakota Conservation Districts
Natural Resources Conservation Service
SD Department of Agriculture
South Dakota State University
SD Department of Game, Fish, and Parks
US Fish and Wildlife Service
NRCS certified TSPs
Pheasants Forever

**Implementation:**
Project Coordinator/Range Consultant/Range Specialist
South Dakota Conservation Districts
Natural Resources Conservation Service
SD Department of Agriculture
South Dakota State University
SD Department of Game, Fish, and Parks
US Fish and Wildlife Service
NRCS certified TSPs
Pheasants Forever
Farmers and Ranchers

**Financial Assistance:**
USDA Farm Service Agency
Natural Resources Conservation Service
TMDL Implementation Projects
SD Department of Agriculture
SD Department of Game, Fish, and Parks
US Fish and Wildlife Service
Ducks Unlimited
Pheasants Forever
World Wildlife fund

**Objective 2:** Transfer grassland management information to a minimum of 10,000 (10,000) South Dakota producers, 20 (20) researchers, 40 (40) grassland specialists and approximately 190,000 (190,000) other individuals.

**Task 2:** Complete information and outreach activities that promote and provide opportunities for involvement in grassland management and bring about an awareness of the water quality impact(s) of improved grassland management targeted towards 319 TMDL implementation project areas, riparian areas, and grasslands in southeast South Dakota.

**Product 3:** Existing web site maintained, farmer/rancher workshops, grazing schools, news releases and summer grazing tours.

Grassland management information transfer and outreach activities will include maintaining the project web site, rancher/farmer workshops, grazing schools, news releases, and grassland tours.

The primary target audience for grazing system planning and implementation outreach activities is information farmers/ranchers, resource managers, the research community and university students; the secondary the general public.

The web site hosted and maintained by SDACD, can be accessed at:

http://www.sdconservation.org/grassland/managing/gmd/index.html

Site features include:

- a journal describing demonstration site activities and
- links to other grazing information resources.

The project will use social marketing opportunities such as those available through *Facebook* to provide information to youth not associated with livestock based agriculture.

In partnerships with local organizations and agencies, grassland workshops will be held throughout the state, to include continuation of the successful summer birding tours. This project will also provide technical and financial assistance to continue the annual grazing school, summer grazing bus tours, and work with the print and electronic media (newspaper, magazine, TV, radio, etc.). In addition, this project will provide monitoring and evaluation materials such as grazing sticks and *Grasslands Plants of South Dakota and the Northern Great Plains* books to assist producers with their forage production and allocation as well as plant identification on the ranches and farms.

The quantities, milestones and cost of the activities are shown in Table 4.

**Table 4. Information Transfer and Outreach Activities with Costs.**

| Activity | Milestone | | Cost/Unit ($) | Total Cost ($) |
|---|---|---|---|---|
| | Contacts/Participants | Units | | |
| Web site | 100,000(100,000) | 2 (2) years | 200.00/year | 400.00 (400) |
| Farmer/Rancher Workshops | 180(180) | 6(6) | 2,000.00 (2,500) | 12,000.00(15,000) |
| Grazing Schools | 50(50) | 2(2) | 8,500.00 (9,000) | 17,000.00(18,000) |
| Media Releases | 96,000(96,000) | 4 (4) | Project Staff | 0.00 |
| Leopold Conservation Award Tours | 150 (150) | 2(2) | 3,000.00 (4,000) | 6,000.00(8,000) |
| Grassland "Birding" Tours | 100(100) | 2(2) | 2,000.00 (3,000) | 4,000.00(6,000) |
| Total | | | | 39,400.00(47,000) |

**Activity team leader**: Project Coordinator and Information Specialist/Outreach Coordinator

**Milestones:** See Table above

**Total Cost – Task 2, Product 3: $40,000 ($47,000)** **319 Cost: $10,000 ($22,000)**

**RESPONSIBLE AGENCIES**

**Technical Assistance and Coordination:**

Information Specialist/Outreach Coordinator
Project Coordinator
South Dakota Association of Conservation Districts

**Planning Technical Assistance:**

Information Specialist/Outreach Coordinator
Project Coordinator/Range Consultants
Natural Resources Conservation Service
SD Department of Agriculture
South Dakota State University
Conservation Districts
Demonstration Site Farmers/Ranchers

**Information Transfer:**
Information Specialist/Outreach Coordinator
Project Coordinator
SD Association of Conservation Districts
Natural Resources Conservation Service
South Dakota State University Cooperative Extension Service
Demonstration Site Farmers/Ranchers

**Implementation:**

Information Specialist/Outreach Coordinator
Project Coordinator
South Dakota State University
USDA Natural Resources Conservation Service
Demonstration Site Farmers/Ranchers
World Wildlife Fund

**Financial Assistance:**

Natural Resources Conservation Service
TMDL Implementation Projects
South Dakota State University
World Wildlife Fund

The second project goal is:

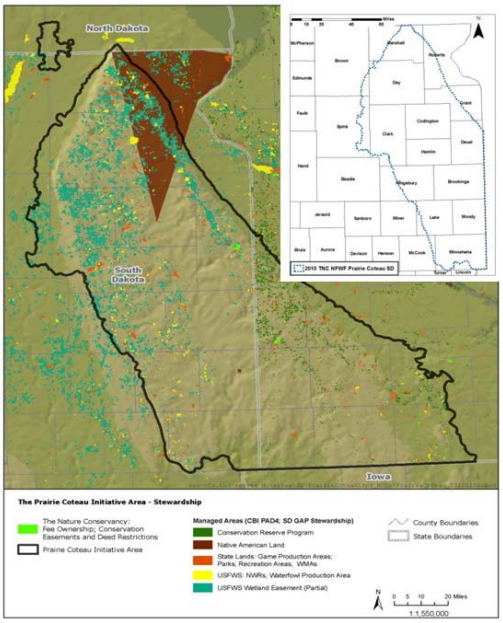
To develop standardized and repeatable methodology to assess South Dakotas remaining native grasslands that can be adapted to other regions of the great plains in order to measure impacts of grassland conversion on conservation of ranching, habitat, and watersheds.

**Objective 3:** Assess remaining native grasslands in South Dakota and portions of western Minnesota

**Task 3:** The South Dakota portion of the Prairie Coteau landscape was completed during June 2014 (Phase I) and are included in Table 2 below. Task 3 will be completed in phases and tracked as products 4-7 below. Each product is based on a specific geographic region with specific funding sources. The complete dataset is needed to address water quality concerns in broader watersheds.
Table 1. Phase I. South Dakota Prairie Coteau (completed June 2014 with federal TNC funds)

Table 1. Phase I. Minnesota Prairie Coteau

| Phase I. South Dakota Prairie Coteau Landscape Area | | | | |
|---|---|---|---|---|
| **County** | **Landcape/project area phase** | **State** | **Total county $mi^2$** | **$mi^2$ completed in SD Prairie Coteau Phase I** |
| **Brookings** | Prairie Coteau | SD | 792 | 66 |
| **Clark** | Prairie Coteau | SD | 958 | 903 |
| **Codington** | Prairie Coteau | SD | 689 | complete |
| **Day** | Prairie Coteau | SD | 1,028 | 1,020 |
| **Deuel** | Prairie Coteau | SD | 623 | 620 |
| **Grant** | Prairie Coteau | SD | 681 | 345 |
| **Hamlin** | Prairie Coteau | SD | 507 | complete |
| **Kingsbury** | Prairie Coteau | SD | 832 | 557 |
| **Lake** | Prairie Coteau | SD | 563 | 507 |
| **Marshall** | Prairie Coteau | SD | 838 | 506 |
| **McCook** | Prairie Coteau | SD | 574 | 47 |
| **Miner** | Prairie Coteau | SD | 570 | 5 |
| **Minne haha** | Prairie Coteau | SD | 807 | 736 |
| **Moody** | Prairie Coteau | SD | 519 | complete |
| **Roberts** | Prairie Coteau | SD | 1,101 | 316 |
| **Spink** | Prairie Coteau | SD | 1,504 | 231 |
| | **Totals** | | **12,587** | **5,859** |

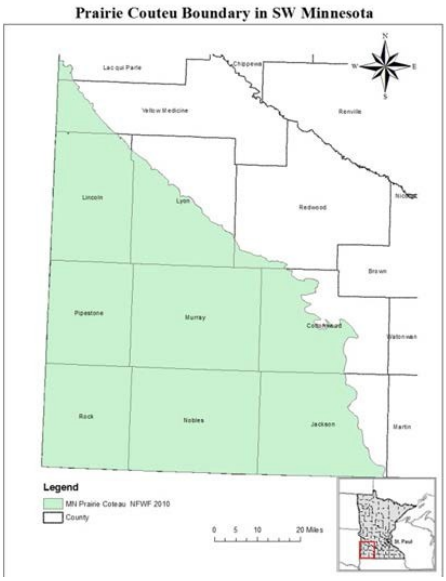


**Product 4:** Phase II results. Report to partners for 11 MN counties and distribution of GIS data layer for use in conservation planning, program planning, and grassland status assessments. (Previous SD counties included in this phase are recorded in Table I (Phase I) above.

**Product 4 Cost:** All costs for accomplishing task 3: product 4 (Minnesota Prairie Coteau) will be met through funding provided by the Minnesota Department of Natural Resources ($20,000).
**Total Cost – Task 3, Product 4: ($20000 + fixed costs)** **319 Cost: ( $0)**

Table 2. Phase II. Minnesota Prairie Coteau

| Phase II. Minnesota Prairie Coteau Landscape Area | | | | |
|---|---|---|---|---|
| **County** | **Landcape/project area phase** | **State** | **Phase II to be compleated MN Prairie Coteau mi$^2$** | **Est time to complete phase II MN Prairie Coteau(15 mi$^2$/hr)** |
| **Lac qui Parle** | Prairie Coteau | MN | 12 | 1 |
| **Yellow Medicine** | Prairie Coteau | MN | 100 | 7 |
| **Redwood** | Prairie Coteau | MN | 34 | 2 |
| **Lincoln** | Prairie Coteau | MN | 543 | 36 |
| **Lyon** | Prairie Coteau | MN | 397 | 26 |
| **Pipestone** | Prairie Coteau | MN | 466 | 31 |
| **Murray** | Prairie Coteau | MN | 720 | 48 |
| **Cottonwood** | Prairie Coteau | MN | 371 | 25 |
| **Rock** | Prairie Coteau | MN | 483 | 32 |
| **Nobles** | Prairie Coteau | MN | 723 | 48 |
| **Jackson** | Prairie Coteau | MN | 571 | 38 |
| | **Totals** | | **4,420** | **295** |



**Product 5:** Phase III results. Report to partners on 9 SD Missouri Coteau counties and distribution of GIS data layer for use in conservation planning, program planning, and grassland status assessments.

**Product 5 Cost:** All costs for accomplishing task 3, product 5 (South Dakota Missouri Coteau) will be met through funding provided by The Nature Conservancy ($20,000).
**Total Cost – Task 3, Product 5: ($20,000+ fixed costs)** **319 Cost: ($0)**

Table 3. Phase III. South Dakota Missouri Coteau

| Phase III. South Dakota Missouri Coteau Landscape Area | | | | | |
|---|---|---|---|---|---|
| **County** | **Landcape/project area phase** | **State** | **Total county $mi^2$** | **Phase III to be completed Missouri Coteau $mi^2$** | **Est time to complete phase III Mo. Coteau (15 $mi^2$/hr)** |
| **Campbell** | Missouri Coteau | SD | 734 | 257 | 17 |
| **Edmunds** | Missouri Coteau | SD | 1,126 | 794 | 53 |
| **Faulk** | Missouri Coteau | SD | 982 | 557 | 37 |
| **Hand** | Missouri Coteau | SD | 1,437 | 65 | 4 |
| **Hyde** | Missouri Coteau | SD | 861 | 247 | 16 |
| **McPherson** | Missouri Coteau | SD | 1,137 | 881 | 59 |
| **Potter** | Missouri Coteau | SD | 861 | 214 | 14 |
| **Sully** | Missouri Coteau | SD | 1,007 | 112 | 7 |
| **Walworth** | Missouri Coteau | SD | 709 | 56 | 4 |
| | **Totals** | | **8,852** | **3,183** | **212** |

**Product 6:** Phase IV results. Report to partners on all or portions of 44 eastern counties and distribution of GIS data layer for use in conservation planning, program planning, and grassland status assessments.

**Product 6 Cost:** It is anticipated that all costs for accomplishing task 3, product 6 (remainder of eastern South Dakota) will be met through funding provided by various partners, including but not limited to SD NRCS ($35,000) and SD GF&P ($35,000).
**Total Cost – Task 3, Product 6: ($70,000 + fixed costs)** **319 Cost: ($0)**

Table 4. Phase IV. Remainder of eastern South Dakota

| Phase IV. Completion of South Dakota East River Counties | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| County | Landcape/project area phase | State | Total county $mi^2$ | $mi^2$ completed in SD Prairie Coteau Phase I | Phase III to be completed Missouri Coteau $mi^2$ | Est time to complete phase III Mo. Coteau (15 $mi^2$/hr) | Phase IV Remainder East River mi2 | Est time to complete Phase IV Remainder East River (15 $mi^2$/hr) |
| **Campbell** | Missouri Coteau | SD | 734 | | 257 | 17 | 477 | 32 |
| **Edmunds** | Missouri Coteau | SD | 1,126 | | 794 | 53 | 332 | 22 |
| **Faulk** | Missouri Coteau | SD | 982 | | 557 | 37 | 425 | 28 |
| **Hand** | Missouri Coteau | SD | 1,437 | | 65 | 4 | 1,372 | 91 |
| **Hyde** | Missouri Coteau | SD | 861 | | 247 | 16 | 614 | 41 |
| **McPherson** | Missouri Coteau | SD | 1,137 | | 881 | 59 | 256 | 17 |
| **Potter** | Missouri Coteau | SD | 861 | | 214 | 14 | 647 | 43 |
| **Sully** | Missouri Coteau | SD | 1,007 | | 112 | 7 | 895 | 60 |
| **Walworth** | Missouri Coteau | SD | 709 | | 56 | 4 | 653 | 44 |
| **Brookings** | Prairie Coteau | SD | 792 | 66 | | | 726 | 48 |
| **Clark** | Prairie Coteau | SD | 958 | 903 | | | 55 | 4 |
| **Codington** | Prairie Coteau | SD | 689 | complete | | | 0 | 0 |
| **Day** | Prairie Coteau | SD | 1,028 | 1,020 | | | 8 | 1 |
| **Deuel** | Prairie Coteau | SD | 623 | 620 | | | 3 | 0 |
| **Grant** | Prairie Coteau | SD | 681 | 345 | | | 336 | 22 |
| **Hamlin** | Prairie Coteau | SD | 507 | complete | | | 0 | 0 |
| **Kingsbury** | Prairie Coteau | SD | 832 | 557 | | | 275 | 18 |
| **Lake** | Prairie Coteau | SD | 563 | 507 | | | 56 | 4 |
| **Marshall** | Prairie Coteau | SD | 838 | 506 | | | 332 | 22 |
| **McCook** | Prairie Coteau | SD | 574 | 47 | | | 527 | 35 |
| **Miner** | Prairie Coteau | SD | 570 | 5 | | | 565 | 38 |
| **Minnehaha** | Prairie Coteau | SD | 807 | 736 | | | 71 | 5 |
| **Moody** | Prairie Coteau | SD | 519 | complete | | | 0 | 0 |
| **Roberts** | Prairie Coteau | SD | 1,101 | 316 | | | 785 | 52 |
| **Spink** | Prairie Coteau | SD | 1,504 | 231 | | | 1,273 | 85 |
| **Aurora** | East River | SD | 708 | | | | 708 | 47 |
| **Beadle** | East River | SD | 1,259 | | | | 1,259 | 84 |
| **Bon Homme** | East River | SD | 564 | | | | 564 | 38 |
| **Brown** | East River | SD | 1,713 | | | | 1,713 | 114 |
| **Brule** | East River | SD | 817 | | | | 817 | 54 |
| **Buffalo** | East River | SD | 471 | | | | 471 | 31 |
| **Charles Mix** | East River | SD | 1,097 | | | | 1,097 | 73 |
| **Clay** | East River | SD | 412 | | | | 412 | 27 |
| **Davison** | East River | SD | 436 | | | | 436 | 29 |
| **Douglas** | East River | SD | 432 | | | | 432 | 29 |
| **Hanson** | East River | SD | 435 | | | | 435 | 29 |
| **Hughes** | East River | SD | 742 | | | | 742 | 49 |
| **Hutchinson** | East River | SD | 813 | | | | 813 | 54 |
| **Jerauld** | East River | SD | 526 | | | | 526 | 35 |
| **Lincoln** | East River | SD | 577 | | | | 577 | 38 |
| **Sanborn** | East River | SD | 569 | | | | 569 | 38 |
| **Turner** | East River | SD | 617 | | | | 617 | 41 |
| **Union** | East River | SD | 461 | | | | 461 | 31 |
| **Yankton** | East River | SD | 521 | | | | 521 | 35 |
| | **Totals** | | **34,609** | **5,859** | **3,183** | **212** | **23,852** | **1,590** |

**Product 7:** Phase V results. Report to partners on 22 western SD counties and distribution of GIS data layer for use in conservation planning, program planning, and grassland status assessments.

**Product 7 Cost:** It is anticipated that all costs for accomplishing task 3, product 7 (western South Dakota) will be met through this grant with matching contributions provided by funding partners as described in products 4-6.

**Product 7 Total Cost: ($0 + fixed costs)** **319 Cost: ($0)**

Products 4-7 have fixed costs associated with SDSU personnel who will perform these tasks. Total costs for Task 3 are as follows.

**Task 3 Products 4-7 Total Cost: ($237,205)** **319 Cost: ($127,205)**

Table 5. Phase V. Western South Dakota.

| Phase IV. South Dakota West River Counties | | | | | |
|---|---|---|---|---|---|
| **County** | **Landcape/project area phase** | **State** | **Total county $mi^2$** | **Phase V West River $mi^2$** | **Est time to complete Phase V (15 $mi^2$/hr)** |
| **Bennett** | West River | SD | 1,185 | 1,185 | 79 |
| **Butte** | West River | SD | 2,250 | 2,250 | 150 |
| **Corson** | West River | SD | 2,470 | 2,470 | 165 |
| **Custer** | West River | SD | 1,557 | 1,557 | 104 |
| **Dewey** | West River | SD | 2,302 | 2,302 | 153 |
| **Fall River** | West River | SD | 1,740 | 1,740 | 116 |
| **Gregory** | West River | SD | 1,015 | 1,015 | 68 |
| **Haakon** | West River | SD | 1,811 | 1,811 | 121 |
| **Harding** | West River | SD | 2,671 | 2,671 | 178 |
| **Jackson** | West River | SD | 1,864 | 1,864 | 124 |
| **Jones** | West River | SD | 970 | 970 | 65 |
| **Lawrence** | West River | SD | 800 | 800 | 53 |
| **Lyman** | West River | SD | 1,642 | 1,642 | 109 |
| **Meade** | West River | SD | 3,471 | 3,471 | 231 |
| **Mellette** | West River | SD | 1,307 | 1,307 | 87 |
| **Pennington** | West River | SD | 2,777 | 2,777 | 185 |
| **Perkins** | West River | SD | 2,870 | 2,870 | 191 |
| **Shannon** | West River | SD | 2,094 | 2,094 | 140 |
| **Stanley** | West River | SD | 1,444 | 1,444 | 96 |
| **Todd** | West River | SD | 1,389 | 1,389 | 93 |
| **Tripp** | West River | SD | 1,612 | 1,612 | 107 |
| **Ziebach** | West River | SD | 1,961 | 1,961 | 131 |
| | **Totals** | | **41,202** | **41,202** | **2,747** |

**RESPONSIBLE AGENCIES: Tasks 3, products 4-7.**

**Technical Coordination:**
Range Field Specialist, SDSU Extension

**Technical/Data Assistance:**
SD Farm Services Agency
US Fish and Wildlife Service
SD Department of Game, Fish, and Parks
MN Department of Natural Resources
The Nature Conservancy
SD Natural Resources Conservation Service
South Dakota State University

**Implementation:**
Range Field Specialist, SDSU Extension

**Financial Assistance:**
SD Department of Game, Fish, and Parks
MN Department of Natural Resources
The Nature Conservancy
SD Natural Resources Conservation Service
South Dakota State University
South Dakota Grassland Coalition

**Objective 4:** Provide information on watershed modeling in eastern South Dakota.

**Task 4:** Provide information on modeling hydrologic and water quality impacts of grassland losses for 3 South Dakota watersheds in eastern, north central, and western South Dakota.

**Product 8:** Hydrologic and water quality metrics in three watersheds associated with grassland conversion in South Dakota. Task 7 will be accomplished by using the following procedure and resources.

- Data: Streamflow, precipitation, water quality, and land use are the major datasets that will be utilized for the analysis. More than 15 years of daily streamflow data measured near the outlets of the selected watersheds will be obtained from USGS observation stations for a period of 1995-2010. Climate data (e.g. precipitation and temperature) corresponding also to the study period for rain gage stations located in the study watersheds will be obtained from South Dakota Office of Climatology. Water quality data for sediment, total phosphorus (TP), nitrate-nitrogen ($NO_3$-N), and fecal coliform bacteria, collected at water quality stations within the watersheds, will be obtained from the South Dakota Department of Environment and Natural Resources (DENR) for the 1995-2010 study period. The land use maps to be used in the analysis will be a mixture of land use maps from the National

Land Cover Database (NLCD), quantified land uses (Reitsma et al., 2014), and hypothetical land uses (see "Simulation Scenarios" section below for further description on the land use maps).

- Watershed model: The analysis proposed in this study will use the Soil and Water Assessment Tool (SWAT; Arnold et al., 1998). SWAT is a process-based, distributed-parameter watershed scale model for simulation of long-term hydrologic and water quality impacts of various watershed management strategies (Arnold et al., 1998). The model has been widely used in many watershed scale studies (e.g. Gitau et al., 2004; Gassman et al., 2007; Chaubey et al., 2010; Cibin et al., 2012). SWAT divides the watershed into subwatersheds using watershed topographic information. During simulations, each subwatershed is treated as an individual unit. The subwatersheds are further partitioned into hydrologic response units (HRU) using land use, soil and slope information. The HRU is the smallest spatial unit that the model uses to simulate hydrologic, sediment, nutrient, and agricultural chemical yields. The model is capable for routing runoff and chemicals through streams and reservoirs with readily available input data (precipitation, temperature, solar radiation, relative humidity and wind speed). Other basic input data, besides weather, required for the SWAT model include topography, land use, soil and management information. It also allows addition of flows and inclusion of measured data from point sources. The major components of the model consist of weather, surface runoff, groundwater/baseflow, percolation, return flow, evapotranspiration (ET), transmission losses, pond and reservoir storage, reach routing, crop growth, irrigation, groundwater flow, nutrient and pesticide loads, and water transfer. Detailed description of the SWAT model components and representation of hydrologic and water quality processes is provided in Neitsch et al. (2005; 2009).
- Simulation scenarios: The SWAT model will be calibrated and validated using a split-time approach (Schilling et al., 2014) at monthly time-scale. The calibration and validation periods will be set to two non-overlapping periods, consisting of 1995-2002 and 2003-2010, respectively.
  To assess how changing grassland extent would influence streamflow and water quality in the in the study watersheds, a baseline scenario will be simulated with the calibrated model for a period of 1995-2010 (16 years). The baseline scenario will allow to have a reference case for comparison prior to performing "what if" scenario simulations. The following land use conditions will be evaluated in the selected watershed:
  - Baseline scenario: In this scenario, the existing land use condition in the watersheds will be evaluated with land use map extracted from NLCD and quantified grassland map (see Reitsma et al., 2014 and Bauman, 2014). Although many land use maps are currently available in NLCD, the 2011 national land cover dataset (http://www.mrlc.gov/nlcd2011.php) will be used in the proposed study to portray the latest existing land use condition in the watershed. Quantification of undisturbed grassland are described in a section above. All "what if" scenarios will be simulated with hypothetical land uses, which follow:
  - Hundred percent grass scenario: All of the cropland in the watershed will be converted to grass; we will assume grass at mature stage.
  - Fifty percent grass scenario: In this scenario, 50% of the cropland in the watershed will be grass and the other 50% will be the existing cropland condition.
  - Corn-grass scenario: 50% of the cropland in the watershed will be grass and the other 50% will be planned for corn.
  - Soybean-grass scenario: 50% of the cropland in the watershed will be grass and the other 50% will be soybean.
  - Alfalfa-grass scenario: 50% of the cropland in the watershed will be grass and the other 50% will be alfalfa.

- Upstream grass scenario: All of the cropland in upstream subwatersheds will be grass and the remaining watershed (central and southern portions) will be kept in the existing land use condition.
- Center grass scenario: All of the cropland in the central portion of the watershed will be grass and the remaining watershed (upstream and southern portions) will be kept in the existing land use condition.
- Downstream grass scenario: All of the cropland in the downstream portion of the watersheds will be grass and the remaining watershed (central and southern portions) will be kept in the existing land use condition.

In addition to the scenarios described above, time variant land use/land cover change scenarios will be evaluated to account for hydrologic and water quality impacts of undisturbed versus disturbed grassland. These scenarios include:

- Baseline scenario: All cropland in the watershed will be converted to mature grass.
- Corn-grass rotation: In this scenario, corn will be planted during the first 8 years of the simulation period (1995-2002), and grass will be kept during the last 8 years (2003-2010) on all cropland.
- Soybean-grass rotation: soybean will replace corn during the first 8 years of the simulation period (1995-2002), and grass will be kept during the last 8 years (2003-2010) on all cropland.
- Alfalfa-grass rotation: alfalfa will replace corn during the first 8 years of the simulation period (1995-2002), and grass will be kept during the last 8 years (2003-2010) on all cropland.
- Grass-crop rotation: Three scenarios will be designed to have corn, soybean, and alfalfa on all cropland during the last 8 years of the simulation period, and grass during the first 8 years.
- Grass-crop-grass rotation: Theses three scenarios will rotate grass and crop by using grass during the first 4 years (1995-1998), a crop during the following 8 years (1999-2006), and grass during the last 4 years (2007-2010). Corn, soybean, and alfalfa will be evaluated.
- Grass-crop-grass rotation: Three scenarios will implement grass the first 4 years of the simulation period, and rotate crop-grass every 2 years thereafter. Corn, soybean, and alfalfa will also be used, respectively, in each scenario.

- Statistical analysis: Tukey pairwise comparison tests will be used to evaluate differences between mean annual surface runoff, streamflow, losses in sediment, TP, $NO_3$-N, and fecal coliform bacteria associated with land use scenarios within each watershed.

Milestones:

- Data compilation
- Model set up
- Model calibration and validation
- Scenario simulations
- Interpretation of results
- Final report

**Total Cost – Task 7, Product 8: ($95,891)** **319 Cost: ($55, 891)**

**RESPONSIBLE AGENCIES: Tasks 7.**

**Technical Coordination:**
Grassland Hydrologist, SDSU Department of Ag. & Biosystems Engineering

**Technical/Data Assistance:**
See description of resources in Task 7.

**Implementation:**
Grassland Hydrologist, SDSU Department of Ag. & Biosystems Engineering
Graduate Research Assistant, SDSU Department of Ag. & Biosystems Engineering

**Financial Assistance:**
South Dakota State University
South Dakota Grassland Coalition

**Objective 5:** Monitor and evaluate project progress in relation to meeting established milestones and attaining the project goal.

**Task 8:** Monitor project activities and file reports as outlined in the project implementation plan to determine compliance with grant and contractual agreements, memoranda of understandings, reporting requirements, and the SDGLC by-laws.

**Product 9: Annual and final reports**

Monitoring of project progress, evaluation of data collected and reporting will be completed by the project coordinator and SDACD as outlined in the association's agreement with SDGLC and described in the monitoring sand evaluation section of this application.

The information collected will be used to complete annual (October) and final reports and provide progress updates to SDGLC's project partners.

Annual reports will be prepared by the project coordinator using the electronic format provided by DENR to facilitate entry into GRTS. The reports will include:

- a cumulative summary and evaluation of activities completed relative to project milestones and progress toward attaining the project goal,
- information regarding amendments to the project implementation plan ( PIP)
- a discussion of problems encountered and actions taken to address the challenge, and
- estimates of load reductions realized calculated using STEPL.

The final report will be prepared in the format provided by DENR and submitted to the department electronically.

**Milestones:**

- Annual reports - 2
- Final report - 1

**Total Cost: $7,265 ($7,500)** **319 Cost: $5,000 ($7,500)**

**RESPONSIBLE AGENCIES**

**Coordination:**

Project Coordinator
South Dakota Association of Conservation Districts
South Dakota Grassland Coalition
South Dakota Department of Environment and Natural Resources

**Implementation:**

Project coordinator
Grassland managers/producers,
SDSU, Animal and Range Science Department staff (Outreach Coordinator)
Project partners
SDGLC Board of Director's members

**Financial Assistance:**

Grassland Management and Planning Project – 319 Grant

**3.3 Milestone Table**

See Attachment A. Grasslands Segment 4 Extended Milestones

**3.4. Required Permits**

Permits and clearances required to install the practices selected to develop a managed grazing system will be identified during the planning process. The permits and clearances will be obtained by the agency or organization providing implementation technical assistance prior to installation of the practices.

Permits and clearances that may be required include:

- Section 401 and 404 permits for shoreline and riparian BMP installation,
- Section 402 stormwater construction permit if construction will disturbs 1 acre or more or is located near to a waterbody,
- State Historical Preservation Office clearance for any BMPs involving ground disturbing activities and

- Threatened and endangered species habitat/presence determinations and compliance with the requirements identified in the clearance EPA completed for this project through consultation with the USFWS.

**3.5. Lead Sponsor and Why**

The SD Grasslands Coalition is the project sponsor. A summary of accomplishments that support the coalition continuing as the lead project partner follows.

The South Dakota Grassland Coalition has:

- developed partnerships with a broad spectrum of individual, organization and agency stakeholders interested in grassland management in South Dakota and the surrounding states and
- provided the leadership that lead to the successful completion four Section 319 project grants (FFY 1999, 2001, 2007 and 2013).

Public and private stakeholder partnerships represented by "interest" category include:

Wildlife and Conservation:

- Ducks Unlimited,
- SD Ornithological Society
- Sand Country Foundation
- The Nature Conservancy
- Pheasants Forever
- World Wildlife Fund

Grazing Lands Societies and Livestock Industry:

- SD Chapter of the Society for Range Management,
- SD Cattlemen's Association
- Nebraska Grazing Lands Coalition
- North Dakota Grazing Lands Coalition

Local Conservation/Water Quality Programs:

- Local conservation districts,
- Belle Fourche River Partnership,
- TMDL Implementation Projects
- SD Association of Conservation Districts

Governmental:

- South Dakota State University Department of Natural Resource Management, Cooperative Extension Service, and Geographic Information Science Center of Excellence

- Lower Brule and Crow Creek Sioux Tribes
- SD Departments of Agriculture; Game, Fish and Parks; and Environment and Natural Resources,
- Natural Resource conservation Service
- US Fish and Wildlife Service
- SD Governor's Pheasant Habitat Work Group
- Minnesota Department of Natural Resources
- SD Farm Services Agency
- MN Farm Services Agency

SDGLC's leadership in promoting grasslands issues and environmental protection is recognized beyond the boundaries of SD. The coalition:

- was the recipient of the 2007 USDA NRCS Excellence in Conservation and EPA Region 8 Environmental Achievement Awards and
- has assisted with the selection of the Sand Country Foundation's SD Leopold Conservation Award honoree since 2010.
- Has collaborated with grazing coalitions in North Dakota, Minnesota, and Nebraska and conservation organizations such as The Nature Conservancy and World Wildlife Fund.

**3.6. Maintenance and Operations Roles and Responsibilities**

Project activities planned are primarily directed toward technical assistance for the development of managed grazing systems and providing the training livestock producers and resource managers need to successfully operate the systems and information transfer. Project staff refers the producers to other service providers for the financial and technical assistance associated with the installation of the conservation practices identified during the planning process.
Producers that install the practices are required to enter an agreement that outlines operation and maintenance (O & M) responsibilities of the producer and agency or organization providing the assistance. The practice and its components will be maintained by landowners based on *the Natural Resources Conservation Service Technical Guide* length of life practices guidelines.

Ownership of and/or control monitoring of equipment acquired by SDGLC by purchase, lease or loan from other project partners will remain with the partner organization funding purchase unless otherwise specified by a contractual agreement or memorandum of understanding.

**4.1. Coordination Plan**

The Grasslands Management and Planning project was developed by a partnership that included producers and local, state and federal agencies and organizations. Partnerships were solidified and expanded during the completion of three subsequent project segments. The proposed fourth project segment will offer additional stakeholders the opportunity to become part of the partner's cooperative efforts to address water quality by promoting environmentally sound grassland management in SD.

This fourth project segment expands the scope of the conservation and environmental protection work and reputation previously established by the SDGC. Specifically, the SDGC will now increase its scope

of work with additional focus on determining the area and location of South Dakota's remaining native grassland resources in order to assist producers and partner organizations in improved management and enhancement of this diminishing resource. Further, through the watershed modeling component of this project, SDGC will have improved information for public distribution concerning the landscape-level effects that conversion of remnant native grassland can have on watersheds and water quality.

The Grassland Coalition's financial and technical assistance partners are listed below. The partners have indicated that t contribution(s) made during past project will continue is indicated.

**PROJECT PARTNERS AND RESPONSIBILITIES**

South Dakota Grassland Coalition:

The SD Grassland Coalition is the project sponsor. The Coalition will provide leadership for project management, coordination, and administration. See section 3.5 for information summarizing why the coalition is the appropriate entity to provide leadership for the implementation of the project workplan.

Most project partnerships are not contractual. Many do not involve contributions of financial assistance that are included in the project budget. For example, the partnership with the:

1. Sand Country Foundation's Leopold Conservation Award recognizes families who "keep their operation economically and environmentally sustainable". Currently nine states participate in the program. The award is given to one ranch in each participating state each year. The winner receives a Leopold Crystal, a ranch sign and a $10,000 cash prize.

   The South Dakota Cattlemen's Association and the SD Grasslands Coalition are sponsors for the award given in South Dakota. The funds do not pass through the project budget. Financial and other contributors include:

   | | |
   |---|---|
   | American Bank & Trust | Belle Fourche River Watershed Partnership |
   | Bradley Fund for the Environment | Daybreak Ranch |
   | Ducks Unlimited, Inc. | DuPont-Pioneer |
   | Farm Credit Services of America | Mosaic Company |
   | Millborn Seeds | Mortenson Family |
   | NRCS | Professional Alliance |
   | SD DENR | South Dakota Conservation Districts |
   | SD Dept. Of Ag-Resource Conservation & Forestry | |
   | SD Discovery Center | SD Farm Bureau Federation |
   | SD Game Fish & Parks | SD Grasslands Coalition |
   | SDSU Foundation | The Nature Conservancy |
   | US FWS-Partners for Fish & Wildlife | World Wildlife Fund |

   For more information regarding the award access:

   http://leopoldconservationaward.org/states

**2.** SD Chapter of the Society for Range Management, SD Cattleman's Association, Ducks Unlimited, SD GFP and Crow Creek Sioux Tribe promote the involvement in/or provide funds for the installation of practices used to install managed grazing systems.

Additional project partner contributions that directly impact the completion of project related tasks are summarized in the Table 5.

**Table 5. Project Partners Contributions.**

| Agency/Organization | Contribution |
|---|---|
| Nongovernmental | |
| Nebraska Grazing Lands Coalition | Range and Pasture Journal publication partner |
| SD Association of Conservation Districts | Contractual services for administration, accounting services and web site host and maintenance; liaison to conservation districts; provide, train and supervise project staff and TSPs using project and Farm Bill Implementation Technical Assistance funds provided by NRCS. |
| Local land Owners | Grazing school Field Exercise location |
| SD Ornithological Society | Organize and host field days that promote managed grazing as a BMP that supports avian diversity and habitat. |
| Governmental | |
| Local | |
| Belle Fourche River Partnership | Technical assistance for grazing system planning in the Belle Fourche River TMDL Implementation Project Area |
| Conservation Districts | Local contact for livestock producers; outreach and information transfer; technical assistance for BMP planning and installation. |
| TMDL Implementation Projects | Local contact for producers; outreach/information transfer and BMP planning and installation technical assistance. |
| The Nature Conservancy | Financial assistance and data resources for untilled sod (native grass) mapping project, Phase III: SD Missouri Coteau $20,000. |
| | |
| State | |
| SD Department of Agriculture | Financial assistance for BMP installation and technical assistance to conservation districts. |
| SD DENR | Technical assistance and training for project management and staff; BMP installation and water quality sampling and data interpretation through the 319 Program. |
| SDSU and SDSU Cooperative Extension Service | Contractual services for a portion of an FTE to coordinate/assist with information transfer and the grazing schools; management and coordination of demonstration sites; contact point for producers. General oversight, coordination, and management of both the untilled sod (native grass) mapping project and the watershed modeling projects. |
| South Dakota Department of Game, Fish, and Parks | Financial assistance and data resources for untilled sod (native grass) mapping project, Phase IV: eastern SD. $35,000. |
| Minnesota Department of Natural Resources | Financial assistance and data resources for untilled sod (native grass) mapping project, Phase II: Minnesota Prairie Coteau. $20,000. |
| | |
| Federal/Tribal | |

| | |
|---|---|
| US EPA | Financial assistance through DENR's Section 319 project grants. |
| USDA FSA | Financial assistance for BMP installation through the CRP Program. |
| USDA NRCS | Financial and technical assistance for BMP planning and installation through the EQIP and Farm Bill Implementation Technical Assistance funds provided to SDACD. Financial assistance and data resources for untilled sod (native grass) mapping project, Phase IV: eastern SD. $35,000. |
| USDI FWS | Technical and financial assistance for grassland seeding, grazing systems, multiple purpose ponds and riparian fencing through the Partners for Fish and Wildlife Program. |
| SD Farm Services Agency | Common Land Unit data |
| MN Farm Services Agency | Common Land Unit data |

### 4.2. Support

Local and resource management agency and organization support is indicated by the:

- ranchers who serve on the Grassland Coalition Board of Directors,
- demand for project services by landowner and
- financial and technical assistance partnerships developed that have contributed to the ongoing success of the project.

### 4.3. Coordination with Other Programs

The completion of the Grassland Management and Planning PIP will be accomplished through partnerships with local, state and federal agencies and organizations. Financial and technical assistance for the installation of the grassland management practices planned will be completed using cost share programs. Examples of resource coordination include but are not limited to partnership with the:

- Natural Resources Conservation Service – funds for planning and installation of practices through the Farm Bill Implementation Technical Assistance and EQIP programs and access services available through the agency's information specialists,
- Conservation Districts - technical assistance and information networks and implementation assistance through the SD Soil and Water Conservation Fund,
- South Dakota Association of Conservation Districts – project management assistance and host the project web site,
- South Dakota Department of Game, Fish and Parks and the US Fish & Wildlife Service - funding for water development and fencing,
- Ducks Unlimited – financial assistance for practice installation,
- South Dakota State University – project information specialist/outreach coordinator services by a Range Science staff member, grassland mapping staff, watershed modeling staff, and
- SD Governor's Pheasant Habitat Work Group

Additional programs and project partners are identified in Section 4.0 of this application. For a more detailed description of coordination with other agencies and programs access:
http://denr.sd.gov/dfta/wp/wqprojects/grasslandseg2fnlrpt.pdf

### 4.4. Non-Duplication of Effort

Project activities selected to provide technical assistance to grassland managers and grassland management information and training opportunities were identified by the sponsor's project partners.

The sponsor and project staff will serve as the primary grassland technical assistance provider to existing Section 319 projects, and coordinate assistance offered by its project partners to maximize and accelerate the delivery of grassland technical assistance.

### 5.1. Evaluation and Monitoring

Success of project activities both as individual actions and in attaining the project goal will be evaluated based on monitoring project activities. Monitoring activities will track:

- milestone accomplishment in relation to planned,
- outcome(s) realized from project activities in relation to the intended purpose,
- effects on water quality and vegetation parameters as evidenced by load reductions realized using STEPL and change in ecological condition respectively,
- contributions to improving sustainability of grassland managers' operations as evidenced by information provided by ranchers who attend grazing schools and antidotal information provided by operators who have installed systems and
- responses to questionnaires distributed at the end of each tour, workshop or grazing school to determine changes to the outreach program or a specific activity that may be needed as well as and assessing the effectiveness of the activity an action that supports attaining the project goal.
- Use of native grassland and watershed modeling data and results in partner conservation program planning and implementation.

Project monitoring will be completed by a team consisting of:

- the project coordinator,
- grassland managers/producers,
- SDSU, Animal and Range Science Department staff (Outreach Coordinator),
- project partners and
- SDGLC Board of Director's members.

The information collected will be used to complete annual (October) reports of project activities, and provide project progress updates to all project partners and funders. A final report will be completed at the end of the project.

Annual reports will be prepared by the project coordinator using format provided by DENR to facilitate entry into GRTS. The reports will include:

- a cumulative summary and evaluation of activities completed relative to project milestones and progress toward attaining the project goal,
- information regarding amendments to the PIP
- a discussion of problems encountered and actions taken to address the challenge, and
- estimates of load reductions realized calculated using STEPL.

The final report will be prepared in the format provided by DENR and submitted to the department electronically.

**5.2. Project Monitoring Plan**

Data used to track the sources and uses of project finances, prepare reports and evaluate project success relative to accomplishment in relation to the milestone schedule and goal attainment will be collected and interpreted by activity category. The data will be entered in the DENR electronic project management program to facilitate report preparation. The categories for which data that will be collected and the responsibility for collection and interpretation follow.

1. Project Administration

   Project administration will be monitored by SDGLC Board of Directors by:

   - reviewing financial records provided by SDACD and entered in the DENR Project Management Program (Tracker),
   - tracking the completion of project tasks as specified in the PIP,
   - considering input provided by project partners and project participants and
   - reports to the SDGLC Board of Directors by the project coordinator and SDACD.

2. Assistance Activities

   The project coordinator will collect data to evaluate the development and implementation of grassland management plans, mapping project progress, and modeling project progress by monitoring the:

   - number of on-farm visits and landowner/operator contacts,
   - number and acres of management plans developed by county,
   - number and acres of grassland management plans implemented by county,
   - load reductions realized from BMPs installed using STEPL,
   - conservation practices and units of each used to implement a grassland management plan,
   - location of operations assisted and demonstrations sites using GPS and
   - financial data to track the source and use of cash and inkind funds expended to plan and implement grassland management plans.
   - County map completions of untilled sod, data layer sharing, and reports
   - Watershed modeling completion reports

3. Information Transfer and Education

The project coordinator will collect and organize report data provided by the outreach coordinator and other project partners. Information that will be collected includes:

- attendance at tours, workshops and grazing schools,
- responses to questionnaires returned after each tour, workshop or school,
- number of visits to the project web site and producer/public web questions/comments and
- media releases/events by type (TV, radio, newsprint), topic, and estimated coverage or outreach by the release/event.
- Native grassland mapping reports, including distribution, location, and acreage
- Watershed modeling reports, including impacts of loss of remnant grasslands in relation to water quality, erosion, and flooding.

## 6.0. Budget

## PART 1: FUNDING SOURCES

| Funding Source By Year | July 2013 - June 2014 | July 2014 - June 2015 | Original Budget | July 2015 - June 2016 | July 2016 - June 2017 | Budget Extension | Total |
|---|---|---|---|---|---|---|---|
| EPA SECTION 319 FUNDS | $100,500 | $100,500 | | $231,039 | $231,039 | | |
| **319 Subtotal** | | | **$201,000** | | | **$462,077** | **$663,077** |
| OTHER FEDERAL FUNDS | | | | | | | |
| 1.) NRCS (FA) | $98,687.50 | $98,687.50 | $197,375 | $87,500 | $87,500 | 175,000 | |
| 3.) NRCS-Mapping (FA) | | $35,000 | $35,000 | | | | |
| **Federal Subtotal** | | | **$232,375** | | | **$175,000** | **$407,375** |
| STATE FUNDS | | | | | | | |
| CWSRF | $57,500 | $57,500 | $115,000 | | | | $115,000 |
| GF&P, Dept of Ag & DENR (FA/TA) | $37,050 | $37,050 | $74,100 | $57,050 | $57,050 | $114,100 | $223,220 |
| GFP-Mapping | | $35,000 | $35,000 | | | | |
| SDSU (FA/TA) | | | | $20,000 | $20,000 | $40,000 | |
| MN DNR (FA) | | $20,000 | $20,000 | | | | |
| **State Subtotal** | | | **$244,100** | | | **$154,100** | **$398,200** |
| LOCAL FUNDS | $73,700 | $113,700 | | $81,200 | $81,200 | | |
| Grassland Coalition/CD (TA) | $2,500 | $2,500 | $5,000 | $2,500 | $2,500 | $5,000 | |
| Private Organizations (TNC/DU/ Other) | $2,500 | $42,500 | $45,000 | $2,500 | $2,500 | $5,000 | |
| Landowners (Cash /Inkind) | $68,700 | $68,700 | $137,400 | $76,200 | $76,200 | $152,400 | |
| **Local Subtotal** | | | **$187,400** | | | **$162,400** | **$349,800** |
| | | | | | | | |
| **Matching Subtotal** | | | **$431,500** | | | **$316,500** | $748,000 |
| **Total** | | | **$864,875** | | | **$953,577** | **$1,818,452** |

FA – Financial Assistance TA – Technical Assistance

**Part 2: Detailed Budget.**

See Attachment B. Grasslands Segment 4 Extended Budget.

### 8.1 Threatened and Endangered Species

Procedures that will be followed to ensure the project will promote the recovery of threatened and endangered species and will not adversely affect the species are based on three main premises:

1. managed grazing systems planned and implemented will promote the restoration or preservation of critical grassland habitat,
2. while the project will be implemented on a statewide basis, with first priority for assistance directed to water quality project areas, many of the grazing systems planned and implemented will be in areas for which threatened and endangered species consultation has been completed, and
3. NRCS and the US FWS involvement in planning and installing grazing systems ensures personnel trained with the recovery of threatened and endangered species will be involved with the design and implementation of practices completed to install the BMP.

Threatened and endangered most likely to be encountered during the project and the procedure to be followed relative to each species are:

1. Bald Eagle

   Project activities that disturb possible nesting sites or reduce food sources are not planned. If any actions become necessary that might impact bald eagle(s) that are in or might visit the project area, the sponsor or its agent will contact DENR for approval to complete the action before proceeding.

2. Whooping Crane

   If a whooping crane or cranes are observed at any project work site, all mechanical activities at the site will be suspended until the bird(s) leave the site under their own volition. Migration of the species through the state occurs during mid to late April and mid to late October.

3. Topeka Shiner

   In stream activities are not planned. Most riparian practices implemented are management rather than construction in nature.

   However, some practices such as streambank stabilization, and activities undertaken to maintain or improve meanders and install a multipurpose dam may require construction along or in a stream. In these instances, the project sponsor will work closely with the USFWS during site evaluation; design and construction to ensure that installing the BMPs do not adversely affect the species.

4. Black Tailed Prairie Dog

The Black Tailed Prairie Dog is a candidate species for listing under the Threatened and Endangered Species Act. Activities implemented as part of the project will comply with the State of South Dakota Prairie Dog Management Plan adopted during 2005. A copy of the plan is available by accessing:

http://gfp.sd.gov/wildlife/docs/prairiedog-management-plan.pdf

5. Black Footed Ferret

   The existence of Black Footed Ferrets (BFF) is directly linked to the presence of prairie dogs. The sponsor will:

   - comply with the SD Prairie Dog Management Plan, and
   - consult with the USFWS relative to the need for a BFF survey if actions are planned that may adversely effect the survival of a native or introduced population of BFF.

   The three demonstration sites installed before but included in this project are in areas blocked cleared by USFWS for BFF surveys.

6. Pallid Sturgeon
   Most riparian activities included in the project workplan are management rather than construction in nature, and therefore will not affect Pallid Surgeon habitat or population(s). None of the three demonstration sites installed prior to but included in this project are adjacent to water bodies that contain the species. See previous question regarding demo sites.

7. Poweshiek skipperling and Dakota Skipper butterflies
   The U.S. Fish and Wildlife Service listed the Dakota skipper as threatened and the Poweshiek skipperling as endangered under the Endangered Species Act on October 22, 2014. The U.S. Fish and Wildlife Service also proposed designating critical habitat for both prairie butterflies. These butterflies are primarily found within the Prairie Coteau portions of eastern South Dakota and western Minnesota. While the mapping and watershed modeling portions of the project will include focus on this region, no physical activity will be undertaken with these projects that would impact these species in any way. However, results of the both the untilled sod mapping and watershed modeling project could provide significant information that could be employed in the long-term conservation efforts of these two species, as well as many other native-prairie endemic species.

**Appendix A: Milestone Table** — **Grassland Management And Planning Project Segment 4 Extension**

| OBJECTIVE/TASK/PRODUCT | Quantity | Group | Year 1: | | | | Year 2: | | | | Year 3: | | | | Year 4 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Jul-Sept. | Oct.-Dec. | Jan.-Mar. | Apr.-Jun. | Jul-Sept. | Oct.-Dec. | Jan.-Mar. | Apr.-Jun. | Jul-Sept. | Oct.-Dec. | Jan.-Mar. | Apr.-Jun. | Jul-Sept. | Oct.-Dec. | Jan.-Mar. | Apr.-Jun. |
| **Objective 1: Grassland Management Systems** | | | 2013 | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | |
| **Planning and Implementation** | | | | | | | | | | | | | | | | | | |
| **Task 1: Planning & Implementation of Grassland** | | | | | | | | | | | | | | | | | | |
| **Management Systems:** | | | | | | | | | | | | | | | | | | |
| Product 1: Planning | 160,000 ac. | 1,5,6,7,8,12 | | | | | | | | | | | | | | | | |
| Year 1: 80,000 acres, Year 2: 80,000 acres | (160, 000) ac. | | 7,500 | 15,000 | 7,000 | 7,000 | 8,000 | 20,000 | 7,500 | 8,000 | 7,500 | 15,000 | 7,000 | 7,000 | 8,000 | 20,000 | 7,500 | 8,000 |
| Year 3: 80,000 acres, Year 4: 80,000 acres | | | 7,500 | 15,000 | 7,000 | 7,000 | 8,000 | 20,000 | 7,500 | 8,000 | 7,500 | 15,000 | 7,000 | 7,000 | 8,000 | 20,000 | 7,500 | 8,000 |
| Product 2: Implementation | 120,000 acres | | | | | | | | | | | | | | | | | |
| Year 1: 60,000 acres, Year 2: 60,000 acres | (120,000 acres) | 1,5,6,7,8,12 | 3,000 | 20,000 | 5,000 | 2,000 | 3,000 | 20,000 | 5,000 | 2,000 | 3,000 | 20,000 | 5,000 | 2,000 | 3,000 | 20,000 | 5,000 | 2,000 |
| Year 3: 60,000 acres, Year 4: 60,000 acres | | 1,5,6,7,8,12 | 3,000 | 20,000 | 5,000 | 2,000 | 3,000 | 20,000 | 5,000 | 2,000 | 3,000 | 20,000 | 5,000 | 2,000 | 3,000 | 20,000 | 5,000 | 2,000 |
| Practices to Install Grazing Systems | | | | | | | | | | | | | | | | | | |
| Marginal Pastureland CRP | 250 acres | | | 50 | 75 | | | 50 | 75 | | | 50 | 75 | | | 50 | 75 | |
| Fence | | | | | | | | | | | | | | | | | | |
| Cross | 80,000 (80,000 LF) | 1,4,5,6,7,12 | 10,000 | 20,000 | | 10,000 | 10,000 | 20,000 | | 10,000 | 10,000 | 20,000 | | 10,000 | 10,000 | 20,000 | | 10,000 |
| Riparian Exclusion | 40,000 (40,000 LF) | 1,4,5,6,7,12 | 5,000 | 10,000 | | 5,000 | 5,000 | 10,000 | | 5,000 | 5,000 | 10,000 | | 5,000 | 5,000 | 10,000 | | 5,000 |
| Pipeline | 125,000 (125,000)LF | 1,6,7,12 | | 15,000 | | 25,000 | 20,000 | | | 20,000 | | 15,000 | | 25,000 | 20,000 | | | 20,000 |
| Rural Water Hook-ups | 2 (2) each | 1,6,7,12 | | 1 | | 1 | | | | | | 1 | | 1 | | | | |
| Tanks | 40 (40) each | 1,6,7,12 | 5 | 5 | | 5 | | 5 | | 5 | 5 | 5 | | 5 | | 5 | | 5 |
| Wells | 4 (4) each | | | | | | | | | | | | | | | | | |
| Dugouts/Dams | 6 (6) each | 1,4,5,6,7,12 | | 1 | | 1 | | | | | | 1 | | 1 | | | | |
| Stream Crossing | 1(1) each | 1,6,7,12 | | 1 | | | | | | | | 1 | | | | | | |
| Grass Seeding | 500 (500) acres | 1,4,5,6,7,12 | | 25 | | 25 | | 25 | | 25 | | 25 | | 25 | | 25 | | 25 |
| | | | | | | | | | | | | | | | | | | |
| **Objective 2: Information Transfer** | | | | | | | | | | | | | | | | | | |
| **Task 2: Information and Education Events** | | | | | | | | | | | | | | | | | | |
| Product 3: | | | | | | | | | | | | | | | | | | |
| Web Site maintenance | 2 (2) years | 1,10 | Continuous | | | | | | | | Continuous | | | | | | | |
| Farmer/Rancher Workshops | 6 (6) | 1,2,4,5,6,7,9,12 | 2 | | 1 | | 1 | | 1 | | 2 | | 1 | | 1 | | 1 | |
| Grazing School | 2 (2) | 1,6,7,9,11,12 | 1 | | | | 1 | | | | 1 | | | | 1 | | | |
| Press Releases | 4 (4) | 1,7,10,11,12 | 1 | 1 | | | 1 | 1 | | | 1 | 1 | | | 1 | 1 | | |
| Leopold Award Tours | 2 (2) | 1,2,4,5,6,7,9,12 | 1 | | | | 1 | | | | 1 | | | | 1 | | | |
| Grassland "Birding" Tours | 2 (2) | | 1 | | | | 1 | | | | 1 | | | | 1 | | | |
| | | | | | | | | | | | | | | | | | | |
| **Objective 3: Mapping Project** | | | | | | | | | | | | | | | | | | |
| **Task 3: Mapping Assessment** | 4 | 1,6,12,13,15 | | | | | | | | | | | | 1 | 2 | | | |
| Product 4: GIS data layers of Prairie Coteau | 1 | | | | | 1 | | | | | | | | | | | | |
| Product 5: GIS data layer of Missouri Coteau | 1 | | | | | | | | | | | | | 1 | | | | |
| Product 6: GIS data layer of eastern SD | 1 | | | | | | | | | | | | | | 1 | | | |
| Product 7: GIS data layer of western SD | 1 | | | | | | | | | | | | | | 1 | | | |
| | | | | | | | | | | | | | | | | | | |
| **Objective 4: Watershed modeling SD watersheds** | | | | | | | | | | | | | | | | | | |
| **Task 4: Assessment of hydrologic modeling** | | | | | | | | | | | | | | | | | | |
| Product 8: Hydrologic model and water quality metrics for SD watersheds | 3 | 1,12 | | | | | | | | | | | | | | | | 3 |
| **Objective 5: Reporting and Monitoring** | | | | | | | | | | | | | | | | | | |
| **Task 5: Reporting** | | | | | | | | | | | | | | | | | | |
| Product 9: Reports/Project Management | | | | | | | | | | | | | | | | | | |
| Contract For Services | | | | | | | | | | | | | | | | | | |
| Two (2) Annual Reports | 2 (2) each | 1,9,10,12 | | | | | | | | | | | | | | | | |
| One (1) Final Report | 1 each | 1,9,10,12 | | | | | | | | | | | | | | | | |

1. 319 Grassland Mgt. & Planning
2. SD Dept. Agriculture
3. SD Lakes & Streams Assoc.
4. SD Dept. Game, Fish, & Parks
5. US Fish & Wildlife Service
6. USDA Natural Resources Cons. Serv.
7. Producers/Operators
8. SD Conservation Districts
9. SD Grassland Coalition
10. SD Association of Conservation Districts
11. SD Dept. of Environment and Natural Resources
12. South Dakota State University
13. MN DNR
14. The Nature Conservancy
15. USDA Farm Service Agency

# Attachment B: Budget

# Grasslands Segment 4 Extension

## Grassland Management Planning and Assistance

| CATEGORY | Year 1 | Year 2 | Year 3 | Year 4 | 319 | 319 addition | WQ Funds | Federal | State | Local |
|---|---|---|---|---|---|---|---|---|---|---|
| | July 2013 -June 2014 | July 2014 - June 2015 | July 2015 -June 2016 | July 2016 -June 2017 | | | | NRCS/US&FW | GF&P/SDRCF/SDSU/ MN DNR | |
| **Personnel:** | | | | | | | | | | |
| SDACD:Range Specialist and Project Coordinator- 1.5 FTE | | | | | | | | | | |
| (Benefits Included) (3/4 319, 1/4 FBITA) | $81,000.00 | $81,000.00 | $ 84,000.00 | $ 84,000.00 | $70,000.00 | $126,000.00 | $51,500.00 | $82,500.00 | | |
| SDACD Project Administrative (Includes Benefits)) | $4,750.00 | $4,750.00 | $5,000.00 | $5,000.00 | $7,125.00 | $10,000.00 | | $2,375.00 | | |
| Range Consultant - Contractual | $65,000.00 | $71,000.00 | $20,000.00 | $22,500.00 | $ 50,000.00 | $30,000.00 | $52,000.00 | $46,500.00 | | |
| 50,000 Acres (30,000 Acres Planning/20,000Acres Followup) | | | | | | | | | | |
| SDSU Outreach/Information Specialist-.1 FTE | $13,704.53 | $13,704.53 | $4,948.00 | $5,097.00 | $ 18,175.00 | $10,045.00 | $9,234.06 | | | |
| SDSU Contractual (newsletter service) | | | $1,000.00 | $1,000.00 | | $2,000.00 | | | | |
| SDSU Information Specialist-Travel | | | $7,500.00 | $7,500.00 | | $15,000.00 | | | | |
| SDSU Employee Benefits | | | $1,117.00 | $1,117.00 | | $2,234.00 | | | | |
| SDSU Grant Administration | | | $4,026.00 | $4,026.00 | | $8,052.00 | | | | |
| | | | | | | | | | | |
| Project Work Group | $10,000.00 | $10,000.00 | $10,000.00 | $10,000.00 | | | | $10,000.00 | $10,000.00 | $20,000.00 |
| | | | | | | | | | | |
| **Project Administration/Management** | | | | | | | | | | |
| General Liability | $500.00 | $500.00 | $500.00 | $500.00 | $1,000.00 | $1,000.00 | | | | |
| Audit/Compilation | | $1,500.00 | | $1,500.00 | $1,500.00 | $1,500.00 | | | | |
| Endangered Species and/or Historical/Cultural Surveys (4 @ $500 each) | $1,000.00 | $1,000.00 | $1,000.00 | $1,000.00 | | | | | | $4,000.00 |
| **Office Supplies/Operations** | **$2,400.00** | **$2,400.00** | $3,775.00 | $3,775.00 | $4,800.00 | $7,550.00 | | | | |
| **Travel:** | **$16,700.00** | **$16,700.00** | $18,050.00 | $18,050.00 | $33,400.00 | $36,100.00 | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **Subtotal: Personnel, Administration, Operations, Supplies, and Travel** | **$195,054.53** | **$202,554.53** | **$ 160,916.00** | **$ 165,065.00** | **$ 186,000.00** | **$ 249,481.00** | **$ 112,734.06** | **$ 141,375.00** | **$ 10,000.00** | **$ 24,000.00** |
| | | | | | | | | | | |
| **Objective 1: Technical Assistance for Rotational Grazing** | | | | | | | | | | |
| **Task 1: 320,000 acres planned/240,000 acres implemented** | | | | | | | | | | |
| **Product 1: Rotational Grazing Plans - 320,000 Ac.** | | | | | | | | | | |
| (Technical assistance costs are shown under Personnel (Project Coordinator, Range Specialists, and Range Consultant) | | | | | | | | | | |
| **Product 2: Rotational Grazing Plans implemented - 240,000 ac.** | $150,000.00 | $180,000.00 | $150,000.00 | $180,000.00 | | | | $231,000.00 | $178,200.0000 | $250,800.00 |
| (Technical assistance costs are shown under Personnel (Project Coordinator, Range Specialists, and Range Consultant) | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **Objective 2: Information and Education** | | | | | | | | | | |
| **Task 2: Information and Education Activities:** | | | | | | | | | | |
| **Product 3: Web Site, Workshops, Grazing Schools, News Releases, Grazing Sticks, Grasslands Plant ID Books and Ranch Grazing Tours** | **$20,000.00** | **$20,000.00** | $23,500 | $23,500.00 | $10,000.00 | $22,000.00 | | | | $55,000.00 |
| | | | | | | | | | | |
| **Objective 3: Mapping project** | | | | | | | | | | |
| **Task 3: Mapping assessment** | | | | | | | | | | |
| **Product 4: GIS data layer of Prairie Coteau** | | $ 20,000.00 | | | | | | | $ 20,000.00 | |
| **Product 5: GIS data layer of Missouri Coteau** | | $ 20,000.00 | | | | | | | | $ 20,000.00 |
| **Product 6: GIS data layer of eastern SD** | | **$35,000.00** | $ 35,000.00 | | | | | $ 35,000.00 | $ 35,000.00 | |
| **Product 7: GIS data layer of western SD** | | | | | | | | | | |
| SDSU Extension Range Field Specialist 10 % time | | | $7,326.00 | $7,546.00 | | $14,872.00 | | | | |
| SDSU Senior Ag Reseach Tech 100% time | | | $31,200.00 | $0.00 | | $31,200.00 | | | | |
| SDSU Assistant Ag Research Tech 100% time | | | $31,200.00 | $0.00 | | $31,200.00 | | | | |
| SDSU Employee benefits | | | $20,414.00 | $2,082.00 | | $22,496.00 | | | | |
| SDSU Grant Administration | | | $ 24,789.00 | $2,648.00 | | $27,437.00 | | | | |
| | | | | | | | | | | |
| **Objective 4: Watershed modeling of SD watersheds** | | | | | | | | | | |
| SDSU Grassland Hydrologist | | | $20,000.00 | $20,000.00 | | | | | $40,000.00 | |
| SDSU Graduate Student 49% time | | | $18,989.00 | $19,559.00 | | $38,548.00 | | | | |
| SDSU Employee Benefits | | | $380.00 | $391.00 | | $771.00 | | | | |
| SDSU Graduate Student Remission | | | $3,200.00 | $3,400.00 | | $6,600.00 | | | | |
| SDSU Grant Administration | | | $4,986.00 | $4,986.00 | | $9,972.00 | | | | |
| **Task 4: Assessment of hydrologic modeling of three watersheds** | | | | | | | | | | |
| **Product 8: Hydrologic model and water quality metrics for three watersheds** | | | | | | | | | | |
| | | | | | | | | | | |
| **Objective 5: Reporting/Monitoring** | | | | | | | | | | |
| **Task 5: Reporting** | | | | | | | | | | |
| **Product 9: Reports/Project Management: progress/final reports** | **$1,500.00** | **$5,765.94** | $1,500.00 | $6,000.00 | $5,000.00 | $7,500.00 | $2,265.94 | | | |
| **Subtotal: Reporting and Monitoring** | | | | | | | | | | |
| | | | | | | | | | | |
| **Project Totals:** | $ 366,554.53 | $ 483,320.47 | $ 533,400.00 | $ 435,177.00 | $ 201,000.00 | $ 462,077.00 | $ 115,000.00 | $ 407,375.00 | $ 283,200.00 | $ 349,800.00 |
| **Local & State Match** | | | | | | | | | **$633,000.00** | |
| **Match Ineligible For This Project:** (Federal or Allocated to Another Project) | | | | | | | | $407,375.00 | | |

U.S. Department of the Interior
U.S.FISH AND WILDLIFE SERVICE

Habitat and Population Evaluation Team
3425 Miriam Avenue
Bismarck, North Dakota 58503

DATE: October 10, 2014

TO: Proposal Review Team

FROM: Scott McLeod, acting HAPET Project Leader

SUBJECT: Grant proposal

The Habitat and Population Evaluation Team (HAPET) is pleased to support the research proposal "Quantifying undisturbed land and modeling grassland conversion impacts to watersheds in South Dakota and Minnesota." Loss of grassland habitat is a critical issue in the Prairie Pothole Region and we believe this project will help us identify undisturbed grasslands, which cannot be identified with satellite imagery or other existing data. In addition, this project will help us assess potential impacts to wildlife populations and watersheds if undisturbed grasslands are lost.

We look forward to continuing our working partnership with the South Dakota Extension office and The Nature Conservancy in South Dakota. Please feel free to contact me if you have any questions.

# United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Dakota Partners for Fish & Wildlife Office
P.O. Box 247, 520-B 3rd Avenue North
Brookings, South Dakota 57006
Phone: 605-697-2500 FAX: 605-697-2505


September 30, 2014

Mr. Pete Bauman, Range Extension Field Specialist
South Dakota Extension Service Field Office
1910 West Kemp Avenue
Watertown, SD 57201

RE: Grant Support-- Quantifying undisturbed land and modeling grassland conversion impacts to watersheds in South Dakota and Minnesota.

Dear Mr. Bauman:

The U.S. Fish and Wildlife Service via the South Dakota Partners for Fish and Wildlife Program (SDPFW) fully supports your ongoing effort to map the remaining native prairie habitats throughout western Minnesota and all of South Dakota. The initial mapping and modeling work completed by your work group in 2014 on the Prairie Coteau of South Dakota is already yielding a wide variety of conservation planning and outreach benefits.

The initial 2014 work on the Prairie Coteau clearly demonstrates the high value of expanding this effort throughout western Minnesota and all of South Dakota. The expanded mapping and modeling efforts would yield immediate conservation benefits in two primary arenas:

(1) Strategically targeting of conservation delivery: The SDPFW program works with private landowners to deliver a wide variety of voluntary grassland and wetland conservation practices. A statewide inventory of remaining native prairie tracts would be a valuable tool in helping to target limited conservation funds.

(2) Outreach tool for expanded conservation funding: Landowner interest in many types of grassland conservation practices continues to far outstrip current funding levels throughout South Dakota. As such, conservation planners are routinely working with a wide variety of non-governmental organizations and non-federal partners to raise additional grassland conservation funds. A comprehensive summary of existing native prairie would be extremely useful in highlighting current conservation challenges and opportunities as we compete for additional funds.

Once again, we fully support your expanded effort to quantify and model remaining native prairie tracts, and look forward to assisting in any way possible as you move forward.

Sincerely,

---===--

Kurt Forman
South Dakota Partners for Fish and Wildlife Coordinator

SDSU Extension

The Nature Conservancy
Protecting nature. Preserving life.

# QUANTIFYING UNDISTURBED LAND AND MODELING GRASSLAND CONVERSION IMPACTS TO WATERSHEDS IN SOUTH DAKOTA AND MINNESOTA

9/26/2014

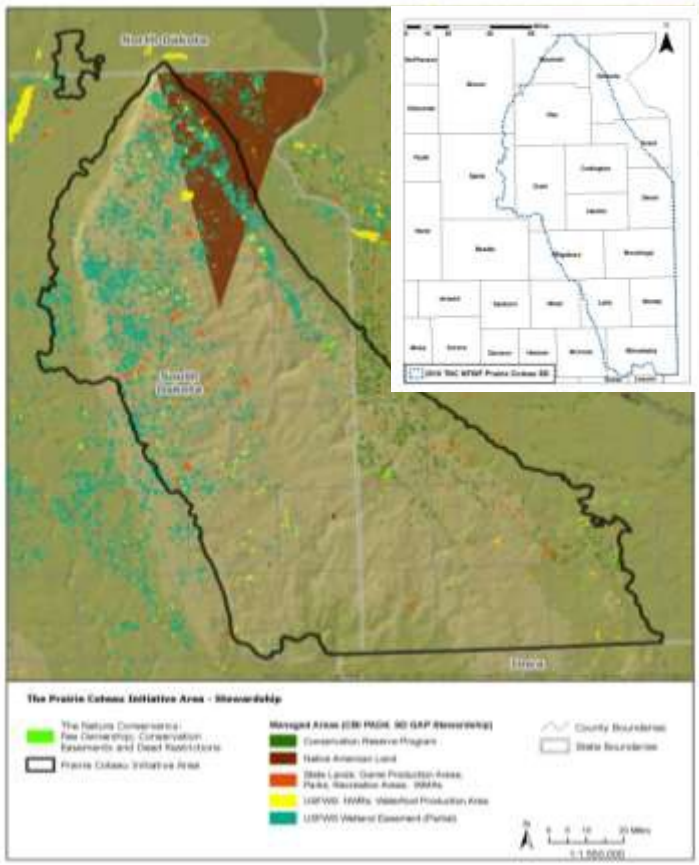
A project description and funding proposal for partner organizations in South Dakota and Minnesota for Phases II – V of a comprehensive plan to map the remaining tracts of potentially undisturbed land in South Dakota and Minnesota.

# Quantifying undisturbed land and modeling grassland conversion impacts to watersheds in South Dakota and Minnesota

**A PROJECT DESCRIPTION AND FUNDING PROPOSAL FOR PARTNER ORGANIZATIONS IN SOUTH DAKOTA AND MINNESOTA FOR PHASES II – V OF A COMPREHENSIVE PLAN TO MAP THE REMAINING TRACTS OF POTENTIALLY UNDISTURBED LAND IN SOUTH DAKOTA AND MINNESOTA.**

## Introduction:

Figure 1: Prairie Coteau Landscape and portion of the Prairie Coteau in South Dakota that was mapped in Phase I (inset).



In June 2014, South Dakota State University through funding provided by The Nature Conservancy under a grant awarded from the National Fish and Wildlife Foundation (NFWF Grant Agreement #2009-0084-000) completed an initial pilot project (Phase I) to develop methodology for simple and systematic mapping of the last remaining potential areas of undisturbed grasslands and woodlands across portions of 17 eastern South Dakota counties commonly referred to as the Prairie Coteau region. With Common Land Unit data provided by South Dakota Farm Services Agency and with other data sets provided by partner organizations, we evaluated over 5,800 sections of land in the project area.

Phase I results: With our methods, we estimate there are approximately 1,102,271 acres of undisturbed grasslands and woodlands remaining representing (20.3%) of the 5,434,508 total acres within the South Dakota Prairie Coteau Boundary as defined by the 2010 TNC NFWF Business Plan. Of these 1,102,271 remnant undisturbed acres, 1,065,262 acres (96.6%) are classified as 'undisturbed grasslands' and 37,009 acres (3.4%) are 'undisturbed woodlands'. Approximately 276,184 acres (25.1%) of undisturbed grasslands and woodlands are permanently protected from conversion

through conservation ownership or permanent conservation easements, representing 5.1% of the 5,434,508 total SD Prairie Coteau Acres.

*The full final report from Phase I Quantifying Undisturbed Land On South Dakota's Prairie Coteau, all associated charts, maps, and GIS shape files are available from Joe Blastick at The Nature Conservancy jblastick@tnc.org.*

# Project Description

Going forward, we propose to continue this project in phases, with each phase focused on a certain landscape our block of counties in South Dakota and Minnesota until we have completed mapping all 66 South Dakota counties and the counties comprising the primary grassland biomes of Minnesota. Further, we intend to incorporate landscape-level watershed modeling on at least three watersheds to determine the environmental impacts of continued grassland loss in relation to runoff, soil erosion, and water quality. Watersheds will be selected based on the results from the mapping project and will likely include one cross-border watershed in the Prairie Coteau region of eastern South Dakota and western Minnesota, one in the Missouri Coteau region of northcentral South Dakota, and one in northwestern South Dakota's range country.

# Methods

During Phase I of the project, we developed a methodology for assessing the history of land use in the region via simple layering methods in ARC GIS in order to deduce the location and size of remaining land tracts that are potentially undisturbed (native) native sod - regardless of current vegetation type or quality. We utilized 2012 USGS aerial imagery (2012 National Ag. Imagery Program Mosaic, http://datagateway.nrcs.usda.gov/) as our base layer data, projected on-screen at approximately 8,000 ft. elevation. This projection was selected to allow the technician to view a full square mile section (640 acres) when identifying, evaluating, and qualifying land use. We will utilize the same methodology to complete phases II through V of the project. Within each phase, we will follow the same basic methodology as described below.

*Step 1:* The 2012 Farm Service Agency's (FSA) Common Land Unit (CLU) cropland data layer will then applied to the given area. We will make no attempt in this study to verify the accuracy of the CLU cropland data layer, rather we will accept the layer as measured data provided by MN and SD FSA. The CLU Crop data layer includes all recorded historic cropland and is applied to land tracts enrolled in current or historic United States Department of Agriculture (USDA) programs dating back to approximately the 1950's, however an exact initial date is not available. It is important to note that the CLU Crop layer reports historic cropping disturbance, but not all current and historic acres included in the 2012 CLU Crop layer are necessarily agricultural crops today, as these acres may have been allowed to re-vegetate as 'go back' to pasture, been developed for non-ag uses, or are in some type of conservation program. The 2012 CLU cropland data layer will be overlaid on the base 2012 USGS maps and shaded black to represent previous land disturbance. This first level analysis will allow us to define areas without a recorded cropping history (non-crop) for further analysis.

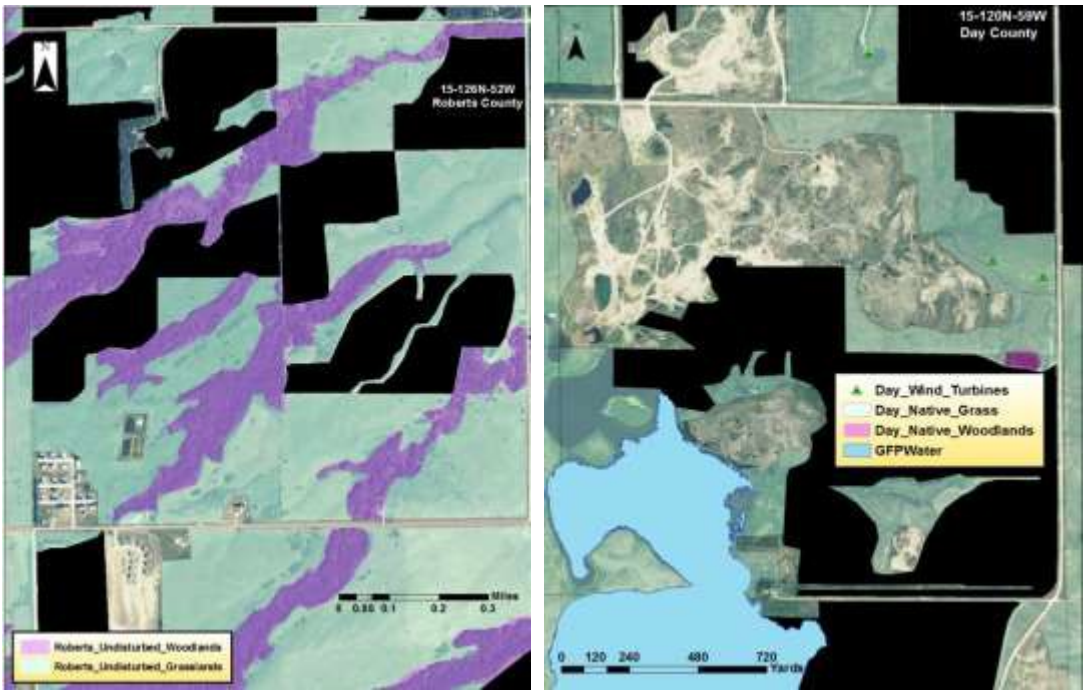
*Step 2:* Technicians will then map remaining undisturbed (native) grasslands and woodlands by evaluating remaining non-crop land tracts for indicators of disturbance. The CLU layer does not provide comprehensive representation of all crop fields if they are not enrolled in a USDA program or assigned a farm number. Crop land not represented in the CLU layer may include but is not limited to: 1) land cropped prior to the establishment of the CLU data (circa 1950) or not enrolled in USDA programs, 2) land removed from CLU tracking due to removal from USDA programs or retired farm number, or 3) land recently cropped without being enrolled in a USDA farm program or land enrolled but not yet recorded. Other disturbed areas on non-cropped land include such uses as: farmsteads, building sites, lawns, municipalities, planted shelterbelts, feedlots, gravel pits, etc.

Non-CLU disturbed areas will not be mapped per se, rather initial native 'undisturbed grasslands' and 'undisturbed woodlands' polygons will be developed with on-screen digitizing by *excluding* the known CLU cropland layer and all additional identified disturbed tracts (Figure 2). Initial undisturbed (native) grasslands and woodlands include all wetlands, lakes, and streams not included in the CLU cropland layer. Undisturbed grasslands and woodlands will be further refined by removing known measured layers such as the South Dakota Department of Game, Fish, and Parks lakes (SDGFP) 2010 water layer and various data layers provided by the Minnesota Department of Natural Resources. Similar to the FSA CLU cropland layer, we will make no attempt to verify the accuracy of the landscape data layers provided by partners in this project and will simply accept them as measured data.

Undisturbed woodlands will be determined as having closed canopy woodlands. Specific analysis techniques may be adjusted as we encounter significant changes in woodland characteristics across different regions.

*Step 3:* Other landscape statistics such as protected status and county-level analysis will be performed by analyzing various data layers. Of primary interest may be the relative overlap of undisturbed grasslands and woodlands with records of permanent conservation protection. Conservation protection will be derived by compiling the most up-to-date protection maps provided by project partners and will include requests including but not limited to: US Fish and Wildlife Service fee ownership lands (refuges and waterfowl protection areas) and grassland easements; SD Game Fish and Parks fee ownership lands (parks and game production areas); MN DNR Fee ownership and associated coverages; Nature Conservancy grassland preserves; USDA Natural Resources Conservation Service Wetland Reserve Program easement acres; Northern Prairies Land Trust easement acres; Minnesota Land Trust easement acres. Protection layers will be requested organizations holding the fee title to the property or the easement.

Figure 2: Two sample sections of land in Roberts and Day Counties of South Dakota. Black areas indicate FSA CLU land tracts with a known cropping history excluded from analysis. Large water bodies as determined by SD GF&P lakes layer were removed. Undisturbed (native) grasslands and woodlands were then mapped based on identification of other obvious land disturbance such as building sites, planted trees, municipalities, feedlots, gravel pits, etc.




As each phase of the project is completed, we will produce various analysis products. Figure 3 is a sample of a landscape level map depicting areas of undisturbed grasslands and woodlands. Table 1 provides an example of what type of data will be reported for each phase of the project.

Within our undisturbed layers there will remain a possibility that certain individual tracts could have a historic cropping or tillage history that is not detectible with the 2012 USGS imagery. These areas are commonly known as 'go back' pasture or hay land. An example would be a land tract that might have been farmed or a tillage attempt made decades ago. These tracts may not have been enrolled in any type of government farm program and thus may not have been tracked through any formal system. The condition and vegetative cover of these areas today is unpredictable, and they may be vegetated with varying degrees of quality, structure, and diversity of native, tame and exotic species.

Figure 3: Undisturbed (potentially native) grasslands and woodlands remaining within the South Dakota portion of the Prairie Coteau based on the 2012 landscape analysis.

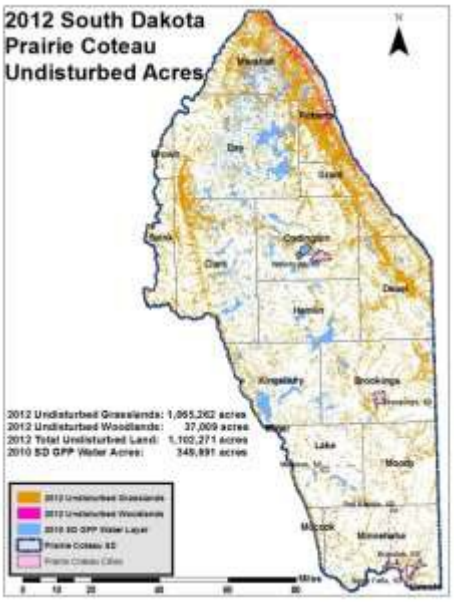


Table 1: Prairie Coteau Landscape Statistics.

| 2012 County and Landscape Statistics Within the 2010 TNC NFWF SD Prairie Coteau Boundary | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| County | Total County Area ($mi^2$) | Total County Area (Acres) Based on NRCS County Data | County Area (Acres) Within 2010 TNC NFWF Prairie Coteau Boundary | Percent of County Area Within 2010 TNC NFWF Prairie Coteau Boundary | 2012 FSA CLU Layer Acres Within 2010 TNC NFWF Prairie Coteau Boundary | 2012 Other Disturbed Land Acres (non CLU crop, new crop, buildings sites, planted shelterbelts, Crop municipalities, gravel pits, feedlots, etc.) Within 2010 TNC NFWF Prairie Coteau Boundary | GF&P Water Layer Acres Within 2010 TNC NFWF Prairie Coteau Boundary | 2012 Undisturbed Grassland Acres Within 2010 TNC NFWF Prairie Coteau Boundary | 2012 Undisturbed Woodlands Acres Within 2010 TNC NFWF Prairie Coteau Boundary | 2012 Total Undisturbed (Grasslands and Woodlands) Acres Within 2010 TNC NFWF Prairie Coteau Boundary | Percent of County Acres Classified as Undisturbed (Grasslands and Woodlands) Within 2010 TNC NFWF Prairie Coteau Boundary | 2012 Undisturbed Acres *With* 'Protected' Status Within the 2010 TNC NFWF Prairie Coteau Boundary | Percent of 2012 Undisturbed Acres *With* 'Protected' Status Within the 2010 TNC NFWF Prairie Coteau Boundary | Percent of County Acres Classified as 'Undisturbed' *With* 'Protected' Status Within the 2010 TNC NFWF Prairie Coteau Boundary |
| Brookings | 792 | 515,025 | 515,025 | 100.0% | 374,192 | 47,581 | 14,635 | **76,958** | **1,659** | **78,617** | 15.3% | **11,671** | 14.8% | 2.3% |
| Brown | 1,713 | 1,107,146 | 42,114 | 3.8% | 30,239 | 5,640 | 56 | **6,179** | **0** | **6,179** | 14.7% | **184** | 3.0% | 0.4% |
| Clark | 958 | 619,036 | 578,000 | 93.4% | 396,621 | 23,499 | 45,665 | **111,959** | **256** | **112,215** | 19.4% | **27,984** | 24.9% | 4.8% |
| Codington | 689 | 458,789 | 458,789 | 100.0% | 303,274 | 42,187 | 32,693 | **80,478** | **157** | **80,635** | 17.6% | **13,447** | 16.7% | 2.9% |
| Day | 1,028 | 698,013 | 685,426 | 98.2% | 436,693 | 17,753 | 108,939 | **120,000** | **2,040** | **122,040** | 17.8% | **28,049** | 23.0% | 4.1% |
| Deuel | 623 | 407,511 | 396,964 | 97.4% | 247,248 | 29,089 | 10,344 | **109,162** | **1,122** | **110,283** | 27.8% | **39,633** | 35.9% | 10.0% |
| Grant | 681 | 440,242 | 221,067 | 50.2% | 117,668 | 11,631 | 1,803 | **85,681** | **4,284** | **89,964** | 40.7% | **36,146** | 40.2% | 16.4% |
| Hamlin | 507 | 344,191 | 344,191 | 100.0% | 256,133 | 22,938 | 27,444 | **37,379** | **296** | **37,675** | 10.9% | **4,656** | 12.4% | 1.4% |
| Kingsbury | 832 | 552,500 | 356,593 | 64.5% | 248,123 | 22,876 | 41,727 | **43,446** | **420** | **43,867** | 12.3% | **7,093** | 16.2% | 2.0% |
| Lake | 563 | 367,942 | 324,401 | 88.2% | 258,763 | 23,635 | 13,005 | **28,626** | **371** | **28,997** | 8.9% | **4,360** | 15.0% | 1.3% |
| Marshall | 838 | 566,512 | 323,660 | 57.1% | 132,088 | 14,716 | 36,468 | **131,097** | **9,291** | **140,388** | 43.4% | **50,314** | 35.8% | 15.5% |
| McCook | 574 | 369,238 | 30,001 | 8.1% | 21,644 | 1,422 | 800 | **5,815** | **320** | **6,135** | 20.4% | **290** | 4.7% | 1.0% |
| Miner | 570 | 364,998 | 3,232 | 0.9% | 2,805 | 226 | 42 | **159** | **0** | **159** | 4.9% | **0** | 0.0% | 0.0% |
| Minnehaha | 807 | 520,746 | 471,270 | 90.5% | 338,895 | 69,093 | 6,652 | **52,584** | **4,046** | **56,630** | 12.0% | **2,970** | 5.2% | 0.6% |
| Moody | 519 | 333,518 | 333,518 | 100.0% | 261,307 | 24,759 | 2,831 | **43,255** | **1,367** | **44,621** | 13.4% | **4,733** | 10.6% | 1.4% |
| Roberts | 1,101 | 726,494 | 202,289 | 27.8% | 68,677 | 9,480 | 6,229 | **106,530** | **11,372** | **117,902** | 58.3% | **41,500** | 35.2% | 20.5% |
| Spink | 1,504 | 965,715 | 147,969 | 15.3% | 113,012 | 8,637 | 358 | **25,955** | **7** | **25,962** | 17.5% | **3,157** | 12.2% | 2.1% |
| Total | **14,300** | **9,152,096** | **5,434,508** | **59.4%** | **3,607,384** | **375,162** | **349,691** | **1,065,262** | **37,009** | **1,102,271** | **20.3%** | **276,184** | **25.1%** | **5.1%** |

Overall, we believe that our 'undisturbed' grassland and woodland layers may harbor several thousand acres with a disturbance history, but we do not feel the impacts of such will significantly alter the overall evaluation of acres/area of remnant native land tracts across landscape.

# Project Deliverables

It is our intent to openly share the results of this project with partner organizations. Currently, there exists no comprehensive or accurate source of data depicting undisturbed (native) grasslands in South Dakota. While Minnesota does have several data layers developed through the Minnesota County Biological Survey that depict various qualities and locations of remaining native grasslands, they do not have a source to locate all remaining undisturbed tracts (regardless of quality).

As an example, Figure 4 depicts the difference between The Nature Conservancy's native grassland layer developed at a regional scale (circa 2001) as compared to our recent layer developed under this methodology. While the 2001 regional layer (depicted with the dark outline) captures the large blocks, it does not capture the remnant scattered native grasslands.

Our data will provide Federal, State, and NGO conservation organizations an additional tool for estimating native grassland and woodland conversion rates over time and space as well as a base layer for establishing/refining grassland protection strategies, conservation programs, and focus areas. Finally, while we are not able to include an analysis of remnant grassland quality, our data will provide a 'road map' for future analysis of the quality of the identified grasslands, aiding in refining research and monitoring locations when such studies require focus on particular habitats.

Specifically, each phase of the project will build toward a single comprehensive coverage map (shape file) of remaining potential undisturbed grassland and woodlands. This shapefile and all associated maps and reports will be made available upon request.

Further, we will provide county level maps that will help further define areas where more localized programs or partnerships may be developed (Figure 5).

Figure 5: Clark County, SD Undisturbed Grassland map based on 2012 data.

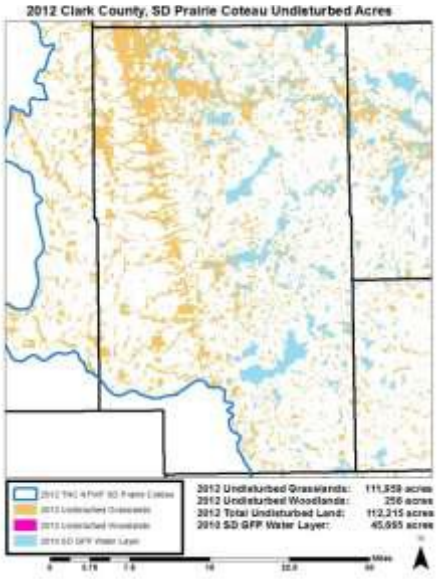
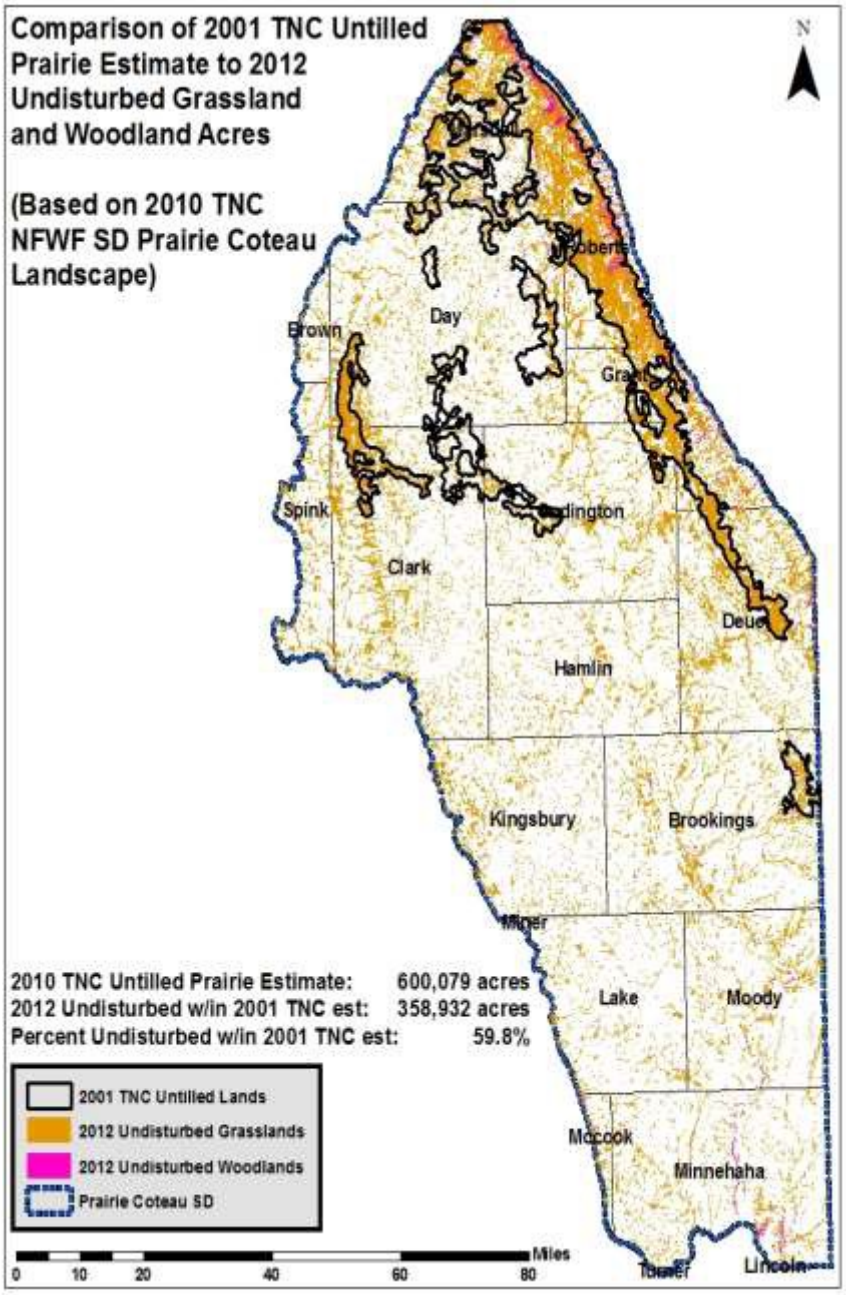



Figure 4: Occurrence of 2012 undisturbed grassland and woodland areas as compared to 2001 TNC Untilled Prairie areas of the South Dakota Prairie Coteau.



# Description of Project Land Mapping Phases

## Phase I: South Dakota Prairie Coteau Landscape Area

**Description:** All or portions of 17 eastern South Dakota counties as defined by The Nature Conservancy and the National Fish and Wildlife Foundation in their Business Plan for the Prairie Coteau.
**Completion Cost:** ~ $30,518
**Primary Funding Source:** The Nature Conservancy, federal NFWF grant funds
**Completion target date:** Completed June 2014

| Phase I. South Dakota Prairie Coteau Landscape Area | | | | |
|---|---|---|---|---|
| **County** | **Landcape/project area phase** | **State** | **Total county $mi^2$** | **$mi^2$ completed in SD Prairie Coteau Phase I** |
| **Brookings** | Prairie Coteau | SD | 792 | 66 |
| **Clark** | Prairie Coteau | SD | 958 | 903 |
| **Codington** | Prairie Coteau | SD | 689 | complete |
| **Day** | Prairie Coteau | SD | 1,028 | 1,020 |
| **Deuel** | Prairie Coteau | SD | 623 | 620 |
| **Grant** | Prairie Coteau | SD | 681 | 345 |
| **Hamlin** | Prairie Coteau | SD | 507 | complete |
| **Kingsbury** | Prairie Coteau | SD | 832 | 557 |
| **Lake** | Prairie Coteau | SD | 563 | 507 |
| **Marshall** | Prairie Coteau | SD | 838 | 506 |
| **McCook** | Prairie Coteau | SD | 574 | 47 |
| **Miner** | Prairie Coteau | SD | 570 | 5 |
| **Minnehaha** | Prairie Coteau | SD | 807 | 736 |
| **Moody** | Prairie Coteau | SD | 519 | complete |
| **Roberts** | Prairie Coteau | SD | 1,101 | 316 |
| **Spink** | Prairie Coteau | SD | 1,504 | 231 |
| | **Totals** | | **12,587** | **5,859** |

## Phase II(A&B): Minnesota Prairie Coteau Landscape Area

**Description:** II(A) will include all or portions of 11 Western Minnesota counties as defined by The Nature Conservancy and the National Fish and Wildlife Foundation in their Business Plan for the Minnesota Prairie Coteau. II(B) will include all or portions of 4 western MN counties in the Lac Qui Parle management team work area.

**Estimated Completion Cost:** $38,209

**Primary Funding Source:** Minnesota DNR, non-federal funds

**Completion target date:** February 2015

| Phase II. Minnesota Prairie Coteau Landscape Area | | | | |
|---|---|---|---|---|
| **County** | **Landcape/project area phase** | **State** | **Phase II to be completed MN Prairie Coteau mi$^2$** | **Est time to complete phase II MN Prairie Coteau(15 mi$^2$/hr)** |
| **Lac qui Parle** | Prairie Coteau | MN | 12 | 1 |
| **YellowMedicine** | Prairie Coteau | MN | 100 | 7 |
| **Redwood** | Prairie Coteau | MN | 34 | 2 |
| **Lincoln** | Prairie Coteau | MN | 543 | 36 |
| **Lyon** | Prairie Coteau | MN | 397 | 26 |
| **Pipestone** | Prairie Coteau | MN | 466 | 31 |
| **Murray** | Prairie Coteau | MN | 720 | 48 |
| **Cottonwood** | Prairie Coteau | MN | 371 | 25 |
| **Rock** | Prairie Coteau | MN | 483 | 32 |
| **Nobles** | Prairie Coteau | MN | 723 | 48 |
| **Jackson** | Prairie Coteau | MN | 571 | 38 |
| | **Totals** | | **4,420** | **295** |
| | **40 hr weeks needed to complete** | | | **7** |


| Phase II(B). Minnesota Lac Qui Parle Area | | | | |
|---|---|---|---|---|
| **County** | **Landcape/project area phase** | **State** | **Phase II to be completed MN Prairie Coteau mi$^2$** | **Est time to complete phase II MN Prairie Coteau(15 mi$^2$/hr)** |
| **Big Stone** | Lac Qui Parle | MN | 499 | 33 |
| **Chippewa** | Lac Qui Parle | MN | 581 | 39 |
| **Lac Qui Parle** | Lac Qui Parle | MN | 765 | 51 |
| **Swift** | Lac Qui Parle | MN | 742 | 49 |
| | **Totals** | | **2,587** | **172** |
| | **40 hr weeks needed to complete** | | | **4** |

## Phase III: South Dakota Missouri Coteau Landscape Area

**Description:** All or portions of 17 eastern South Dakota Counties as defined by The Nature Conservancy and the National Fish and Wildlife Foundation in their Business Plan for the Prairie Coteau:

**Estimated Completion Cost:** $20,000

**Primary Funding Source:** The Nature Conservancy, non-federal funds

**Completion target date:** April 2015

| Phase III. South Dakota Missouri Coteau Landscape Area | | | | | |
|---|---|---|---|---|---|
| **County** | **Landcape/project area phase** | **State** | **Total county $mi^2$** | **Phase III to be completed Missouri Coteau $mi^2$** | **Est time to complete phase III Mo. Coteau (15 $mi^2$/hr)** |
| **Campbell** | Missouri Coteau | SD | 734 | 257 | 17 |
| **Edmunds** | Missouri Coteau | SD | 1,126 | 794 | 53 |
| **Faulk** | Missouri Coteau | SD | 982 | 557 | 37 |
| **Hand** | Missouri Coteau | SD | 1,437 | 65 | 4 |
| **Hyde** | Missouri Coteau | SD | 861 | 247 | 16 |
| **McPherson** | Missouri Coteau | SD | 1,137 | 881 | 59 |
| **Potter** | Missouri Coteau | SD | 861 | 214 | 14 |
| **Sully** | Missouri Coteau | SD | 1,007 | 112 | 7 |
| **Walworth** | Missouri Coteau | SD | 709 | 56 | 4 |
| | **Totals** | | **8,852** | **3,183** | **212** |
| | **40 hr weeks needed to complete** | | | | **5** |

## Phase IV(A&B): Completion of South Dakota East River Counties

**Description:** IV(A&B) includes all 44 eastern South Dakota Counties and will complete those counties only partially mapped during Phases I and III.

**Estimated Completion Cost:** $70,000

**Primary Funding Source:** IV(A) SD NRCS ($35,000 federal funds); IV(B)SD GF&P (35,000 non-federal funds)

**Completion target date:** December 2015

| Phase IV. Completion of South Dakota East River Counties | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| County | Landcape/project area phase | State | Total county $mi^2$ | $mi^2$ completed in SD Prairie Coteau Phase I | Phase III to be completed Missouri Coteau $mi^2$ | Est time to complete phase III Mo. Coteau (15 $mi^2$/hr) | Phase IV Remainder East River mi2 | Est time to complete Phase IV Remainder East River (15 $mi^2$/hr) |
| Campbell | Missouri Coteau | SD | 734 | | 257 | 17 | 477 | 32 |
| Edmunds | Missouri Coteau | SD | 1,126 | | 794 | 53 | 332 | 22 |
| Faulk | Missouri Coteau | SD | 982 | | 557 | 37 | 425 | 28 |
| Hand | Missouri Coteau | SD | 1,437 | | 65 | 4 | 1,372 | 91 |
| Hyde | Missouri Coteau | SD | 861 | | 247 | 16 | 614 | 41 |
| McPherson | Missouri Coteau | SD | 1,137 | | 881 | 59 | 256 | 17 |
| Potter | Missouri Coteau | SD | 861 | | 214 | 14 | 647 | 43 |
| Sully | Missouri Coteau | SD | 1,007 | | 112 | 7 | 895 | 60 |
| Walworth | Missouri Coteau | SD | 709 | | 56 | 4 | 653 | 44 |
| Brookings | Prairie Coteau | SD | 792 | 66 | | | 726 | 48 |
| Clark | Prairie Coteau | SD | 958 | 903 | | | 55 | 4 |
| Codington | Prairie Coteau | SD | 689 | complete | | | 0 | 0 |
| Day | Prairie Coteau | SD | 1,028 | 1,020 | | | 8 | 1 |
| Deuel | Prairie Coteau | SD | 623 | 620 | | | 3 | 0 |
| Grant | Prairie Coteau | SD | 681 | 345 | | | 336 | 22 |
| Hamlin | Prairie Coteau | SD | 507 | complete | | | 0 | 0 |
| Kingsbury | Prairie Coteau | SD | 832 | 557 | | | 275 | 18 |
| Lake | Prairie Coteau | SD | 563 | 507 | | | 56 | 4 |
| Marshall | Prairie Coteau | SD | 838 | 506 | | | 332 | 22 |
| McCook | Prairie Coteau | SD | 574 | 47 | | | 527 | 35 |
| Miner | Prairie Coteau | SD | 570 | 5 | | | 565 | 38 |
| Minnehaha | Prairie Coteau | SD | 807 | 736 | | | 71 | 5 |
| Moody | Prairie Coteau | SD | 519 | complete | | | 0 | 0 |
| Roberts | Prairie Coteau | SD | 1,101 | 316 | | | 785 | 52 |
| Spink | Prairie Coteau | SD | 1,504 | 231 | | | 1,273 | 85 |
| Aurora | East River | SD | 708 | | | | 708 | 47 |
| Beadle | East River | SD | 1,259 | | | | 1,259 | 84 |
| Bon Homme | East River | SD | 564 | | | | 564 | 38 |
| Brown | East River | SD | 1,713 | | | | 1,713 | 114 |
| Brule | East River | SD | 817 | | | | 817 | 54 |
| Buffalo | East River | SD | 471 | | | | 471 | 31 |
| Charles Mix | East River | SD | 1,097 | | | | 1,097 | 73 |
| Clay | East River | SD | 412 | | | | 412 | 27 |
| Davison | East River | SD | 436 | | | | 436 | 29 |
| Douglas | East River | SD | 432 | | | | 432 | 29 |
| Hanson | East River | SD | 435 | | | | 435 | 29 |
| Hughes | East River | SD | 742 | | | | 742 | 49 |
| Hutchinson | East River | SD | 813 | | | | 813 | 54 |
| Jerauld | East River | SD | 526 | | | | 526 | 35 |
| Lincoln | East River | SD | 577 | | | | 577 | 38 |
| Sanborn | East River | SD | 569 | | | | 569 | 38 |
| Turner | East River | SD | 617 | | | | 617 | 41 |
| Union | East River | SD | 461 | | | | 461 | 31 |
| Yankton | East River | SD | 521 | | | | 521 | 35 |
| | Totals | | 34,609 | 5,859 | 3,183 | 212 | 23,852 | 1,590 |
| | 40 hr weeks needed to complete | | | | | 5 | | 40 |

## Phase V: South Dakota West River Counties

**Description:** Includes all 22 western South Dakota Counties.
**Estimated Completion Cost:** $105,000
**Anticipated Primary Funding Sources:**
SD Grasland Coalition/SD DENR 319 grant funds, NGPJV, others
**Anticipated source of cash match applied toward Federal 319 funds:** MN DNR, TNC, SD GF&P, NGPJV, others.
**Completion target date:** June 2017

| Phase IV. South Dakota West River Counties | | | | | |
|---|---|---|---|---|---|
| **County** | **Landcape/project area phase** | **State** | **Total county $mi^2$** | **Phase V West River $mi^2$** | **Est time to complete Phase V (15 $mi^2$/hr)** |
| **Bennett** | West River | SD | 1,185 | 1,185 | 79 |
| **Butte** | West River | SD | 2,250 | 2,250 | 150 |
| **Corson** | West River | SD | 2,470 | 2,470 | 165 |
| **Custer** | West River | SD | 1,557 | 1,557 | 104 |
| **Dewey** | West River | SD | 2,302 | 2,302 | 153 |
| **Fall River** | West River | SD | 1,740 | 1,740 | 116 |
| **Gregory** | West River | SD | 1,015 | 1,015 | 68 |
| **Haakon** | West River | SD | 1,811 | 1,811 | 121 |
| **Harding** | West River | SD | 2,671 | 2,671 | 178 |
| **Jackson** | West River | SD | 1,864 | 1,864 | 124 |
| **Jones** | West River | SD | 970 | 970 | 65 |
| **Lawrence** | West River | SD | 800 | 800 | 53 |
| **Lyman** | West River | SD | 1,642 | 1,642 | 109 |
| **Meade** | West River | SD | 3,471 | 3,471 | 231 |
| **Mellette** | West River | SD | 1,307 | 1,307 | 87 |
| **Pennington** | West River | SD | 2,777 | 2,777 | 185 |
| **Perkins** | West River | SD | 2,870 | 2,870 | 191 |
| **Shannon** | West River | SD | 2,094 | 2,094 | 140 |
| **Stanley** | West River | SD | 1,444 | 1,444 | 96 |
| **Todd** | West River | SD | 1,389 | 1,389 | 93 |
| **Tripp** | West River | SD | 1,612 | 1,612 | 107 |
| **Ziebach** | West River | SD | 1,961 | 1,961 | 131 |
| | **Totals** | | **41,202** | **41,202** | **2,747** |
| | **40 hr weeks needed to complete** | | | | **69** |

## Phase VI: Additional Minnesota Counties as Requested

**Description:** NA.
**Estimated Completion Cost: NA**
**Primary Funding Source:** MN DNR, Others
**Completion target date:** NA

# Description of Watershed Modeling

**Modeling grassland hydrology and water quality**

## 1. Objective

The objective of this study is to evaluate changes in hydrology and water quality associated with changes in the extent of South Dakota's grassland. Distinction in specific grass species will not be considered in the simulations. The term "grass" and "grassland" in this study pertain to the family of native grass in general.

## 2. Study watersheds

Three watersheds, selected respectively in the Prairie Coteau (eastern South Dakota), Missouri Plateau (central South Dakota), and Great Plains of western South Dakota, will be used for the analysis (Figure 1). These locations are identified for the selection of the study watersheds because of the abundance of undisturbed grassland in these areas. In addition, these areas are representative of grass landscape in South Dakota and the Western Corn Belt States.

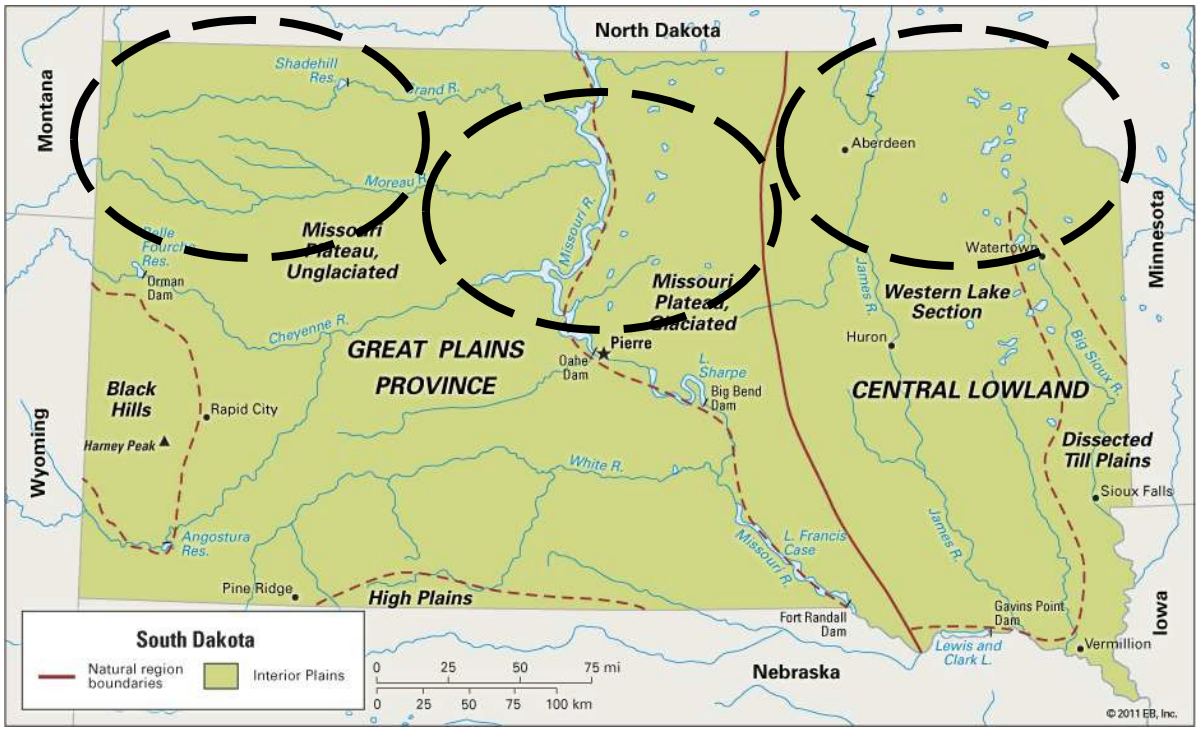



Figure 1. South Dakota map (from Britannica.com) showing potential locations of the three watersheds to be used in the proposed study. These locations are indicated with dashed circles.

## 3. Data and watershed model

*3.1.Data description*

Streamflow, precipitation, water quality, and land use are the major datasets that will be utilized for the analysis. More than 15 years of daily streamflow data measured near the outlets of the selected

watersheds will be obtained from USGS observation stations for a period of 1995-2010. Climate data (e.g. precipitation and temperature) corresponding also to the study period for rain gage stations located in the study watersheds will be obtained from South Dakota Office of Climatology. Water quality data for sediment, total phosphorus (TP), nitrate-nitrogen ($NO_3$-N), and fecal coliform bacteria, collected at water quality stations within the watersheds, will be obtained from the South Dakota Department of Environment and Natural Resources (DENR) for the 1995-2010 study period. The land use maps to be used in the anaylsis will be a mixture of land use maps from the National Land Cover Database (NLCD), quantified land uses (Reitsma et al., 2014), and hypothetical land uses (see "Simulation Scenarios" section below for further description on the land use maps).

### *3.2.Watershed model description*

The analysis proposed in this study will use the Soil and Water Assessment Tool (SWAT; Arnold et al., 1998). SWAT is a process-based, distributed-parameter watershed scale model for simulation of long-term hydrologic and water quality impacts of various watershed management strategies (Arnold et al., 1998). The model has been widely used in many watershed scale studies (e.g. Gitau et al., 2004; Gassman et al., 2007; Chaubey et al., 2010; Cibin et al., 2012). SWAT divides the watershed into subwatersheds using watershed topographic information. During simulations, each subwatershed is treated as an individual unit. The subwatersheds are further partitioned into hydrologic response units (HRU) using land use, soil and slope information. The HRU is the smallest spatial unit that the model uses to simulate hydrologic, sediment, nutrient, and agricultural chemical yields. The model is capable for routing runoff and chemicals through streams and reservoirs with readily available input data (precipitation, temperature, solar radiation, relative humidity and wind speed). Other basic input data, besides weather, required for the SWAT model include topography, land use, soil and management information. It also allows addition of flows and inclusion of measured data from point sources. The major components of the model consist of weather, surface runoff, groundwater/baseflow, percolation, return flow, evapotranspiration (ET), transmission losses, pond and reservoir storage, reach routing, crop growth, irrigation, groundwater flow, nutrient and pesticide loads, and water transfer. Detailed description of the SWAT model components and representation of hydrologic and water quality processes is provided in Neitsch et al. (2005; 2009).

## 4. Simulation scenarios

The SWAT model will be calibrated and validated using a split-time approach (Schilling et al., 2014) at monthly time-scale. The calibration and validation periods will be set to two non-overlapping periods, consisting of 1995-2002 and 2003-2010, respectively.

To assess how changing grassland extent would influence streamflow and water quality in the in the study watersheds, a baseline scenario will be simulated with the calibrated model for a period of 1995-2010 (16 years). The baseline scenario will allow to have a reference case for comparison prior to performing "what if" scenario simulations. The following land use conditions will be evaluated in each of the three locations selected for the proposed study:

- Baseline scenario: In this scenario, the existing land use condition in the watersheds will be evaluated with land use map extracted from NLCD and quantified grassland map (see Reitsma et al.,

2014 and Bauman, 2014). Although many land use maps are currently available in NLCD, the 2011 national land cover dataset (http://www.mrlc.gov/nlcd2011.php) will be used in the proposed study to portray the latest existing land use condition in the watersheds. Quantification of undisturbed grassland are described in a section above (see section "will put Pete Bauman's section here" of this proposal). All "what if" scenarios will be simulated with hypothetical land uses, which follow.

- Hundred percent grass scenario: All of the cropland in the watersheds will be converted to grass; we will assume grass at mature stage.
- Fifty percent grass scenario: In this scenario, 50% of the cropland in the watersheds will be grass and the other 50% will be the existing cropland condition.
- Corn-grass scenario: 50% of the cropland in the watersheds will be grass and the other 50% will be planned for corn.
- Soybean-grass scenario: 50% of the cropland in the watersheds will be grass and the other 50% will be soybean.
- Alfalfa-grass scenario: 50% of the cropland in the watersheds will be grass and the other 50% will be alfalfa.
- Upstream grass scenario: All of the cropland in upstream subwatersheds will be grass and the remaining watersheds (central and southern portions) will be kept in the existing land use condition.
- Center grass scenario: All of the cropland in the central portion of the watersheds will be grass and the remaining watersheds (upstream and southern portions) will be kept in the existing land use condition.
- Downstream grass scenario: All of the cropland in the downstream portion of the watersheds will be grass and the remaining watersheds (central and southern portions) will be kept in the existing land use condition.

**5. Statistical analysis**

Tukey pairwise comparison tests will be used to evaluate differences between mean annual surface runoff, streamflow, losses in sediment, TP, $NO_3$-N, and fecal coliform bacteria associated with land use scenarios within each watershed.

6. **Anticipated funding:** It is anticipated funding for the watershed modeling project will be provided through the SD Grasland Coalition/SD DENR 319 grant funds with match provided through South Dakota State University.

SDSU Extension

The Nature Conservancy
Protecting nature. Preserving life.

# QUANTIFYING UNDISTURBED LAND ON SOUTH DAKOTA'S PRAIRIE COTEAU

6/30
2014

A report to The Nature Conservancy from South Dakota State University based on the Prairie Coteau boundary as defined by the April 30, 2010 TNC National Fish and Wildlife Foundation Business Plan "Conserving and Restoring Tallgrass Prairie: Prairie Coteau, South Dakota and Minnesota".

**Authors:**
**Pete Bauman**, SDSU Extension Range Field Specialist, Watertown, SD.
**Joe Blastick**, Land Steward, The Nature Conservancy, Clear Lake, SD.
**Cody Grewing**, SDSU Senior Agriculture Technician, Brookings, SD.
**Alexander Smart**, SDSU Range Professor, Brookings, SD.

**Acknowledgements:**

Jim Madsen, contractor: mapping support.

Matt Morlock, Field Data Team Analyst, SD Pheasants Forever, assisted with initial GIS systems development and interpretation of FSA Common Land Unit data.

The following SDSU staff provided assistance with mapping methods, analysis, lab space and manuscript review: Xu Lan, Associate Professor, Plant Ecology/Rangeland Ecology; Dianne Narem, Graduate Research Assistant, Plant Ecology/Rangeland Ecology; Kurt Reitsma, SDSU Extension Associate; Michael Wimberly, Professor and Senior Scientist, Geospatial Sciences Center of Excellence;
Carol Johnston, Professor, Wetland Ecosystems/GIS Applications in Ecology.

Common Land Unit data provided by South Dakota Farm Services Agency under a USDS Section 1619 Cooperator Memorandum of Understanding, Huron, SD. South Dakota Farm Services Agency staff that assisted in securing Common Land Unit data included Jamie White, Executive Officer; Daryl Campbell, Agriculture Program Specialist. Huron, SD.

South Dakota water data layer provided by South Dakota Department of Game, Fish, and Parks, Pierre, SD. The following SD Game, Fish and Parks Staff provided assistance with mapping data and access to imagery: Chelsea Krause, Division Staff Specialist – GIS Coordinator; Dave Ode, Coordinator of the SD Natural Heritage Database. Pierre, SD.

South Dakota Nature Conservancy ownership, 2001 untilled prairie, and Northern Prairies Land Trust easement data layers provided by the Nature Conservancy, Minneapolis, MN. The Nature Conservancy staff that assisted included Emily Mack, Field Steward, Prairie Coteau Project Office, Clear Lake, SD; Rich Johnson, Conservation Information Manager, Minnesota Field Office, Minneapolis, MN.

South Dakota US Fish and Wildlife Service protected lands data provided by the Habitat and Population Evaluation Team (HAPET), Bismarck, ND. US Fish and Wildlife Service staff that assisted with securing grassland easement data included Connie Mueller, Project Leader, Waubay National Wildlife Refuge Complex, Waubay, SD; Susan Kvas, Supervisory Fish and Wildlife Biologist, Habitat and Population Evaluation Team (HAPET), Bismarck, ND.

***Funding for this research provided by The Nature Conservancy through a grant awarded from the National Fish and Wildlife Foundation (NFWF Grant Agreement #2009-0084-000)***

# *Executive Summary:*

We employed simple GIS methods and 2012 USGS aerial imagery to evaluate land use in all or portions of 17 counties within on the South Dakota portion of the Prairie Coteau. Central to our process was the acquisition and use of South Dakota Farm Service Agency's 2012 Common Land Unit (CLU) data layer. We utilized the CLU layer to identify all areas of known previous and current cropping history and then removed those acres from analysis. We then removed all known large water bodies as defined by South Dakota Game, Fish, and Parks Department's 2010 water layer. Finally, we evaluated the landscape by reviewing remaining land in every square-mile (approximately 8,500 sections) for additional disturbances (farms, gravel pits, building sites, recent cropping, etc.). The remaining land tracts were then categorized as 'undisturbed grassland' or 'undisturbed woodland'. We estimate there are approximately 1,102,271 acres of undisturbed grasslands and woodlands remaining representing (20.3%) of the 5,434,508 total acres within the South Dakota Prairie Coteau Boundary as defined by the 2010 TNC NFWF Business Plan. Of these 1,102,271 remnant undisturbed acres, 1,065,262 acres (96.6%) are classified as 'undisturbed grasslands' and 37,009 acres (3.4%) are 'undisturbed woodlands'. Approximately 276,184 acres (25.1%) of undisturbed grasslands and woodlands are permanently protected from conversion through conservation ownership or permanent conservation easements, representing 5.1% of the 5,434,508 total SD Prairie Coteau Acres. Overall, 1,140,732 acres are included in thirteen TNC Conservation Focus Areas. Our data suggests that 512,841 acres (45.0%) of the Focus Areas are classified as undisturbed grasslands and woodlands, with 199,791 acres (39%) of those undisturbed grasslands and woodlands acres within Focus Areas under permanent conservation protection status. These 199,197 undisturbed protected acres only represent 17.5% of the 1,140,732 total Focus Area acres and 3.7% of the 5,434,508 total SD Prairie Coteau Acres.

# Quantifying undisturbed land on South Dakota's Prairie Coteau

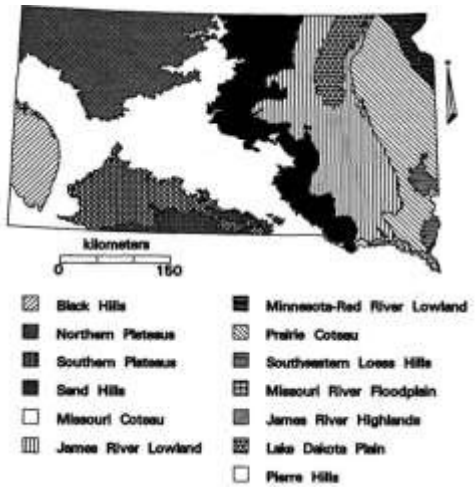
**A REPORT TO THE NATURE CONSERVANCY FROM SOUTH DAKOTA STATE UNIVERSITY BASED ON THE PRAIRIE COTEAU BOUNDARY AS DEFINED BY THE APRIL 30, 2010 TNC NATIONAL FISH AND WILDLIFE FOUNDATION BUSINESS PLAN "CONSERVING AND RESTORING TALLGRASS PRAIRIE: PRAIRIE COTEAU, SOUTH DAKOTA AND MINNESOTA".**

## Introduction:

The Prairie Coteau portion of the Prairie Pothole Region is a rich Wisconsin-age glacial moraine extending from north of the North Dakota-South Dakota border in Sargent County, ND near Veblen, SD through several southeastern South Dakota and southwestern Minnesota Counties. The Prairie Coteau is characterized by agricultural and non-agricultural land uses, tallgrass prairie managed as habitat, native and tame pastures, wetlands, and eastern deciduous forests in the coulees or draws (Loeschke circa 1995). Also unique to the Prairie Coteau geology and ecology are its perennial flowing streams, rich east-slope woodlands, and relative abundance of calcareous fens.

Elevation of the Prairie Coteau Ranges from 1,250 to over 2000 feet above sea level and rises to over 600 feet above the surrounding valleys of the Minnesota and James Rivers (USGS 2013). Several small tributaries originate on the Prairie Coteau, condensing into increasingly larger streams and contributing to the flows of larger rivers such as the James, Big Sioux, and Minnesota Rivers; ultimately contributing to the Missouri, Mississippi, and Red River Basins.

Figure 1. The Prairie Coteau as defined by Johnson et al. (1995).



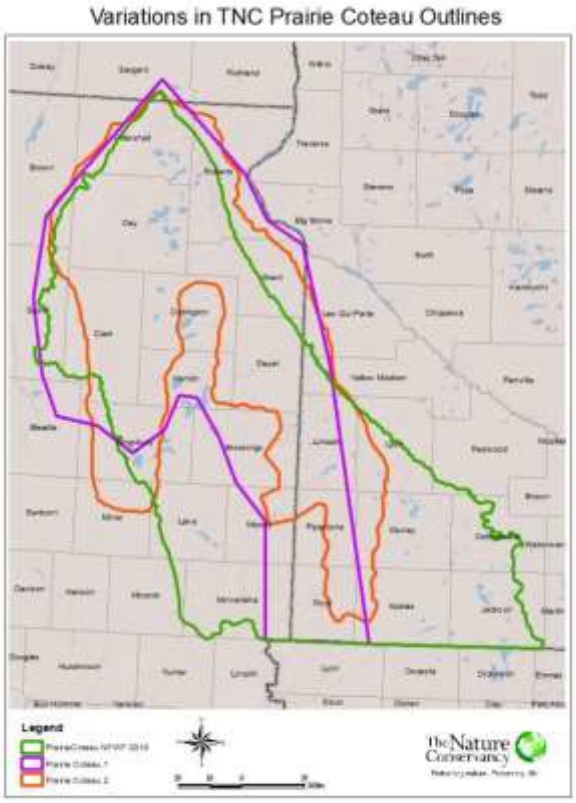

The Prairie Coteau was described by George Catlin in 1844 as "perhaps the noblest mound of its kind in the world". Several internal reports by The Nature Conservancy (TNC or the Conservancy) address the value of the Prairie Coteau to the Northern Great Plains (Aldreich et al. 1997, TNC 1998, Chapman et al. 1998, Leoschke circa 1995, Miller 2001, TNC NFWF 2010). Collectively, these reports include estimates of native untilled grasslands on the Prairie Coteau ranging from 700,000 acres (Miller 2001) to 1.4 million acres (TNC NFWF 2010).

Although the Prairie Coteau is a unique land form, there is no singular authority that has defined the landscape boundaries. Initial maps by early explores such as Nicollet's 1845 map

were inaccurate, and several authors since have defined physiographic regions based on various geographic criteria (Johnson et al 1995). Johnson et al. (1995) mapped South Dakota's physiographic regions based primarily on soils informed by topographic features, and this is perhaps the most comprehensive study on the matter in regard to the geographical shape of the Prairie Coteau in South Dakota (Figure 1). Johnson et al. (1995) sized the Prairie Coteau in South Dakota at 22,471 $km^2$, or roughly 5.5 million acres.

> ***Prairie Coteau***
>
> *The Prairie Coteau (Fig. 2) is a wedge-shaped highland with its apex just north of the South Dakota-North Dakota border in Sargent County, North Dakota. Its eastern and western escarpments are steepest in the north and taper off to the south. Near its northern end, the plateau of the Prairie Coteau lies 300 m above the Minnesota-Red River Lowland. The region's topography is highly variable and was formed by a series of glacial advances over a preglacial shale plateau (Flint 1955; Lemke et al. 1965). Each successive glacial advance was less extensive, and consequently glacial drift and topography are older at the center of the coteau. High relief knob-and-kettle terrain, produced chiefly by the collapse of superglacial till from the Mankato substage of glaciation, occurs at the north end of the coteau, and along the eastern margin where the escarpment is steepest. Extensive areas of Carey substage-age till occur throughout the west and central portions of the Coteau along its longest axis. The most mature topography occurs east of the Big Sioux River in an area of relatively dissected terrain with numerous tributary streams.*
>
> *Turkey Ridge is a range of highlands in southeastern South Dakota which Flint (1955) included in the James River Highlands physiographic region. This site and the area to the north and east have the same glacial history and soils as the rest of the Prairie Coteau. Based on soils, we extended the Prairie Coteau southward to include Turkey Ridge and the intervening area.*
>
> *Soil series used to delineate the Prairie Coteau (Table 1) are Udic Hap10borolls in the north, and Udic Hap1ustolls south of an east-west axis through the center of the Coteau along the southern borders of Brookings and Kingsbury counties. Other soil series used to delineate the Prairie Coteau belonged to Typic Ca1ciboroll, Typic Endoaquoll, and Udertic Haploboroll taxonomic subgroups.*
>
> - Johnson et al. (1995)

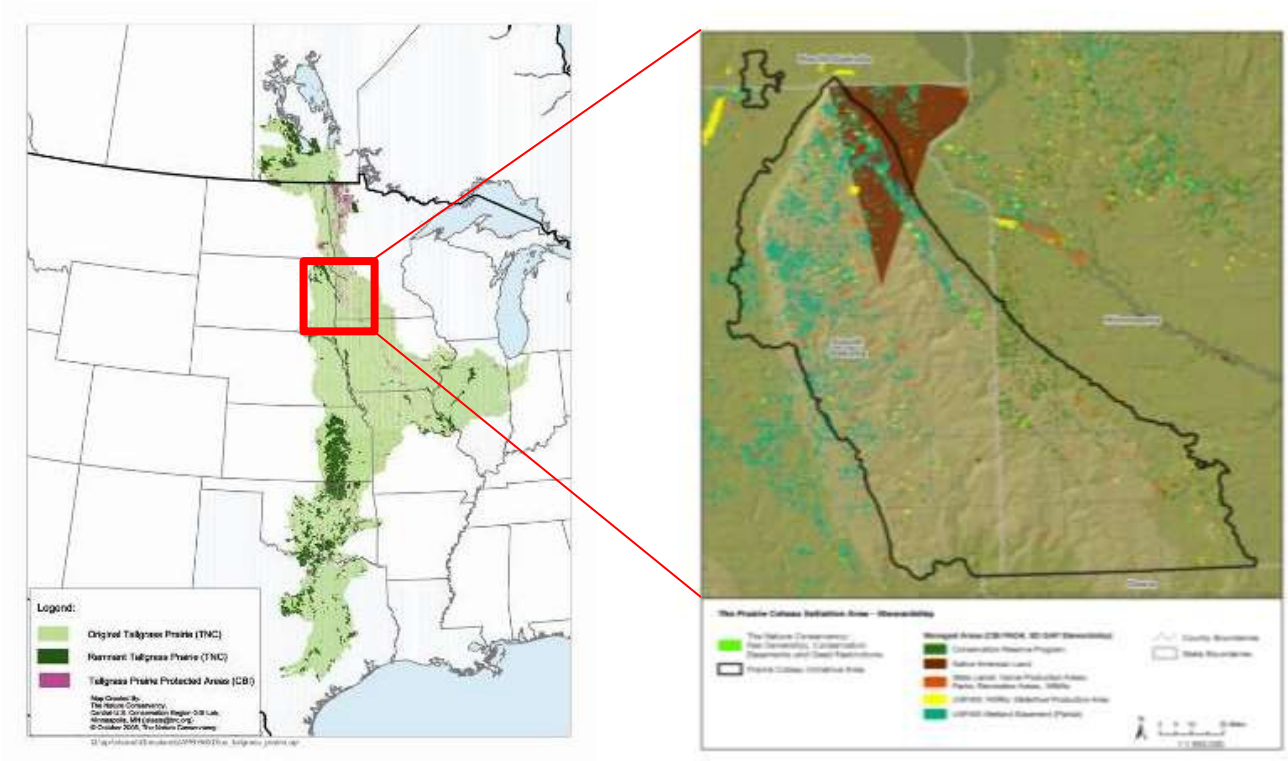
Figure 2. The Prairie Coteau as defined by The Nature Conservancy in recent years. The most current being the 2010 TNC NFWF Business Plan boundary (green).




Beyond geography, the actual boundary of a landscape can be defined based on a mix of geology and programmatic goals. Johnson et al. (1995) suggested that "landscapes within physiographic regions may have topography, land use, and wildlife habitat unlike adjacent regions". Smart et al. (2003) provide a vivid description of the Prairie Coteau beyond its strict geology or vegetation, discussing the overall scope and feel of the landscape.

The Nature Conservancy has used several iterations of the boundaries of the Prairie Coteau in recent years as a means of meshing the geological and ecological features of the landscape with programmatic goals and objectives of the organization (Figure 2). For the purposes of this analysis, we will use the 2010 TNC National Fish and Wildlife Foundation (NFWF) landform boundary as described in the 2010 TNC NFWF Business Plan (Figure 3) (TNC NFWF 2010).

Figure 3. The Prairie Coteau as defined by The Nature Conservancy in the 2010 TNC NFWF Business Plan.



This 2010 internal report developed by The Nature Conservancy as a Business Plan for the National Fish and Wildlife Foundation under the larger umbrella of the Prairie Coteau Habitat Partnership reported the following statistics for the Prairie Coteau (TNC NFWF 2010):

*"The Prairie Coteau is approximately 8.3 million acres in size. Of approximately 2.3 million acres of grassland (native prairie plus planted grassland) that remain in the Prairie Coteau (27.7% of the overall landform), 1.4 million acres of untilled tallgrass prairie (17.4% of landscape) were present in 2001. Another 703,000 acres (8.5%) of the landscape is covered by wetlands including 197,000 acres of temporary and seasonal wetland (many of which are cropped), 282,000 acres of semi-permanent wetland and 210,000 acres of permanent wetlands associated with lakes and ponds.*

*At least 262,000 acres of the untilled prairie (18%) are protected with federal or state grassland easements and if we assume a 50:50 mix of prairie:wetland on conservation lands owned in fee title (265,000 acres), an estimated 27 percent of the untilled grassland in the Prairie Coteau are protected. An additional 136,169 acres of wetlands and grassland buffer (19% of the wetlands) are protected with easements. With the same 50:50 mix of prairie:wetland on fee title conservation lands, an estimated 38 percent of the wetland is protected."*

It is important to note that the above synopsis was based on the entirety of the Prairie Coteau landform as defined in the report, including portions in Minnesota, South Dakota, and North Dakota. Within the NFWF outline for the Prairie Coteau lies 17 South Dakota counties including all or portions of: Marshall, Roberts, Day, Brown, Spink, Grant, Clark, Codington, Hamlin, Deuel, Brookings, Kingsbury, Lake, Moody, Miner, Minnehaha, and McCook; all or portions of 11 Minnesota counties including: Lac Qui Parle, Yellow Medicine, Lincoln, Lyon, Redwood, Pipestone, Murray, Cottonwood, Rock, Nobles,

and Jackson; and one North Dakota County: Sargent. This report only analyzes the 17 counties in the South Dakota portion of the Prairie Coteau (Figure 4).

Figure 4. South Dakota portion of the 2010 TNC NFWF Prairie Coteau boundary.


South Dakota is losing its perennial grassland cover at a rate that is concerning to many individuals and organizations. The statewide rate of grassland loss, while likely measurable, has not been quantified in regard to actual loss of *native* grasslands. The lack of specific data concerning native grassland loss is true of the Prairie Coteau region as well.

Several non-profit conservation organizations and government agencies have committed resources to this unique landscape. The Nature Conservancy (TNC), Pheasants Forever (PF), Ducks Unlimited (DU), Northern Prairies Land Trust (NPLT), US Fish and Wildlife Service (USFWS), and SD Game, Fish, and Parks are but a few of the most prominent organizations working to preserve the ecology of the area. While claims of the Prairie Coteau's relatively intactness are prevalent, the location and scope of truly native (untilled) grasslands remaining on the Prairie Coteau is difficult to quantify beyond the generalities provided in the 2010 TNC NFWF Business Plan. Ironically, while most of these organizations have made attempts to map and identify portions of the highest-quality regions, none have developed a base map that attempted to comprehensively quantify and map the actual remaining tracts of untilled or unaltered 'native' sod at a landscape scale.

The 2010 TNC NFWF Business Plan cites conversion, fragmentation, and degradation/homogenization as leading threats to the long-term integrity of the landscape, including but not limited issues with inappropriate grazing, suppressed fire, and invasive species. Categorically, Doherty et al. (2013) cited the similar landscape influences for the greater Prairie Pothole Region. Of particular importance is land conversion from grasslands to row-crop agriculture, the drivers of which are discussed thoroughly in papers cited in the discussion portion of this report. The 2010 Business Plan also states there are five areas on the South Dakota side of the Prairie Coteau that harbor over 20,000 acres of native prairie each. As with many such reports, numbers are derived via various measures and very little information is provided as to the source or accuracy of the total area or percent of untilled or native sod. It is assumed these statistics were a 'best guess' inferred from the information available at the time, including information derived from the Conservancy's 2001 untilled prairie data layer.

Most studies attempting to quantify land use change have utilized some type of GIS remote sensing or other technology to derive at a conversion rate. Most typically, studies rely on the National Agricultural Statistics Service's (NASS) Cropland Data Layer (CDL) to report total acres 'lost' or a percent change over a period of time (Wright and Wimberly 2013; Johnston 2013, 2014; Faber et al. 2012, Decision Innovation Solutions 2013). This type of analysis can be very powerful in reporting land use trends, but because researchers have not been able to accurately and consistently separate native grasslands from

other types of planted grasslands (such as CRP), grass-like crops (such as hayfields), or other grassy habitats using NASS CDL data, it becomes nearly impossible to accurately map vegetation type at a meaningful scale.

Decision Innovation Solutions (2013) addressed the issue of error in land covers reported by NASS CDL data, especially in relation to those that "are more grassy in nature". Typically, analysts group most or all of the following NASS CDL cover categories together under a 'grass' or 'grass-like' label for analysis: 36-alfalfa, 37-other hay/non-alfalfa, 62-pasture/grass, 87-wetlands, 171-grassland herbaceous, 181-pasture/hay, and 195-herbaceous wetlands. However, Johnston (2013) also found that NASS CDL data even confused corn crops with cattail sloughs. These issues with interpretation of NASS CDL data render it impossible to quantify acreage and location of undisturbed land or native sod with any confidence.

The objective of our work was to develop a simple, systematic, repeatable, and cost-effective approach to estimating location and total area of land tracts that are likely undisturbed (i.e. native) grasslands and woodlands on the South Dakota portion of the Prairie Coteau. The central component to our analysis was the utilization of the 2012 South Dakota Farm Service Agency's (FSA) Common Land Unit (CLU) cropland data layer.

# Methods

We utilized the South Dakota portion of the 2010 TNC NFWF Business Plan boundary for the Prairie Coteau as our analysis area. Sand Lake National Wildlife Refuge and the Hecla Sandhills were excluded from this analysis as they are disjunct landforms.

We developed a methodology for assessing the history of land use in the region via simple layering methods in ARC GIS in order to deduce the location and size of remaining land tracts that are potentially undisturbed (native) native sod - regardless of current vegetation type or quality. We utilized 2012 USGS aerial imagery (2012 National Ag. Imagery Program Mosaic, http://datagateway.nrcs.usda.gov/) as our base layer data, projected on-screen at approximately 8,000 ft. elevation to analyze approximately 8,500 square miles within the SD portion of the landscape boundary. This projection was selected to allow the technician to view a full square mile section (640 acres) when identifying, evaluating, and qualifying land use.

*Step 1:* The 2012 Farm Service Agency's (FSA) Common Land Unit (CLU) cropland data layer was then applied to the 17 counties of the South Dakota Prairie Coteau. We made no attempt in this study to verify the accuracy of the CLU cropland data layer, rather we accepted the layer as measured data provided by FSA. The CLU Crop data layer includes all recorded historic cropland and is applied to land tracts enrolled in current or historic United States Department of Agriculture (USDA) programs dating back to approximately the 1950's, however an exact initial date is not available. It is important to note that the CLU Crop layer reports historic cropping disturbance, but not all current and historic acres included in the 2012 CLU Crop layer are necessarily agricultural crops today, as these acres may have been allowed to re-vegetate as 'go back' to pasture, been developed for non-ag uses, or are in some type

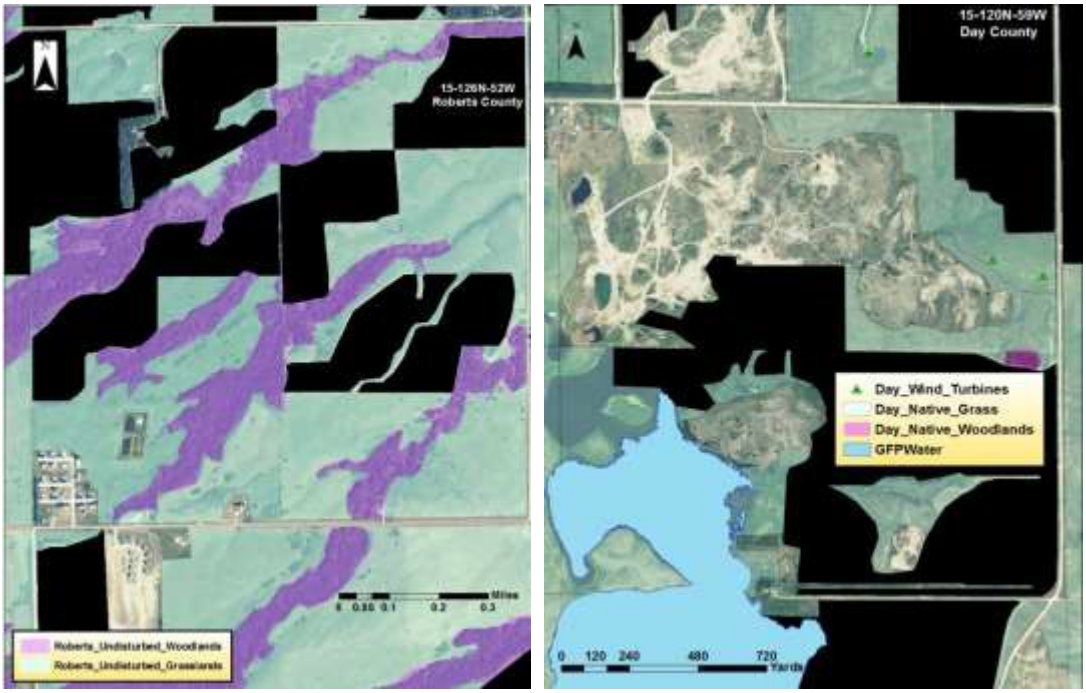
of conservation program. The 2012 CLU cropland data layer was overlaid on the base 2012 USGS maps and shaded black to represent tillage. This first level analysis allowed us to define areas without a recorded cropping history (non-crop) for further analysis.

*Step 2:* Technicians then mapped remaining undisturbed (native) grasslands and woodlands by evaluating remaining non-crop land tracts for indicators of disturbance. The CLU layer does not provide comprehensive representation of all crop fields if they were not enrolled in a USDA program or assigned a farm number. Crop land not represented in the CLU layer may include but is not limited to: 1) land cropped prior to the establishment of the CLU data (circa 1950) or not enrolled in USDA programs, 2) land removed from CLU tracking due to removal from USDA programs or retired farm number, or 3) land recently cropped without being enrolled in a USDA farm program or land enrolled but not yet recorded. Other disturbed areas on non-cropped land including such uses as: farmsteads, building sites, lawns, municipalities, planted shelterbelts, feedlots, gravel pits, etc.

Non-CLU disturbed areas were not mapped per se, rather initial native 'undisturbed grasslands' and 'undisturbed woodlands' polygons were developed with on-screen digitizing by *excluding* the known CLU cropland layer and all additional identified disturbed tracts (Figure 5). Initial undisturbed (native) grasslands and woodlands included all wetlands, lakes, and streams not included in the CLU cropland layer. Undisturbed grasslands and woodlands were further refined by removing the South Dakota Department of Game, Fish, and Parks lakes (SDGFP) 2010 water layer. Similar to the FSA CLU cropland layer, we made no attempt to verify the accuracy of the SDGFP lake layer, rather we simply accepted it as measured data.

Undisturbed woodlands were determined as having closed canopy comprised of deciduous species, and were primarily located in areas typically associated with eastern hardwood remnants (coulees, ravines, river bottoms, and lake shores). Closed canopy conifer stands were removed from the woodland layer if it was obvious they were planted in a pattern for wind protection or wildlife habitat (as is typical in this region). Acres covered with scattered deciduous trees remained in the native 'undisturbed' grassland layer as long as they did not appear to be planted and did not approach a closed canopy forest. Final undisturbed grassland and woodland layers were then developed through correction of polygon data for all 8,500 sections by a single qualified technician who thoroughly reviewed the data for consistency and accuracy.

Figure 5: Two sample sections of land in Roberts and Day Counties of South Dakota. Black areas indicate FSA CLU land tracts with a known cropping history excluded from analysis. Large water bodies as determined by SD GF&P lakes layer were removed. Undisturbed (native) grasslands and woodlands were then mapped based on identification of other obvious land disturbance such as building sites, planted trees, municipalities, feedlots, gravel pits, etc.

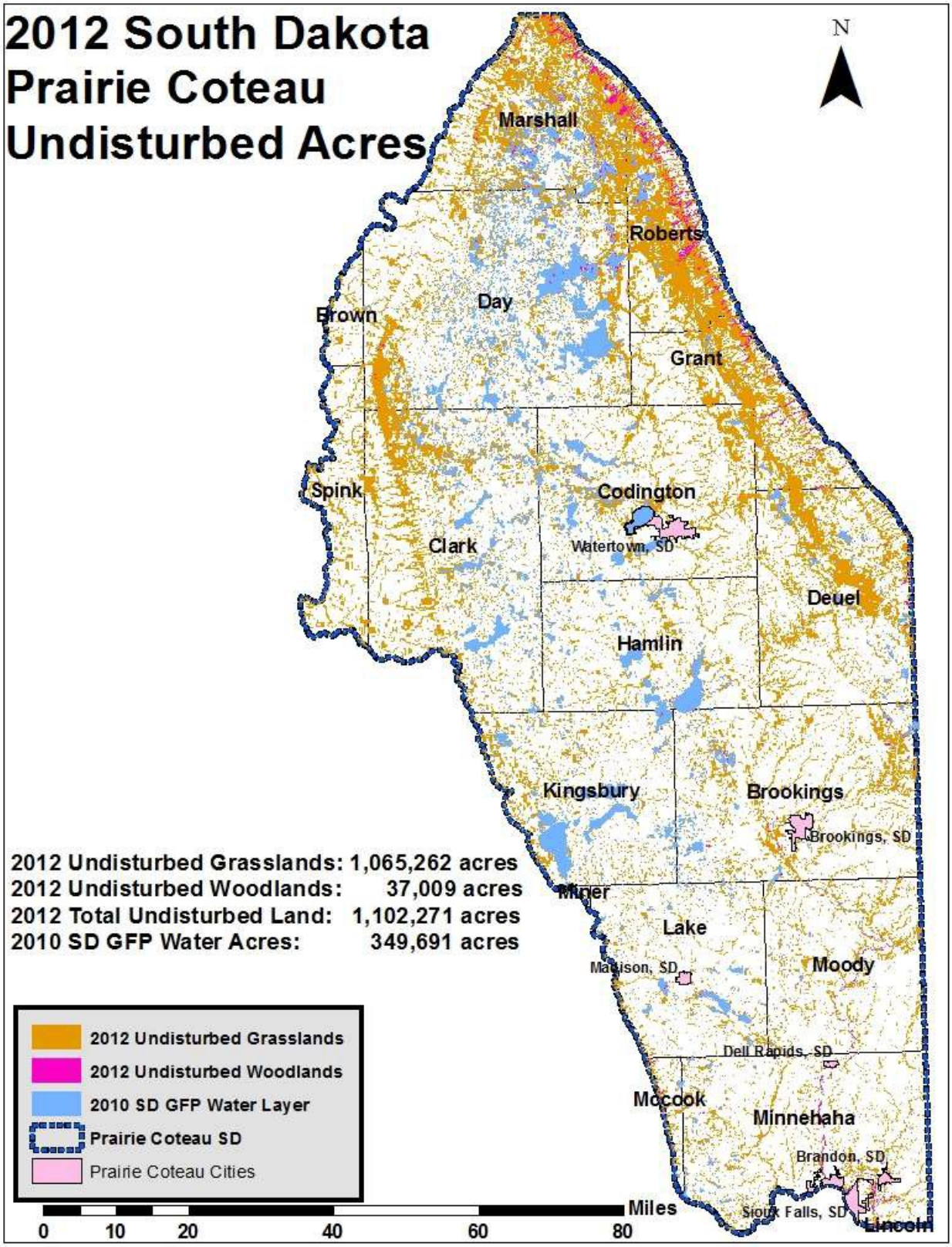



*Step 3:* Other landscape statistics such as protected status and county-level analysis were performed by analyzing various data layers. Of primary interest was the relative overlap of undisturbed grasslands and woodlands with records of permanent conservation protection. Conservation protection was derived by compiling the most up-to-date protection maps available. The 'protection' layer includes: US Fish and Wildlife Service fee ownership lands (refuges and waterfowl protection areas) and grassland easements; SD Game Fish and Parks fee ownership lands (parks and game production areas); Nature Conservancy grassland preserves; USDA Natural Resources Conservation Service Wetland Reserve Program easement acres; and Northern Prairies Land Trust easement acres. Protection layers were derived through direct contact with organizations holding the fee title to the property or the easement.

# Results

Based on our methodology, we estimate there are approximately 1,102,271 acres of undisturbed grassland and woodlands remaining within the 2010 TNC NFWF defined boundary of the Prairie Coteau representing (20.3%) of the 5,434,508 total acres within the South Dakota portion of the landscape. Of these remnant undisturbed acres, 1,065,262 acres (96.6%) are classified as undisturbed grasslands and 37,009 acres (3.4%) are undisturbed woodlands. Approximately 349,691 acres (6.4%) are covered by large lakes as defined by the South Dakota Game, Fish, and Parks (SD GFP) 2010 water data layer (Figure 6).

Figure 6: Undisturbed (potentially native) grasslands and woodlands remaining within the South Dakota portion of the Prairie Coteau based on the 2012 landscape analysis.



Within our undisturbed layers there is a possibility that certain individual tracts could have a historic cropping or tillage history that is not detectible with the 2012 USGS imagery. These areas are commonly known as 'go back' pasture or hay land. An example would be a land tract that might have been farmed or a tillage attempt made decades ago. These tracts may not have been enrolled in any type of government farm program and thus may not have been tracked through any formal system. The condition and vegetative cover of these areas today is unpredictable, and they may be vegetated with varying degrees of quality, structure, and diversity of native, tame and exotic species. Overall, we believe that our 'undisturbed' grassland and woodland layers may harbor several thousand acres with a disturbance history, but we do not feel the impacts of such will significantly alter the overall evaluation of acres/area of remnant native land tracts on the landscape.

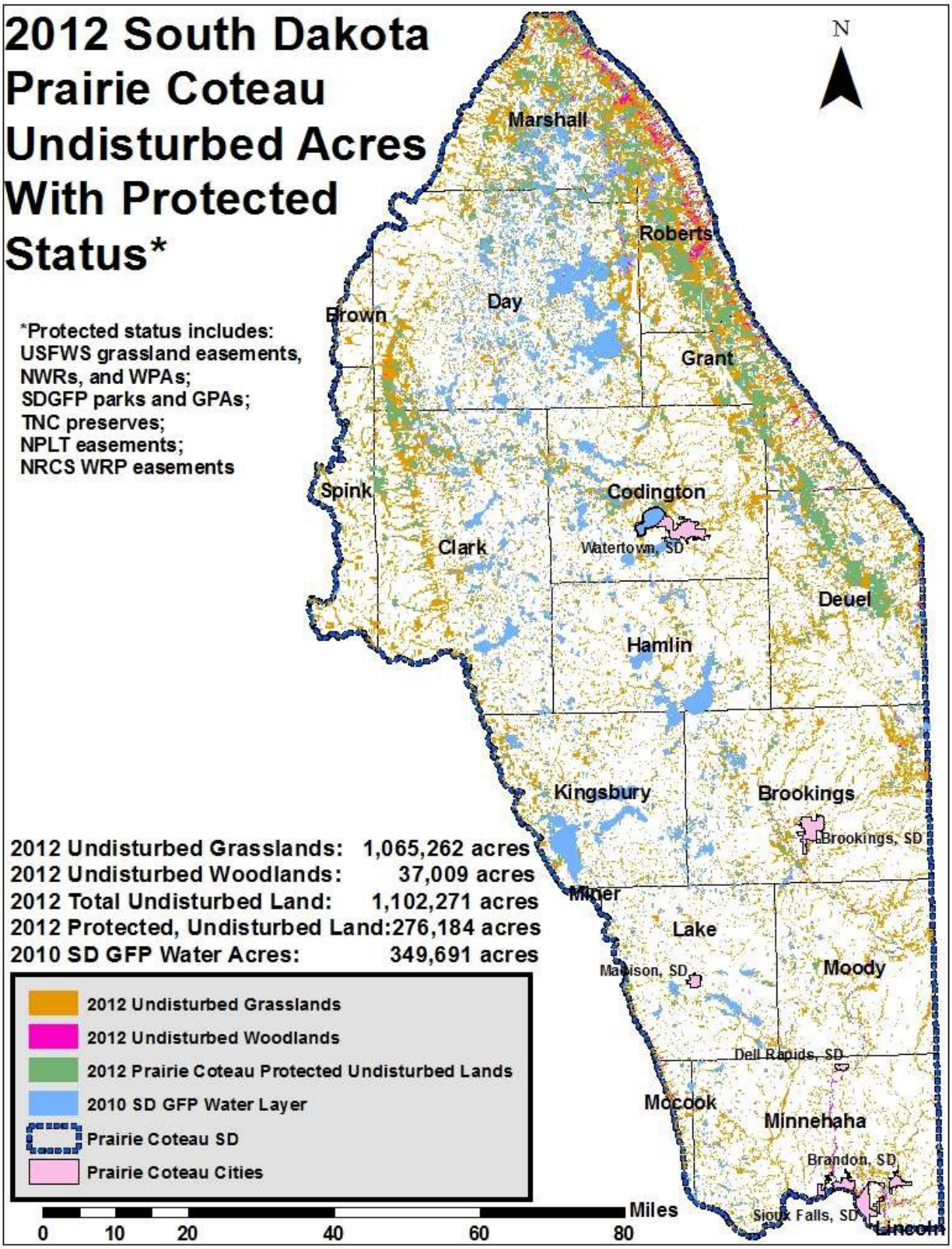
Within the overall SD Prairie Coteau Boundary, approximately 3,607,384 acres (66.4%) are classified as having a cropping history as per the FSA CLU data. An additional 375,162 acres (6.9%) were classified as 'other disturbance' within our analysis.

A key element in understanding the current and future role of these remnant undisturbed tracts in the landscape is evaluating their susceptibility to conversion (Doherty 2013). Of the 1,065,262 acres of undisturbed grasslands and woodlands, 276,184 acres (25.1%) have some sort of permanent protection from conversion. Counties that have the greatest total undisturbed acres under protection are Marshall, Roberts, Deuel, Grant, Day, and Clark. At 20.5%, Roberts County has the highest ratio of undisturbed land under protection as compared to total county acres within the landscape boundary. See Table 1 for full landscape statistics. Figure 7 highlights undisturbed areas that also have some sort of permanent conservation protection status. Appendix A contains county maps of undisturbed grasslands and woodlands. Appendix B contains county maps of undisturbed grasslands and woodlands *with* permanent protection status.

Table 1. 2012 TNC NFWF Prairie Coteau Landscape Statistics.

| 2012 County and Landscape Statistics Within the 2010 TNC NFWF SD Prairie Coteau Boundary | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| County | Total County Area ($mi^2$) | Total County Area (Acres) Based on NRCS County Data | County Area (Acres) Within 2010 TNC NFWF Prairie Coteau Boundary | Percent of County Area Within 2010 TNC NFWF Prairie Coteau Boundary | 2012 FSA CLU Crop Layer Acres Within 2010 TNC NFWF Prairie Coteau Boundary | 2012 Other Disturbed Land Acres (non CLU crop, new crop, buildings sites, planted shelterbelts, municipalities, gravel pits, feedlots, etc.) Within 2010 TNC NFWF Prairie Coteau Boundary | GF&P Water Layer Acres Within 2010 TNC NFWF Prairie Coteau Boundary | 2012 Undisturbed Grassland Acres Within 2010 TNC NFWF Prairie Coteau Boundary | 2012 Undisturbed Woodlands Acres Within 2010 TNC NFWF Prairie Coteau Boundary | 2012 Total Undisturbed (Grasslands and Woodlands) Acres Within 2010 TNC NFWF Prairie Coteau Boundary | Percent of County Acres Classified as Undisturbed (Grasslands and Woodlands) Within 2010 TNC NFWF Prairie Coteau Boundary | 2012 Undisturbed Acres *With* 'Protected' Status Within the 2010 TNC NFWF Prairie Coteau Boundary | Percent of 2012 Undisturbed Acres *With* 'Protected' Status Within the 2010 TNC NFWF Prairie Coteau Boundary | Percent of County Acres Classified as 'Undisturbed' *With* 'Protected' Status Within the 2010 TNC NFWF Prairie Coteau Boundary |
| Brookings | 792 | 515,025 | 515,025 | 100.0% | 374,192 | 47,581 | 14,635 | **76,958** | **1,659** | **78,617** | 15.3% | **11,671** | 14.8% | 2.3% |
| Brown | 1,713 | 1,107,146 | 42,114 | 3.8% | 30,239 | 5,640 | 56 | **6,179** | **0** | **6,179** | 14.7% | **184** | 3.0% | 0.4% |
| Clark | 958 | 619,036 | 578,000 | 93.4% | 396,621 | 23,499 | 45,665 | **111,959** | **256** | **112,215** | 19.4% | **27,984** | 24.9% | 4.8% |
| Codington | 689 | 458,789 | 458,789 | 100.0% | 303,274 | 42,187 | 32,693 | **80,478** | **157** | **80,635** | 17.6% | **13,447** | 16.7% | 2.9% |
| Day | 1,028 | 698,013 | 685,426 | 98.2% | 436,693 | 17,753 | 108,939 | **120,000** | **2,040** | **122,040** | 17.8% | **28,049** | 23.0% | 4.1% |
| Deuel | 623 | 407,511 | 396,964 | 97.4% | 247,248 | 29,089 | 10,344 | **109,162** | **1,122** | **110,283** | 27.8% | **39,633** | 35.9% | 10.0% |
| Grant | 681 | 440,242 | 221,067 | 50.2% | 117,668 | 11,631 | 1,803 | **85,681** | **4,284** | **89,964** | 40.7% | **36,146** | 40.2% | 16.4% |
| Hamlin | 507 | 344,191 | 344,191 | 100.0% | 256,133 | 22,938 | 27,444 | **37,379** | **296** | **37,675** | 10.9% | **4,656** | 12.4% | 1.4% |
| Kingsbury | 832 | 552,500 | 356,593 | 64.5% | 248,123 | 22,876 | 41,727 | **43,446** | **420** | **43,867** | 12.3% | **7,093** | 16.2% | 2.0% |
| Lake | 563 | 367,942 | 324,401 | 88.2% | 258,763 | 23,635 | 13,005 | **28,626** | **371** | **28,997** | 8.9% | **4,360** | 15.0% | 1.3% |
| Marshall | 838 | 566,512 | 323,660 | 57.1% | 132,088 | 14,716 | 36,468 | **131,097** | **9,291** | **140,388** | 43.4% | **50,314** | 35.8% | 15.5% |
| McCook | 574 | 369,238 | 30,001 | 8.1% | 21,644 | 1,422 | 800 | **5,815** | **320** | **6,135** | 20.4% | **290** | 4.7% | 1.0% |
| Miner | 570 | 364,998 | 3,232 | 0.9% | 2,805 | 226 | 42 | **159** | **0** | **159** | 4.9% | **0** | 0.0% | 0.0% |
| Minnehaha | 807 | 520,746 | 471,270 | 90.5% | 338,895 | 69,093 | 6,652 | **52,584** | **4,046** | **56,630** | 12.0% | **2,970** | 5.2% | 0.6% |
| Moody | 519 | 333,518 | 333,518 | 100.0% | 261,307 | 24,759 | 2,831 | **43,255** | **1,367** | **44,621** | 13.4% | **4,733** | 10.6% | 1.4% |
| Roberts | 1,101 | 726,494 | 202,289 | 27.8% | 68,677 | 9,480 | 6,229 | **106,530** | **11,372** | **117,902** | 58.3% | **41,500** | 35.2% | 20.5% |
| Spink | 1,504 | 965,715 | 147,969 | 15.3% | 113,012 | 8,637 | 358 | **25,955** | **7** | **25,962** | 17.5% | **3,157** | 12.2% | 2.1% |
| Total | **14,300** | **9,152,096** | **5,434,508** | **59.4%** | **3,607,384** | **375,162** | **349,691** | **1,065,262** | **37,009** | **1,102,271** | **20.3%** | **276,184** | **25.1%** | **5.1%** |

Figure 7: Undisturbed (potentially native) grasslands and woodlands remaining within the South Dakota portion of the Prairie Coteau that have some level of permanent protection status.



In 2001 the Conservancy mapped large blocks of potentially 'untilled prairie' in the Great Plains. Although not explicitly claiming that all acres within the 'blocks' were native prairie, the layer suggests that the majority of acres included in the blocks were untilled. The 2001 estimate of the largest blocks of untilled prairie included in the 2001 layer as reported in the 2010 TNC NFWF Business Plan was approximately 600,079 acres (11.0%) of the SD Prairie Coteau landscape. Our 2012 data suggests that total potential remaining undisturbed (untilled/native) grasslands and woodlands is 1,102,271 acres (20.3% of the landscape), the difference being the relative lack of inclusion of small/isolated prairie remnants in the 2001 analysis. These small/isolated acres were included in our analysis. However, analysis of 2012 undisturbed grasslands and woodlands occurring ***within*** the 2001 Untilled Prairie 'blocks' suggests that undisturbed/native acres within the blocks were overestimated in the 2001 analysis. We found that within the 600,079 acres of untilled prairie reported in the 2001 TNC data layer, only 358,932 acres (59.8%) were potentially undisturbed grasslands or woodlands in 2012 (Figure 8).

Doherty et al. (2013) detailed the importance of scale and timing in realistic conservation planning. The 2010 TNC NFWF Business Plan identified Conservation Focus Areas for the Prairie Coteau (Figure 9). Focus areas with significant area located within the South Dakota portion of the Prairie Coteau were Bitter Lake-Rush Lake, Bristol, Butler, Crandall, Crocker-Crandall Hills, Dakota Coteau-North, Dakota Coteau-South, Fort Sisseton, Hole-In-The-Mountain, Phipps, Shaokatan Prairies, Waubay Lake Watershed, and Yellow Medicine Coteau.

The 2010 NFWF Business Plan discusses how the perimeter of focus areas were identified as follows *"in South Dakota, the Bismarck [ND] HAPET office identified the boundaries of the focus areas based on modeling of waterfowl and grassland birds. The boundaries of all the focus areas were further adjusted to better reflect watershed boundaries and capture additional grassland and rare species occurrences."*

The shape of the 2010 Focus Areas were also influence by the location of the largest blocks of untilled prairie remaining on the Coteau as identified through the 2001 TNC Untilled Prairie data layer. While this layer is likely a fair representation of the general scale and gross location of untilled prairie, the accuracy of the layer has not been analyzed at the local landscape level. Therefore, while we agree the location of the focus areas are generally defensible, the quantification and physical location of potential untilled prairie within the Focus Areas as represented by the Focus Area maps in the 2010 TNC NFWF Business Plan have been refined/updated by our analysis and are included in this report.

Overall, 1,140,732 acres are included in the thirteen 2010 Focus Areas occurring in South Dakota. We compared the 2001 estimates of untilled prairie to our 2012 estimates of undisturbed grasslands, undisturbed woodlands, and protection status. Based on the 2001 estimate, 576,064 acres (50.1%) of the Focus Areas were comprised of untilled prairie. Our 2012 data suggests that 512,841 acres (45.0%) of the focus areas are classified as undisturbed grasslands and woodlands. The remaining 627,891 acres (55.0%) were classified as CLU Crop, SD GFP water, and 'other' disturbed. While the overall acres of the 2001 estimate of untilled prairie is fairly accurate compared to our 2012 data (50.1% vs 45.0%) the distribution of undisturbed/untilled acres within the Focus Areas was not consistent between the two analysis; with the 2012 data providing improvements in both precision and accuracy of potentially undisturbed grasslands and woodlands within the Focus Areas.

Figure 8: Occurrence of 2012 undisturbed grassland and woodland areas within 2001 TNC Untilled Prairie areas of the South Dakota Prairie Coteau.

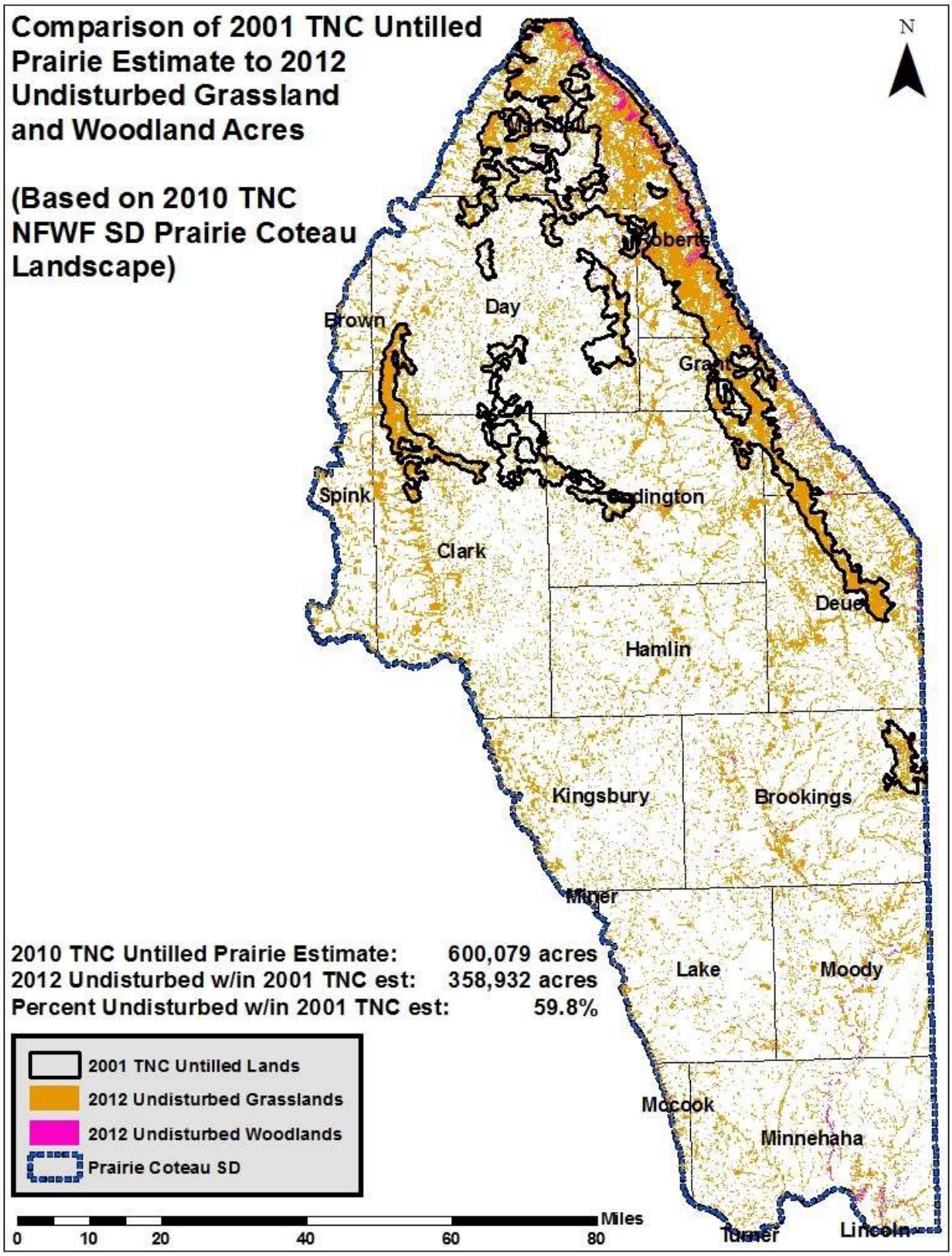
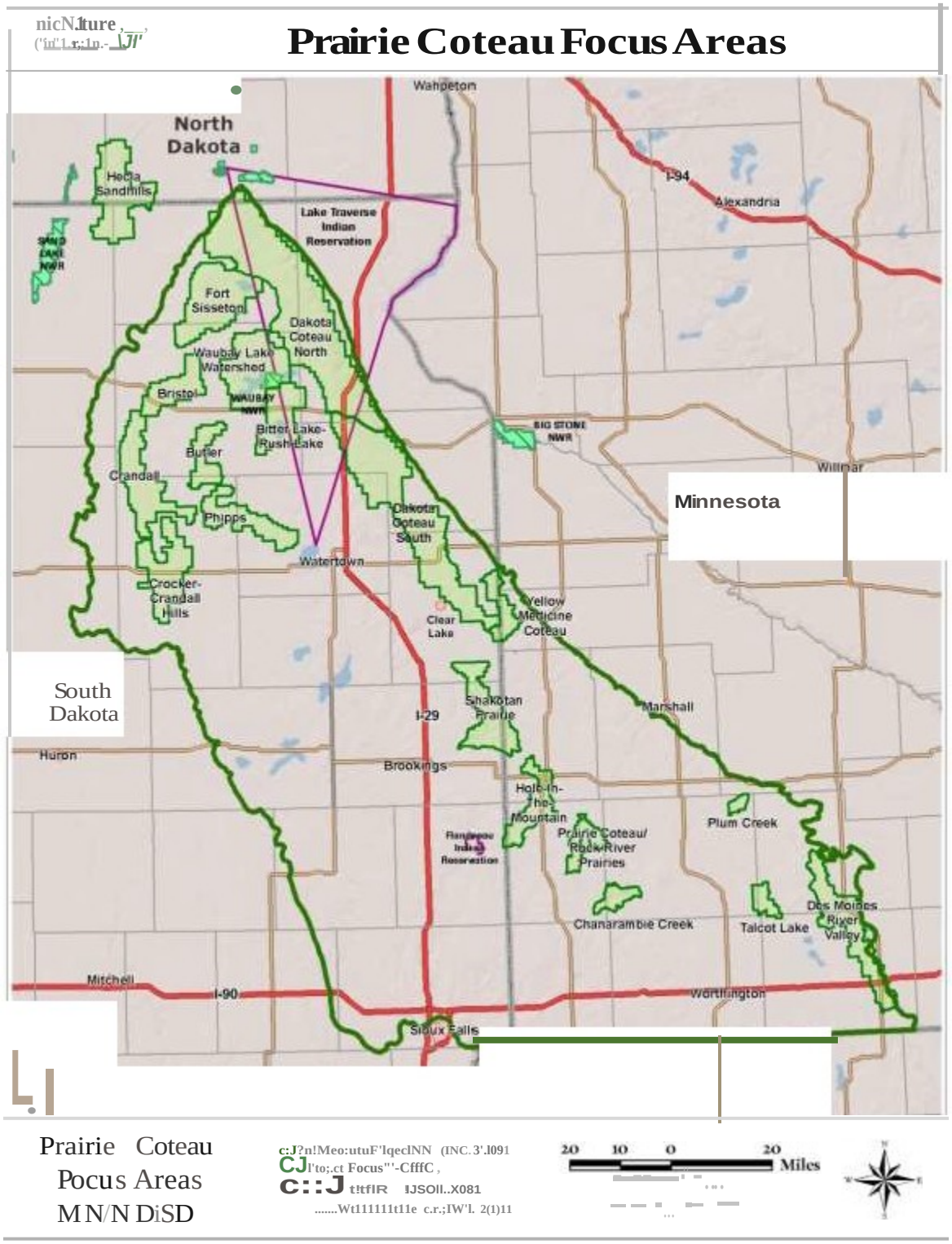


Figure 9. 2010 TNC NFWF Business Plan Conservation Focus Areas for the Prairie Cot.au.



In addition to the overall analysis of remaining undisturbed grassland and woodland acres within the Focus Areas, we also analyzed the level of conservation protection on these acres. Of the 512,841 acres of undisturbed grasslands and woodlands in the Focus Areas, 199,791 acres (39%) had some sort of permanent conservation protection status as of 2012. When compared to the 1,140,732 *total* acres within the focus areas, 2012 undisturbed acres with protection status was 17.5%. See Table 2 for full Focus Area statistics. Appendix C contains updated Focus Area maps of undisturbed grasslands and woodlands *with* permanent protection status.

Table 2. 2012 TNC NFWF Prairie Coteau Focus Area Statistics.

| 2012 TNC NFWF Prairie Coteau Focus Area Analysis (For SD Portions of Focus Areas Only) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Focus Area | Focus Area Acres Within SD Prairie Coteau | 2001 'Disturbed' Acres In Focus Area | 2001 TNC Untilled Prairie Acres In Focus Area | 2012 Total FSA CLU Crop, Other Disturbed, and SD GFP Water Acres In Focus Area | 2012 Total Undisturbed (Grasslands and Woodlands) Acres In Focus Area | Percent of Focus Area Classified as Undisturbed (Grasslands and Woodlands) In Focus Area | 2012 Total Undisturbed Land Acres *With* 'Protected' Status In Focus Area | Percent of 2012 Undisturbed Acres *With* 'Protected' Status In Focus Area | Percent of Focus Area Classified as 'Undisturbed' *With* 'Protected' Status |
| Bitter Lake-Rush Lake | 54,266 | 31,026 | 23,240 | 42,255 | 12,012 | 22.1% | 2,296 | 19.1% | 4.2% |
| Bristol | 46,371 | 41,318 | 5,053 | 37,592 | 8,779 | 18.9% | 1,862 | 21.2% | 4.0% |
| Butler | 32,632 | 14,983 | 17,650 | 27,311 | 5,321 | 16.3% | 998 | 18.8% | 3.1% |
| Crandall | 82,755 | 37,146 | 45,609 | 33,860 | 48,895 | 59.1% | 18,916 | 38.7% | 22.9% |
| Crocker-Crandall Hills | 75,259 | 75,259 | 0 | 54,189 | 21,070 | 28.0% | 2,709 | 12.9% | 3.6% |
| Dakota Coteau-North | 310,548 | 51,770 | 258,777 | 108,701 | 201,847 | 65.0% | 77,301 | 38.3% | 24.9% |
| Dakota Coteau-South | 213,849 | 121,514 | 92,334 | 97,097 | 116,751 | 54.6% | 65,460 | 56.1% | 30.6% |
| Fort Sisseton | 103,273 | 40,150 | 63,124 | 63,697 | 39,577 | 38.3% | 16,533 | 41.8% | 16.0% |
| Hole-in-the-Mountain | 801 | 801 | 0 | 287 | 514 | 64.2% | 0 | 0.0% | 0.0% |
| Phipps | 56,604 | 20,491 | 36,113 | 40,544 | 16,060 | 28.4% | 5,518 | 34.4% | 9.7% |
| Shaokatan Prairies | 55,111 | 37,113 | 17,997 | 34,389 | 20,721 | 37.6% | 1,490 | 7.2% | 2.7% |
| Waubay Lake Watershed | 96,908 | 80,742 | 16,166 | 81,444 | 15,464 | 16.0% | 5,389 | 34.8% | 5.6% |
| Yellow Medicine Coteau | 12,355 | 12,355 | 0 | 6,524 | 5,831 | 47.2% | 1,319 | 22.6% | 10.7% |
| **Total** | **1,140,732** | **564,668** | **576,064** | **627,891** | **512,841** | **45.0%** | **199,791** | **39.0%** | **17.5%** |

# Discussion

The last several years have yielded great interest from researchers and policy makers regarding land conversion and many popular, semi-technical, and technical papers have been published on the topic. The most notable papers providing background on the status of the Prairie Pothole Region, South Dakota, and the Prairie Coteau in general are summarized below.

Wright and Wimberly (2013) analyzed NASS CDL data from 2006 to 2012 across five states, including South Dakota. As is typical the various grass-dominated land covers could not be resolved in the satellite imagery due to their spectral similarity. Overall, while acknowledging the inability to separate native sod from other grassland types, Wright and Wimberly (2013) reported a net loss of approximately 451,000 acres of all South Dakota grasslands from 2006 to 2012. The authors found that grassland conversion in the Dakotas took place primarily east of the Missouri River and they suggested that landowners in Minnesota and the Dakotas may be seeking higher rates of return from high-quality

pasture by converting those lands to crops, a trend that is consistent with observations on the Prairie Coteau over the last decade or so.

Johnston (2013, 2014) analyzed land use change via NASS CDL data from 2006 to 2012, National Wetlands Inventory (NWI), and U.S Geological Survey National Land Cover Database (NLCD) for wetland use change for the Dakota Prairie Pothole Region of North Dakota and South Dakota. These studies incorporated all grassland/herbaceous, pasture, and hay cover by merging them into a single 'grassland' layer (not including alfalfa). Johnston (2014) found that grassland cover rose slightly annually from 2006 to 2011 via annual 'exchanges' in grassland acres with other crops until a major decline in grassland cover was recorded from 2011 to 2012. Perhaps the most notable observation by Johnston (2014) is the discussion of loss on long-duration natural land (land continuously in non-crop vegetation for five or six years), which the author suggests may serve as a 'proxy' for native sod conversion. Conversion of these lands averaged about 4% annually from 2010 to 2011 and 2.7% from 2011 to 2012. However, the author suggests that the majority of land converted to agricultural expansion was not native prairie, but rather other herbaceous vegetation rotated into production intentionally or unintentionally due to climatic or other factors.

The Environmental Working Group published two recent papers on the topic of land conversion (Faber et al. 2012; Cox and Rundquist 2013). While not peer reviewed, these papers did draw on similar data sources for analysis. Faber et al. (2012) utilized 2008 – 2011 NASS CDL data in a method of pixel counting for their landscape analysis. They reported that the counties in the Prairie Coteau region of South Dakota and Minnesota each experienced between 5,000 and 50,000 acres of conversion of grasslands/wetlands/shrubs to crop production. This data, while reported in map form on a county by county basis, cannot be quantified in relation to our 2010 TNC NFWF Prairie Coteau boundary, nor can it be used to specifically determine native grassland conversion as their NASS CDL analysis did not differentiate between various grass, hay, CRP or other grass-like vegetation types.

Decision Innovation Solutions (2013) was commissioned by seven state Farm Bureau organizations collectively to evaluate land use change between 2007 and 2012. Again, this study relied on NASS CDL data to determine land use change from a fairly generic category of "grassy habitat" to various other categorical uses including crops, woody habitat, and non-agricultural uses. Similar to Faber et al. (2012), this report indicates conversion of grassy habitat in South Dakota Prairie Coteau counties as ranging from between 1- 25,000 acres to 1-75,000 acres per county from 2007 to 2012; mostly attributed to conversion to crops. Somewhat surprisingly, conversion of grassy habitat to woody habitat was a significant contributor to grassy habitat loss in this report. We speculate that this may be due to lack of refinement in analyzing these land covers rather than true conversion to woody cover. In Minnesota Prairie Coteau counties, conversion of grassy habitat ranged from 1-25,000 per county between 2007 and 2012, again primarily due to cropping.

While none of these reports were specific to the land form we are evaluating, they do indicate trends in shifting land use from grasslands to cropland or other uses across South Dakota and/or the northern Great Plains region, and likely provide adequate indications of trends of grassland loss.

In addition to the papers mentioned above, many papers discuss the relative importance of intact native vegetation and the consequences of land conversion in general. Stephens et al. (2008) and Rashford et

al. (2010) discuss spatial and economic factors related to conversion of grasslands in the Prairie Pothole Region in general, with the Stephens et al. (2008) making an early attempt at predicting land use change over time for the Missouri Coteau region of the Dakotas.

Cox and Rundquist (2013) listed South Dakota as the state with the highest rate of wetland conversion, most of which was concentrated in the Prairie Pothole Region. This report indicated that South Dakota Prairie Coteau counties each lost between 2,500 and 7,500 acres of wetlands between 2008 and 2012. No such analysis was performed on Minnesota Prairie Coteau counties. Johnston et al. (2013), Blann et al. (2009), Werner et al. (2013), Voldseth et al. (2007, 2009), and Doherty et al. (2013) expanded the discussion on wetland conversion in the region, focusing on various impacts as a result of cropping systems, drainage, climate change, and grassland restoration.

Caution should be applied when utilizing any of the mentioned data for evaluating land use changes on the Prairie Coteau specifically because while likely an accurate 'ball park' estimate for the regions sampled, these data do not differentiate between native grasslands and several types of non-native grass or grass-like vegetation and thus cannot provide accurate indication of loss of truly native sod. That said, the trend in grassland loss obviously does include some percentage of native sod and the overall loss of all grassland habitat types can have significant impacts on the general use and distribution of grassland-dependent species.

While it would be simple to assume current land use or rates of conversion for the Prairie Coteau as similar to other regions of South Dakota, the geology of the landform itself is highly variable with some areas lending themselves to conversion to farmland while other areas remain topographically challenging even with today's modern farm equipment. In addition, because of the prevalence of conservation work in the region, 276,184 acres of undisturbed land in the South Dakota portion of the Prairie Coteau are under permanent protection from land conversion due to conservation easements or agency ownership.

Perhaps the most locally accurate numbers on land use change relative to the Prairie Coteau to be reported thus far would be those of Reitsma et al. (2014). Using a rather unique system of point observations to verify NASS CDL trends in nine observation areas based on USDA-NASS reporting districts, the authors evaluated landscape gain/loss and percent change of several categories of land use. Statewide, they reported approximately a 1.8 million acre loss in South Dakota's overall grassland coverage from 2006 – 2012 with this method (over four times what was reported by Wright and Wimberly [2013]). As with previous studies, 'grasslands' included range, pasture, hay, alfalfa, and other grasslands. Habitat (wetlands and forests) increased over the same time period by approximately 129,000 acres statewide.

Of greatest significance in the Reistma et al. (2014) paper to this report were the estimated land use changes to the Northeast NASS district (including Prairie Coteau counties of Marshall, Day, Roberts, Clark, Codington, Hamlin, Grant, and Deuel counties) and to the East Central NASS district (including Prairie Coteau Counties of Kingsbury, Brookings, Sanborn, Miner, Lake, Moody, Davison, Hanson, McCook, and Minnehaha counties). Although not exact, these two NASS regions do encompass the majority of the Prairie Coteau in South Dakota and more closely mimic our focal area than do other studies.

For the northeast NASS district, Reitsma et al. (2014) reported a gain of 239,700 acres of cropland (12.7%); a loss of 269,000 acres of grasslands (16.9%); no change in non-ag land; a loss of 24,000 acres of habitat (8.1%); and a gain of 53,300 acres of water cover (17.2%) from 2006 to 2012. In the East Central District they report a gain of 163,000 acres of cropland (7.8%); a loss of 217,200 acres of grassland (15.9%); a gain in non-ag land of 4,900 acres (2.6%); a gain in habitat of 37,000 acres (18.5%); and a gain in water of 12,300 acres (13.5%). Of most notable significance to the Prairie Coteau in this report is the combined loss of grasslands in these two regions totaling an approximately 486,200 acres.

Doherty et al. (2013) made the most comprehensive attempt to date to not only quantify land use change, but to also tie land use decisions directly to conservation strategies. Arguably, this paper drew on the widest array of known data to develop a general 'picture' of the Prairie Pothole Region. Of particular not in this paper is the effect of both time and scale as critical factors in developing land use policy/opportunity that are reflective of agency conservation goals. While not specific to the Prairie Coteau, the parallels in this paper in regard to land use decisions and drivers between the greater Prairie Pothole Region and the Prairie Coteau are largely comparable.

Further complicating any analysis of land use change is the fact that historically many areas of the Prairie Coteau were farmed only to be allowed to re-vegetate naturally (more or less). These tracts, if identified, are often referred to as 'go-back' pastures, indicating they were allowed to 'go-back' or vegetate naturally. The conversion and subsequent natural reclamation of these tracts occurred primarily prior to the onset of the heavy use of agricultural herbicides, thus vegetation diversity and quality can be variable. While nearly impossible to confidently categorize from aerial imagery, the land use history of many of these tracts can be determined by on-the-ground evaluation of physical and ecological indicators such as tillage furrows, rock piles, and simple plant communities infested with exotic species. In rare cases, they can be very difficult to identify solely based on plant community composition where physical indicators may be limited and where plant community composition reflects a high diversity of native plants (a very rare occurrence).

Unfortunately simple quantification of land tracts under conservation easement or ownership by agencies is not an accurate indication of native lands because many 'go back' tracts (which are not truly native) are included in easements and ownership. Further, many truly native tracts remain in private ownership as working farms and ranches not under easement or conservation contract, and thus any quantification of native sod based solely on 'protection' status would be a gross underestimate.

Because no baseline exists for native or undisturbed sod on the Prairie Coteau, we cannot provide a reasonable estimate of land use change over time that can support or refute trends reported by others. However, with our methodology, we were able to quantify all areas of the Prairie Coteau that are likely native untilled sod (as of 2012) to a degree not previously attempted. Our methodology provides a 'road map' to future analysis that will provide a baseline of reasonable potential areas of native sod based on known measured data. Final analysis of quality of these tracts can only be quantified by qualified personnel who will evaluate these sites for objective physical or ecological indicators as to what is truly 'native' sod and the quality of the plant community therein.

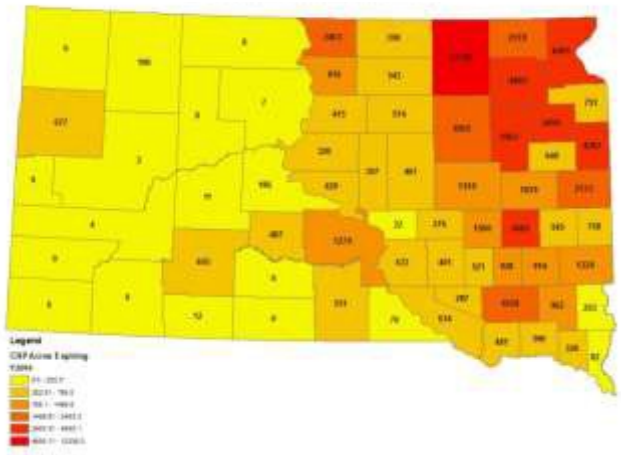
# Management Implications

Rashford et al. (2010) stated that *"the scientific basis for predicting ecological consequences of grassland conversion is much better developed than the basis for predicting conversion itself"*. We found this simple statement to be quite true in our evaluation of attempts to quantify grassland loss. While some authors suggest that land conversion and subsequent loss of grasslands must be considered objectively against societal values (Reitsma et al. 2014), it is important to understand the losses and conversion rates reported in those studies do not differentiate between the general loss of grass cover to the actual loss of native grasslands, nor do they necessarily consider the cumulative loss of native grasslands over time and space. What is consistent across all reports is that we can expect land use changes and conversion to continue (Doherty et al 2013).

Within those reports, native grassland is included as an unidentified portion of total grassland loss. The remainder of grassland conversion reported is better described as grass 'crop' acres, such as Conservation Reserve Program (CRP) acres, small grains, alfalfa, tame grass, or even historic crop fields that have actively or passively re-vegetated with some semblance of native and exotic vegetation. Use of these previously tilled acres and the type of crop they produce (including grasses) may ebb and flow, and these simplified planted habitats can be destroyed and re-created over time and space. The conversion of these grass 'crop' acres can have social, economic, and ecological benefits and detriments, but they are not suitable surrogates for evaluation of the loss of truly native grassland acres (Doherty et al. (2013).

> *When one land use expands, it is always at the expense of another"*
>
> - Johnston (2014)

Figure 10. South Dakota 2014 Conservation Reserve Program Expirations by County (SD Farm Services Agency, May 2014).



The best representation of the 'rotation' of these acres is found in evaluating the gain and loss in CRP acres. Figure 10 shows the expiration of CRP contracts for South Dakota in 2014. The Prairie Coteau region has had some of the highest average acres of expirations since 2012. While many of these acres will likely be rotated to crops if current trends persist, some landowners may choose to re-enroll their acres in CRP contracts for an additional ten or fifteen years. Simply put, CRP can be re-created over time and space.

Native grassland cannot be re-created over time and space. Once converted, native grassland is gone forever. Converted native grassland acres can eventually be re-cropped with grass and grass-like covers that may provide some of the social, economic, and ecological values provided by the original native grassland, but it is impossible to re-create all values inherent in native grassland and undisturbed soils,

thus the ecological, social, and economic impacts of conversion of grass 'crop' acres are not necessarily equal to those incurred with the conversion of native grasslands.

If native grasslands are lost at recent rates reported for all grasslands, a 2-4% annual loss can hypothetically become a 20-40% loss of an irreplaceable resource over a ten year period. Therefore, conversion of remnant native grassland requires a cost/benefit analysis that acknowledges true loss of an irreplaceable ecosystem. Perhaps Doherty et al. (2013) captures the argument for the cumulative effects of time on grassland conversion and conservation policy more thoroughly than any other report, calling for the identification and protection of high-diversity remnant areas as a critical step in conservation planning in relation to timing (i.e. sooner than later).

As grasslands continue to be one of the most threatened ecosystems on the planet, the northern Great Plains is a focal area for grassland conversion. Our methodology not only provides a model for mapping the remainder of the Prairie Coteau in Minnesota, it can be applied to identifying and mapping all of South Dakota's potential remaining native habit, as well as those in other states. Once our methods were refined, mapping became quite simple and efficient. While there is still a small degree of subjectivity involved, our techniques provide a reasonable estimate of native untilled sod with a far greater degree of local accuracy at a usable scale than do previous estimates.

Our native grassland and native woodland results establish a simple base data layer for future analysis. Because of the clarity provided by the USGS imagery, new cropping/conversion or disturbances are quite obvious through on-screen analysis. By utilizing GIS technology to overlay our 2012 grassland and woodland layer results on future USGS aerial imagery, analysis of additional land disturbances within our polygons will allow researchers to estimate an accurate rate of conversion for this region while also allowing continues refine of the undisturbed grassland and woodland layers over time.

Unfortunately, the total acres of undisturbed native grassland can only remain constant or decrease over time. However, there is potential for the woodland portion of the layer to increase if volunteer native woody vegetation infiltrates native grasslands and achieves a density that would indicate closed canopy cover. That measure is somewhat subjective and we believe that significant change in the native woodland layer would be required in order to accurately detect change through short term analysis.

In addition to expansion of native woody cover, the Prairie Coteau will likely be subject to increasing invasions of exotic and aggressive woody species such as eastern red cedar (*Juniperus virginiana*). This situation may pose a particular challenge in future analysis of the undisturbed grassland layer, as these woody invaders can eventually achieve a dense canopy appearance. Our suggestion would be that these areas continue to be classified as native grasslands unless or until the density of trees is so prevalent that physical removal of the trees from the landscape is likely impractical, at which time those land tracts should be eliminated from the native grassland and native woodland data layer and classified as disturbed land.

Overall, our methodology and subsequent results will allow for improved analysis of the quality of the remaining undisturbed portions of the landscape by providing a 'road map' for researchers to target their efforts to quantify overall undisturbed grassland biological diversity and habitat potential. As stated previously, there is a certain percentage of our undisturbed grassland and woodland layers that are likely

'go back' pasture that is relatively low in diversity. Those areas cannot be quantified without some sort of improved evaluation through ground truthing. The same need for ground truthing holds true for identifying the highest quality areas.

Overall, quality, structure and function of remnant grasslands and landscape fragmentation play a key role in overall habitat suitability for a variety of species and are important considerations for a variety of grassland birds (Chapman et al. 1998, Higgins et al. 2002., Rich et al. 2004, Doherty et al. 2013). Current research conducted by South Dakota State University in conjunction with the South Dakota Department of Game, Fish, and Parks is focused on assessing quality of vegetation on the Prairie Coteau (Narem, 2013, unpublished data). In this work, researchers selected a 225 $mi^2$ area located on a portion of the east slope of the Prairie Coteau in Day and Roberts counties to assess habitat suitability for endemic Dakota skipper (*Hesperia dacotae*) and Poweshiek skipperling (*Oarisma poweshiek*) butterflies based on established metrics suitable for the region. Our map will allow for improvements in systematic evaluations of undisturbed grassland habitat quality by allowing researchers to evaluate these tracts based on parameters such as size, location, or relation to other habitats (such as wetlands).

Undisturbed (native) grassland and woodland protection is important for long-term conservation of the Prairie Coteau. Rashford et al. (2010) and Stephens et al. (2008) suggested that grasslands on high-quality soils are more likely to be converted to cropland than grassland on low-quality soils in the Prairie Pothole Region. While this is likely true in most cases, recent observations on the Prairie Coteau have indicated that land managers are willing to engage in the risky conversion of marginal and poor land with the intent of growing crops on the historically rocky and/or wet native prairie/pasture areas, independent of the perceived impacts of market trends.

Figures 11 and 12 illustrate examples of a recent poor land use decision in Grant and Day Counties of the Prairie Coteau in South Dakota. During the period of time represented in Figure 11 (spring 2013), corn prices (assumed to be a primary driver of land conversion) were very high (~$7.00/bu.). Conversely, Figure 12 photos were taken in May of 2014. In this case conversion of native sod to crops continues while corn prices have dipped to approximately $4.00/bu., suggesting the drivers of land conversion are complex (Doherty et al. 2013).

In conclusion, we believe our mapping methods allow assessment of future land use change for previously undisturbed or native tracts that have occurred after 2012 such results will allow conservation organizations such as The Nature Conservancy, The National Fish and Wildlife Foundation, and others to target evaluation and conservation specifically aimed on protection of undisturbed grasslands and woodlands.

Figure 11: Grant County South Dakota (east slope of the Prairie Coteau). Native sod conversion attempted for cropping during the spring of 2013 (left). Light soils and an overwhelming density of rocks appear to have caused the owner to abandon the cropping project by the fall of 2013 (right). Once destroyed with the use of chemical applications and tillage, the total structure and function of this native grassland, its soils, and its ecology can never fully be recreated (photos by Pete Bauman).

Figure 12: Day County South Dakota near Bitter Lake in the Heart of the Prairie Coteau. Native sod conversion to cropping during the spring of 2014 (photos by Ben Lardy).

# Literature Cited

Aldrich, J. M., W. R. Ostlie, and T. M. Faust. 1997. The Status of Biodiversity in the Great Plains: Great Plains Landscapes of Biological Significance. Supplemental Document 2, *In:* W.R. Ostlie, R.E. Schnieder, J.M Aldrich, T.M. Faust, R.L.B. McKim and S.J. Chaplin, The Status of Biodiversity in the Great Plains. The Nature Conservancy, Arlington, VA. 135pp. + VIII.

Blann, K. L, J. L. Anderson, G. R. Sands, and B. Vondracek. 2009. Critical Reviews in Environmental Science and Technology. 39:909-1001.

Catlin, C. 1844. Letters and Notes on the Manners, Customs, and Condition of the North American Indians.

Chapman, K., K. Hiller, and J. Haferman. 1998. Identification of Important Bird Sites in the Northern Tallgrass Prairie Ecoregion: A Step in Ecoregion-Based Conservation. The Nature Conservancy, Minnesota Chapter, Minneapolis, MN, USA.

Cox, C. and S. Rundquist. 2013. Going, Going, Gone! Millions of Acres of Wetlands and Fragile Land Go Under the Plow. Environmental Working Group. 11 pp. http://www.ewg.org/research/going-going-gone

Decision Innovation Solutions. (2013). 2013 *Multi-State Land Use Study: Estimated Land Use Changes 2007-2012*. Urbandale, IA 50322: Decision Innovation Solutions. Retrieved March 17, 2014, from http://www.decision-innovation.com/images/docs/130715%20Multi-State%20Land%20Use%20Report%20(FINAL).pdf

Doherty, K. E., A. J. Ryba, C. L. Stemler, N. D. Niemuth, and W. A. Meeks. 2013. Conservation Planning in an Era of Change: State of the U.S. Prairie Pothole Region. Wildlife Society Bulletin. 37:546-563. http://ppjv.webfactional.com/resources/reports/state-of-the-prairies

Faber, S., S. Rundquist, and T. Male. 2012. Plowed Under: How Crop Subsidies Contribute To Massive Habitat Losses. Environmental Working Group. 12 pp. http://static.ewg.org/pdf/plowed_under.pdf

Higgins, J. J., G. E. Larson, and K. F. Higgins. 2002. Managing Tallgrass Prairie Remnants: The Effects of Different Types of Land Stewardship on Grassland Bird Habitat. Ecological Restoration. 20:18-22.

Johnson, R. R., K. F. Higgins, and D. E. Hubbard. 1995. Using Soils to Delineate South Dakota Physiographic Regions. Great Plains Research: A Journal of Natural Sciences. Paper 211. http://digitalcommons.unl.edu/greatplainsresearch/211

Johnston, Carol A. 2014. Agricultural Expansion: Land Use Shell Game in the U.S. Northern Plains. Landscape Ecology 29:81-95.

Johnston, Carol A. 2013. Wetland Losses Due to Row Crop Expansion in the Dakota Prairie Pothole Region. Wetlands 33:175-182.

Loeschke, M. J. Circa 1995. The Prairie Coteau Natural Areas Inventory: Day, Marshall, and Roberts Countys (sic), South Dakota. South Dakota State University, Brookings, SD. 41 pp.

Miller, C. 2001. Prairie Coteau Conservation Initiative. The Nature Conservancy, Clear Lake, SD. 22 pp.

Narem, 2013. Mapping and Characterization of Native Grassland Habitats on South Dakota's Prairie Coteau. Interim Report. T-54-R-1 Amd #2 Study #: 2464. Jan 1 – Dec 15, 2013.

Rashford, B. S., J. A. Walker, and C. T. Bastian. 2010. Economics of Grassland Conversion to Cropland in the Prairie Pothole Region. Conservation Biology. 25:276-284.

Reitsma, K. D., D. E. Clay, C. G. Carlson, B. H. Dunn, A. J. Smart, D. L. Wright, and S. A. Clay. 2013. Estimated South Dakota Land Use Change from 2006 to 2012. White paper; South Dakota Governors Pheasant Habitat Work Group. SDSU Extension. 03-2001-2014. 4 pp. Available at http://gfp.sd.gov/pheasantsummit/docs/SDSULandUse2001-2014.pdf (Verified May 16, 2014).

Rich, T. D., C. J. Beardmore, H. Berlanga, P. J. Blancher, M. S. 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, T. C. Will. 2004. Partners in Flight North American Landbird Conservation Plan. Cornell Lab of Ornithology, Ithaca, NY.

Smart, A., P. Bauman, and B. Dunn. 2003. Discover the Prairie Coteau: Located in the Heartland of America, this Unique Region Showcases the Diverse Tallgrass Prairie. Rangelands. 25:39-42.

Stephens, S. E., J. A Walker, D. R. Blunck, A. Jayaraman, D. E. Naugle, J. K. Ringelman, and A. J. Smith. 2008. Predicting Risk of Habitat Conversion in Native Temperate Grasslands. Conservation Biology. 22:1320-1330.

The Nature Conservancy, Northern Tallgrass Prairie Ecoregional Planning Team. 1998. Ecoregional Planning in the Northern Tallgrass Prairie Ecoregion. The Nature Conservancy, Midwest Regional Office, Minneapolis, MN, USA. 208 pp. + iv.

The Nature Conservancy. 2010. Business Plan. Conserving and Restoring Tallgrass Prairie: Prairie Coteau, South Dakota and Minnesota. Submitted to the National Fish and Wildlife Foundation. The Nature Conservancy, Minneapolis, MN. 59 pp.

US Geological Survey. 2013. Northern Prairie Wildlife Research Center http://www.npwrc.usgs.gov/resource/habitat/ndsdeco/46l.htm

Voldseth, R. A., W. C. Johnson, T. Gilmanov, G. R. Guntenspergen, and B. V. Millett. 2007. Model Estimation of Land-Use Effects on Water Levels of Northern Prairie Wetlands. Ecological Applications. 17:527-540.

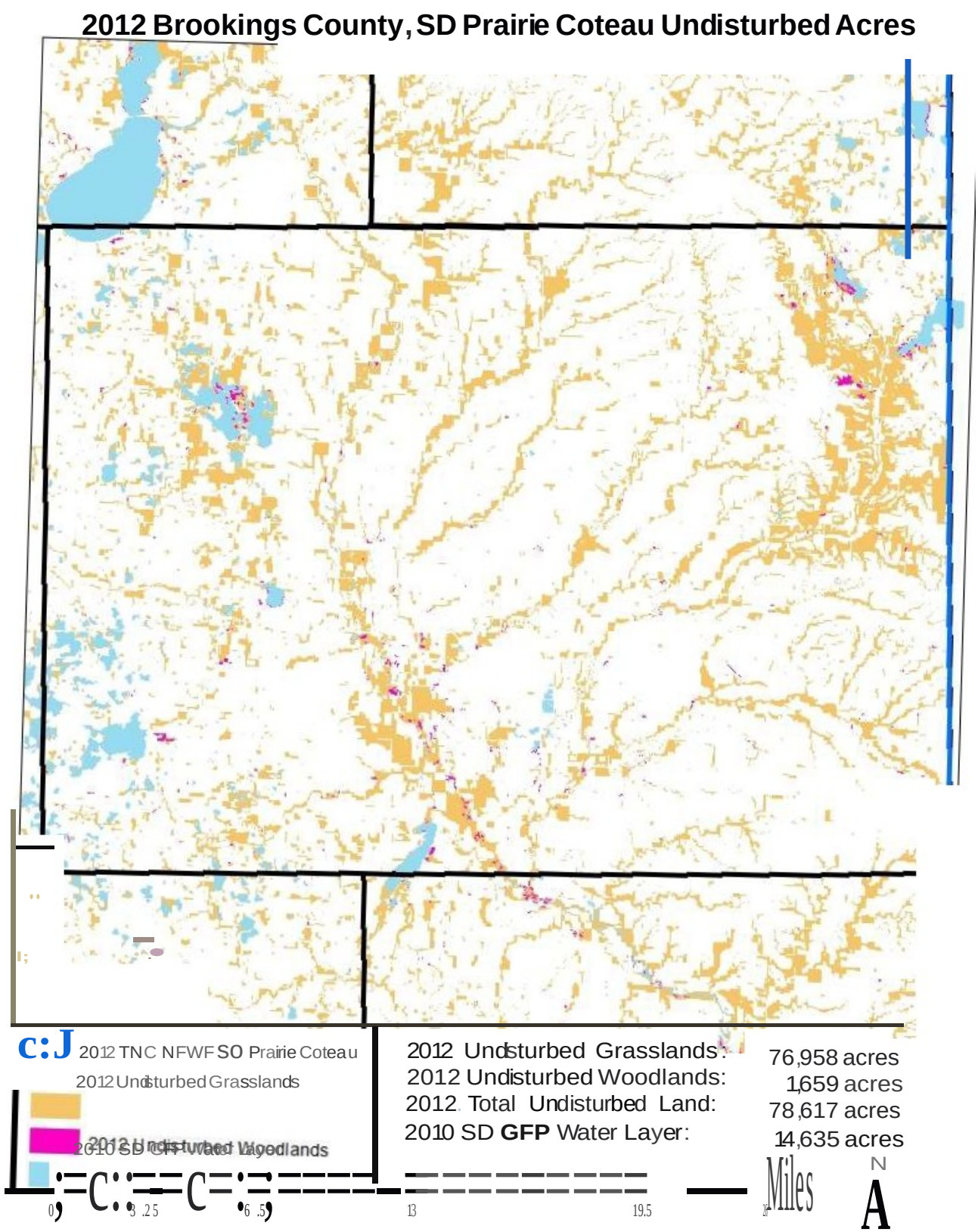
Voldseth, R. A., W. C. Johnson, G. L. Guntenspergen, T. Gilminov, and B.V. Millet. 2009. Adaptation of Farming Practices Could Buffer Effects of Climate Change on Northern Prairie Wetlands. Wetlands. 29:635-647.

Werner, B. A., W. C. Johnson, and G. R. Guntenspergen. 2013. Evidence of 20th Century Climate Warming and Wetland Drying in the North American Prairie Pothole Region. Ecology and Evolution. 3(10):3471-3482.

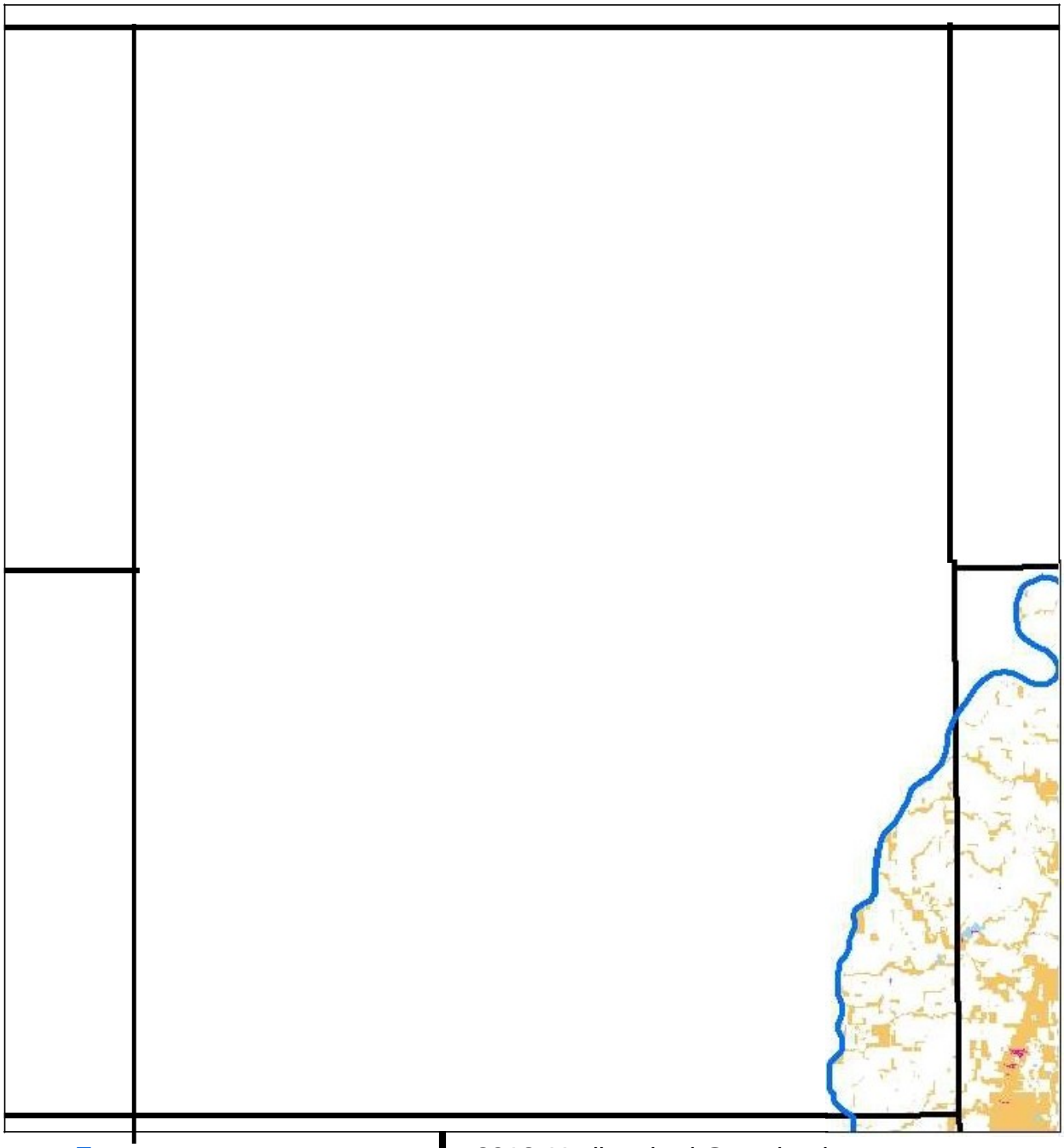
Wright, C. K., and M. C. Wimberly. 2013. Recent Land Use Change in the Western Corn Belt Threatens Grasslands and Wetlands. Proceedings of the National Acadamy of Sciences of the United States, 110(10), 4134-4139.

# Appendix A:

Undisturbed Grasslands and Woodlands in the South Dakota Prairie Coteau, by County.


2012 Brookings County, SD Prairie Coteau Undisturbed Acres
2012 TNC NFWF SD Prairie Coteau
2012 Undisturbed Grasslands
2012 Undisturbed Woodlands
2010 SD GFP Water Layer
2012 Undisturbed Grasslands: 76,958 acres
2012 Undisturbed Woodlands: 1,659 acres
2012 Total Undisturbed Land: 78,617 acres
2010 SD GFP Water Layer: 14,635 acres
0
3.25
6.5
13
19.5
Miles
N

## 2012 Brown County, SD Prairie Coteau Undisturbed Acres



2012 TNC NFWF SD Prairie Coteau

2012 Undisturbed Grasslands
2012 Undisturbed Woodlands
2010 SD GFP Water Layer

| | |
|---|---|
| 2012 Undisturbed Grasslands: | 6,179 acres |
| 2012 Undisturbed Woodlands: | 0 acres |
| 2012 Total Undisturbed Land: | 6,179 acres |
| 2010 SO **GFP** Water Layer: | 56 acres |

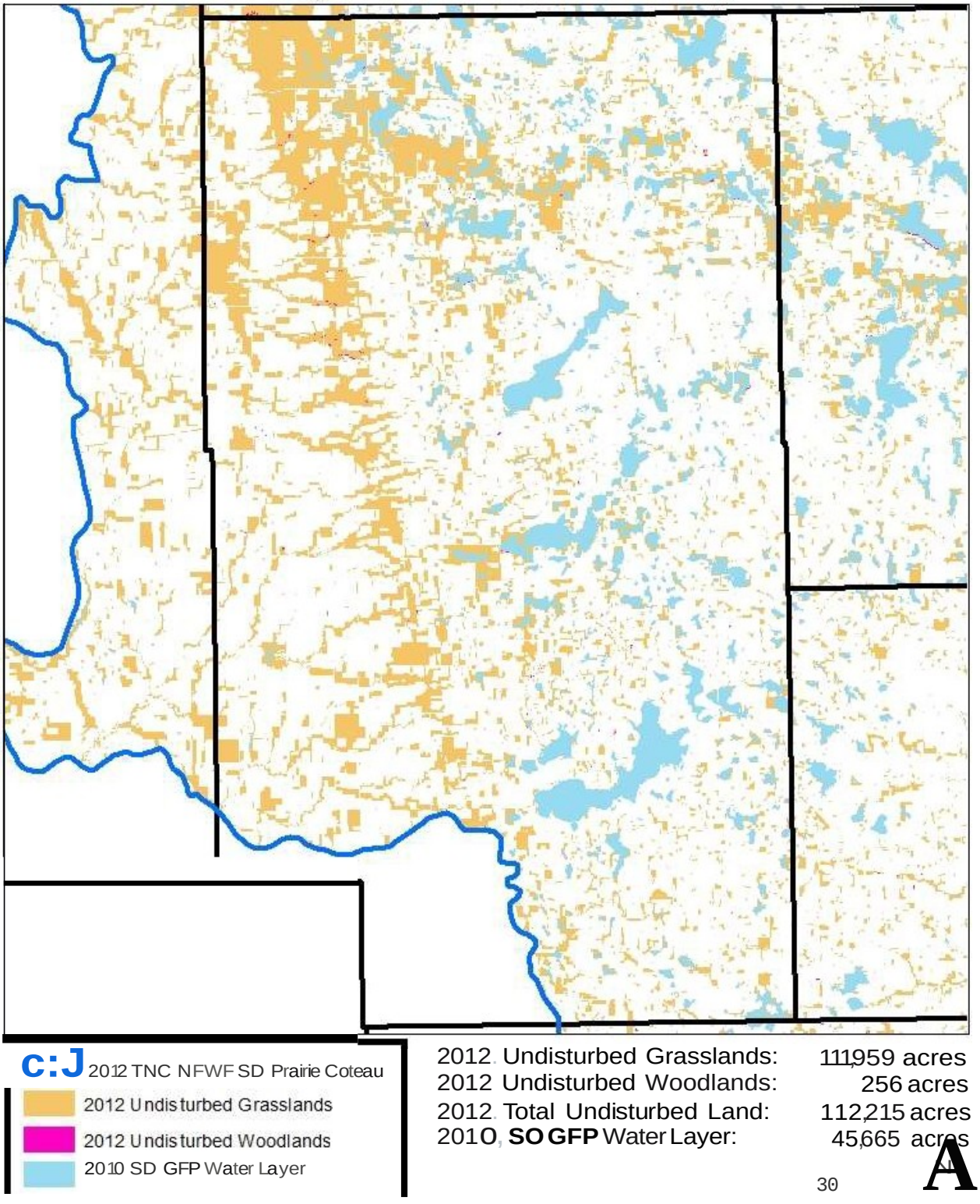
34

A

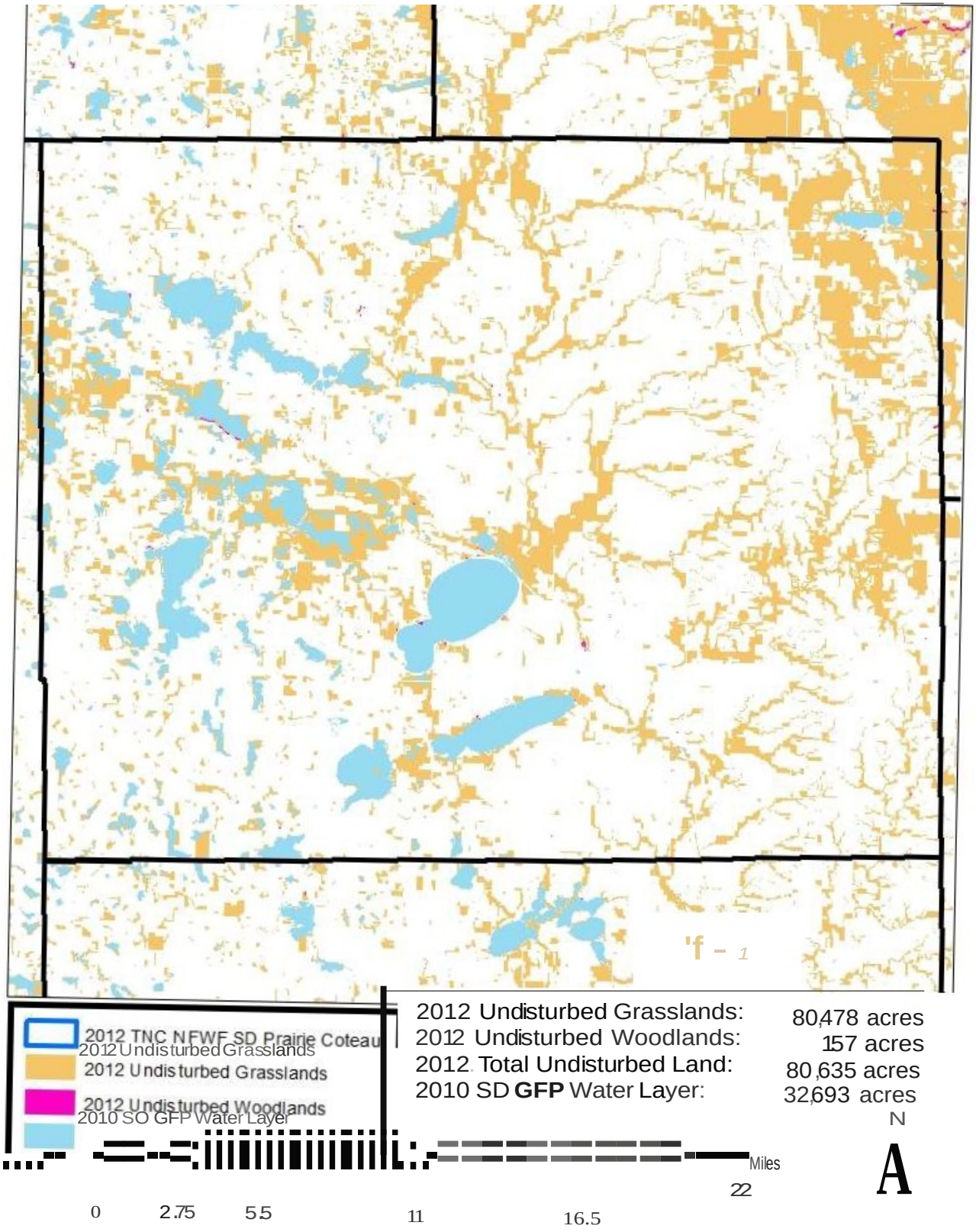
17 25.5

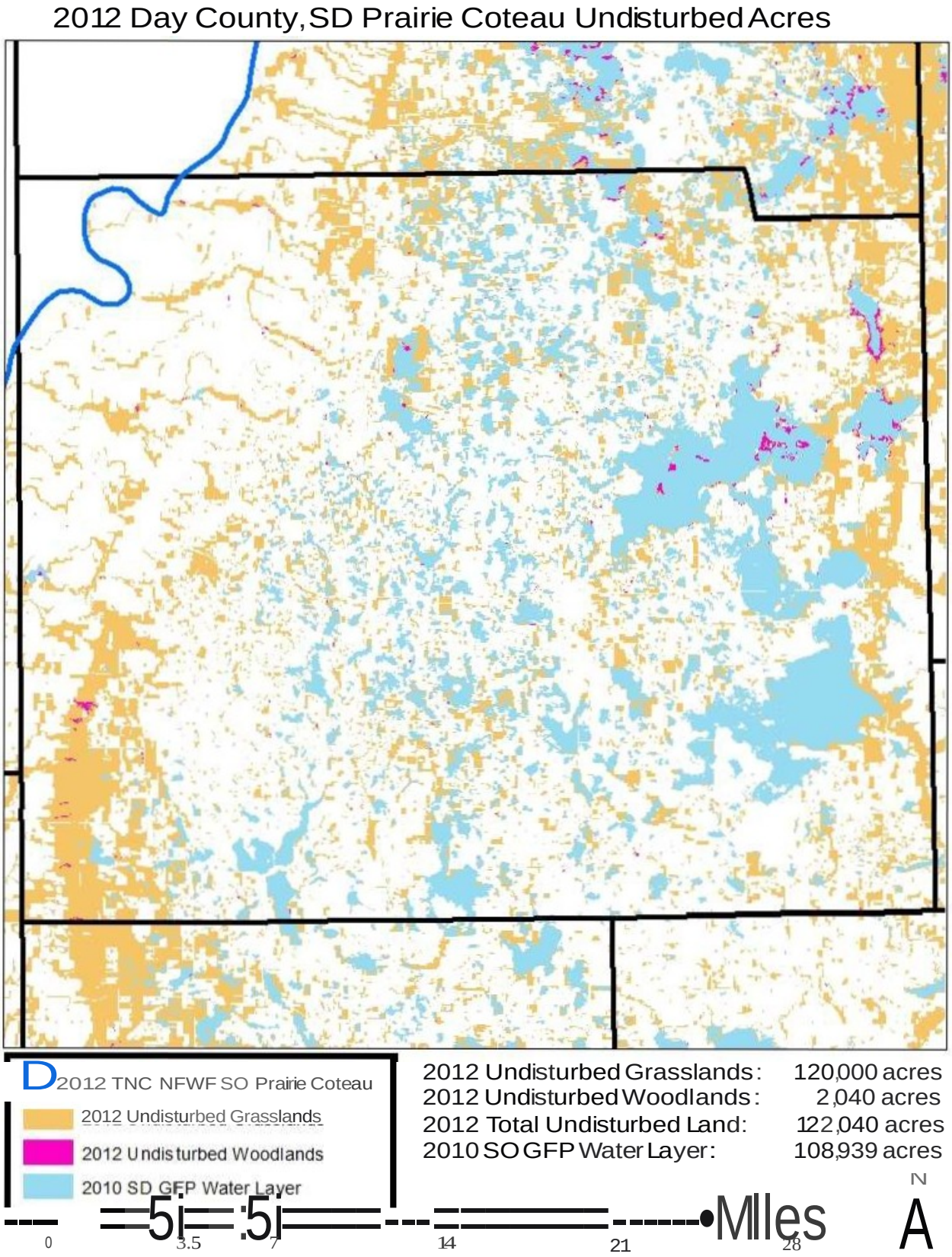
0 4.25 8.5 Miles

## 2012 Clark County, SD Prairie Coteau Undisturbed Acres

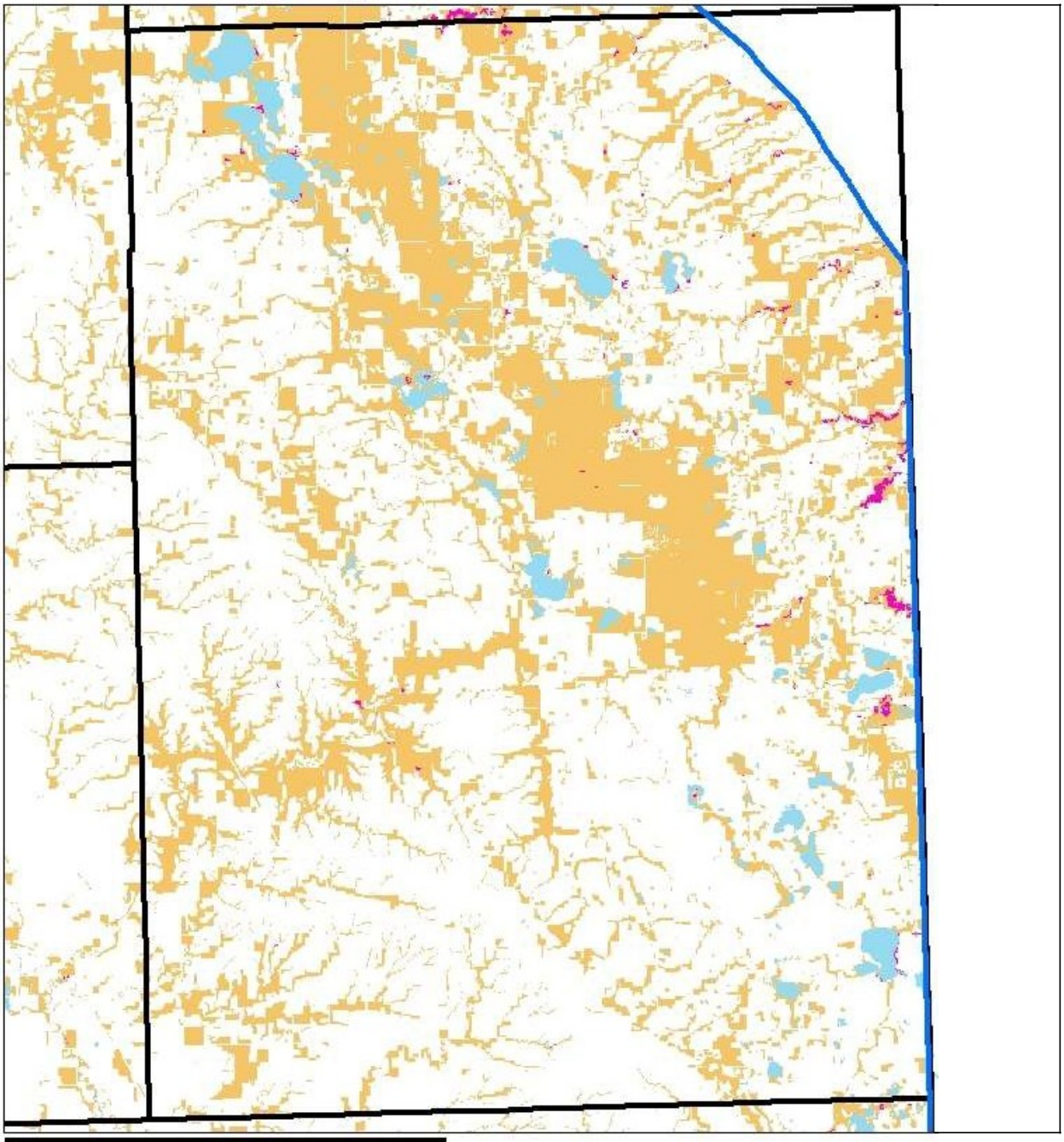


## 2012 Codington County, SD Prairie Coteau Undisturbed Acres

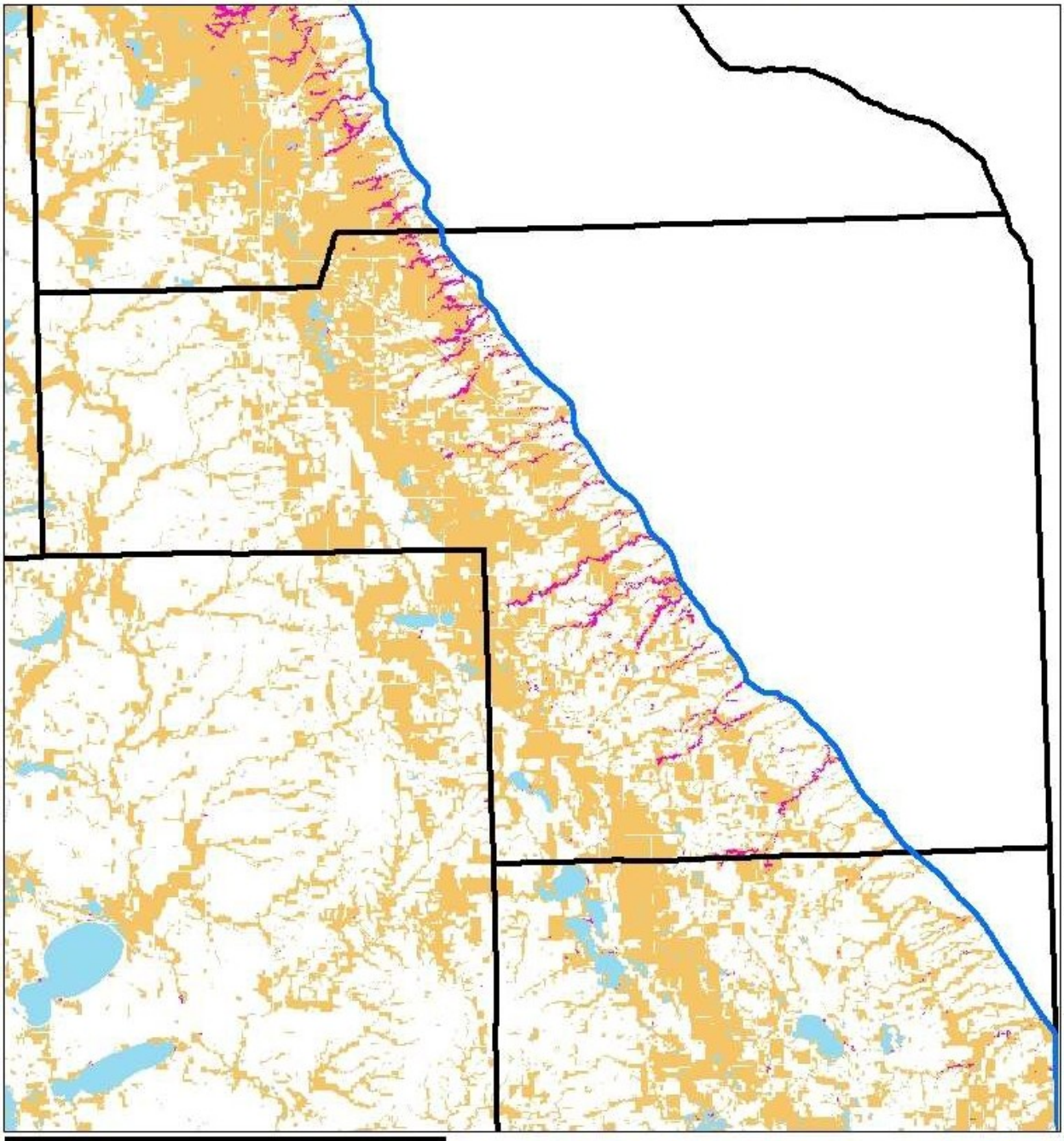



2012 Day County, SD Prairie Coteau Undisturbed Acres
2012 TNC NFWF SO Prairie Coteau
2012 Undisturbed Grasslands
2012 Undisturbed Woodlands
2010 SD GFP Water Layer
2012 Undisturbed Grasslands: 120,000 acres
2012 Undisturbed Woodlands: 2,040 acres
2012 Total Undisturbed Land: 122,040 acres
2010 SO GFP Water Layer: 108,939 acres
0
3.5
7
14
21
28
Miles
N

## 2012 Deuel County, SD Prairie Coteau Undisturbed Acres



## 2012 Grant County, SD Prairie Coteau Undisturbed Acres



2012 TNC NFWF SD Prairie Coteau
2012 Undisturbed Grasslands
2012 Undisturbed Woodlands
2010 SD GFP Water Layer

| | |
|---|---|
| 2012 Undisturbed Grasslands: | 85,681 acres |
| 2012 Undisturbed Woodlands: | 4,284 acres |
| 2012 Total Undisturbed Land: | 89,964 acres |
| 2010 SD GFP Water Layer: | 1,803 acres |

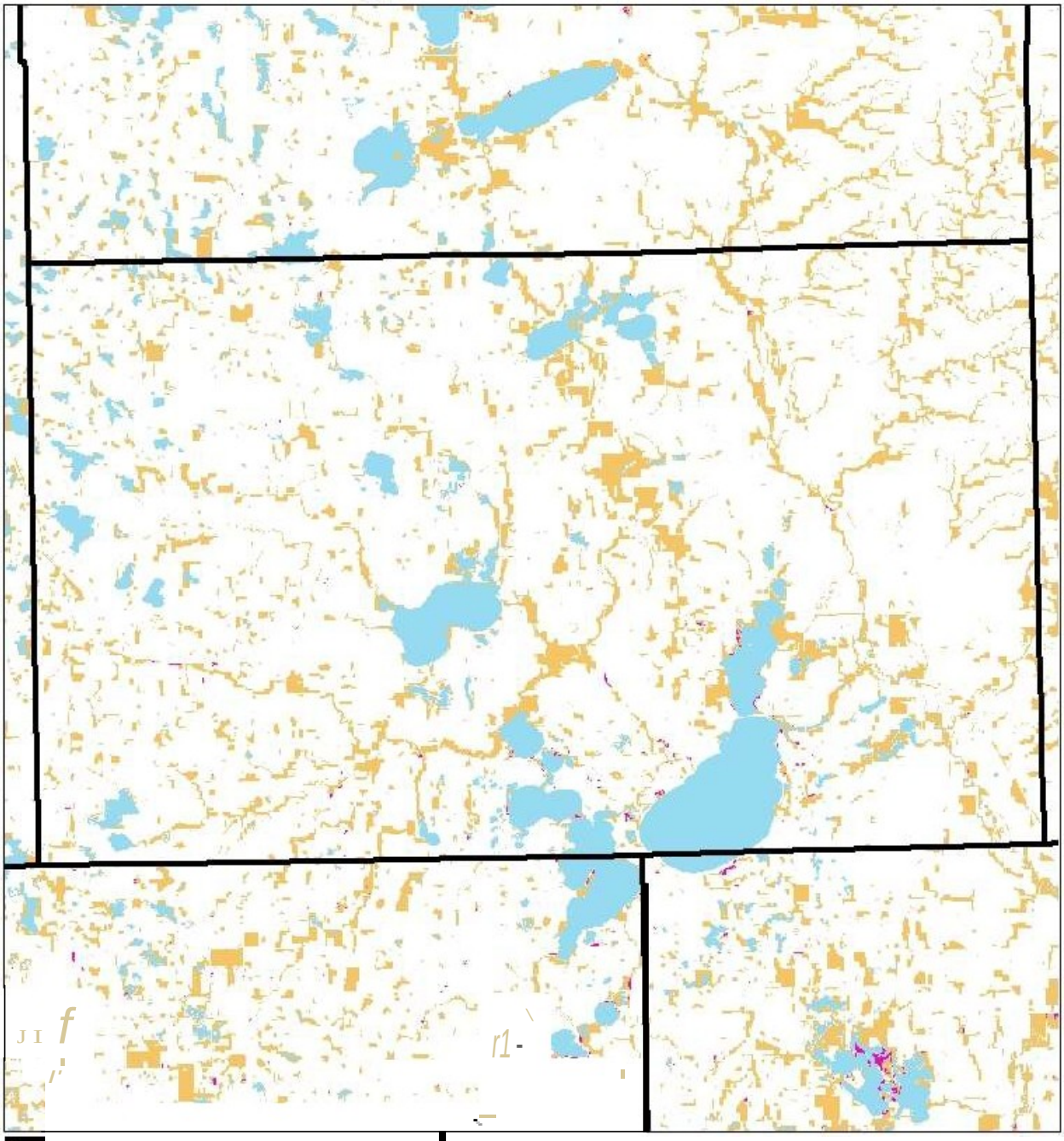
30

A

0 3.75 7.5 15 22.5

Miles

## 2012 Hamlin County, SD Prairie Coteau Undisturbed Acres



2012 TNC NFWF SD Prairie Coteau

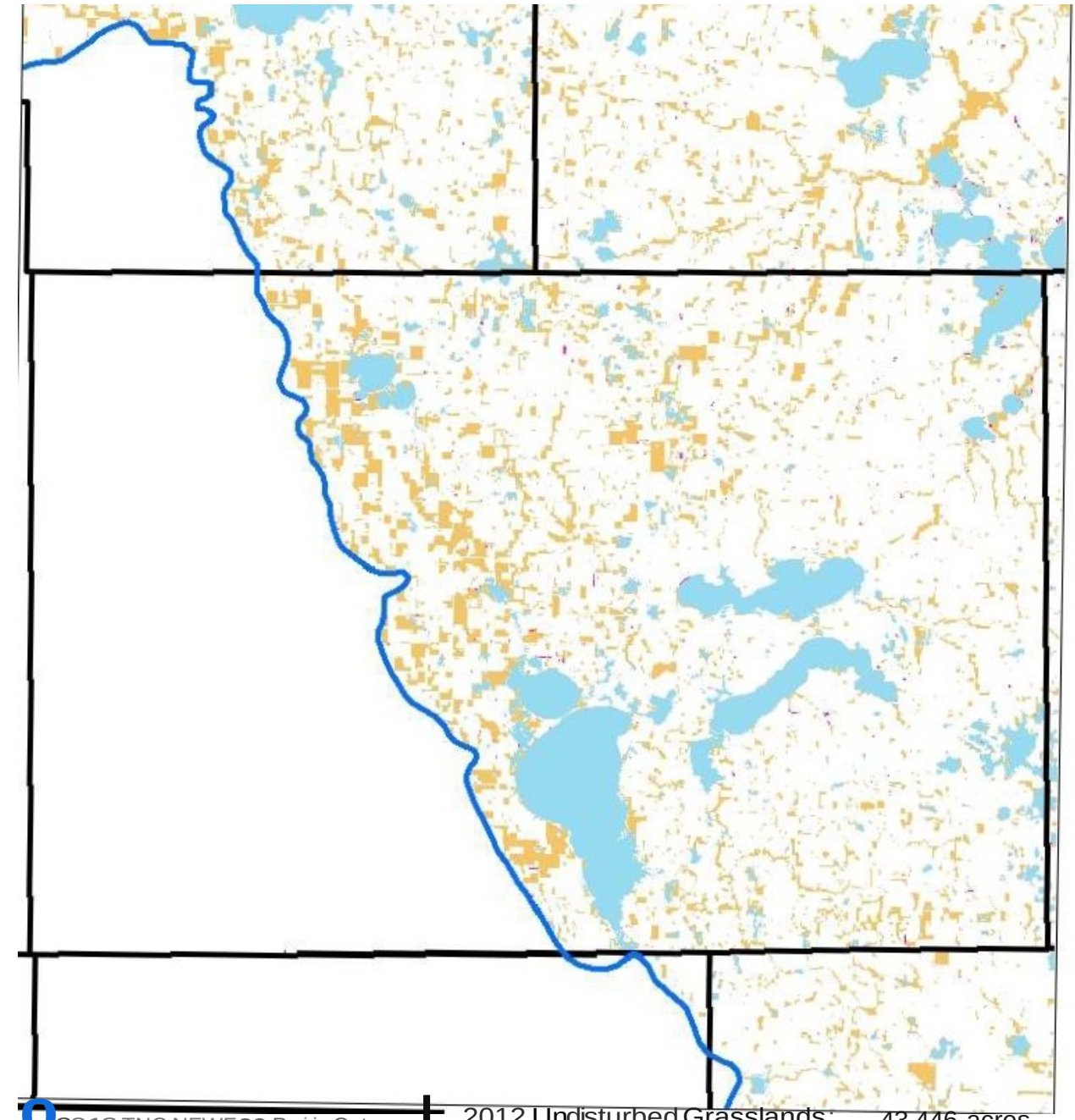
| | |
|---|---|
| 2012 Undisturbed Grasslands: | 37,379 acres |
| 2012 Undisturbed Woodlands: | 296 acres |
| 2012 Total Undisturbed Land: | 37,675 acres |
| 2010 SD GFP Water Layer: | 27,444 acres |

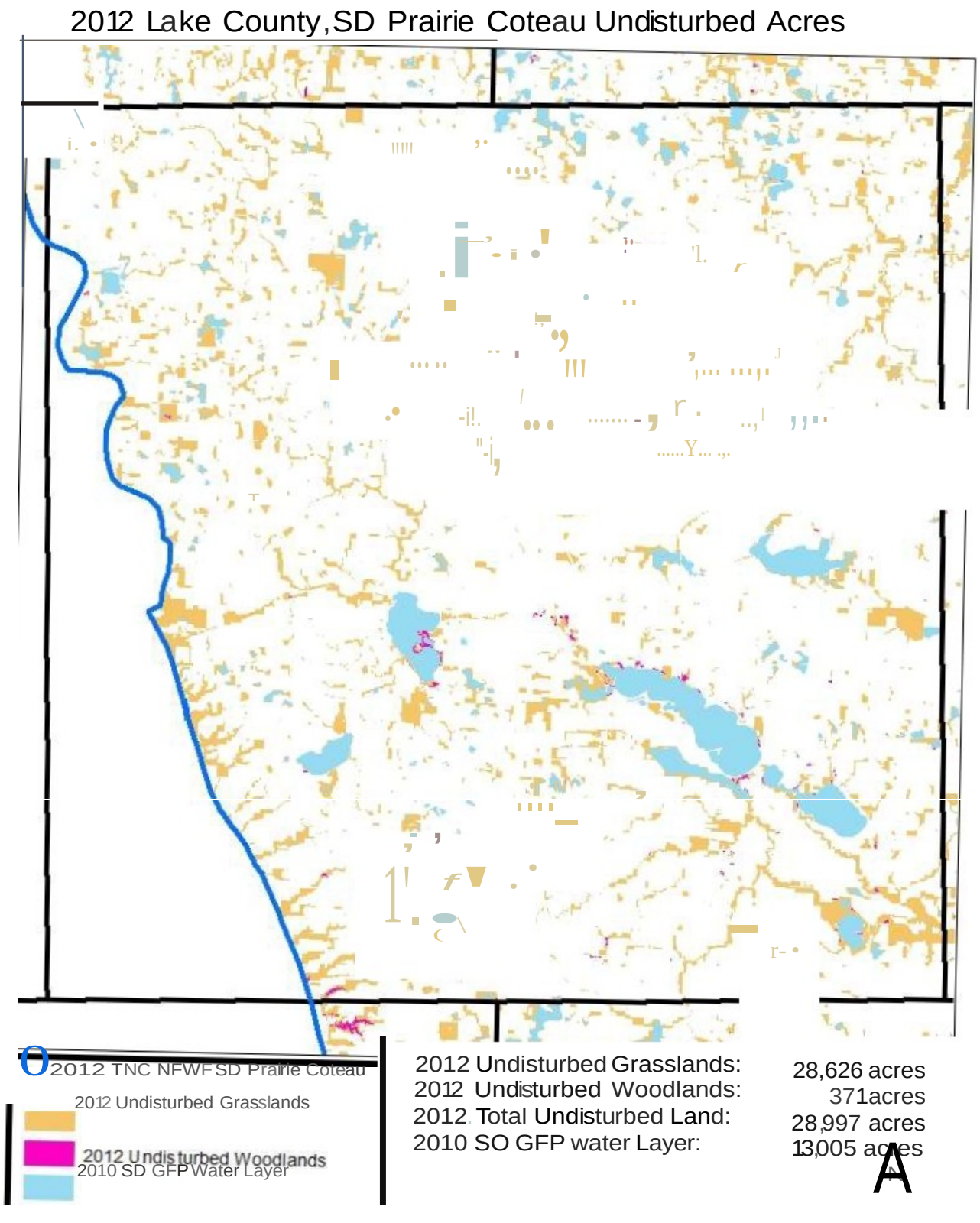
2012 Undisturbed Grasslands
2012 Undisturbed Woodlands
2010 SD GFP Water Layer

0 2.75 5.5 11 16.5 22 Miles

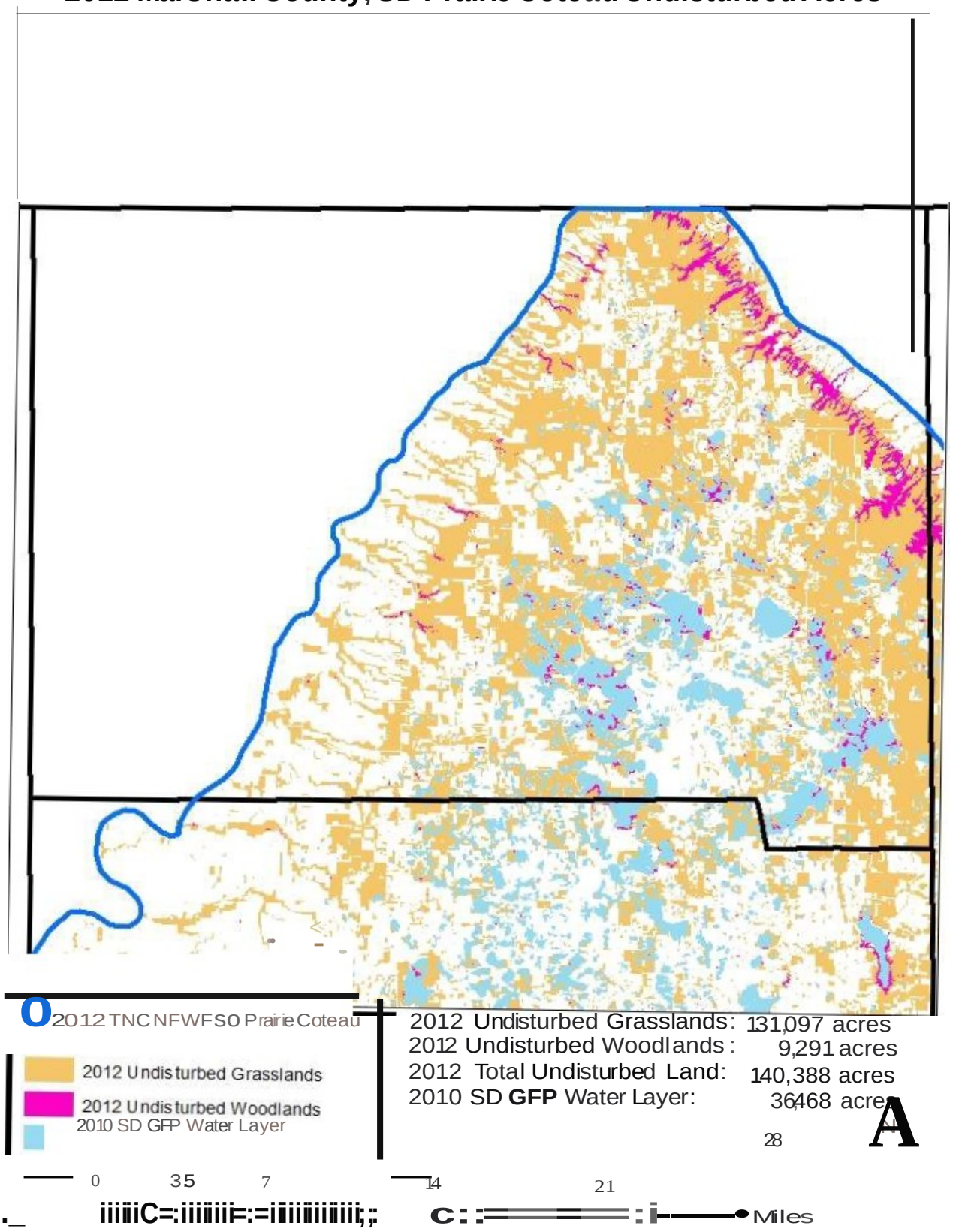
A

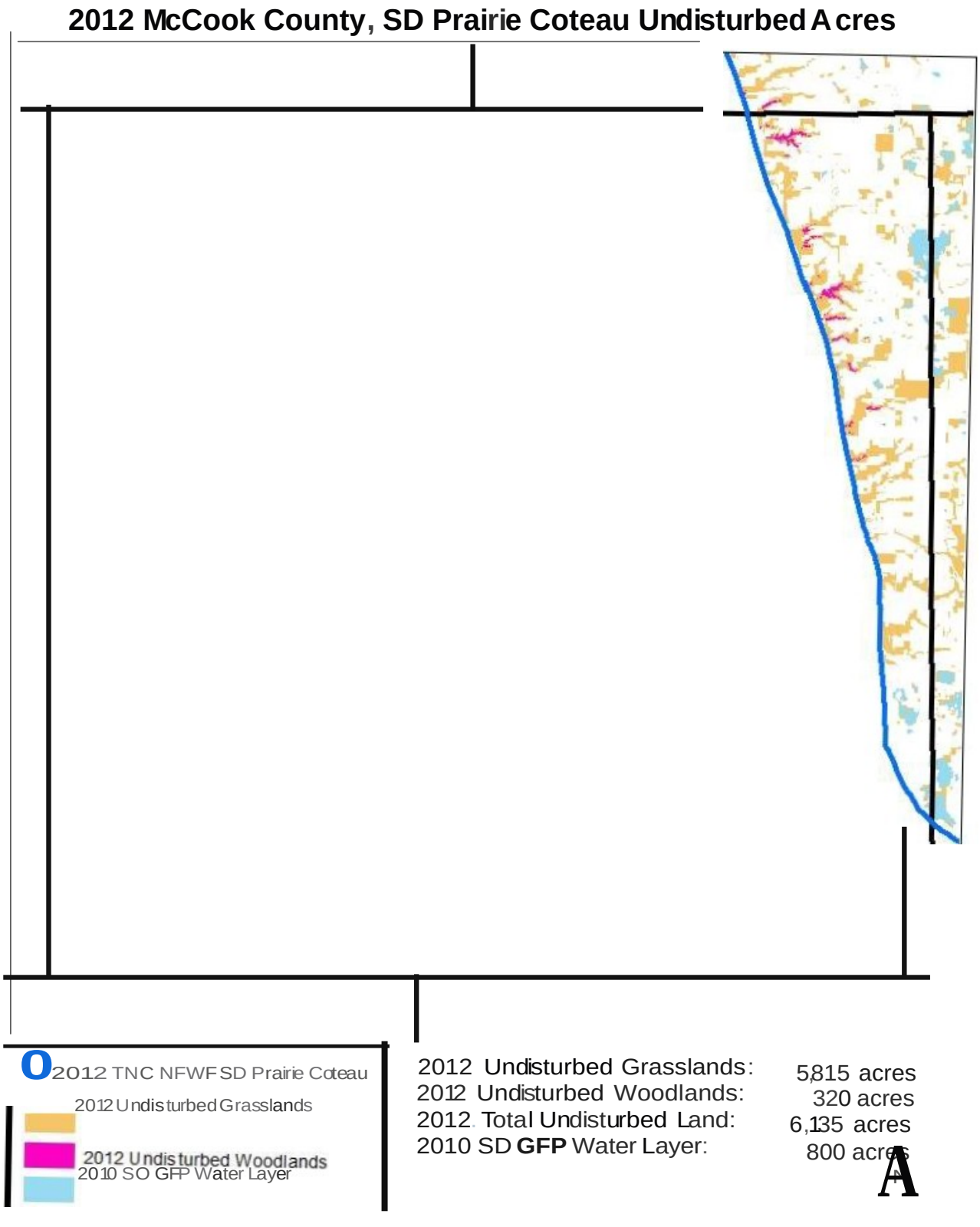
# 2012 Kingsbury County, SD Prairie Coteau Undisturbed Acres



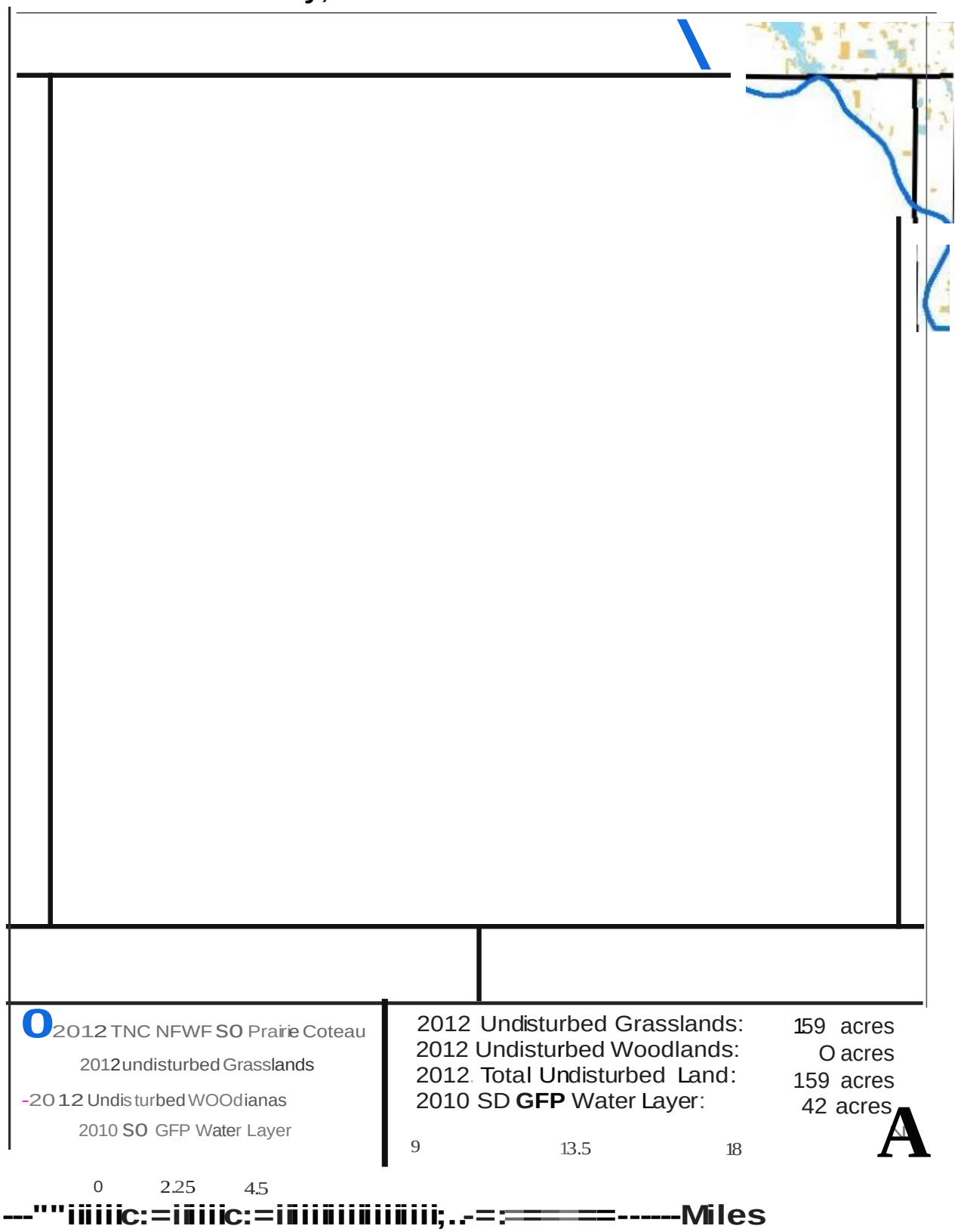

2012 Lake County, SD Prairie Coteau Undisturbed Acres
2012 TNC NFWF SD Prairie Coteau
2012 Undisturbed Grasslands
2012 Undisturbed Woodlands
2010 SD GFP Water Layer
2012 Undisturbed Grasslands: 28,626 acres
2012 Undisturbed Woodlands: 371acres
2012 Total Undisturbed Land: 28,997 acres
2010 SO GFP water Layer: 13,005 acres
A
0
2.25
4.5
9
13.5
18
Miles

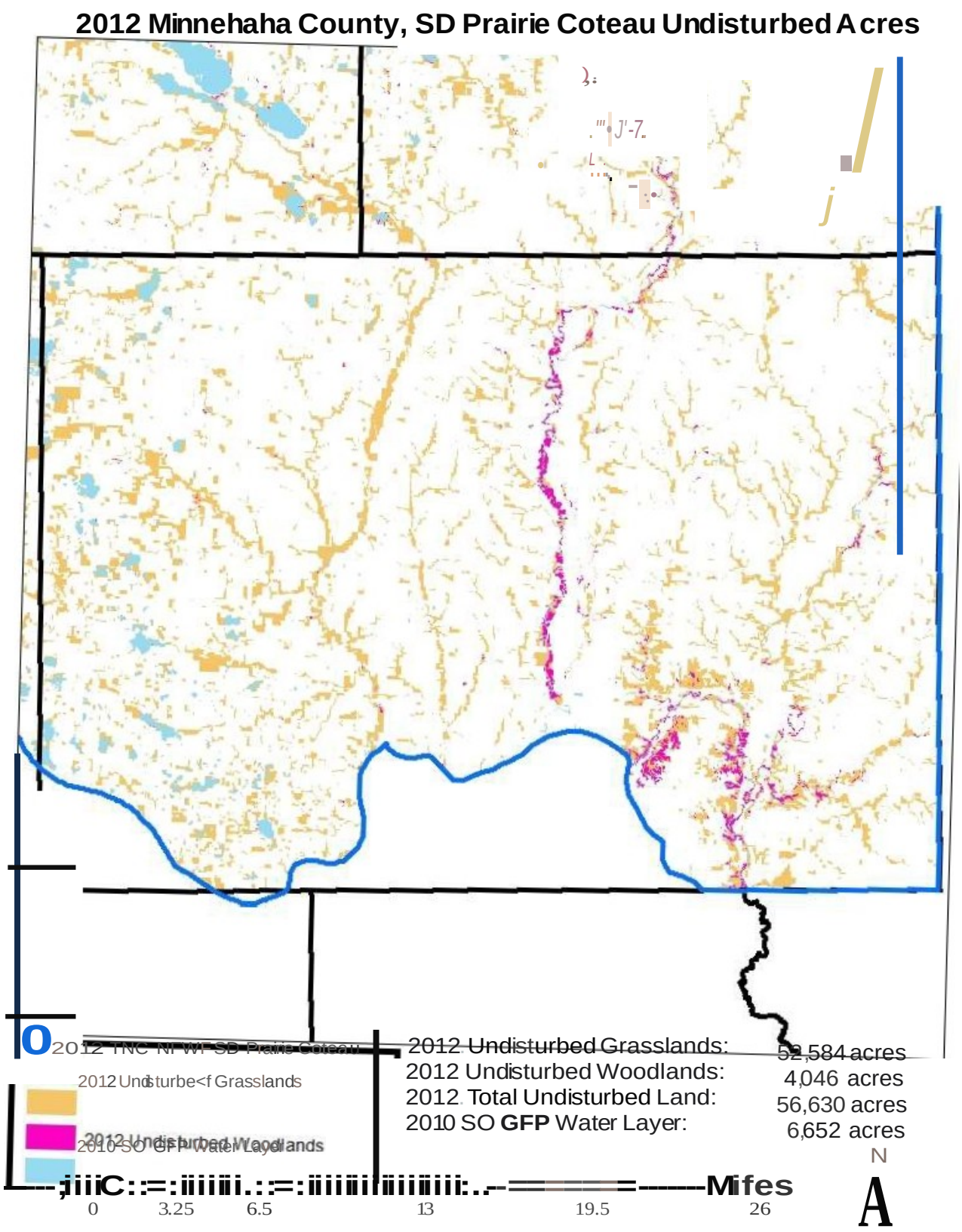
## 2012 Marshall County, SD Prairie Coteau Undisturbed Acres

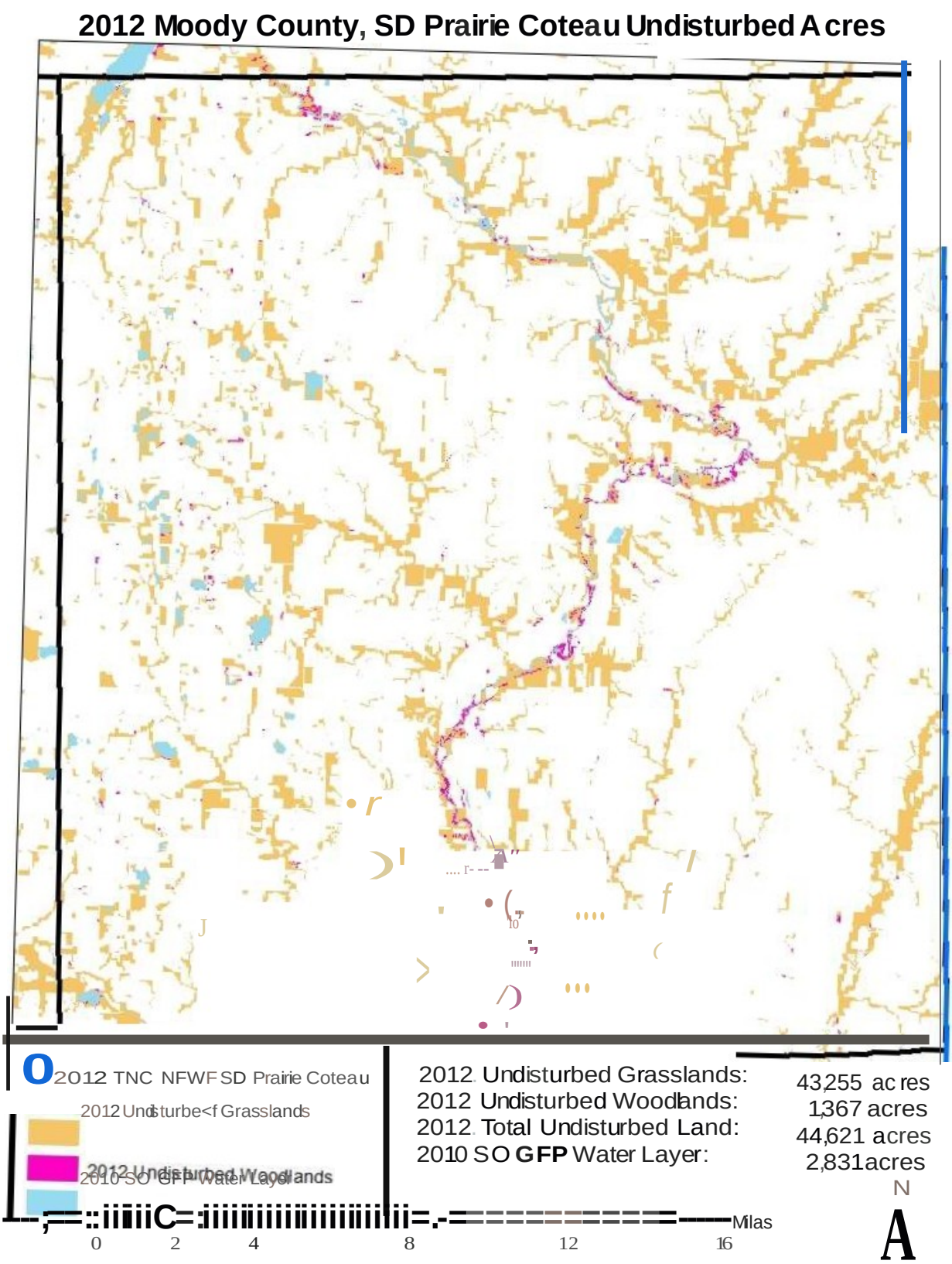



2012 McCook County, SD Prairie Coteau Undisturbed Acres
2012 TNC NFWF SD Prairie Coteau
2012 Undisturbed Grasslands
2012 Undisturbed Woodlands
2010 SO GFP Water Layer
2012 Undisturbed Grasslands: 5,815 acres
2012 Undisturbed Woodlands: 320 acres
2012 Total Undisturbed Land: 6,135 acres
2010 SD GFP Water Layer: 800 acres
A
0 2.25 4.5 9 13.5 18
Miles

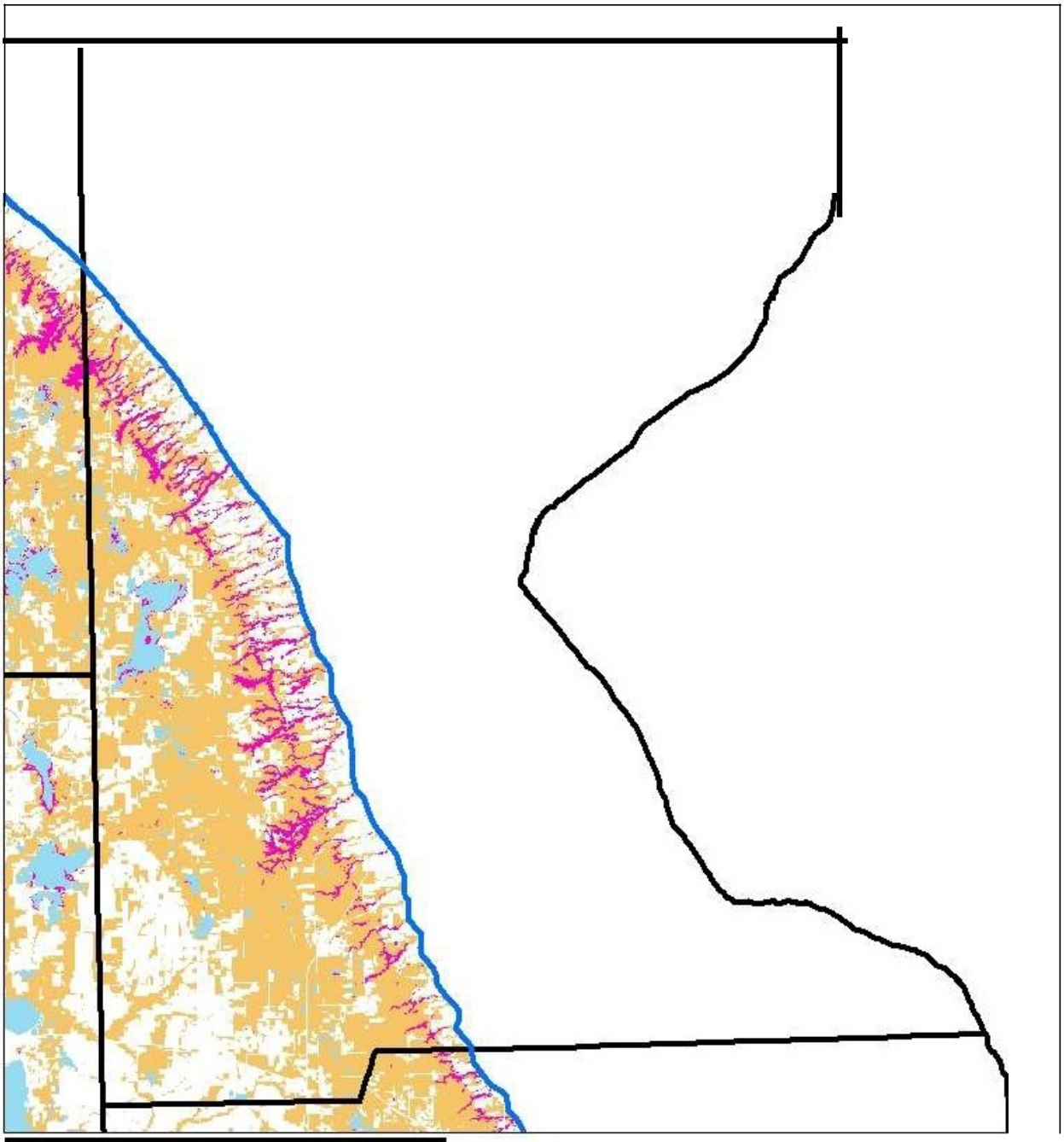
## 2012 Miner County, SD Prairie Coteau Undisturbed Acres




2012 Minnehaha County, SD Prairie Coteau Undisturbed Acres
2012 Undisturbed Grasslands
2012 Undisturbed Woodlands
2010 SO GFP Water Layer
2012 Undisturbed Grasslands: 52,584 acres
2012 Undisturbed Woodlands: 4,046 acres
2012 Total Undisturbed Land: 56,630 acres
2010 SO GFP Water Layer: 6,652 acres
N
0 3.25 6.5 13 19.5 26
Miles


2012 Moody County, SD Prairie Coteau Undisturbed Acres
2012 TNC NFWF SD Prairie Coteau
2012 Undisturbed Grasslands
2012 Undisturbed Woodlands
2010 SO GFP Water Layer
2012 Undisturbed Grasslands: 43,255 acres
2012 Undisturbed Woodlands: 1,367 acres
2012 Total Undisturbed Land: 44,621 acres
2010 SO GFP Water Layer: 2,831acres
N
0 2 4 8 12 16 Miles

## 2012 Roberts County, SD Prairie Coteau Undisturbed Acres



2012 TNC NFWF SD Prairie Coteau
2012 Undisturbed Grasslands
2012 Undisturbed Woodlands
2010 SD GFP Water Layer

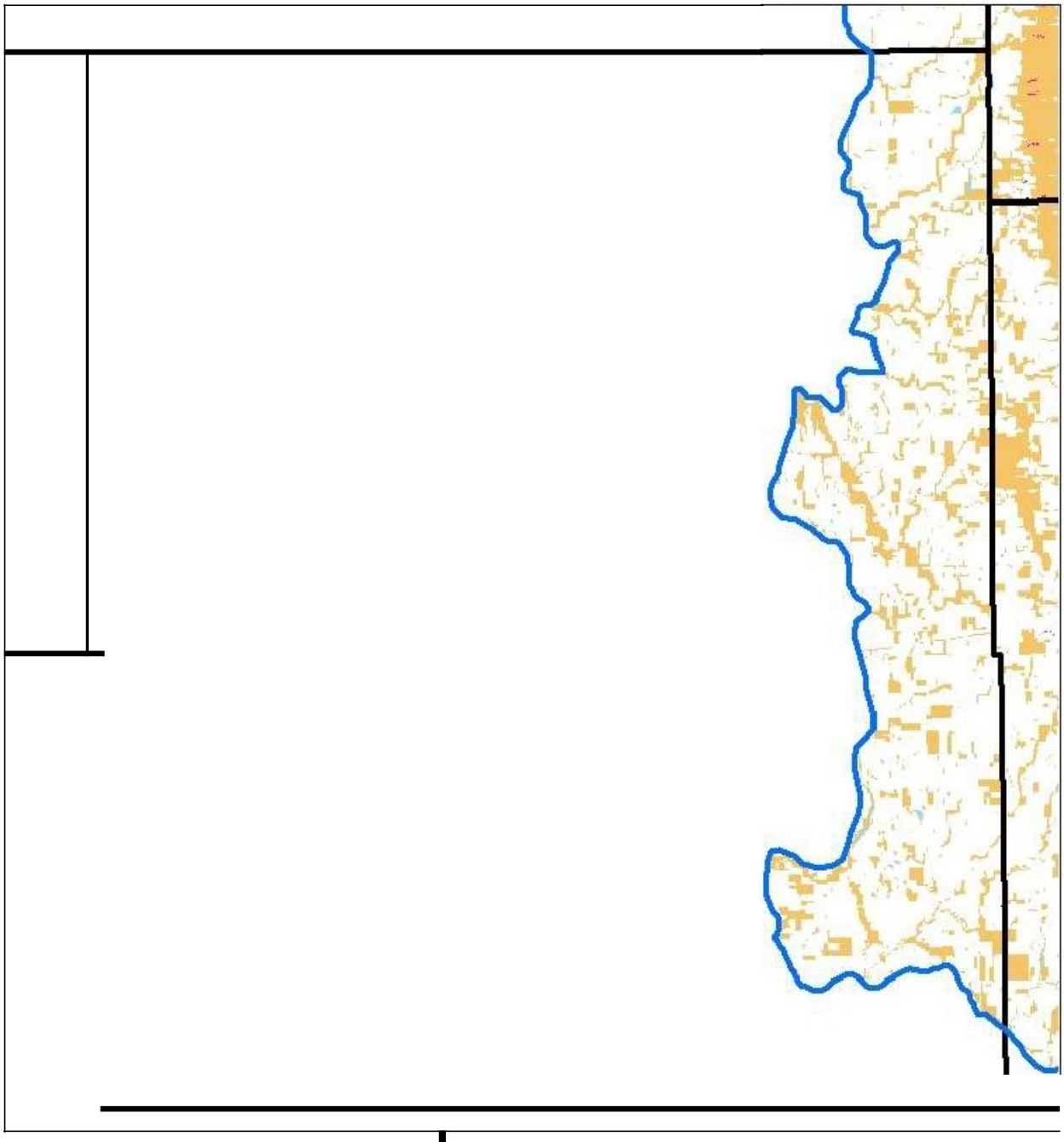
| | |
|---|---|
| 2012 Undisturbed Grasslands: | 106,530 acres |
| 2012 Undisturbed Woodlands: | 11,372 acres |
| 2012 Total Undisturbed Land: | 117,902 acres |
| 2010 SO **GFP** Water Layer: | 6,229 acres |

32

A

0 4 8 16 24 Miles

## 2012 Spink County, SD Prairie Coteau Undisturbed Acres



2012 TNC NFWF SD Prairie Coteau
2012 Undisturbed Grasslands
2012 Undisturbed Woodlands
2010 SD GFP Water Layer

| | |
|---|---|
| 2012 Undisturbed Grasslands: | 25,955 acres |
| 2012 Undisturbed Woodlands: | 7 acres |
| 2012 Total Undisturbed Land: | 25,962 acres |
| 2010 SO **GFP** Water Layer: | 358 acres |

N

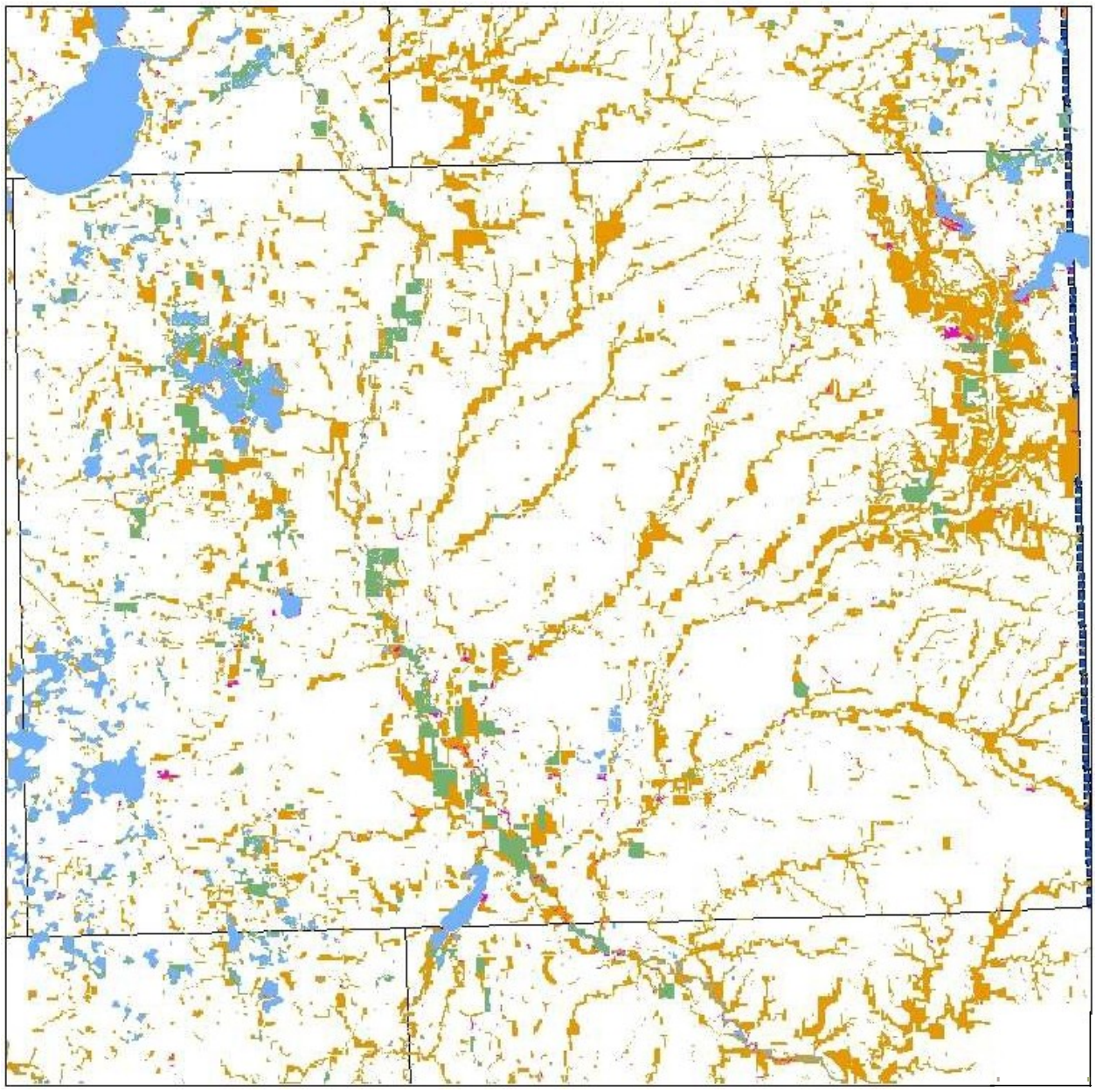
Miles

# Appendix B:

Undisturbed Grasslands and Woodlands in the South Dakota Prairie Coteau *with* Permanent Conservation Protection Status, by County.

The 'protection' layer includes: US Fish and Wildlife Service fee ownership lands (refuges and waterfowl protection areas) and grassland easements; SD Game, Fish, and Parks fee ownership lands (parks and game production areas); Nature Conservancy grassland preserves; USDA Natural Resources Conservation Service Wetland Reserve Program easement acres; and Northern Prairies Land Trust easement acres.

## 2012 Brookings County, SD Undisturbed Acres with Protection Status



- 2012 Undisturbed Grasslands
- 2012 Undisturbed Woodlands
- 2012 Protected Undisturbed Lands
- 2010 SD GFP Water Layer
- Prairie Coteau SO

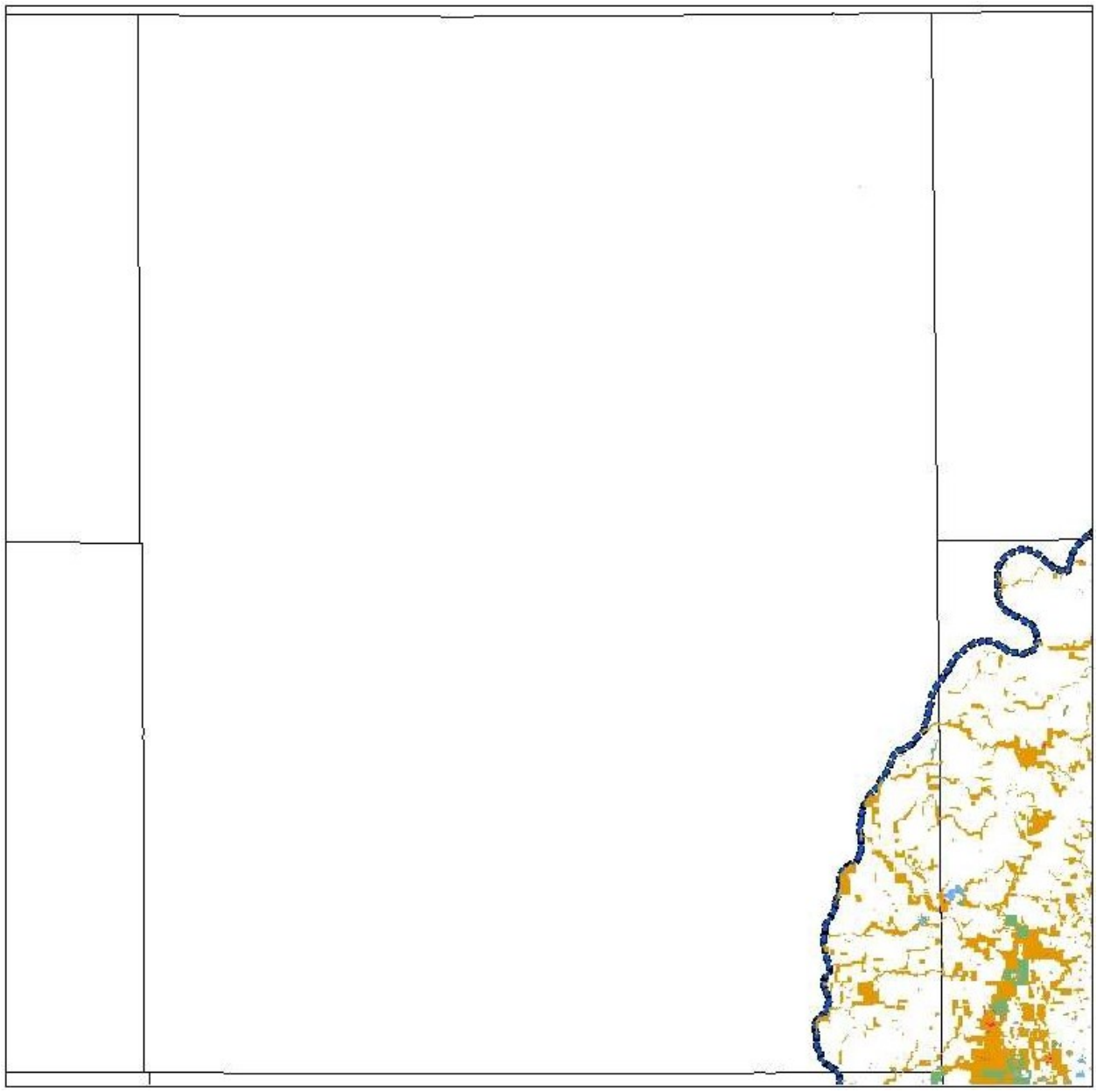
| | |
|---|---|
| 2012 Undisturbed Grasslands: | 76,958 acres |
| 2012 Undisturbed Woodlands: | 1,659 acres |
| 2012 Total Undisturbed Land: | 78,617 acres |
| 2012 Protected Undisturbed Land: | 11,671 acres |
| 201O **SO GFP** Water Acres: | 14,635 acres |

N

0 2.75 5.5 11 16.5 22 Mes

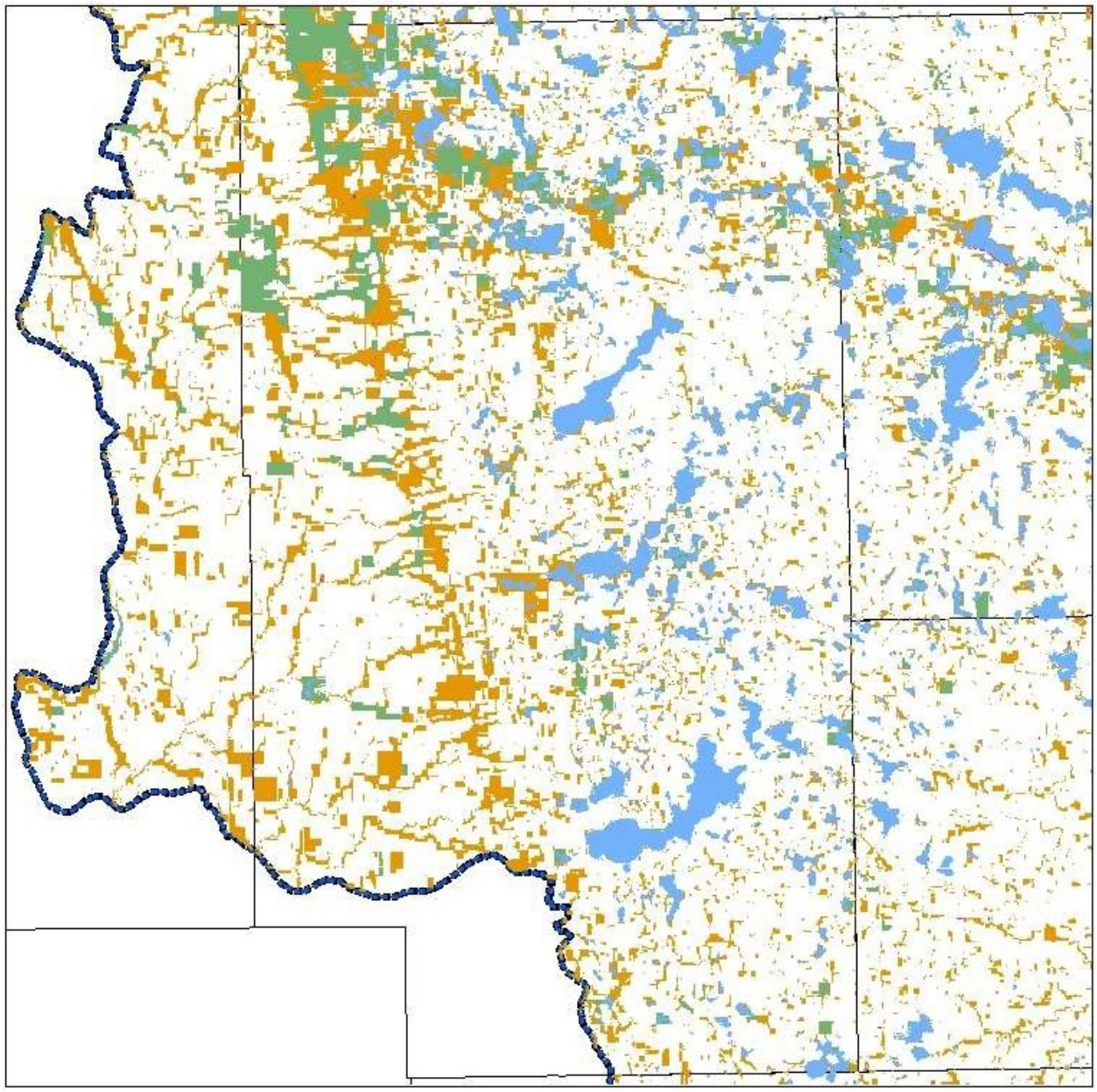
A

## 2012 Brown County, SD Undisturbed Acres with Protection Status




2012 Undisturbed Grasslands: 6,179 acres
2012 Undisturbed Woodlands: O acres
2012 Total Undisturbed Land: 6,179 acres
2012 Protected Undisturbed Land: 184 acres
2010 SO GFP Water Acres: 56 acres

## 2012 Clark County, SD Undisturbed Acres with Protection Status



2012 Undisturbed Grasslands
2012 Undisturbed Woodlands
2012 Protected Undisturbed Lands
2010 SD GFP Water Layer
Prairie Coteau SO

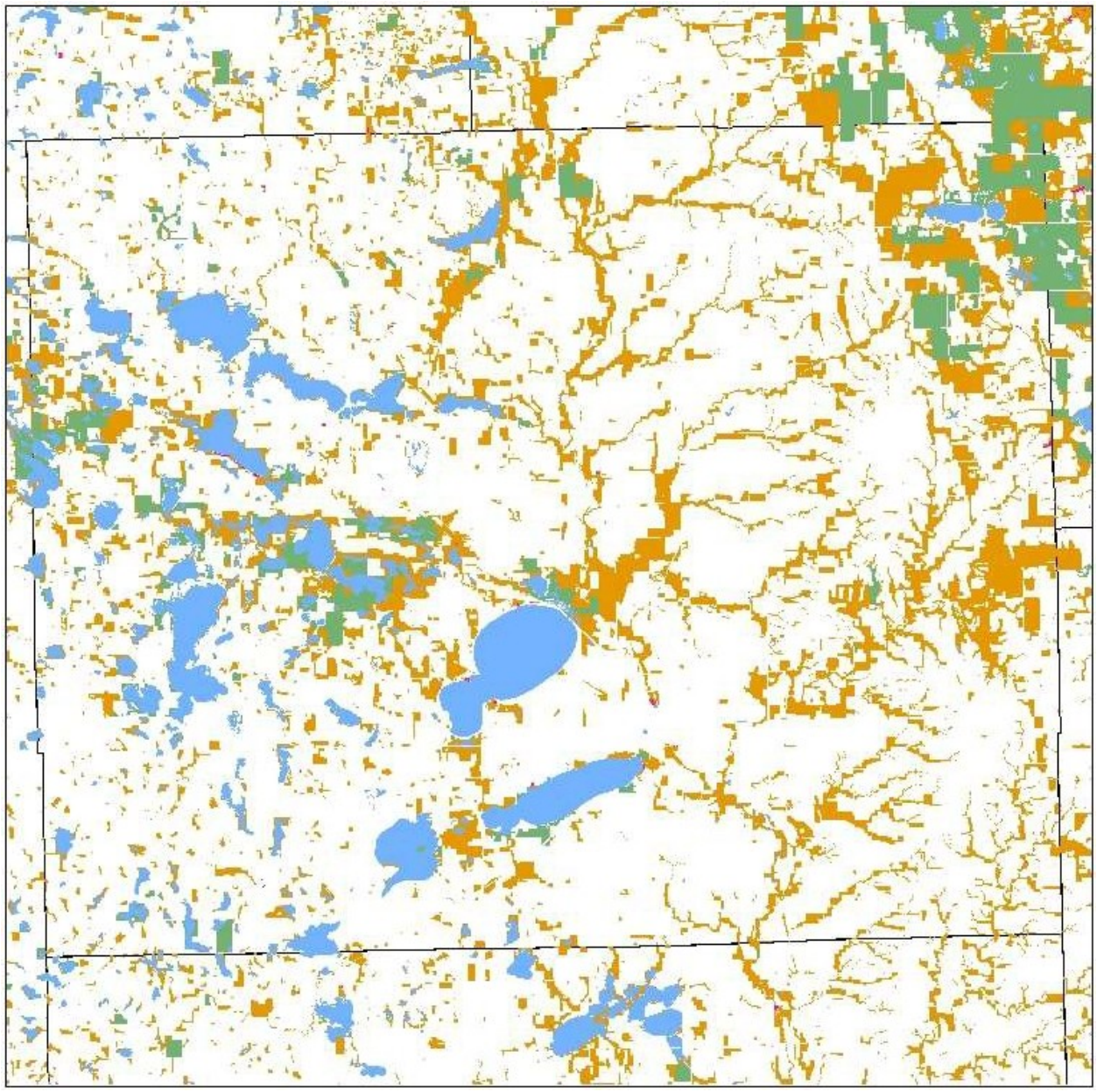
| | |
|---|---|
| 2012 Undisturbed Grasslands: | 111,959 acres |
| 2012 Undisturbed Woodlands: | 256 acres |
| 2012 Total Undisturbed Land: | 112,215 acres |
| 2012 Protected Undisturbed Land: | 27,984 acres |
| 201O SO GFP Water Acres: | 45,665 acres |

0 3.5 7 14 21 28 M1es

N

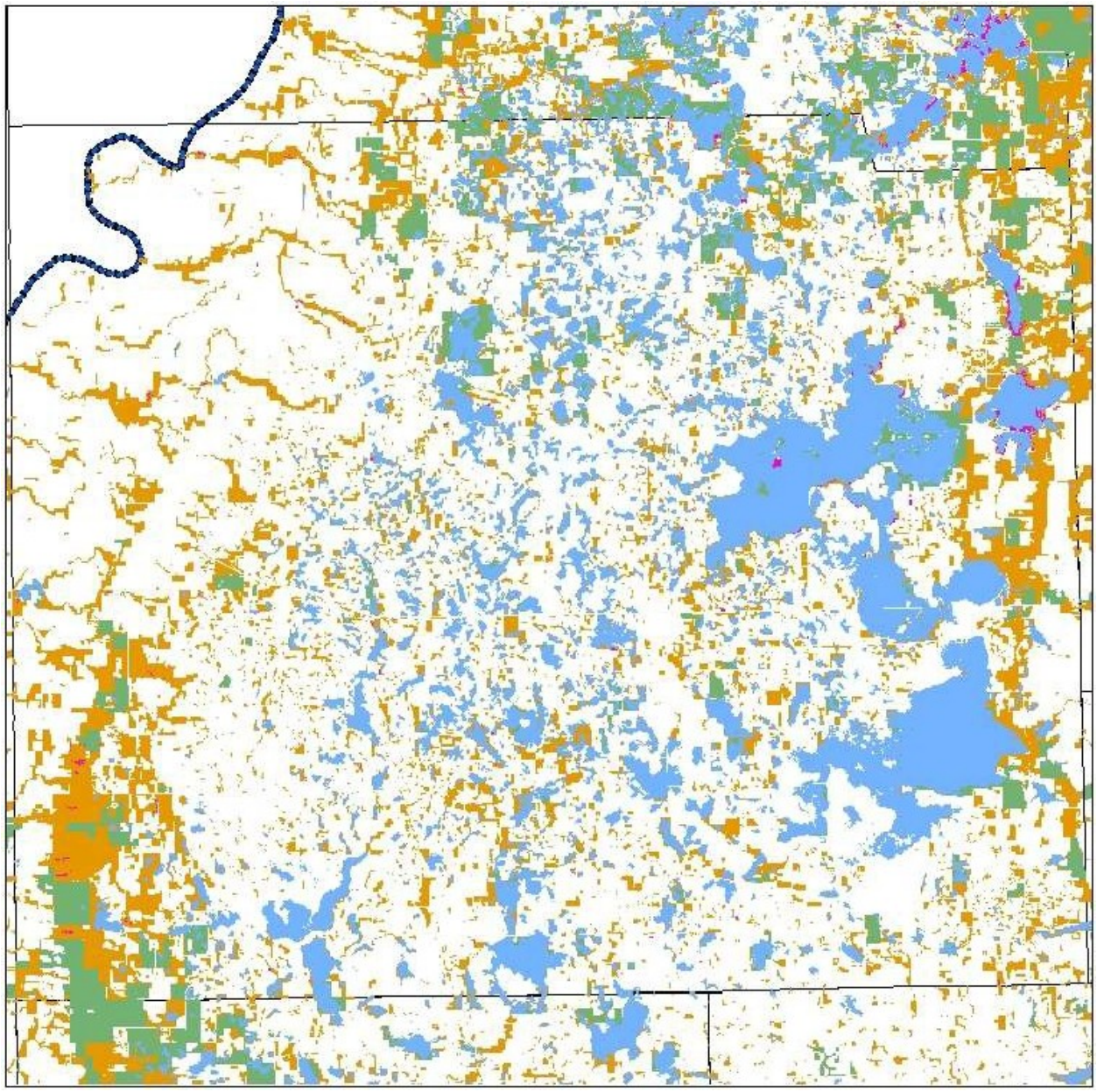
A

## 2012 Codington County, SD Undisturbed Acres with Protection Status




| | |
|---|---|
| 2012 Undisturbed Grasslands: | 80,478 acres |
| 2012 Undisturbed Woodlands: | 157 acres |
| 2012 Total Undisturbed Land: | 80,635 acres |
| 2012 Protected Undisturbed Land: | 13,447 acres |
| 2010 SD GFP Water Acres: | 32,693 acres |

## 2012 Day County, SD Undisturbed Acres with Protection Status



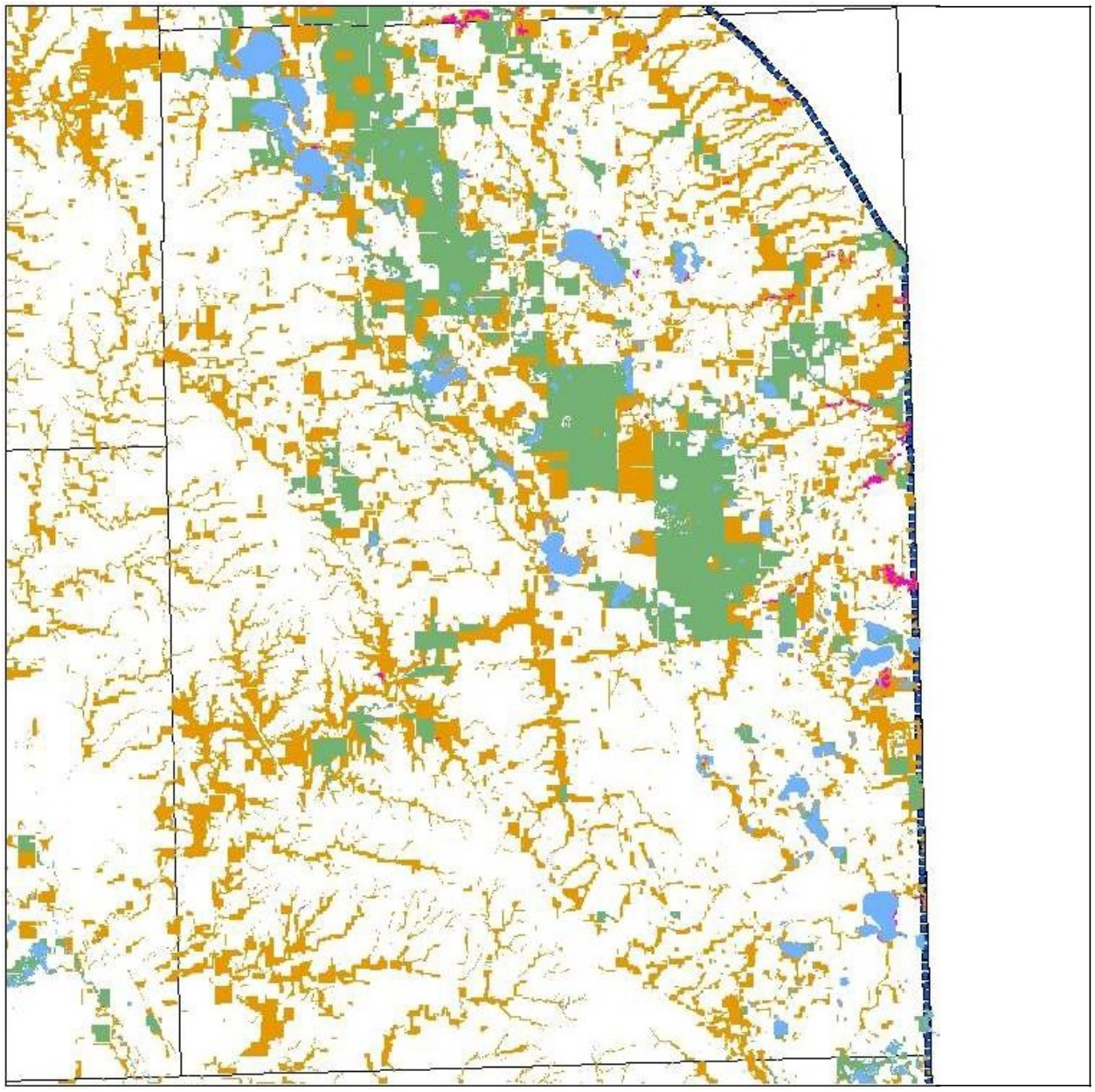
2012 Undisturbed Grasslands
2012 Undisturbed Woodlands
2012 Protected Undisturbed Lands
2010 SD GFP Water Layer
Prairie Coteau SO

| | |
|---|---|
| 2012 Undisturbed Grasslands: | 120,000 acres |
| 2012 Undisturbed Woodlands: | 2,040 acres |
| 2012 Total Undisturbed Land: | 122,040 acres |
| 2012 Protected Undisturbed Land: | 28,049 acres |
| 2010 SO GFP Water Acres: | 108,939 acres |

0 3 6 12 18 24 Mes

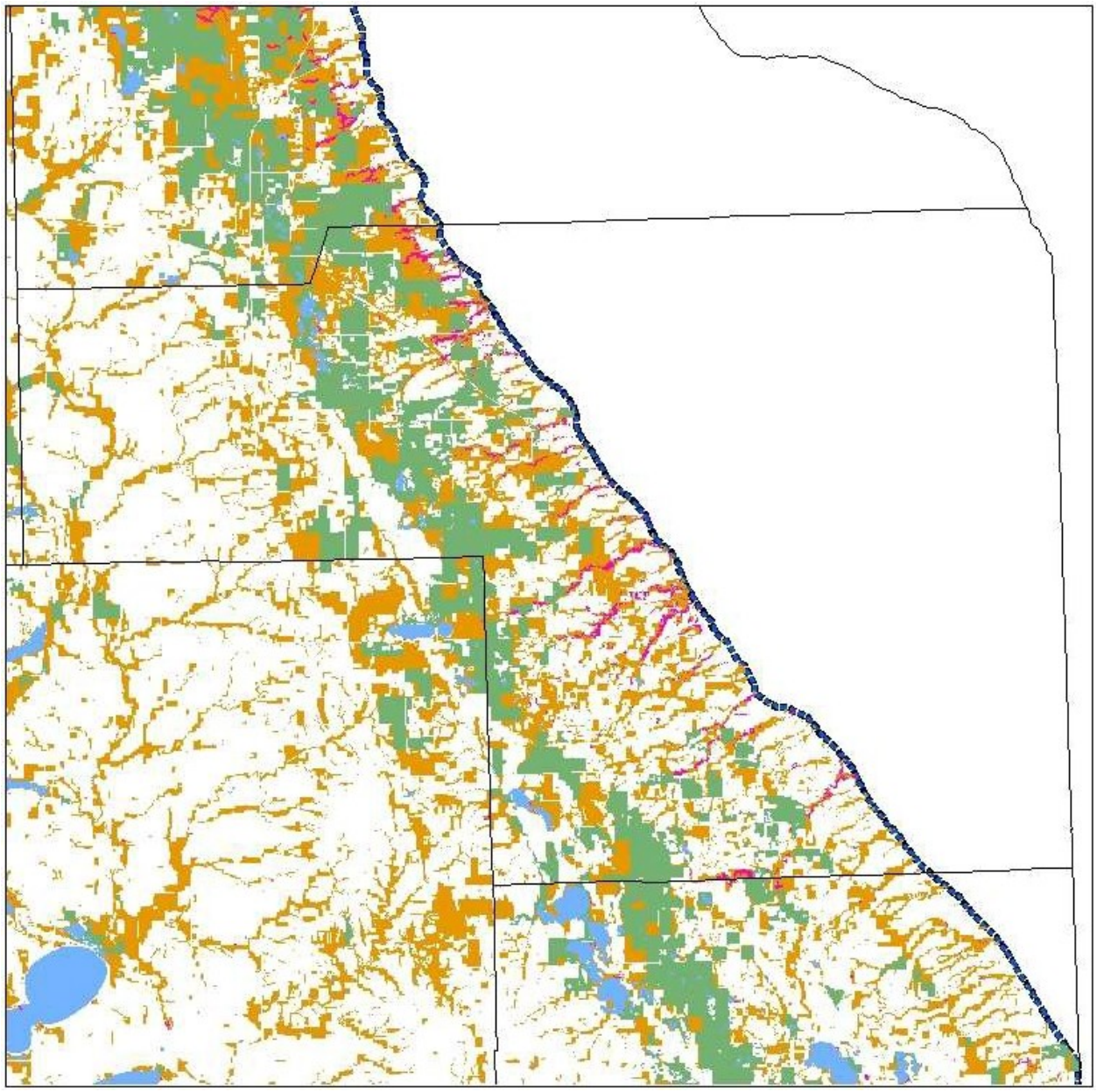
N

## 2012 Deuel County, SD Undisturbed Acres with Protection Status



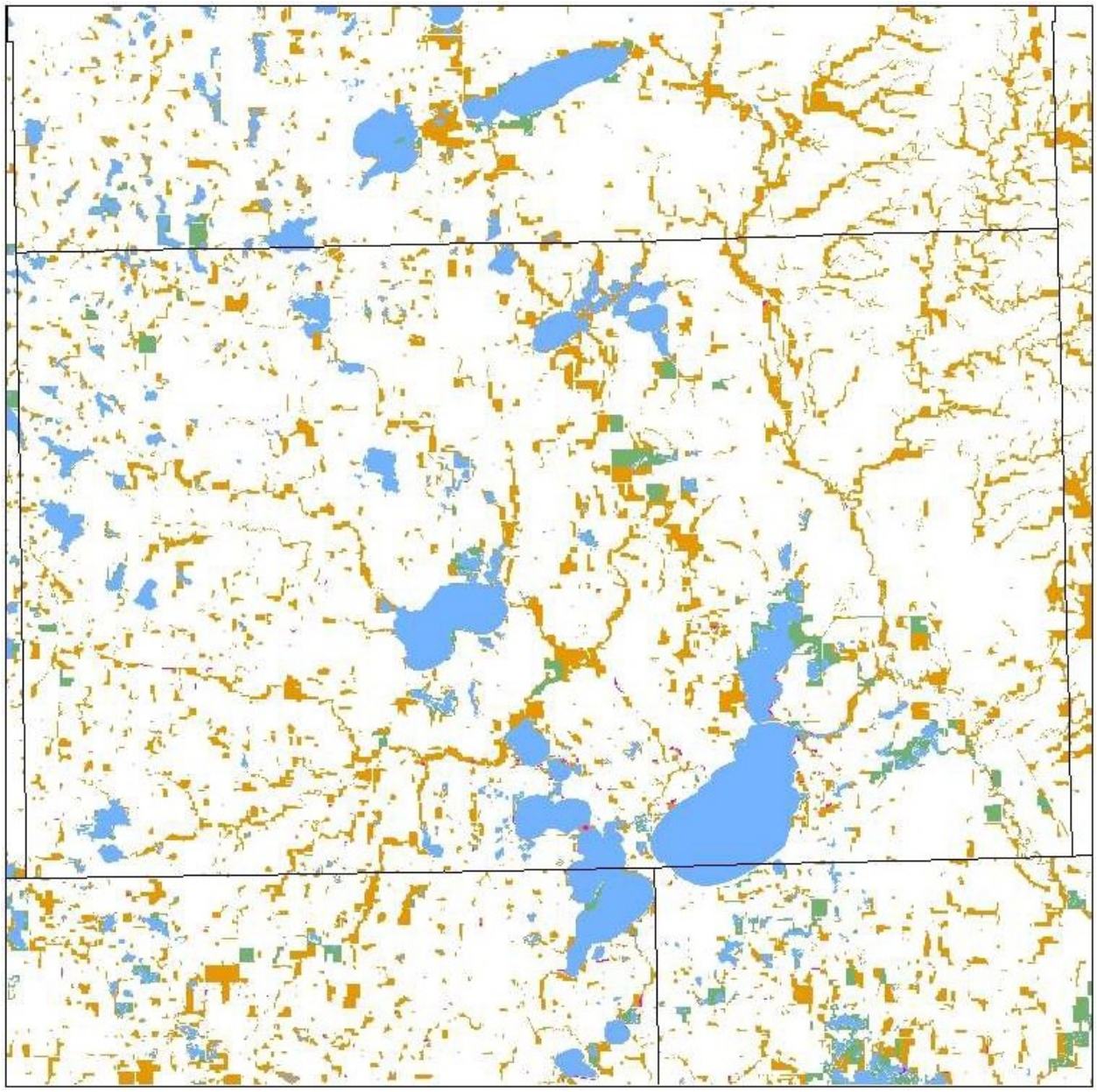

| | |
|---|---|
| 2012 Undisturbed Grasslands: | 109,162 acres |
| 2012 Undisturbed Woodlands: | 1,122 acres |
| 2012 Total Undisturbed Land: | 110,283 acres |
| 2012 Protected Undisturbed Land: | 39,633 acres |
| 2010 SO GFP Water Acres: | 10,344 acres |

## 2012 Grant County, SD Undisturbed Acres with Protection Status




| | |
|---|---|
| 2012 Undisturbed Grasslands: | 85,681 acres |
| 2012 Undisturbed Woodlands: | 4,284 acres |
| 2012 Total Undisturbed Land: | 89,964 acres |
| 2012 Protected Undisturbed Land: | 36,146 acres |
| 2010 SD GFP Water Acres: | 1,803 acres |

## 2012 Hamlin County, SD Undisturbed Acres with Protection Status



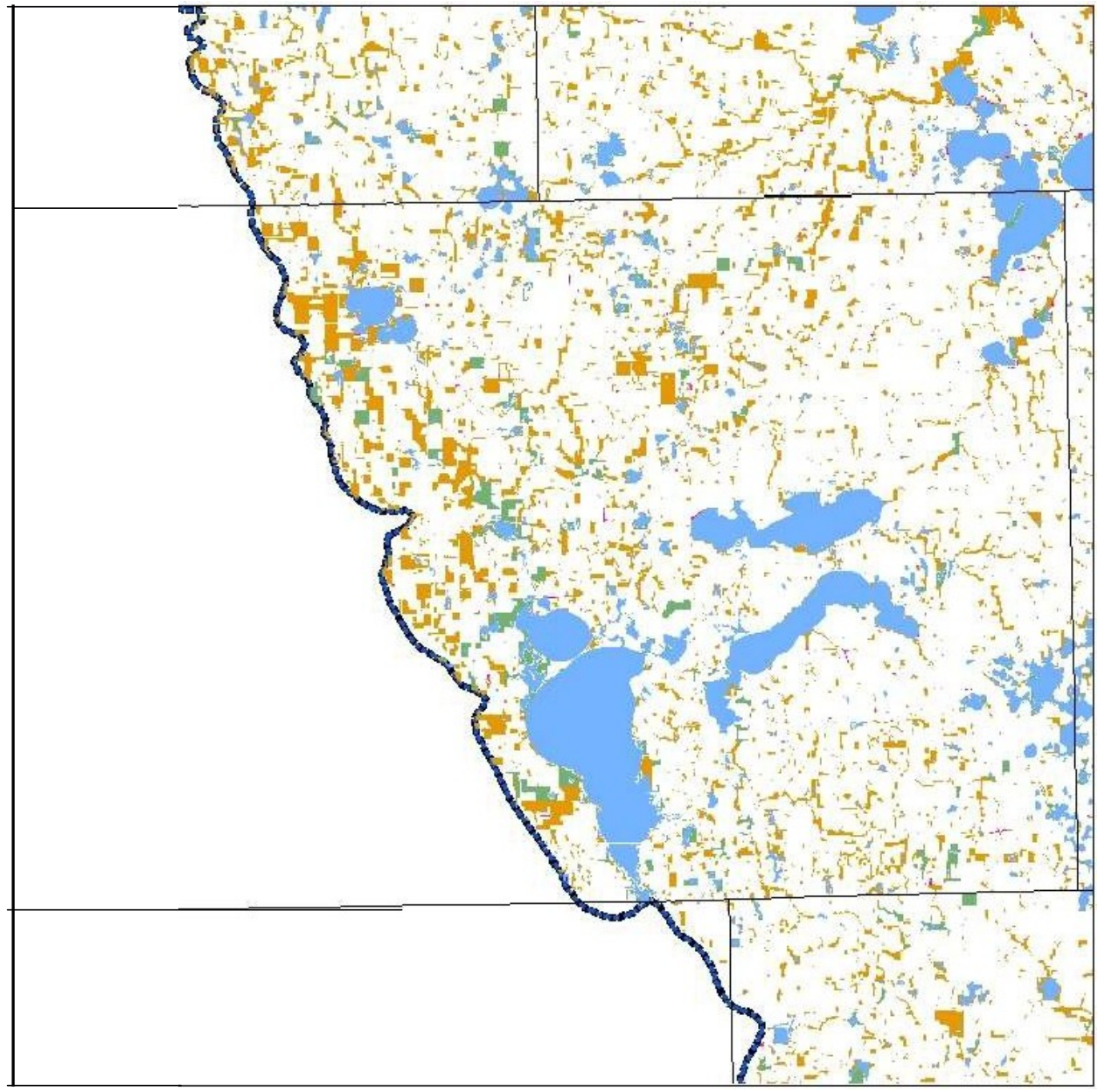
2012 Protected Undisturbed Lands
2012 undisturbed Grasslands
2012 Undisturbed Woodlands
2010 SD GFP Water Layer
Prairie Coteau SO

2012 Undisturbed Grasslands: 37,379 acres
2012 Undisturbed Woodlands: 296 acres
2012 Total Undisturbed Land: 37,675 acres
2012 Protected Undisturbed Land: 4,656 acres
2010 SO GFP Water Acres: 27,444 acres

0 2.5 5 10 15 20 Miles

N

## 2012 Kingsbury County, SD Undisturbed Acres with Protection Status



2012 Protected Undisturbed Lands
2012 undisturbed Grasslands
2012 Undisturbed Woodlands
2010 SD GFP Water Layer
Prairie Coteau SO

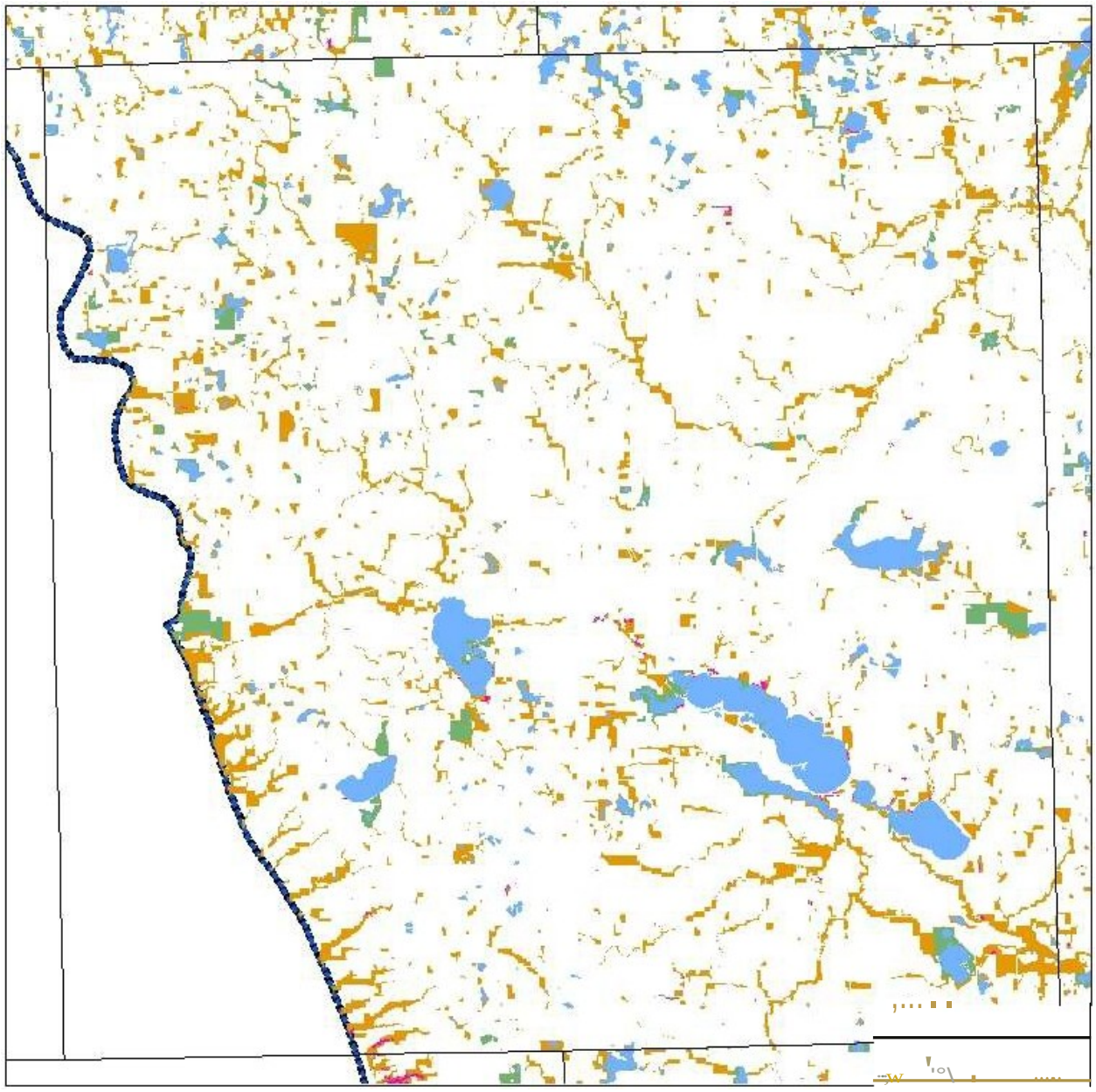
| | |
|---|---|
| 2012 Undisturbed Grasslands: | 43,446 acres |
| 2012 Undisturbed Woodlands: | 420 acres |
| 2012 Total Undisturbed Land: | 43,867 acres |
| 2012 Protected Undisturbed Land: | 7,093 acres |
| 2010 SO GFP Water Acres: | 41,727 acres |

0 3 6 12 18 24 Miles

N

A

## 2012 Lake County, SD Undisturbed Acres with Protection Status



2012 Protected Undisturbed Lands
2012 undisturbed Grasslands
2012 Undisturbed Woodlands
2010 SD GFP Water Layer
Prairie Coteau SO

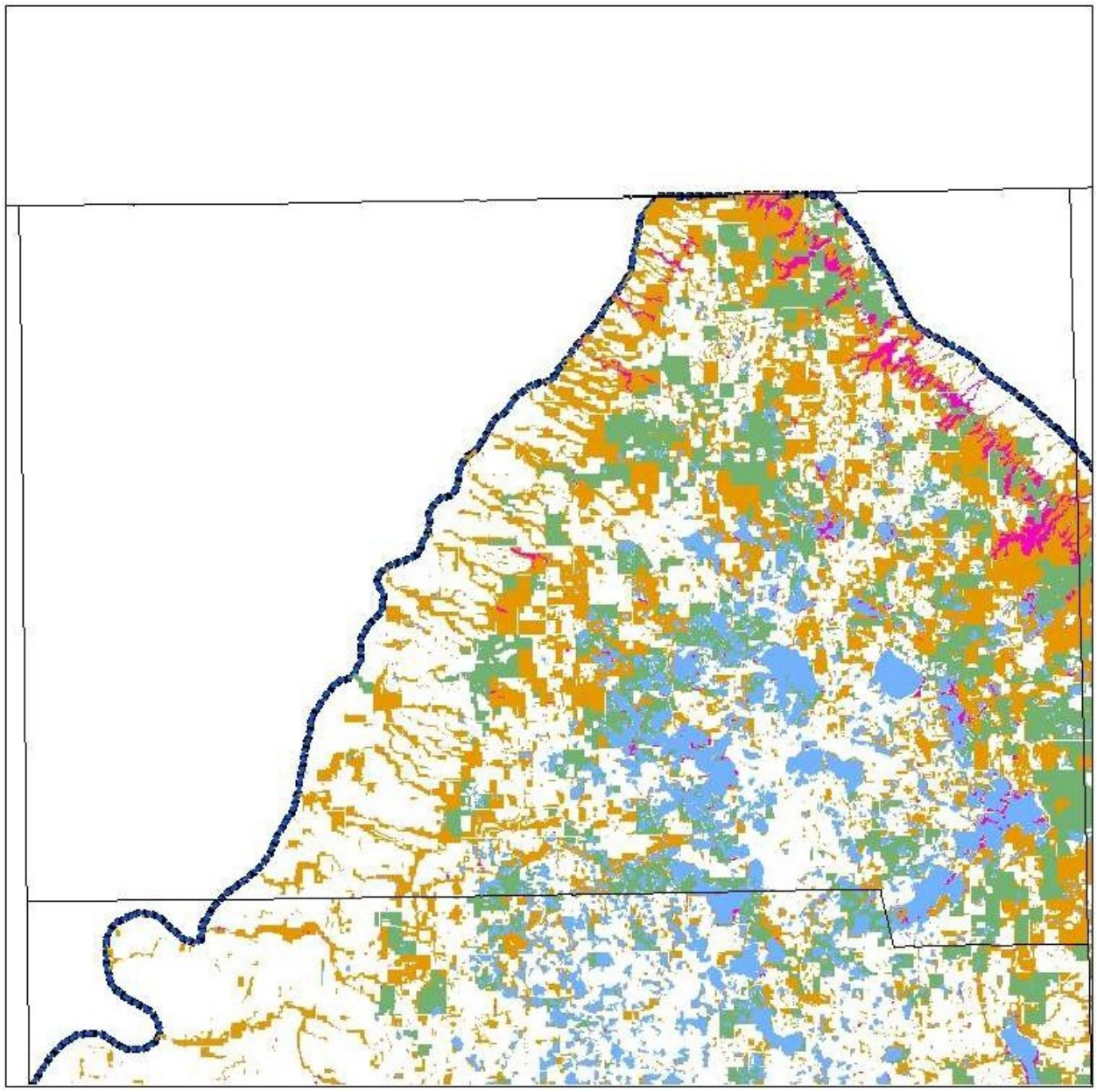
2012 Undisturbed Grasslands: 28,626 acres
2012 Undisturbed Woodlands: 371 acres
2012 Total Undisturbed Land: 28,997 acres
2012 Protected Undisturbed Land: 4,360 acres
2010 SO GFP Water Acres: 13,005 acres

0 2 4 8 12 16 M1es

N

A

## 2012 Marshall County,SD Undisturbed Acres with Protection Status



2012 Protected Undisturbed Lands
2012 undisturbed Grasslands
2012 Undisturbed Woodlands
2010 SD GFP Water Layer
Prairie Coteau SO

| | |
|---|---|
| 2012 Undisturbed Grasslands: | 131,097 acres |
| 2012 Undisturbed Woodlands: | 9,291 acres |
| 2012 Total Undisturbed Land: | 140,388 acres |
| 2012 Protected Undisturbed Land: | 50,314 acres |
| 201O SO GFP Water Acres: | 36,468 acres |

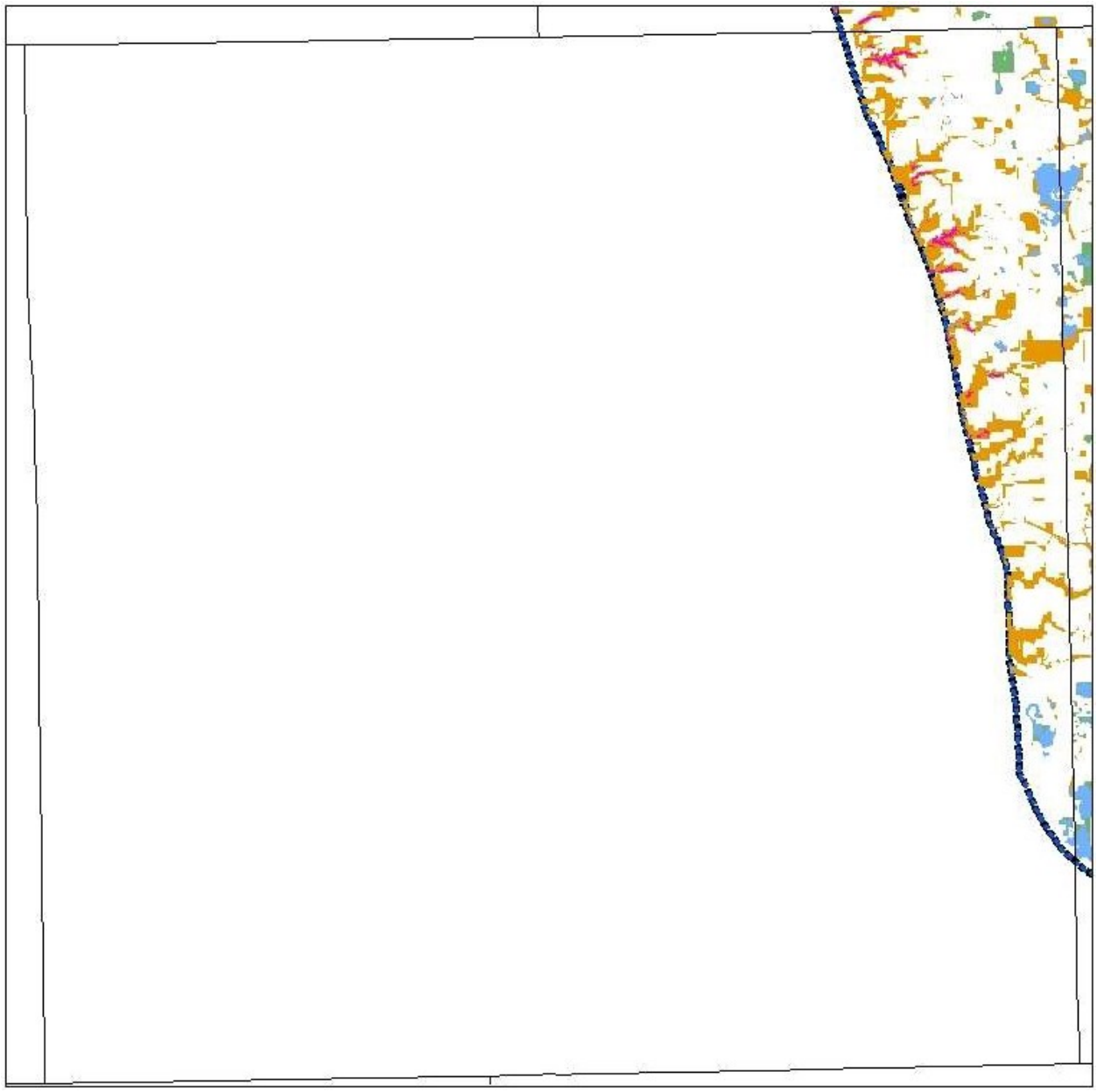
Mes

0 3 6 12 18 24

N

A

## 2012 McCook County, SD Undisturbed Acres with Protection Status



2012 Protected Undisturbed Lands
2012 undisturbed Grasslands
2012 Undisturbed Woodlands
2010 SD GFP Water Layer
Prairie Coteau SO

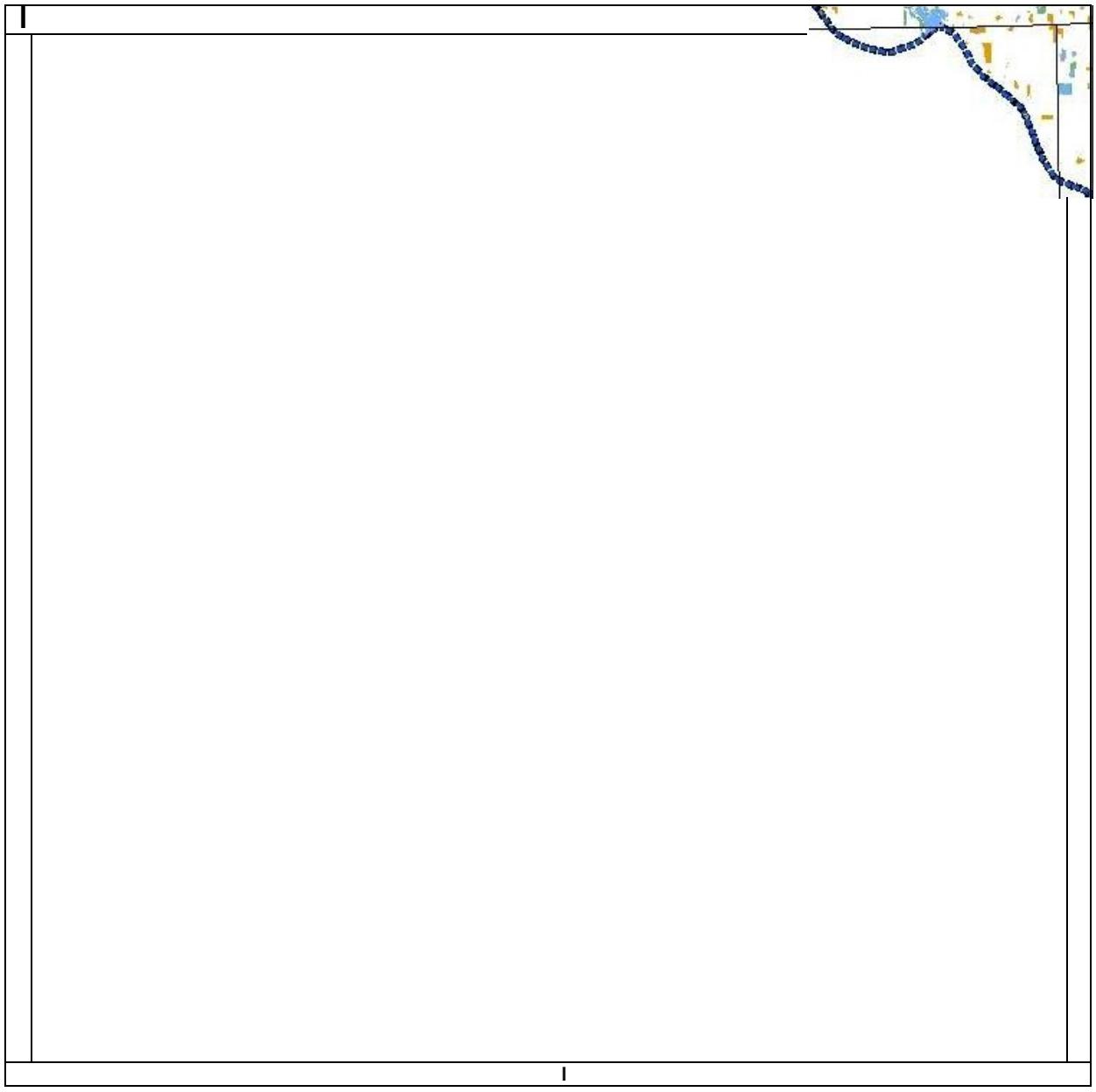
| | |
|---|---|
| 2012 Undisturbed Grasslands: | 5,815 acres |
| 2012 Undisturbed Woodlands: | 320 acres |
| 2012 Total Undisturbed Land: | 6,135 acres |
| 2012 Protected Undisturbed Land: | 290 acres |
| 2010 SO GFP Water Acres: | 800 acres |

Miles

0 2 4 8 12 16

N

## 2012 Miner County, SD Undisturbed Acres with Protection Status

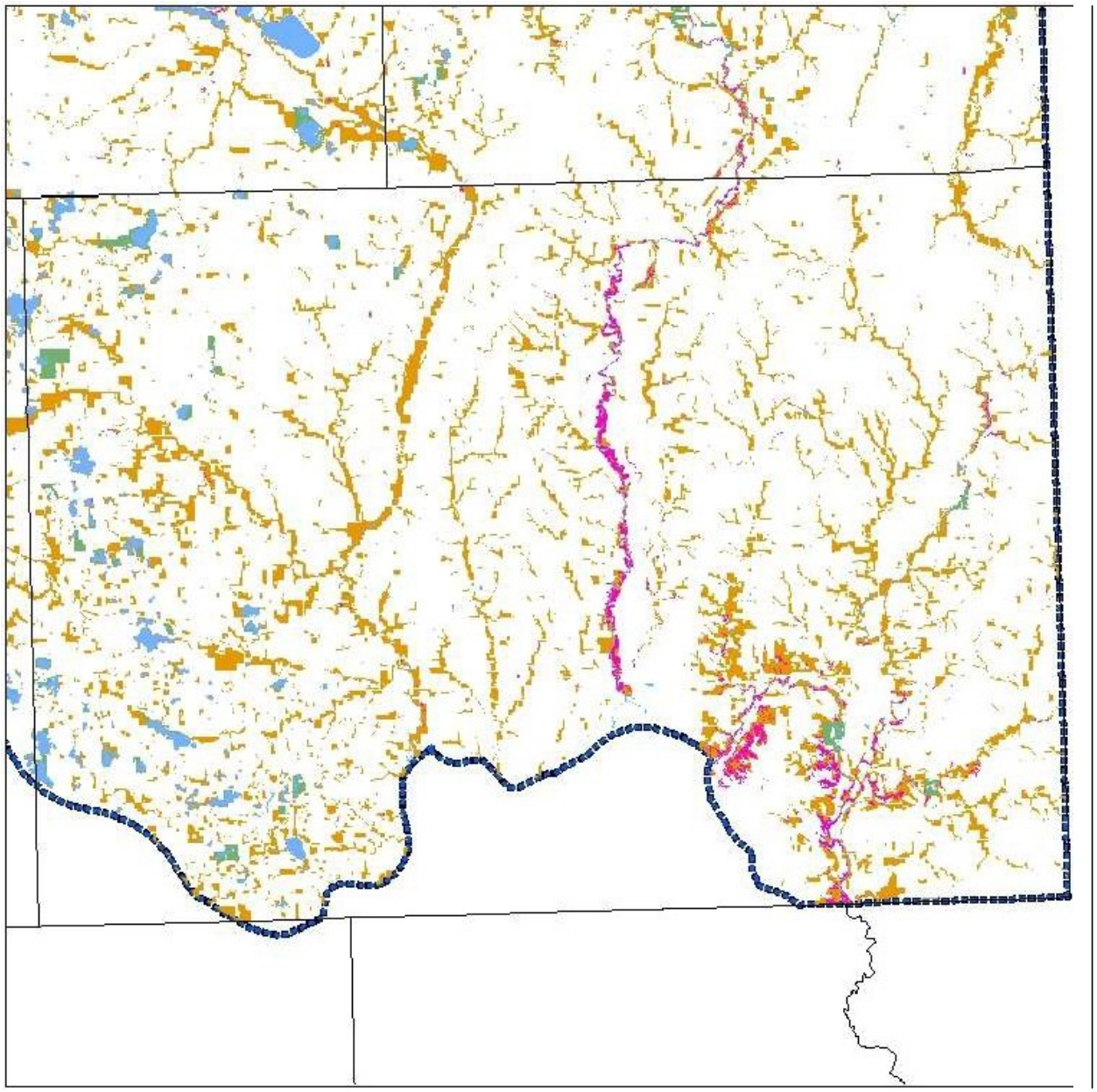


2012 Protected Undisturbed Lands
2012 undisturbed Grasslands
2012 Undisturbed Woodlands
2010 SD GFP Water Layer
Prairie Coteau SO

2012 Undisturbed Grasslands: 159 acres
2012 Undisturbed Woodlands: 0 acres
2012 Total Undisturbed Land: 159 acres
2012 Protected Undisturbed Land: 0 acres
2010 SO GFP Water Acres: 42 acres

0 2 4 8 12 16

## 2012 Minnehaha County, SD Undisturbed Acres with Protection Status



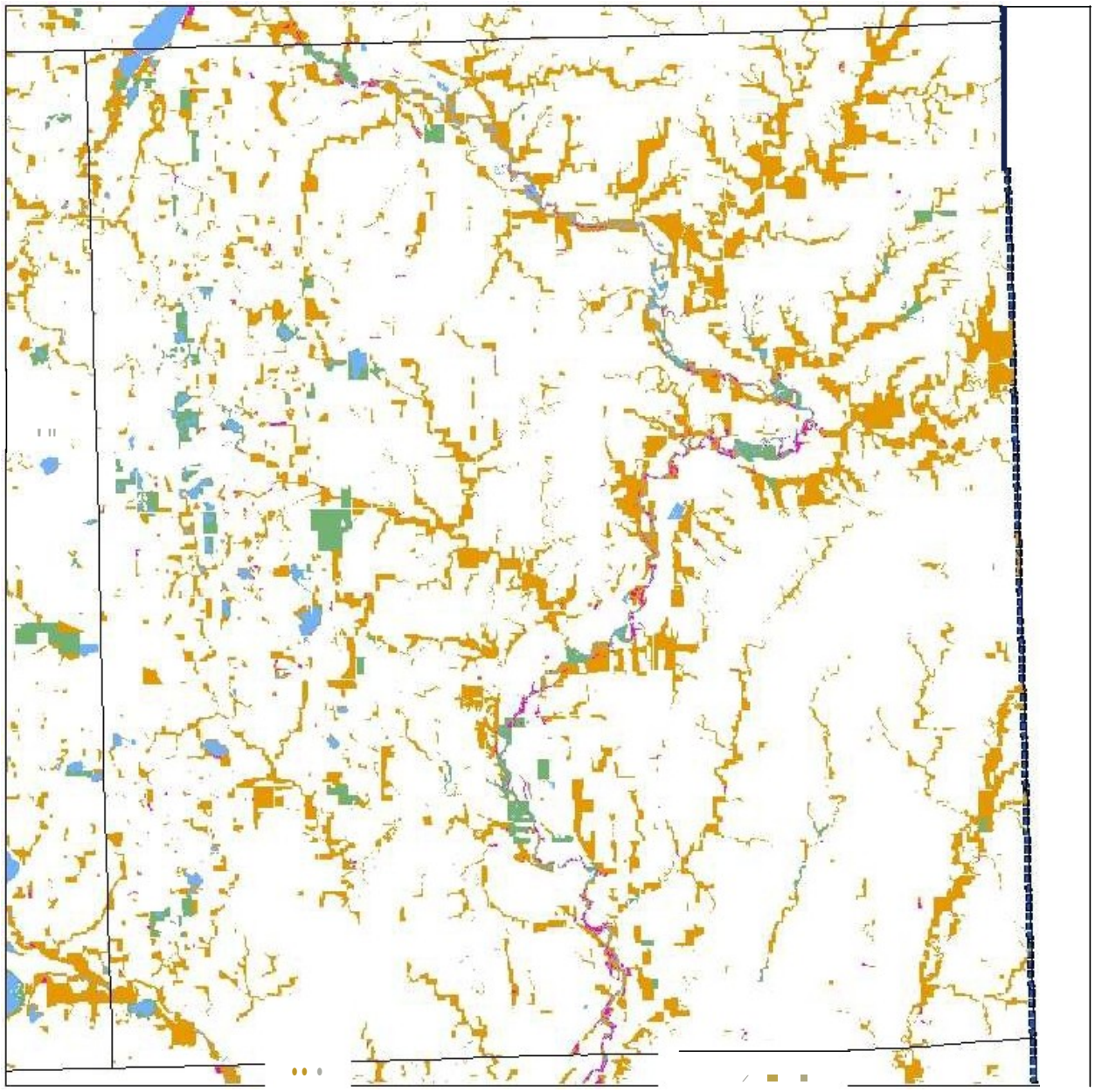
2012 Protected Undisturbed Lands
2012 undisturbed Grasslands
2012 Undisturbed Woodlands
2010 SD GFP Water Layer
Prairie Coteau SO

| | |
|---|---|
| 2012 Undisturbed Grasslands: | 52,584 acres |
| 2012 Undisturbed Woodlands: | 4,046 acres |
| 2012 Total Undisturbed Land: | 56,630 acres |
| 2012 Protected Undisturbed Land: | 2,970 acres |
| 2010 SO GFP Water Acres: | 6,652 acres |

0 2.75 5.5 11 16.5 22 Miles

N

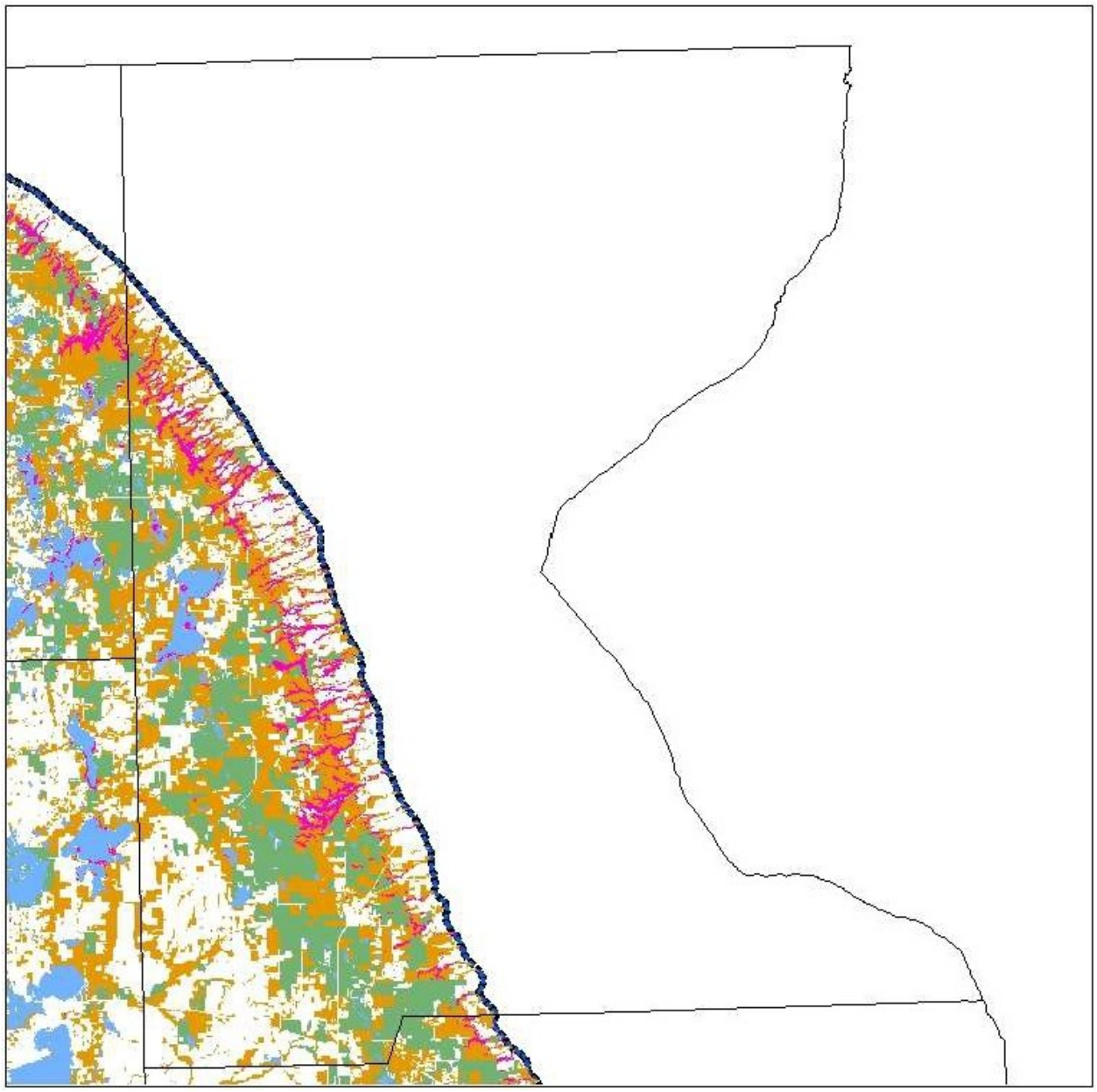
## 2012 Moody County, SD Undisturbed Acres with Protection Status




| | |
|---|---|
| 2012 Undisturbed Grasslands: | 43,255 acres |
| 2012 Undisturbed Woodlands: | 1,367 acres |
| 2012 Total Undisturbed Land: | 44,621 acres |
| 2012 Protected Undisturbed Land: | 4,733 acres |
| 2010 SO GFP Water Acres: | 2,831 acres |

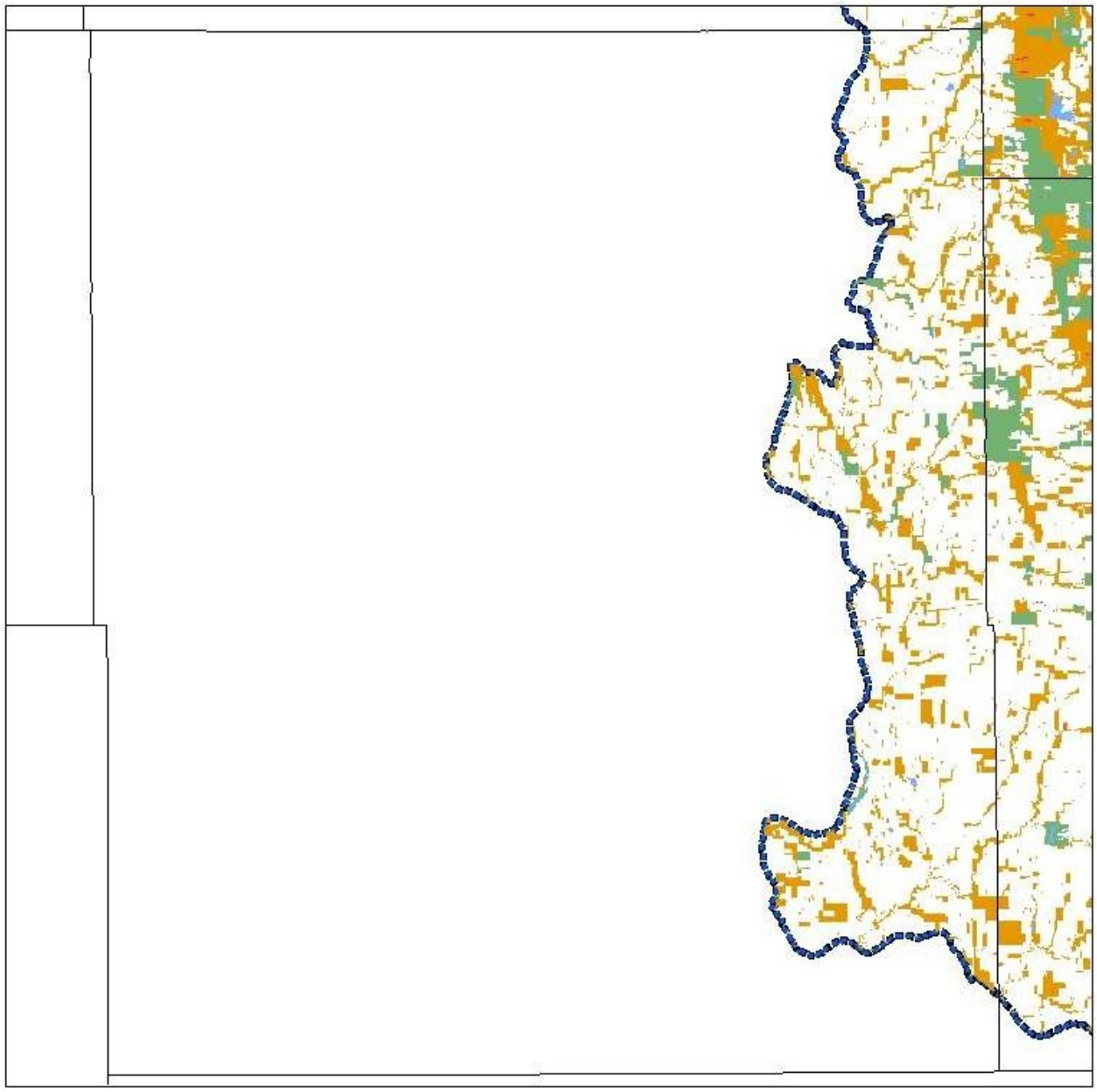
16

## 2012 Roberts County, SD Undisturbed Acres with Protection Status




| | |
|---|---|
| 2012 Undisturbed Grasslands: | 106,530 acres |
| 2012 Undisturbed Woodlands: | 11,372 acres |
| 2012 Total Undisturbed Land: | 117,902 acres |
| 2012 Protected Undisturbed Land: | 41,500 acres |
| 2010 SO GFP Water Acres: | 6,229 acres |

## 2012 Spink County, SD Undisturbed Acres with Protection Status

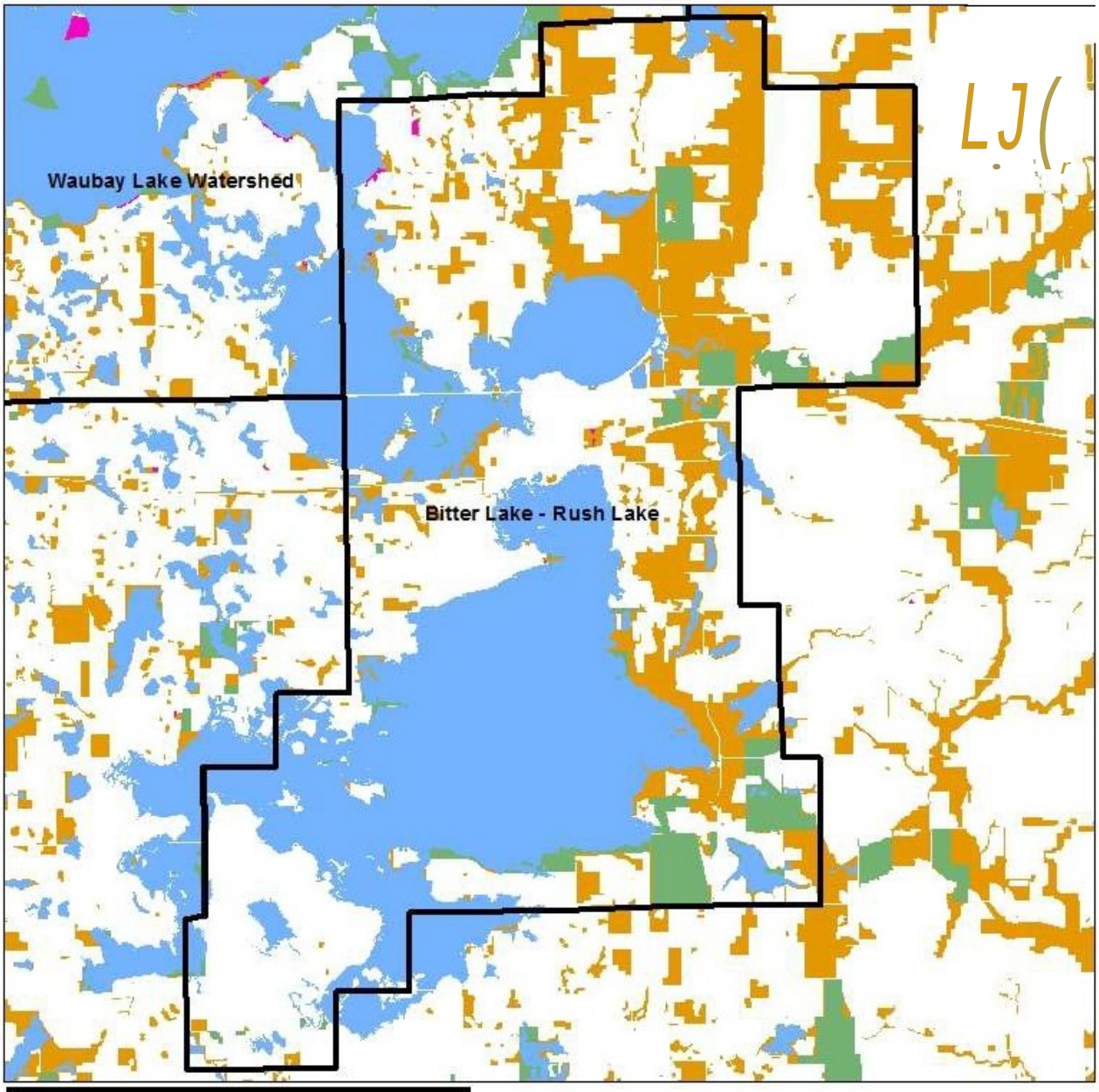



| | |
|---|---|
| 2012 Undisturbed Grasslands: | 25,955 acres |
| 2012 Undisturbed Woodlands: | 7 acres |
| 2012 Total Undisturbed Land: | 25,962 acres |
| 2012 Protected Undisturbed Land: | 3,157 acres |
| 201O SO GFP Water Acres: | 358 acres |

# Appendix C:

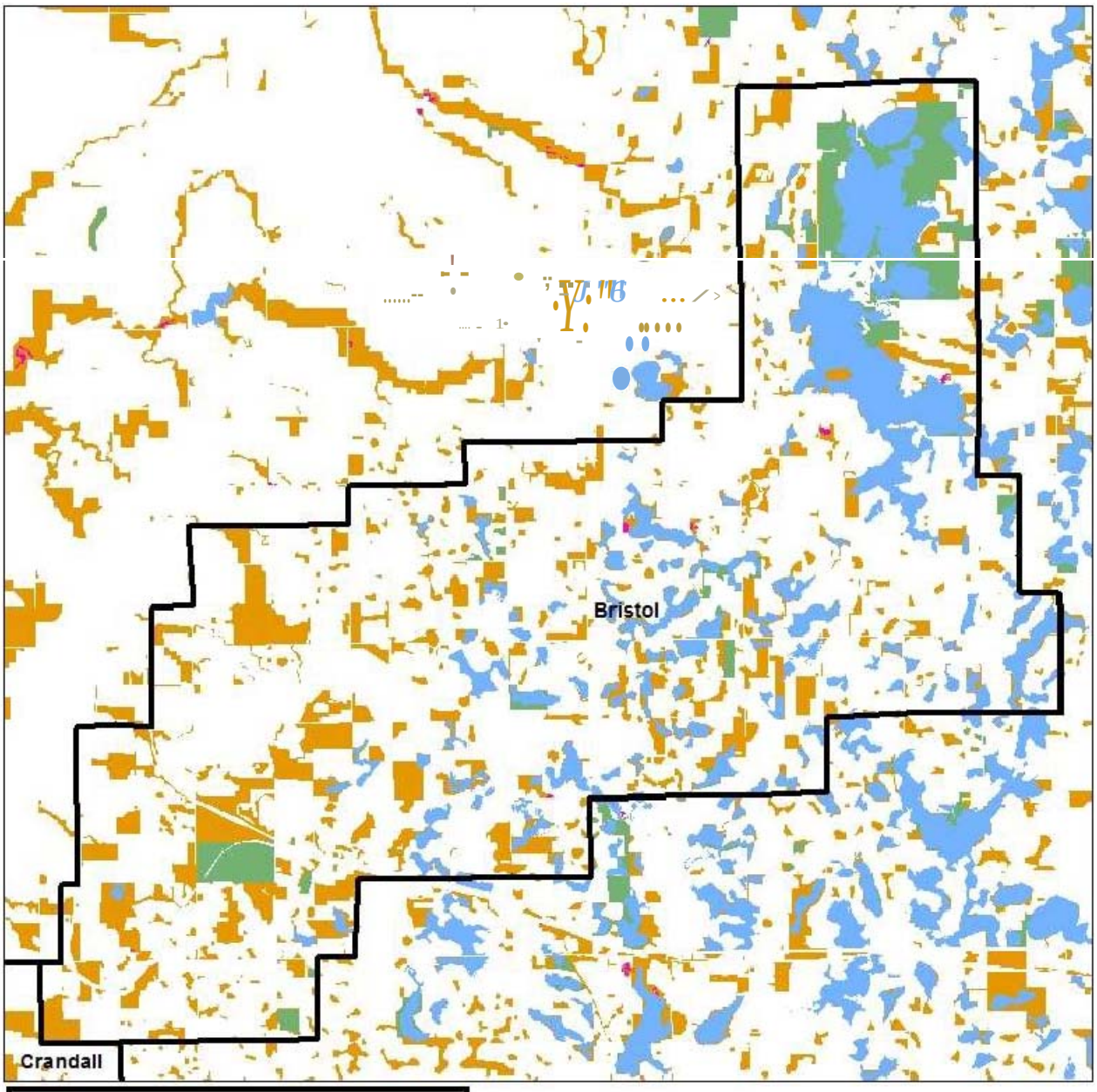
Updated TNC NFWF Focus Area Maps of Undisturbed Grasslands and Woodlands *With* Permanent Protection Status in the South Dakota Prairie Coteau, Based on 2012 Analysis.

## Bitter Lake-Rush Lake Focus Area: 2012 Protection Status




| | |
|---|---|
| 2010 TNC NFWF Focus Area: | 54,266 acres |
| 2012 Undisturbed w/in Focus: | 12,012 acres |
| 2012 Undisturbed Protected: | 2,296 acres |
| 2012 % Undisturbed Protected: | 4.2% |

## Bristol Focus Area:2012 Protection Status




2012 Protected Undisturbed Lands
2012 Undisturbed Grasslands
2012 Undisturbed Woodlands

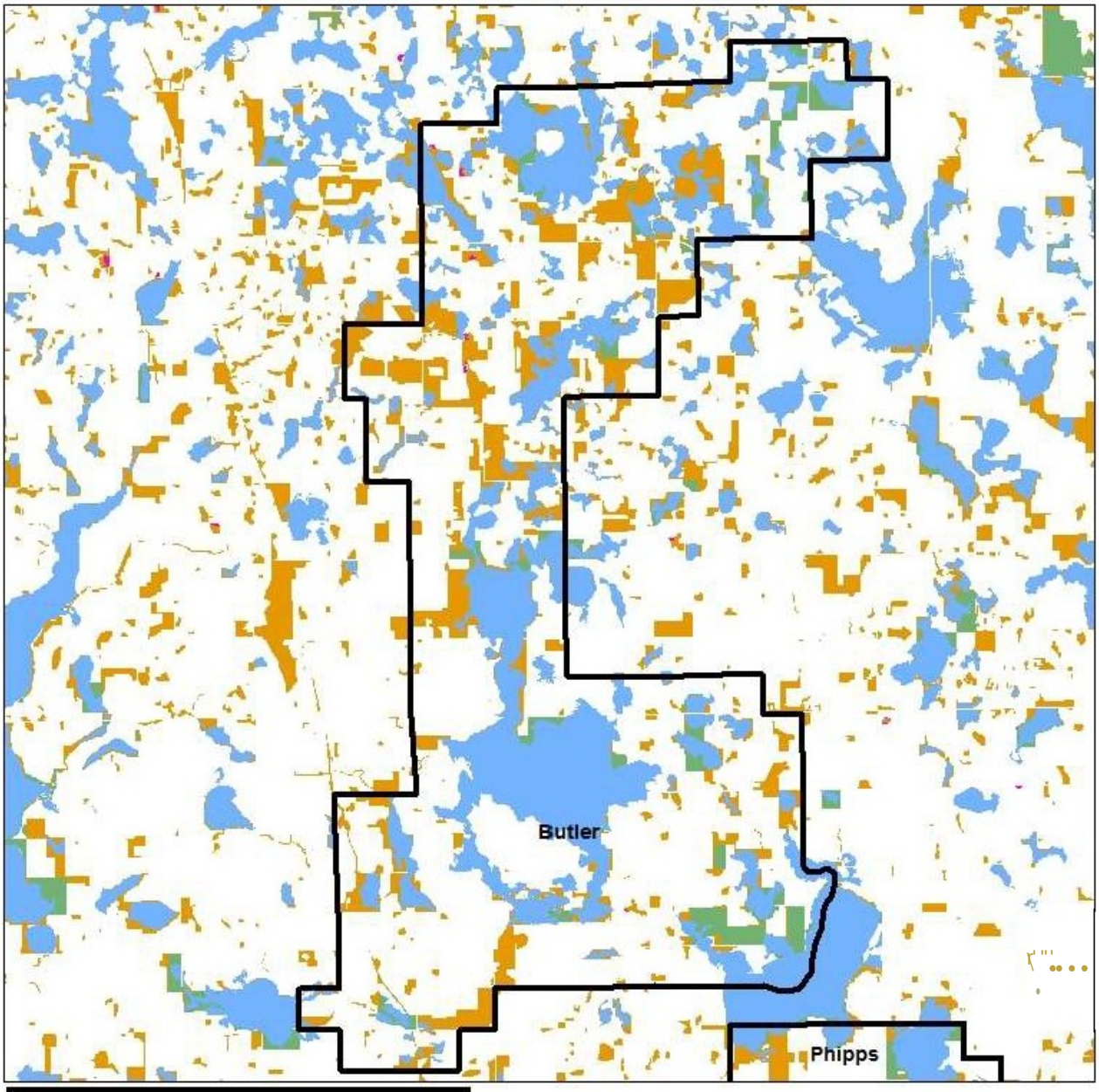
2010 SD GFP Water Layer
Prairie Coteau_SD
TNC_Prairie_Coteau_ Prairie_Cores

2010 TNC NFWF Focus Area: 46,371 acres
2012 Undisturbed w/in Focus: 8,779 acres
2012 Undisturbed Protected: 1,862 acres
2012 % Undisturbed Protected: 4.0%

N

0 1 2 4 6 8 Miles

## Butler Focus Area: 2012 Protection Status




2012 Protected Undisturbed Lands
2012 Undisturbed Grasslands
2012 Undisturbed Woodlands
2010 SD GFP Water Layer
Prairie Coteau SD
TNC_Prairie_Coteau_Prairie_Cores

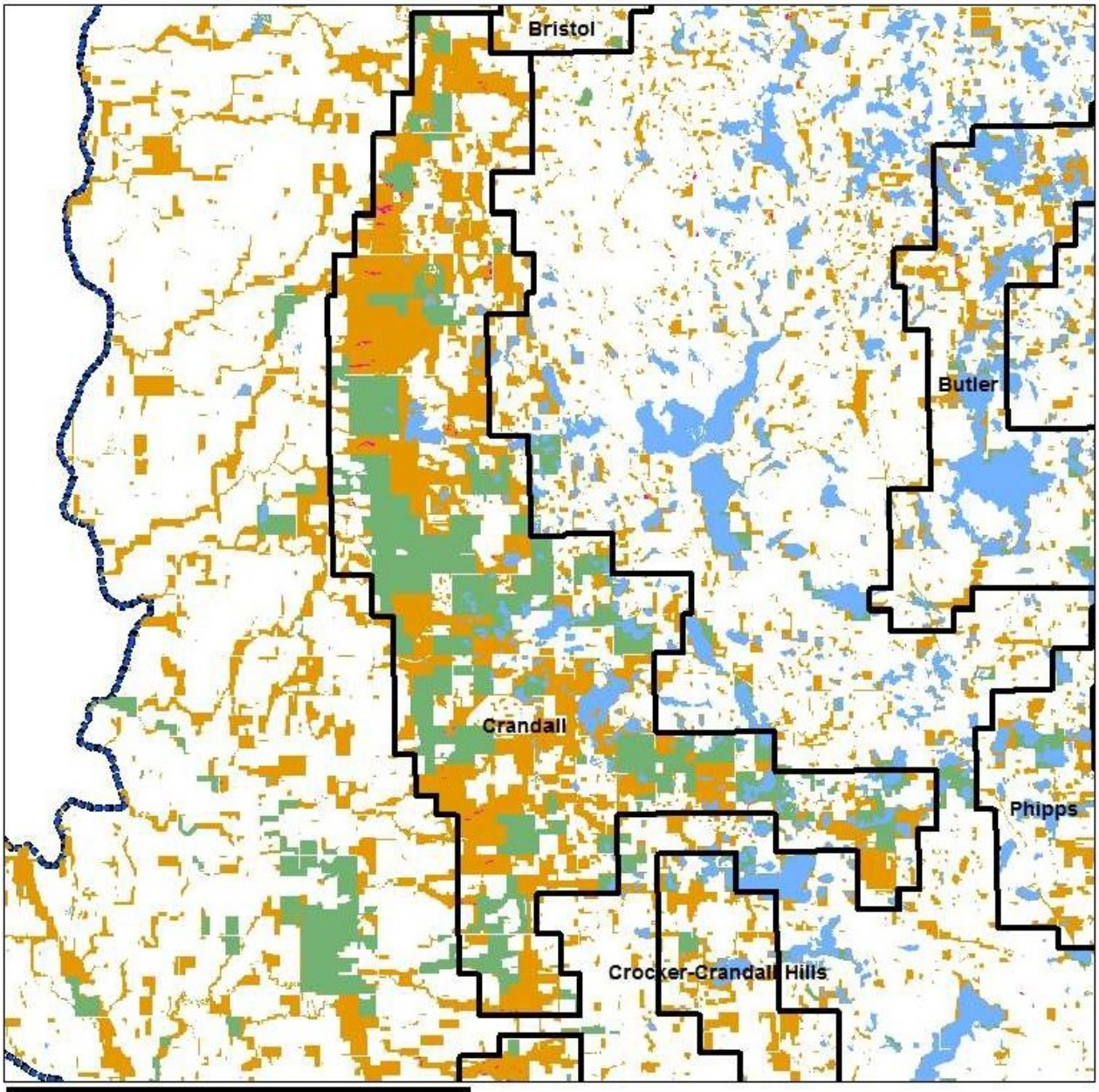
0 1 2 4 6 8 Miles

N

2010 TNC NFWF Focus Area: 32,632 acres
2012 Undisturbed w/in Focus: 5,321 acres
2012 Undisturbed Protected: 998 acres

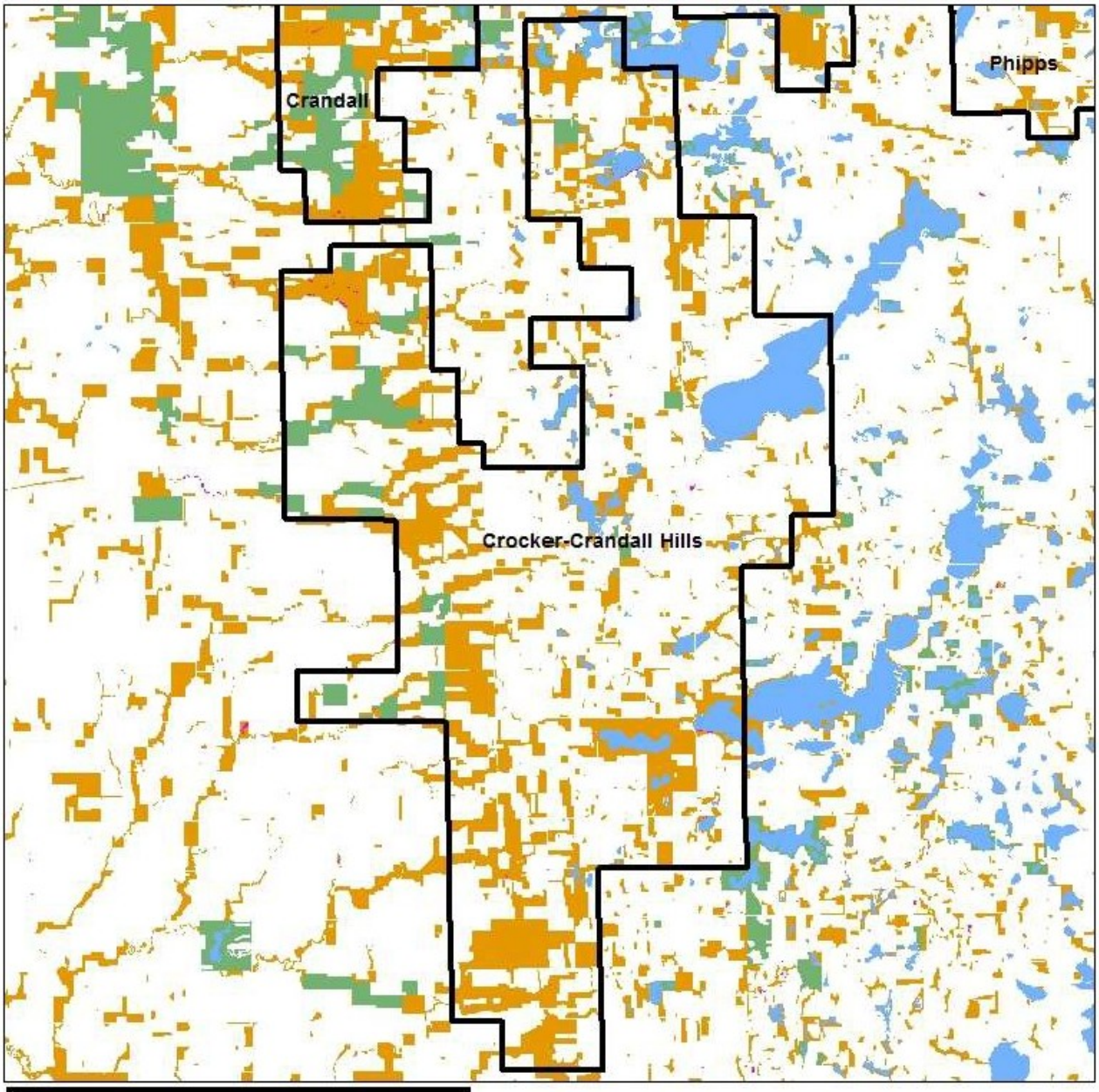
2012 % Undisturbed Protected: 3.1%

## Crandall Focus Area: 2012 Protection Status




2010 TNC NFWF Focus Area: 82,755 acres
2012 Undisturbed w/in Focus: 48,895 acres
2012 Undisturbed Protected: 18,916 acres
2012 % Undisturbed Protected: 22.9%

## Crocker-Crandall Hills Focus Area: 2012 Protection Status



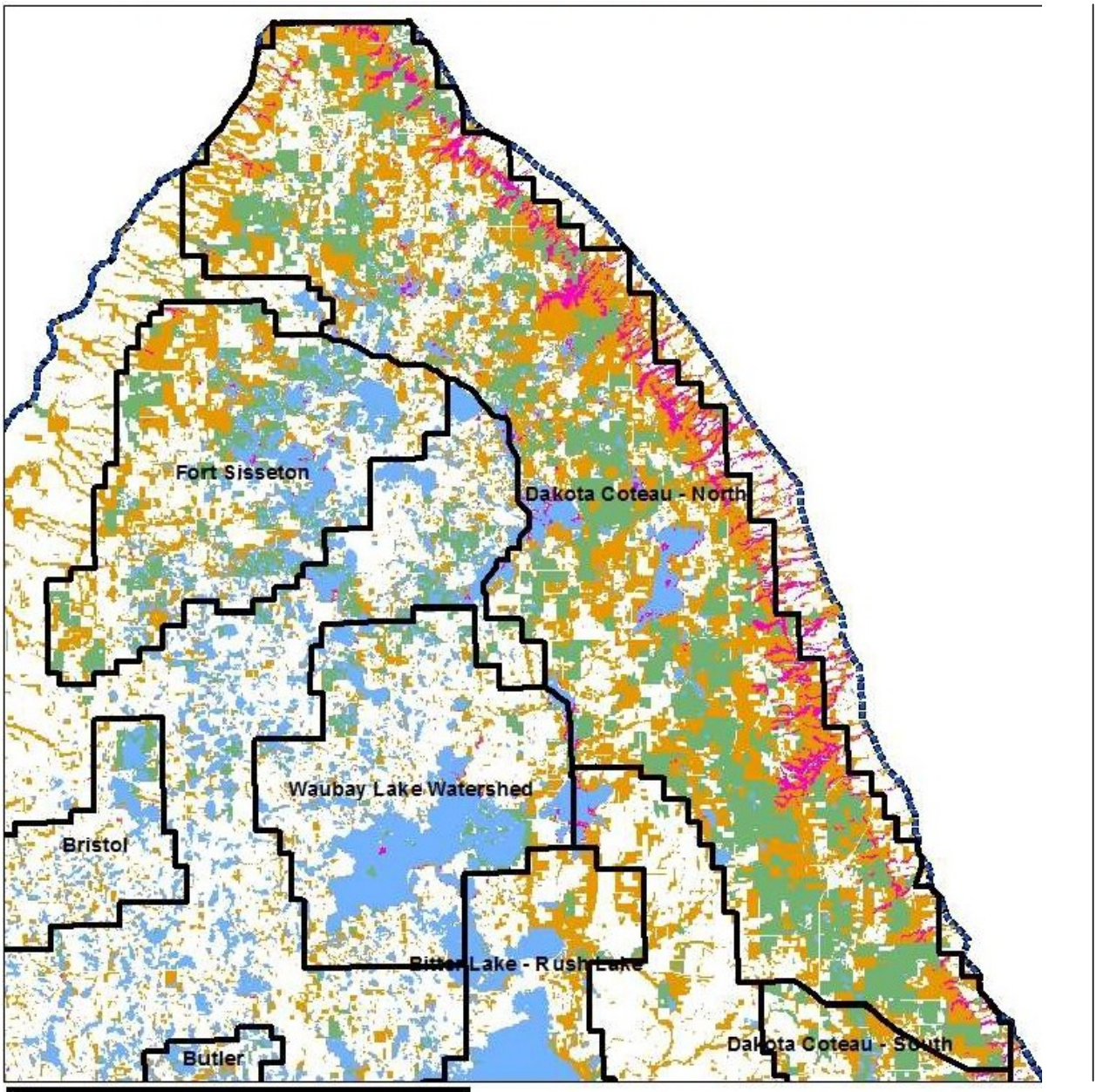

2012 Protected Undisturbed Lands
2012 Undisturbed Grasslands
2012 Undisturbed Woodlands
2010 SD GFP Water Layer
Prairie Coteau SD
TNC_Prairie_Coteau_ Prairie_Cores

2010 TNC NFWF Focus Area: 75,259 acres
2012 Undisturbed w/in Focus: 21,070 acres
2012 Undisturbed Protected: 2,709 acres
2012 % Undisturbed Protected: 3.6%

N

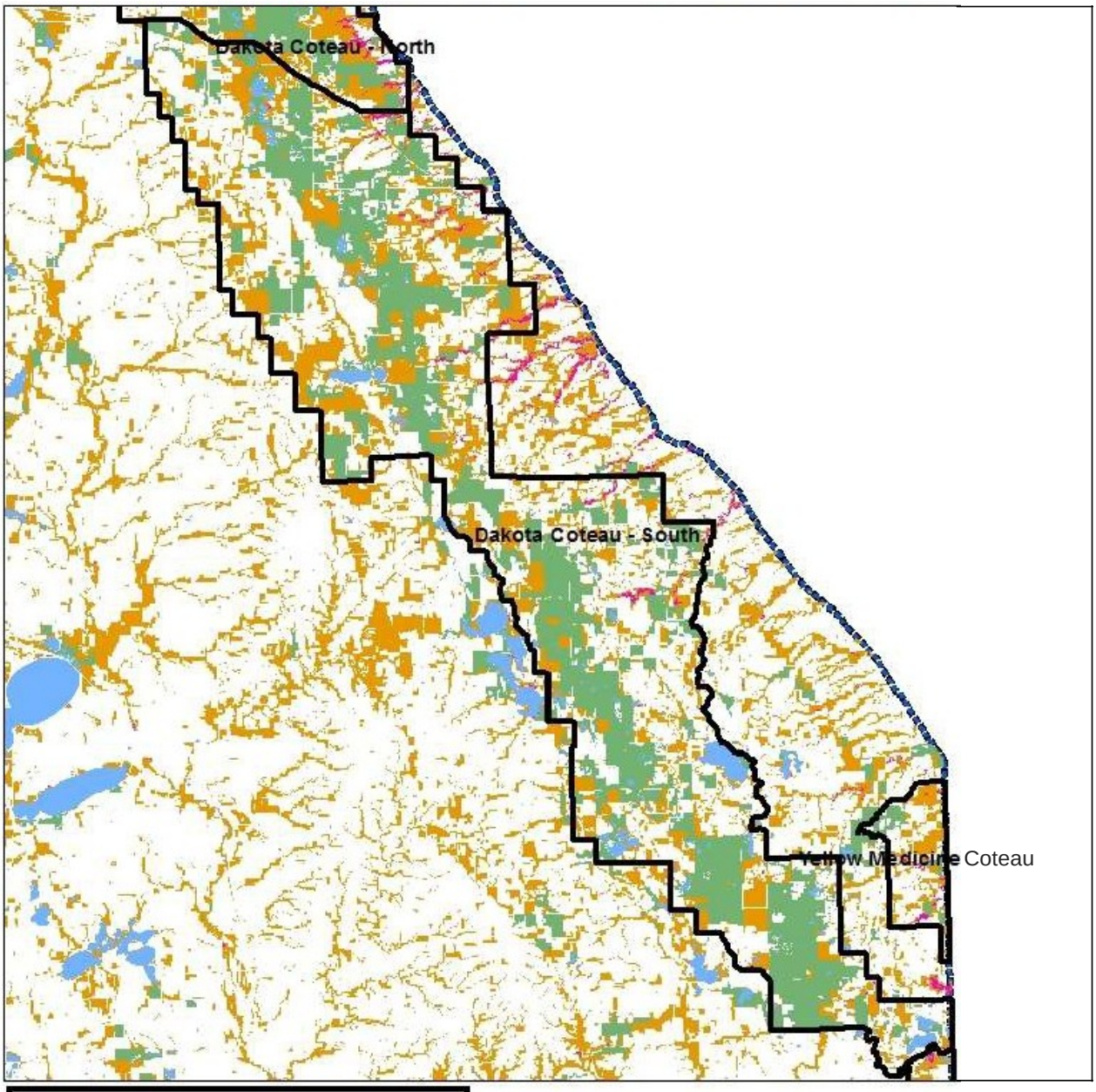
0 1.5 3 6 9 12 Miles

## Dakota Coteau-North Focus Area: 2012 Protection Status



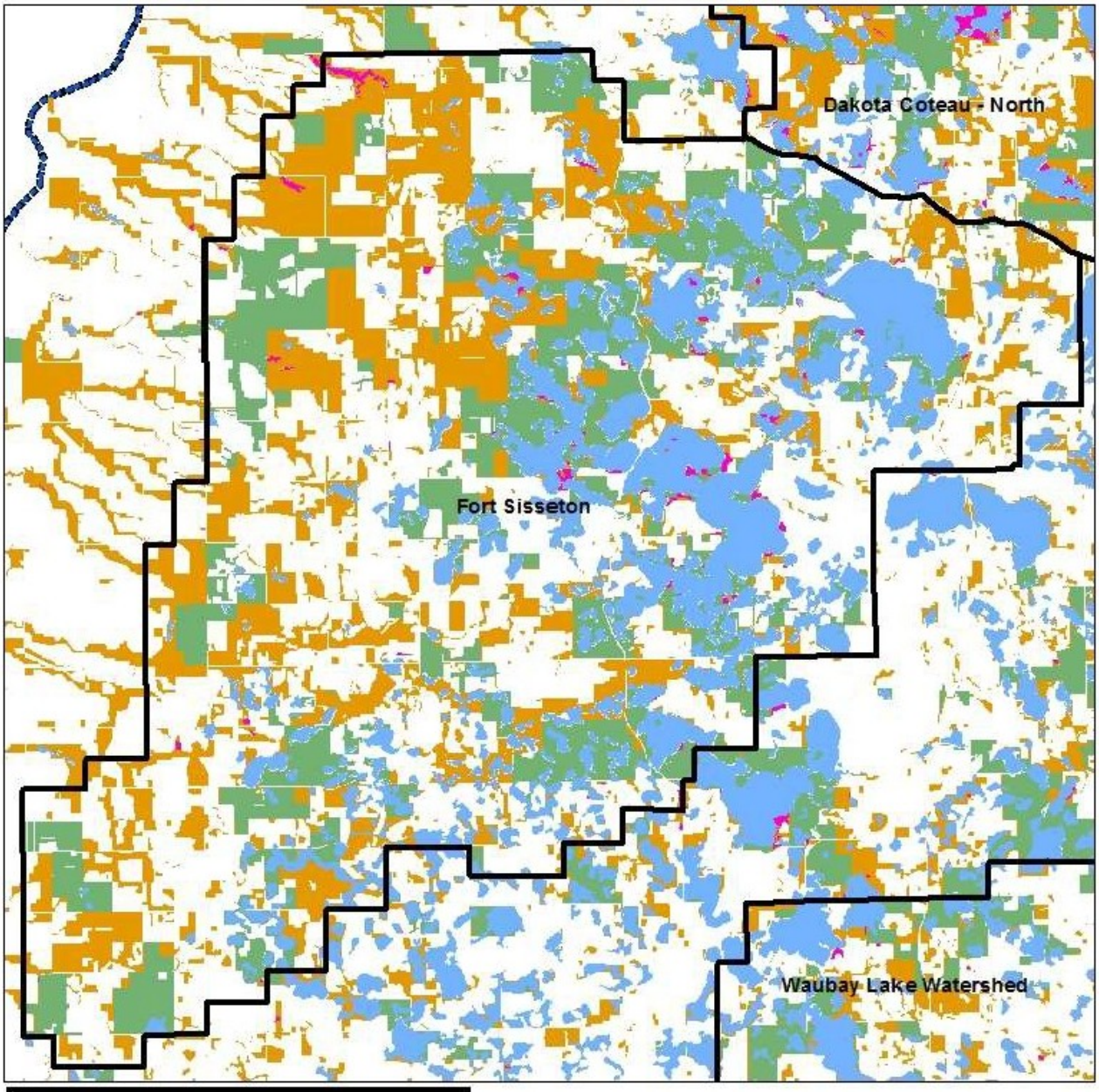

2010 TNC NFWF Focus Area: 310,548 acres
2012 undisturbed w/in Focus: 201,847 acres
2012 Undisturbed Protected: 77,301 acres
2012 °/o Undisturbed Protected: 24.9%

## Dakota Coteau-South Focus Area: 2012 Protection Status




2010 TNC NFWF Focus Area: 213,849 acres
2012 Undisturbed w/in Focus: 116,751 acres
2012 Undisturbed Protected: 65,460 acres
2012 % Undisturbed Protected: 30.6%

## Fort Sisseton Focus Area: 2012 Protection Status



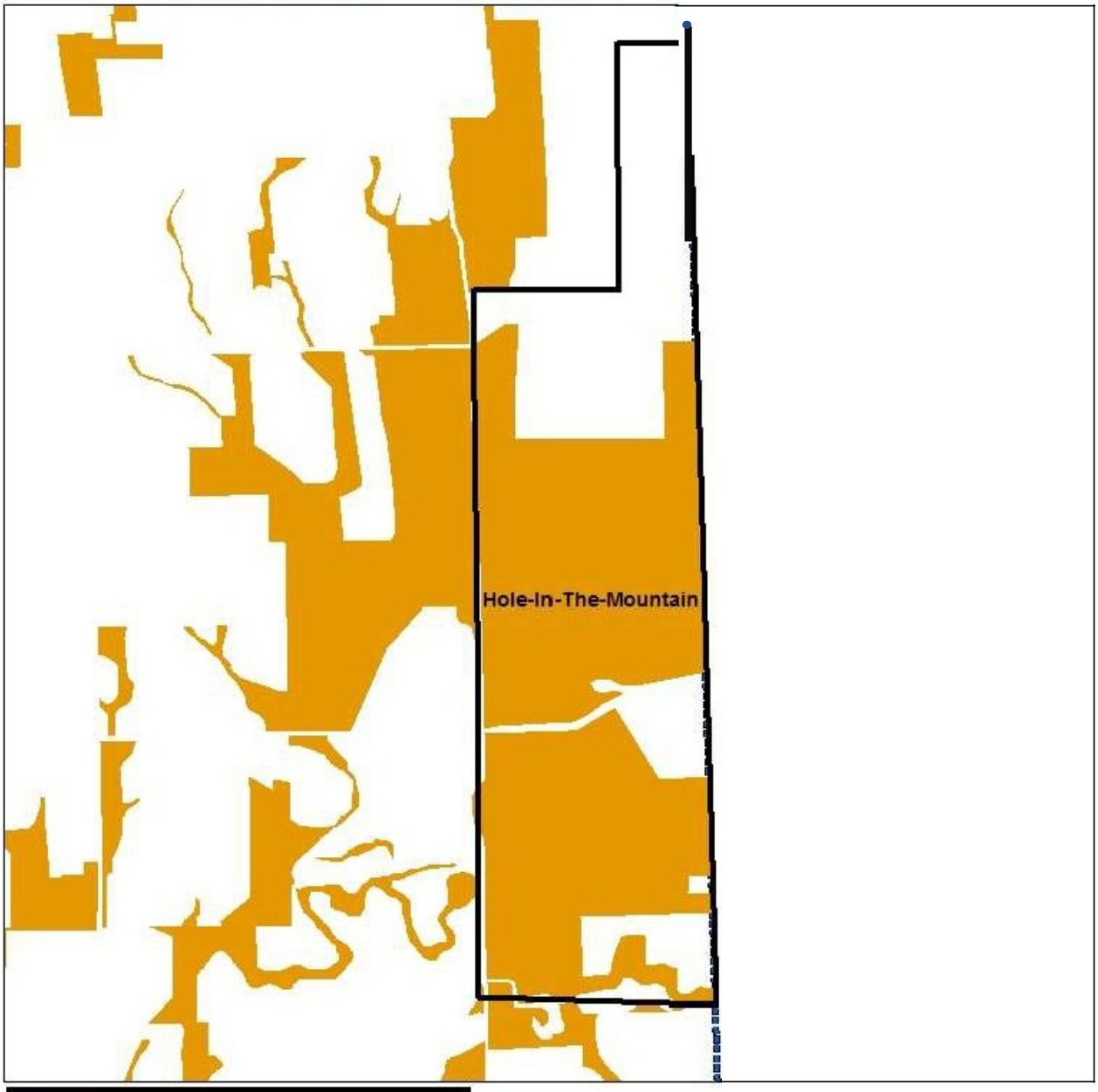

2012 Protected Undisturbed Lands
2012 Undisturbed Grasslands
2012 Undisturbed Woodlands

2010 SD GFP Water Layer
Prairie Coteau_SD
TNC_Prairie_Coteau_ Prairie_Cores

0 1.25 2.5 5 7.5 10

2010 TNC NFWF Focus Area: 103,273 acres
2012 Undisturbed w/in Focus: 39,577 acres
2012 Undisturbed Protected: 16,533 acres
2012 % Undisturbed Protected: 16.0%

## Hole-In-The-Mountain Focus Area: 2012 Protection Status




2012 Protected Undisturbed Lands
2012 Undisturbed Grasslands
2012 undisturbed Woodlands
2010 SD GFP Water Layer
Prairie Coteau SD

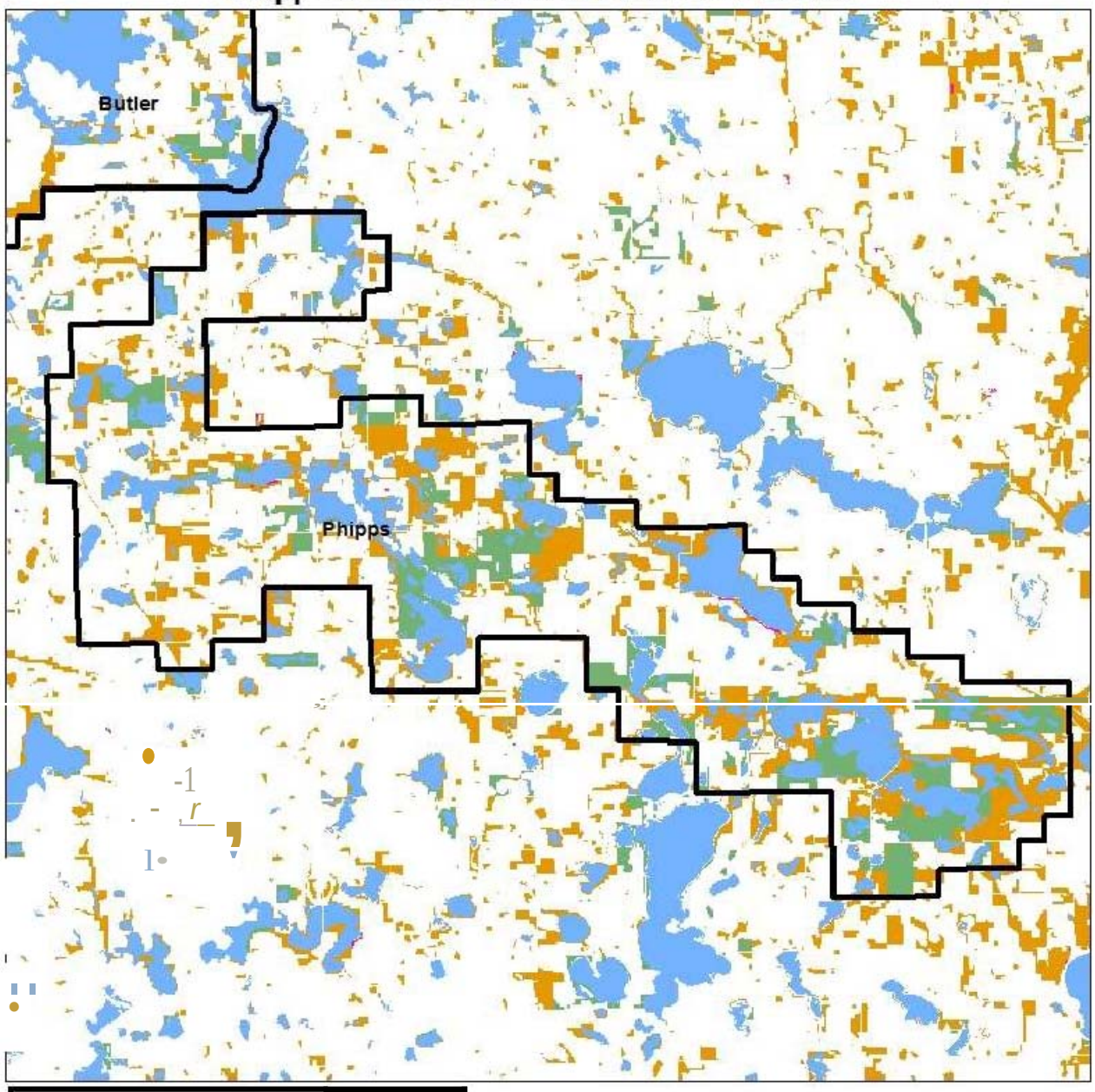
2010 TNC NFWF Focus Area: 801 acres
2012 Undisturbed w/in Focus: 514 acres
2012 Undisturbed Protected: 0 acres
2012 % Undisturbed Protected: 0.0%

0 0.225 0.45 0.9 1.35 Miles

TNC_Prairie_Coteau_Prairie_Cores

18

## Phipps Focus Area: 2012 Protection Status




2012 Protected Undisturbed Lands
2012 Undisturbed Grasslands
2012 Undisturbed Woodlands

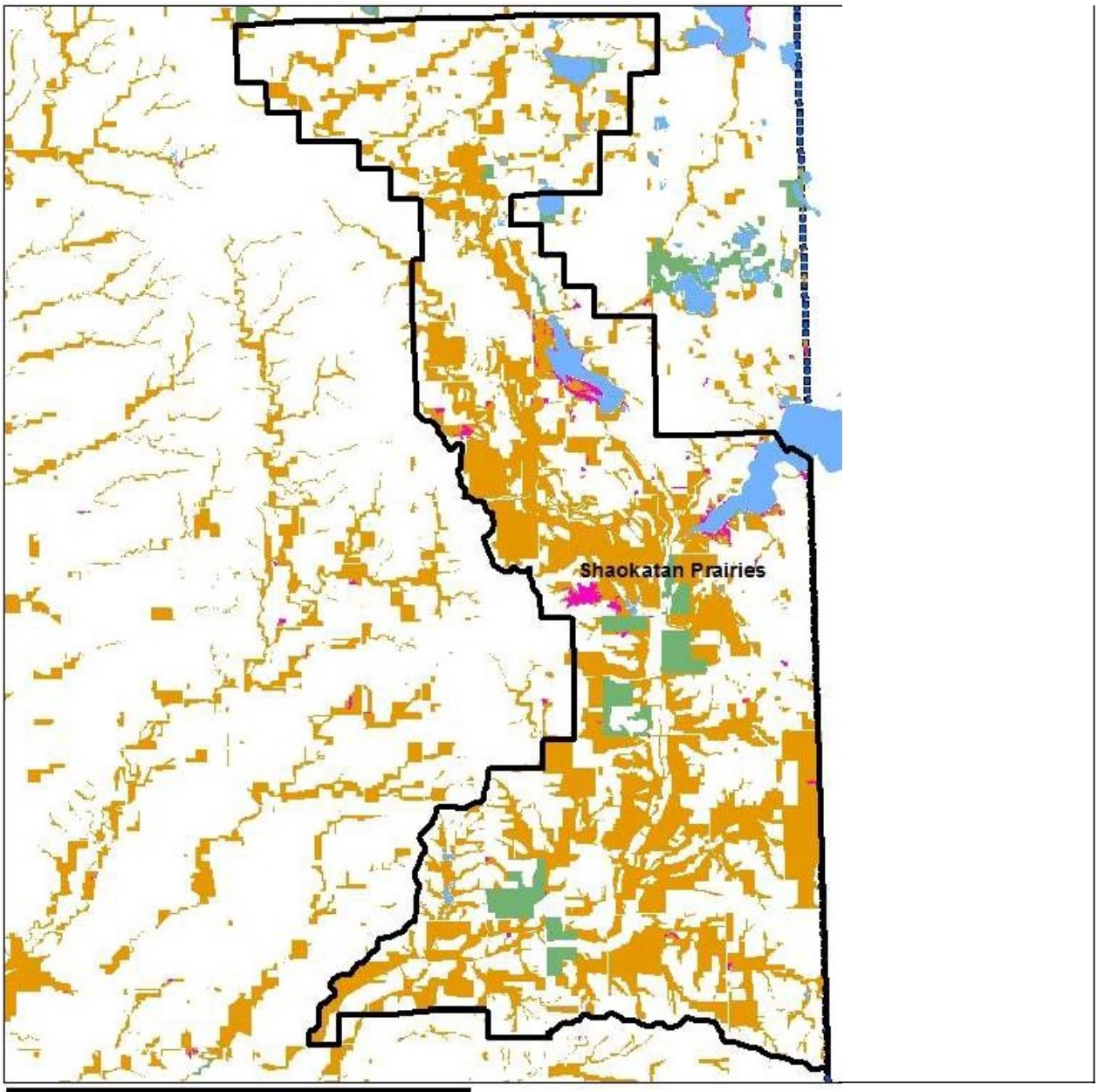
2010 SD GFP Water Layer
Prairie Coteau SD
TNC_Prairie_Coteau_ Prairie_Cores

| | |
|---|---|
| 2010 TNC NFWF Focus Area: | 56,604 acres |
| 2012 Undisturbed w/in Focus: | 16,060 acres |
| 2012 Undisturbed Protected: | 5,518 acres |
| 2012 % Undisturbed Protected: | 9.7% |

0 1.5 3 6 9 12 M1es

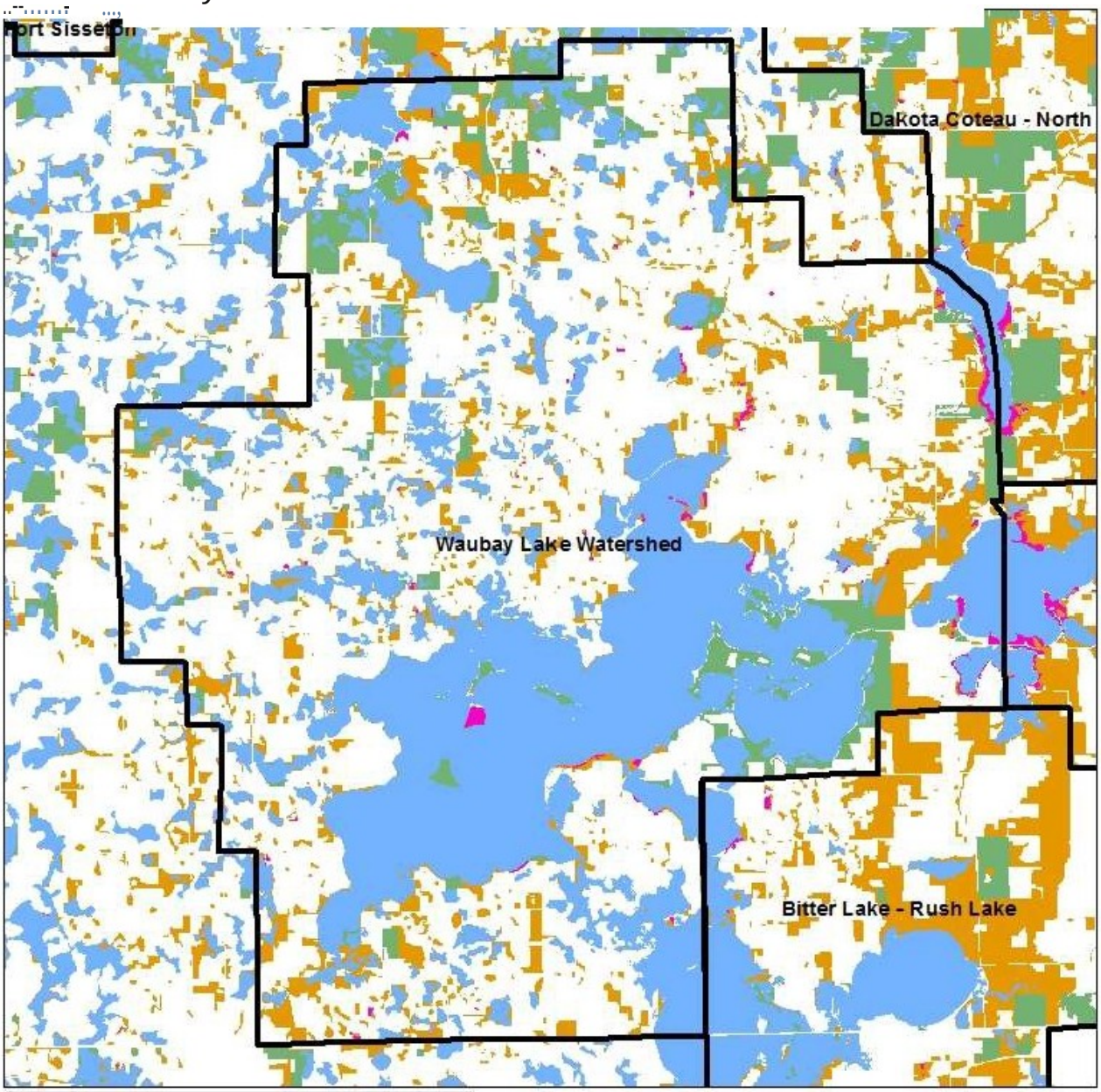
N

## Shaokatan Prairie Focus Area: 2012 Protection Status



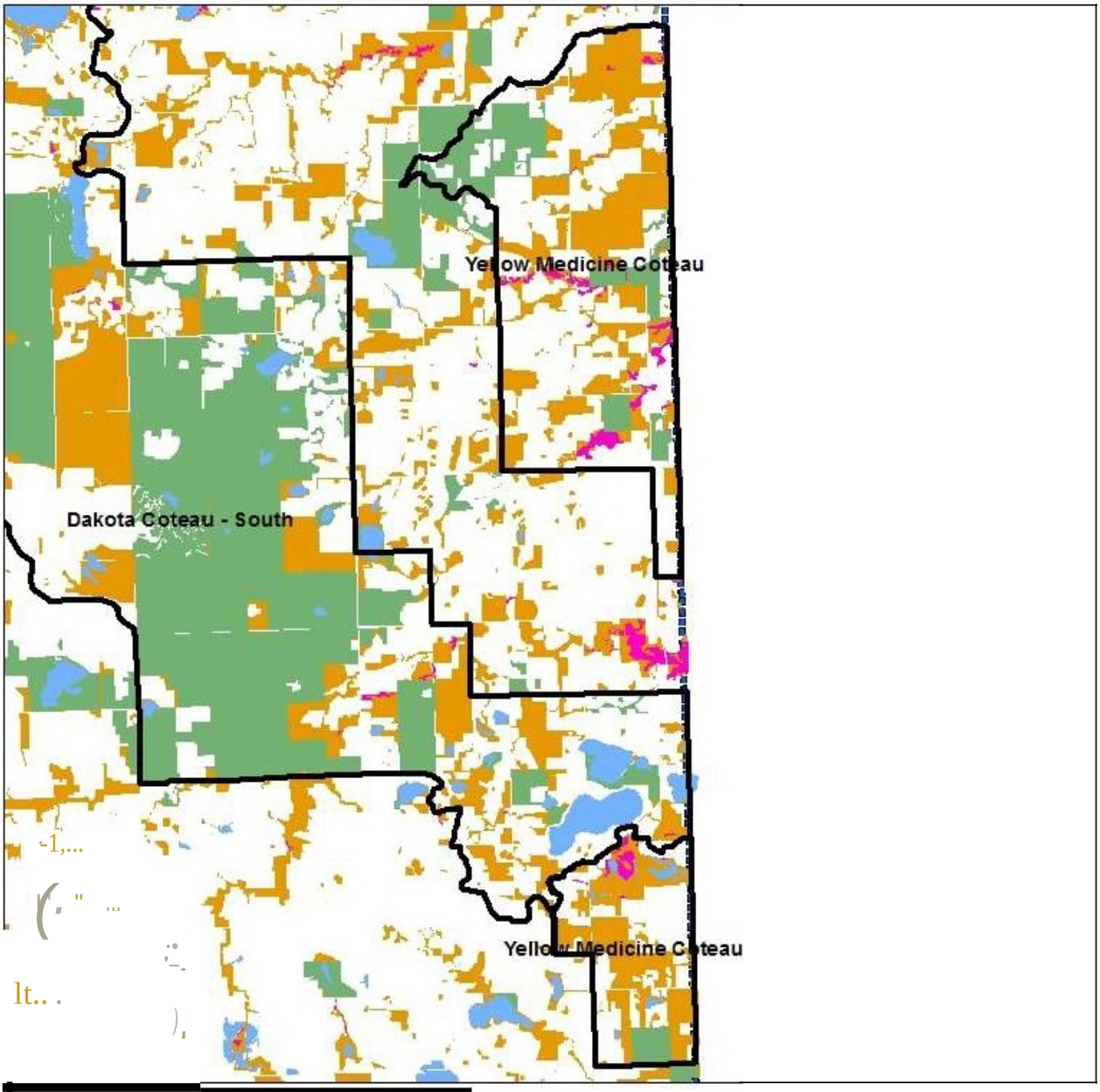

2010 TNC NFWF Focus Area: 55,111 acres
2012 Undisturbed w/in Focus: 20,721 acres
2012 Undisturbed Protected: 1,490 acres
2012 % Undisturbed Protected: 2.7%

## Waubay Lake Watershed Focus Area: 2012 Protection Status




| | |
|---|---|
| 2010 TNC NFWF Focus Area: | 96,908 acres |
| 2012 Undisturbed w/in Focus: | 15,464 acres |
| 2012 Undisturbed Protected: | 5,389 acres |
| 2012 % Undisturbed Protected: | 5.6% |

## Yellow Medicine Coteau Focus Area: 2012 Protection Status




| | |
|---|---|
| 2010 TNC NFWF Focus Area: | 12,355 acres |
| 2012 Undisturbed w/in Focus: | 5,831 acres |
| 2012 Undisturbed Protected: | 1,319 acres |
| 2012 % Undisturbed Protected: | 10.7% |