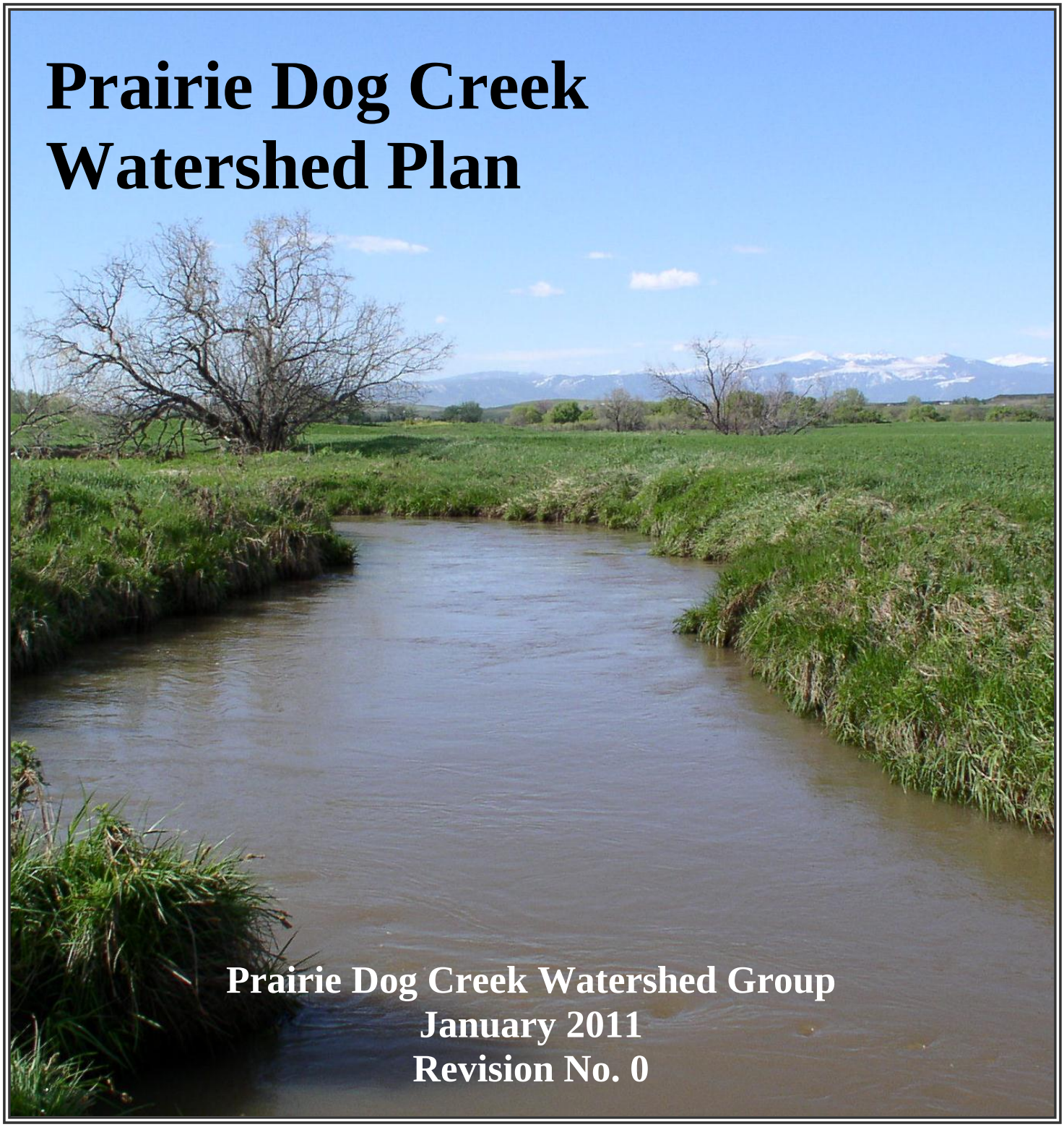
Prairie Dog Creek Watershed Plan



Prairie Dog Creek Watershed Group
January 2011
Revision No. 0

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SIGNATURE PAGE

In February 2007, residents of the Prairie Dog Creek watershed agreed to initiate a watershed assessment and planning effort to address bacteria and other concerns on the watershed.

Following a 45 day public comment period that included an open house, the Prairie Dog Creek Watershed Group incorporated comments from WDEQ and others and approved the Prairie Dog Creek Watershed Plan on January 27, 2011.

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James Bohnsack, Co-chair **John Kane, Co-chair**

The Sheridan County Conservation District Board of Supervisors approved submission of the Prairie Dog Creek Watershed Plan to the Wyoming Department of Environmental Quality (WDEQ) on February 8, 2011.

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Doug Masters **Susan Holmes**

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John Kane **Robert Brug**

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Roger Reinke

The Prairie Dog Creek Watershed Plan has been approved by WDEQ.

_____ _____

John Wagner, Administrator **Date**
Water Quality Division
Wyoming Department of Environmental Quality

The Prairie Dog Creek Watershed Plan has been filed with the Sheridan County Clerk.

_____ _____

Sheridan County Clerk **Date**

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1. EXECUTIVE SUMMARY

The Prairie Dog Creek watershed consists of approximately 231,000 acres (360 square miles) located in central Sheridan County, in north-central Wyoming. Prairie Dog Creek originates in the foothills of the Big Horn Mountains near Moncreiffe Ridge, northwest of Story, Wyoming. This ridge is located in the southwest corner of the watershed, less than a ½ mile above the headwaters of Prairie Dog Creek. The stream flows east until the confluence with Jenks Creek, where it turns north until it enters the Tongue River near the Montana border. Major tributaries to Prairie Dog Creek include Meade, Jenks, SR, Jim, Arkansas, Coutant, Wildcat, and Dutch Creeks. Most of these streams are ephemeral throughout much of their length. Stream flow in Jenks Creek and Meade Creek is augmented during the irrigation season by trans-basin diversions from the Piney Creek drainage. Jenks Creek was likely a steep ephemeral draw until the late 1800's, at which time trans-basin diversions were constructed to divert water from the North and South Forks of Piney Creek through three tunnels located on the northern side of the present community of Story. The ridge through which the tunnels were constructed is known as Tunnel Hill. During the irrigation season, as much as 100 cubic feet per second (cfs) can be diverted from the Piney Creek drainage into Prairie Dog Creek. There is a limited amount of public land along the waterbodies and recreational activities are infrequent.

When levels of a pollutant, such as bacteria, exceed water quality standards, the stream is considered "impaired" and states are required by the Clean Water Act to establish a Total Maximum Daily Load (TMDL) for that pollutant. In 2004, Wyoming Department of Environmental Quality listed the entire length of Prairie Dog Creek on the 303 (d) list of waterbodies for fecal coliform impairments related to recreational uses. This came as a result of WDEQ monitoring in July 2003 (WDEQ, 2003). In 2007, the Sheridan County Conservation District (SCCD) in partnership with the USDA Natural Resources Conservation Service (NRCS) initiated a watershed assessment and planning effort on the Prairie Dog Creek Watershed. The Prairie Dog Creek Watershed Group (PDWG), including landowners and residents, used the information collected in the assessment and local knowledge of the watershed to develop the Prairie Dog Creek Watershed Plan. The two-year assessment provided water quality data to calculate the initial load estimates and load reductions included in the Prairie Dog Creek Watershed Plan.

Subwatershed divisions within the Prairie Dog Creek watershed were made based upon boundaries defined by the United States Geological Survey (USGS). SCCD used the smallest of the HUC divisions, the 12 digit HUCs or 6^{th} level subwatershed divisions, to characterize the Prairie Dog Creek Watershed. The Prairie Dog Creek Watershed Plan includes four subwatersheds; Upper Prairie Dog Creek, Middle Prairie Dog Creek, Lower Prairie Dog Creek, and Dutch Creek.

The primary regulatory concern for the Prairie Dog Creek Watershed is *E. coli* bacteria concentrations in excess of Wyoming Water Quality Standards for primary contact recreation. To fully achieve the primary contact recreation standard of 126 cfu/100 ml, bacteria levels would need to be reduced by over 70%. The PDWG did not feel this was

reasonably achievable, in the short term. The PDWG developed this watershed plan to reduce bacteria loads by 10% in the next five years.

The PDWG also recognized the limitations in the reduction estimates as presented. To fully understand the dynamics of the watershed, especially for bacteria, many more years of data, encompassing many different flow and climate conditions, are needed. The PDWG will continue to adjust load and load reduction estimates as additional data are collected.

The Prairie Dog Creek Watershed Plan includes 18 action items organized into three broad categories: watershed plan implementation, water quality, and awareness and education. Each action item has one or more interim milestones to enable the PDWG to assess whether they are completing the action item as planned. The watershed plan also includes provisions for additional bacteria and turbidity monitoring on a three year rotation.

The action items include providing incentives for on-the-ground improvements, information and education activities, and other activities. Each action item includes information on the subwatershed priority, the entity responsible for the completion of the activity, and the approximate amounts and potential sources of funding needed. The subwatershed priority is to be used as a way to direct information/education activities and as a tool for prioritization of projects when resources (funding and technical) are limited. It is not intended to be used as a way to discourage improvement projects in other subwatersheds. Any project will be considered based on its potential to benefit water quality.

As implementation proceeds, some action items may not be necessary or may not be able to be completed as planned, or there may be others items that have not yet been considered. In addition, as more information becomes available, SCCD may need to adjust load information and reduction estimates. Therefore, the plan needs to be dynamic and ever-changing to meet the needs of current and future watershed issues.

2. INTRODUCTION

2.1 Resource Description

The Prairie Dog Creek watershed consists of approximately 231,000 acres (360 square miles) located in central Sheridan County, in north-central Wyoming (Appendix A). The watershed is identified by hydrologic unit code (HUC) WYTR 10090101-020-2. Prairie Dog Creek originates in the foothills of the Big Horn Mountains near Moncreiffe Ridge, northwest of Story, Wyoming. This ridge is located in the southwest corner of the watershed, less than a ½ mile above the headwaters of Prairie Dog Creek. The stream flows east until the confluence with Jenks Creek, where it turns north until it enters the Tongue River near the Montana border. This is the lowest point in the watershed at 3,435 feet. The total elevation difference is 3,086 feet over a distance of approximately 26 miles (119 feet/mile, or 2.25%), sloping generally from south to north (EnTech, 2001).

Major tributaries to Prairie Dog Creek include Meade, Jenks, SR, Jim, Arkansas, Coutant, Wildcat, and Dutch Creeks. Most of these streams are ephemeral throughout much of their length. Stream flow in Jenks Creek and Meade Creek is augmented during the irrigation season by trans-basin diversions from the Piney Creek drainage. Jenks Creek was likely a steep ephemeral draw until the late 1800's, at which time trans-basin diversions were constructed to divert water from the North and South Forks of Piney Creek through three tunnels located on the northern side of the present community of Story. The ridge through which the tunnels were constructed is known as Tunnel Hill. During the recreational season, as much as 180 cubic feet per second (cfs) can be diverted from the Piney Creek drainage into Prairie Dog Creek. The additional flows resulting from the trans-basin diversions are suspected to contribute to habitat and stream channel degradation (Entech, 2001).

The upper reaches of the watershed lie within Major Land Resource Area (MLRA) 46 – Northern Rocky Mountain Foothills (NRCS, 1986). The approximate lower two-thirds of the watershed lie within MLRA 58B – Northern Rolling High Plains (NRCS, 1986). Approximately 90% of the watershed is rangeland, with half in the 15"–19" Northern Plains Ecological Site group and half in the 10"–14" Northern Plains Ecological Site group (NRCS, 1995). Soils range from very deep loamy and clayey soils on alluvial fans, terraces, and floodplains (Haverdad-Zigweid-Nuncho grouping) to shallow and very shallow loamy soils on slopes up to 90% with rock outcrops (Shingle-Kishona-Cambria grouping) (NRCS, 1986a).

Prairie Dog Creek is somewhat unique for Sheridan County in that it has no municipal water uses or discharges. In 2007 there were two active Wyoming Pollutant Discharge Elimination System (WYPDES) storm water discharge permits within the Prairie Dog Creek watershed, in addition to one active temporary discharge permit. The vast majority of the WYPDES permits active in the Prairie Dog Creek watershed during 2007 were coal-bed methane (CBM) discharges, numbering 322 permits. Few of these outfalls discharge directly into Prairie Dog Creek. Most of the WYPDES CBM discharge permits are first discharged into stockwater reservoirs, pits, or containment units, either

on- or off-channel, then into one of the often unnamed draws or streams that feed the major Prairie Dog Creek tributaries: Coutant Creek, Dutch Creek, Dow Prong, Wildcat Creek, Meade Creek, Murphy Gulch, Arkansas Creek, Wagner Prong, and Jenks Creek.

2.2 Stream Classifications and Listings

As provided in the June 21, 2001 Wyoming Surface Water Classification List (WDEQ, 2001), the stream classifications applicable to the Prairie Dog Creek watershed are Class 2AB and Class 3B (Table 2-1).

Table 2-1. Classifications for streams in the Prairie Dog Creek Watershed

Class 2AB Waterbodies	Class 3B Waterbodies	
Prairie Dog Creek	Wildcat Creek	Coutant Creek
Meade Creek	Dutch Creek	Murphy Gulch
Jenks Creek	Dow Prong	Arkansas Creek
		Wagner Prong

Class 2AB waters are

> those known to support game fish populations or spawning and nursery areas at least seasonally and all their perennial tributaries and adjacent wetlands and where a game fishery and drinking water use is otherwise attainable. . . these waters are presumed to have sufficient water quality and quantity to support drinking water supplies and are protected for that use. Class 2AB waters are also protected for nongame fisheries, fish consumption, aquatic life other that fish, recreation, wildlife, industry, agriculture and scenic value uses (WDEQ, 2007).

In 2001, Class 2AB waters were protected for "primary contact recreation," although primary contact recreation was not specifically defined. In 2007, a definition was added for primary contact recreation; however, the use designation implies protection for both primary and secondary contact recreation. The difference between primary and secondary contact recreation is related to the potential of the activity to result in "ingestion of the water or immersion" (WDEQ, 2007). In neither case does the protection address the quantity of water; rather it ensures that the quality of the water is "safe for human contact" (WDEQ, 2007). Of the 72 stream miles on Prairie Dog Creek, Meade Creek, and Jenks Creek, all but 1.5 miles are on private land and are not conducive to public recreation. However, the classification of 2AB requires these streams to be protected for both primary and secondary contact recreation.

Class 3B waters are

> tributary waters including adjacent wetlands that are not known to support fish populations or drinking water supplies and where those uses are not attainable. Class 3B waters are intermittent and ephemeral streams with sufficient hydrology to normally support and sustain communities of aquatic life including invertebrates, amphibians, or other flora and fauna that inhabit waters of the state at some stage of their life cycles. (WDEQ, 2007).

All Class 3 waters are expected to support aquatic life other than fish, recreation, wildlife, industry, agriculture, and scenic value and must be protected for those uses (WDEQ, 2007).

Table 3-2. Surface Water Classes and Use Designations (WDEQ, 2007)

Class	Drinking Water[2]	Game Fish[3]	Non-Game Fish[3]	Fish Consumption[4]	Other Aquatic Life[5]	Recreation[6]	Wildlife[7]	Agriculture[8]	Industry[9]	Scenic Value[10]
1[1]	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	Yes	Yes	Yes	Yes	Yes
2AB	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2A	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
2B	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2C	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2D	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3A	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
3B	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
3C	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
4A	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
4B	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
4C	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes

[1] Class 1 waters are not protected for all uses in all circumstances. For example, all waters in the National Parks and Wilderness areas are Class 1, however, all do not support fisheries or other aquatic life uses (e.g. hot springs, ephemeral waters, wet meadows, etc.).

[2]The drinking water use involves maintaining a level of water quality that is suitable for potable water or intended to be suitable after receiving conventional drinking water treatment.

[3]The fisheries use includes water quality, habitat conditions, spawning and nursery areas, and food sources necessary to sustain populations of game and non-game fish. This does not include the protection of exotic species which are designated "undesirable" by the Wyoming Game and Fish Department or the U.S. Fish and Wildlife Service with their appropriate jurisdictions.

[4]The fish consumption use involves maintaining a level of water quality that will prevent any unpalatable flavor and/or accumulation of harmful substances in fish tissue.

[5]Aquatic life other than fish includes water quality and habitat necessary to sustain populations of organisms other than fish in proportions which make up diverse aquatic communities common to waters of the state. This does not include the protection of insect pests or exotic species which are designated "undesirable" by the Wyoming Game and Fish Department or the U.S. Fish and Wildlife Service with their appropriate jurisdictions.

[6]Recreational use protection involves maintaining a level of water quality that is safe for human contact. It does not guarantee the availability of water for any recreational purpose. Both primary and secondary contact recreation are protected in Class 2AB waters.

[7]The wildlife use designation involves protection of water quality to a level that is safe for contact and consumption by avian and terrestrial wildlife species.

[8]For purposes of water pollution control, agricultural uses include irrigation or stock watering.

[9]Industrial use protection involves maintaining a level of water quality useful for industrial purposes.

[10]Scenic value involves the aesthetics of the aquatic systems themselves (odor, color, taste, settleable solids, floating solids, suspended solids, and solid waste) and is not necessarily related to general landscape appearance.

When levels of a pollutant, such as bacteria, exceed water quality standards, the stream is considered "impaired" and states are required by the Clean Water Act to establish a Total Maximum Daily Load (TMDL) for that pollutant. The TMDL specifies the amount of a pollutant a waterbody can receive and still meet water quality standards (USEPA, 2008). The TMDL also targets specific pollutant reductions by source.

In 1996, WDEQ listed Prairie Dog Creek on the 303(d) list of impaired water bodies as a result of anecdotal evidence suggesting that the stream was only in partial support of its aquatic life use for siltation, nutrients, flow, habitat, and salinity/total dissolved solids/chlorides (WDEQ, 1996). However, Prairie Dog Creek was among several waterbodies that were included in the 1998 303(d) list on "Table E: 1996 303(d) Waters Requiring Further Monitoring" (WDEQ, 1998).

In 2002, Prairie Dog Creek was listed on Table A of Wyoming's 303(d) List of Waters Requiring TMDLs for aesthetic drinking water impairments due to elevated manganese concentrations. This listing came as a result of monitoring done by the United States Geological Survey (USGS) at Station Number 06306250 near the confluence with the Tongue River. While the concentrations indicated impairments for aesthetic drinking water use (discoloration, taste, odor), the manganese concentrations were not believed to pose a human health risk (WDEQ, 2002) and it was assigned a low priority for TMDL development (WDEQ, 2002). WDEQ suspected the high manganese concentrations resulted from the natural geology of the area; WDEQ may consider site specific criteria for manganese in the future (WDEQ, 2004).

The entire length of Prairie Dog Creek was placed on the 303 (d) List for fecal coliform impairments related to recreational uses in 2004. This came as a result of WDEQ monitoring in July 2003 (WDEQ, 2003). The watershed was assigned a high priority for TMDL development because no local group had committed to develop a watershed plan (WDEQ, 2004). In 2007, the Sheridan County Conservation District (SCCD) in partnership with the USDA Natural Resources Conservation Service (NRCS) initiated a watershed assessment and planning effort on the Prairie Dog Creek Watershed to address bacteria concerns and the priority was changed to low.

The TMDL Workplan Update (WDEQ, 2008) sets the goals and timelines for all waters requiring TMDLs and provisions for schedules to be included in the biannual reports submitted under sections 305(b) and 303(d) of the Clean Water Act. The ranking schedule for TMDLs will consider several factors, including (but not limited to): the severity of the impairment, the USEPA 8-13 year timeframe/date of listing, and staffing and other resources. Approved TMDLs will be reassessed every 5 years. Prairie Dog Creek is scheduled for TMDL development in 2013 (WDEQ, 2010).

Prior to 2004, a watershed plan included general identification of potential contributors (sources) of a pollutant and goals for pollution reduction. The purpose was to develop a tool to guide implementation (work-on-the-ground) and not to quantify the amounts of a pollutant from a specific source. The reason for this was to encourage widespread improvements across the entire watershed rather than to address a single contributor. The

TMDL takes a more focused, targeted approach and attempts to provide a more quantitative evaluation of pollutant sources and more specific reduction targets. Both TMDLs and watershed plans include provisions for sufficient monitoring to allow on-going adjustments in targets, source identification, and implementation strategies. Both are dynamic documents and require an active implementation program to ensure local involvement and control.

Beginning in FY 2004, the USEPA developed guidelines on information that must be included in a watershed plan in order to qualify for incremental funds through Section 319 of the Clean Water Act. To meet these requirements, a watershed plan must incorporate certain provisions of the TMDL process and include goals for implementation. To be effective, the plan must find the balance between quantifying non point pollution sources and developing an implementation strategy that will include landowners/residents and encourage watershed-wide participation.

The Prairie Dog Creek Watershed Group (PDWG), including landowners and residents, used the information collected in the 2007-2008 assessment and local knowledge of the watershed to develop the Prairie Dog Creek Watershed Plan. The two-year assessment provided baseline water quality data to calculate the initial load estimates and load reductions included in the Prairie Dog Creek Watershed Plan.

2.3 Planning Authority

Under Wyoming Statute 11-16-103 Legislative declarations and policy, the SCCD is to

> provide for the conservation of the soil, and soil and water resources of this state, and for the control and prevention of soil erosion and for flood prevention or the conservation, development, utilization, and disposal of water, and thereby to stabilize ranching and farming operations, to preserve natural resources, protect the tax base, control floods, prevent impairment of dams and reservoirs, preserve wildlife, protect public lands, and protect and promote the health, safety and general welfare of the people of this state.

Wyoming Statute 11-16-122 grants Conservation Districts the ability to

> conduct surveys, investigations and research and disseminate information relating to . . . the conservation, development, utilization and disposal of water. . . in cooperation with the government of this state or its agencies . . . [to] develop comprehensive plans for . . . conservation of soil and water resources . . .[that] specify in detail the acts, procedures, performances, and avoidances necessary or desirable to carry out the plans [and to] make public the plans and information and bring them to the attention of owners and occupiers of land within the district.

In 1996, the Wyoming Association of Conservation Districts, the NRCS, and the Wyoming Department of Agriculture saw an increasing need for Conservation Districts to represent local interests and take the lead in watershed planning efforts. As a result they developed the Watershed Strategic Plan, which was updated in 2000, to guide watershed planning efforts across the state (WACD, 2000). This document insists that

"any watershed effort led by a conservation district should be landowner driven . . . [and] any participation on behalf of any landowner is strictly voluntary."

In addition, the Prairie Dog Creek Watershed Plan meets the top priorities of the Wyoming Non-Point Source Management Plan Update (WDEQ, 2000) by conducting an assessment of the condition of surface water, implementing information and education programs that "encourage participation in voluntary efforts to prevent, reduce, and eliminate pollution of the state's water resources," and, through the involvement of the PDWG and local landowners "developing and implementing watershed management plans."

By taking an active role in the planning process, the PDWG, SCCD, and NRCS have adhered to this principle. The landowners followed the steps for watershed planning as outlined in the Watershed Strategic Plan. They identified and prioritized concerns, set goals and objectives, and outlined the activities they felt would achieve the objectives. Included in the Prairie Dog Creek Watershed Plan are elements to solicit funds, implement the plan, and provide for periodic plan evaluation. This watershed plan was written to include the nine essential elements of an EPA Watershed Based Plan as described in the Thursday, October 23, 2003 Federal Register, Vol. 68, No. 205.

2.4 Public Participation

The watershed assessment provided the foundation for the watershed planning and improvement effort. During the assessment, landowners provided access for water quality monitoring as well as information on the parameters and locations to be sampled and other activities on the watershed. In 2007 and 2008, SCCD hosted public watershed meetings to seek input for the assessment and to provide information on watershed planning. Representatives from WDEQ attended the February 2008 meeting to discuss components necessary for the watershed plan to be approved by WDEQ and EPA.

Upon completion of the assessment, landowners participated in a series of meetings to review monitoring results, identify additional concerns and objectives, and outline action items to address the concerns. A considerable amount of time was spent discussing the limited amount of data available and the load and reduction estimates. The PDWG is committed to incorporating additional information into the watershed plan as it becomes available. Participants reviewed drafts of the plan document as it was developed. Finally, the group assigned approximate completion dates for the action items and tasks.

Participation was not limited to a formal, select steering committee. At the first meeting, participants selected two co-chairs for the group. Meetings were open to the public and anyone with an interest in the watershed was encouraged to participate. For the first meeting, SCCD mailed information and agendas to all residents and landowners on the watershed and advertised in local media. For subsequent meetings, information was mailed to all landowners providing sampling access, all participants from previous meetings, and anyone else that had expressed interest. Decisions were based on the consensus of the participants in attendance and every section of the plan was subject to change at any time during the process. Every meeting opened with revisiting the sections

of the plan that had previously been discussed or completed. This provided additional opportunities for landowners to give feedback and/or suggest modifications.

In July 2009, a draft of the plan was submitted to WDEQ and opened for a 45 day public comment period as required by the Wyoming Administrative Procedures Act (W.S. 16-3-101). WDEQ requested additional information, which was submitted in September 2009. WDEQ provided additional comments in January 2010, which resulted in a meeting and initiation of a dialogue among WDEQ and SCCD in April 2010. The purpose of the meeting and subsequent discussions was to find the balance between satisfying the required elements while meeting the needs of the watershed landowners/residents. Without the support and participation of the landowners, it would be impossible to implement any action items, regardless of the attempts to quantify sources. Comments were incorporated into the document as appropriate and the PDWG finalized the plan document in January 2011. Once approved by WDEQ, the plan will be filed with the Sheridan County Clerk.

3. WATERSHED ASSESSMENT AND CONDITIONS

3.1 Subwatershed Characterizations

Subwatershed divisions within the Prairie Dog Creek watershed were made based upon boundaries defined by the United States Geological Survey (USGS). Each hydrologic unit or drainage area is identified by a unique hydrologic unit code (HUC) that ranges from 2-12 digits depending upon the level of division. SCCD used the smallest of the HUC divisions, the 12 digit HUCs or 6th level subwatershed divisions, to characterize the Prairie Dog Creek Watershed. The Prairie Dog Creek Watershed Plan includes four subwatersheds; Upper Prairie Dog Creek, Middle Prairie Dog Creek, Lower Prairie Dog Creek, and Dutch Creek. Each subwatershed was described according to its size, primary land ownership and land uses and other characteristics (Table 3-1).

The Upper, Middle, and Lower Prairie Dog Creek Subwatersheds are the same as the USGS HUC 12 subwatersheds (Appendix A). The Dutch Creek Subwatershed is a combination of the Lower Dutch Creek, Upper Dutch Creek, Wagner Prong Dutch Creek, and Dow Prong Creek USGS HUC 12 subwatersheds. These Dutch Creek subwatersheds were combined because the only sample station included in the assessment was located at the mouth of Dutch Creek (Lower Dutch Creek Subwatershed) and there was very little water quality data in the other three subwatersheds, which lack significant perennial flow. In addition, the Dutch Creek subwatersheds had similar land uses and vegetative cover.

3.1.1 Lower Prairie Dog Creek Subwatershed

The Lower Prairie Dog Creek Subwatershed is the northern-most area of the watershed, and includes Coutant Creek and the ephemeral draws below the Dutch Creek confluence, encompassing approximately 50 square miles (approximately 32,000 acres). This subwatershed includes the PD1 and PD2 water quality sample sites as well as the USGS Gauging Station (Number 06306250) above the Tongue River confluence. Both of these stations are located on Prairie Dog Creek. Coutant Creek, which enters Prairie Dog Creek approximately one and one-half miles above the confluence with the Tongue River, is mostly ephemeral and drains the eastern two-thirds of the lower subwatershed. Land cover is dominated by Wyoming big sagebrush and mixed grass prairie with a small amount of Ponderosa pine along the most eastern edge (Appendix A). Irrigated hayland and riparian areas are adjacent to Prairie Dog Creek with some dryland crops, including wheat, in other areas.

The Lower Prairie Dog Creek Subwatershed is approximately 83% private land, with approximately 15% State of Wyoming land, and approximately 2% federal land under the Bureau of Land Management. The subwatershed is primarily large rangeland parcels where the primary land use is cattle grazing, with parcels greater than 100 acres making up 91% of the land area and 46% of the total number of parcels. Rural residential housing and ranchettes, based on parcels less than 40 acres in size, is estimated to be 3% of the land area (30% of the number of parcels) and is found in small subdivisions along the Lower end of Coutant Creek and adjacent to Prairie Dog Creek. Small acreage parcels (40-100 acres) constitute 24% of the parcel numbers and 7% of the land area.

Irrigated hayland, particularly along the stream courses, make up approximately 9% of the Lower Prairie Dog Creek Subwatershed, encompassing approximately 2,750 acres. There are no paved highways in the Lower subwatershed; County Road #1211 (Lower Prairie Dog Road) runs along the west side and adjacent to Prairie Dog Creek. A railroad spur to the Decker Coal Mine in Montana runs along the east side. The subwatershed has been subject to Coalbed Natural Gas development and an increase in truck traffic on the dirt roads.

3.1.2 Dutch Creek Subwatershed

The Dutch Creek Subwatershed includes the entire Dutch Creek watershed, including the Lower Dutch Creek, Upper Dutch Creek, Wagner Prong Dutch Creek, and Dow Prong Creek USGS HUC 12 subwatersheds. The Dutch Creek Subwatershed includes Arkansas Creek, Dow Prong, and Wagner Prong, as well as their ephemeral tributaries, taking in approximately 186 square miles (approximately 119,000 acres). This subwatershed includes a single water quality sample site, the PD3 station on Dutch Creek above the Prairie Dog Creek confluence.

The Dutch Creek Subwatershed is approximately 76% private land, with approximately 23% State of Wyoming land, and approximately 1% Federal land. The Dutch Creek Subwatershed is almost exclusively large rangeland parcels where land use is devoted to cattle grazing, with approximately 97% of the land area in parcels larger than 100 acres. The number of large parcels (greater than 100 acres) is approximately 63% of the total number of parcels. Rural residential housing and ranchettes (less than 40 acres) comprise 22% of the total number of parcels and a very small percentage of the land area (~1%), most of which is concentrated along Wyoming Highway 336 in the northwest portion of the subwatershed. While there is no significant amount of irrigated land in the Dutch Creek Subwatershed, there is dryland hay production. The exact amount of land use for dryland hay is difficult to quantify due to variability of production and grazing of stockpiled forage instead of traditional haying, but is estimated to be 1 to 2% of the land area. Wyoming Highway 336, which is the only paved highway in the Dutch Creek subwatershed, turns into a gravel road just beyond Wyarno. A network of gravel roads provides access to area in the south and west. US Highway 14 passes just along the southeastern tip of the subwatershed boundary. The Burlington Northern Santa Fe Railroad runs alongside Wyoming Highway 336 and through the center of the subwatershed. The Dutch Creek subwatershed has been subject to some Coalbed Natural Gas development.

3.1.3 Middle Prairie Dog Creek Subwatershed

The Middle Prairie Dog Creek Subwatershed is the portion of the watershed from immediately above the Dutch Creek confluence to below the Meade Creek confluence. The Middle Prairie Dog Creek Subwatershed includes Wildcat Creek and ephemeral tributaries, and encompasses approximately 63 square miles (approximately 40,000 acres). This subwatershed includes the PD3A, PD4, PD5, PD5A, and PD6 water quality sample sites, in addition to the USGS Gauging Station (Number 06306200) above the Wildcat Creek confluence. All of the sample sites are located on Prairie Dog Creek, with the exception of PD4, which is located on Wildcat Creek.

The Middle Prairie Dog Creek Subwatershed is approximately 86% private land, with approximately 14% State of Wyoming land, and less than 1% Federal land. The Middle Prairie Dog Creek Subwatershed is primarily large rangeland parcels with approximately 85% of parcels being larger than 100 acres where grazing is the primary land use. Irrigated hayland, in the areas along the Prairie Dog Creek mainstem, Wildcat Creek and the areas near the Prairie Dog Creek/Wildcat Creek confluence, makes up approximately 20% of the subwatershed, taking in approximately 8,000 acres. Rural residential housing, particularly in areas near the City of Sheridan and along US Highway 14 and Wyoming Highway 336, is estimated to be 7 to 8% of the land area. Paved highways in the Middle subwatershed include US Highway 14, Wyoming Highway 336, and a small section of Interstate 90 along the western boundary. County Road #1211 (Lower Prairie Dog Road) is located in the northern half of the watershed along with other dirt/gravel roads to access residential areas. The City of Sheridan Landfill is located near the eastern edge of the subwatershed.

3.1.4 Upper Prairie Dog Creek Subwatershed

The Upper Prairie Dog Creek Subwatershed includes the area below the Meade Creek confluence to the Prairie Dog Creek headwaters near Moncreiffe Ridge, encompassing approximately 61 square miles (approximately 39,000 acres). The Upper Prairie Dog Creek Subwatershed includes Meade Creek, Pompey Creek, Murphy Gulch, Jenks Creek, and ephemeral tributaries. This subwatershed includes the PD7, PD7A, PD8, PD9, PD10 water quality sample sites. All of the sites are located on Prairie Dog Creek, with the exception of PD7, which is located on Meade Creek.

Though not hydrologically connected, the Upper Prairie Dog Creek Subwatershed is also influenced by the Piney Creek/Prairie Dog Ditch transbasin diversion, which joins Prairie Dog Creek through Jenks Creek, adding as much as 100 cubic feet per second (cfs) to the Prairie Dog Creek watershed during peak irrigation season. The PD 11 water quality sample site was located at the Piney Creek/Prairie Dog Ditch Diversion flume in Story.

The Upper Prairie Dog Creek Subwatershed is made up of approximately 79% private land, approximately 21% State of Wyoming land, and less than 1% Federal land. The area of the Upper Prairie Dog Creek Subwatershed is a mix of large and small parcels. The large parcels (greater than 100 acres) constitute approximately 80% of the land area, but only 19% of the total number of parcels. The large parcels are primarily used for cattle grazing. Irrigated hayland makes up approximately 12% (~4500 acres) of the subwatershed, particularly in the lower portions along Meade Creek and Prairie Dog Creek. Rural residential housing is concentrated along the roadways, including Interstate 90, and US Highways 14 and 87. Although estimated at only 8 to 9% of the land area, the number of parcels less than 40 acres in size is 64.5% of the total number of parcels in the subwatershed. County Road #127 (Upper Prairie Dog Road) runs alongside Prairie Dog Creek between US Highway 14 and US Highway 87.

Table 3-1. Summary of Prairie Dog Creek Subwatershed Characterizations

	Lower	Dutch	Middle	Upper
Size	32,000	119,000	40,000	39,000
Tributaries	Coutant	Arkansas SR Dow Prong Wagner Prong	Wildcat	Meade Creek Murphy Gulch Pompey Jenks
Sample Sites[1]	PD1 PD2	PD3-T	PD3A PD4-T PD5 PD5A PD6	PD7-T PD7A PD8
Land Ownership	83% Private 15% State 1.6% Federal	76% Private 23% State 1% Federal	86% Private 13.5% State 0.1% Federal	79% Private 20.5 % State 0.2% Federal
Land Uses[2]	89% Rangeland 9% Irrigated Hay 2% Residential	97% Rangeland 2% Dry Hay 1% Residential	73% Rangeland 20% Irrigated Hay 7% Residential	80% Rangeland 12% Irrigated Hay 8% Residential
Land Cover	WY Big Sage Mixed grass Ponderosa Pine Dry Crop Irrigated	Mixed grass WY Big Sage Dry crop	Mixed Grass Dry Crop Irrigated	Mixed grass Irrigated Aspen Ponderosa Pine
Residential Parcels < 5 acres (#)	3	18	54	77
Ranchette Parcels 5-40 acres (#)	34	38	108	156
Small acre Parcels 40-100 acres (#)	29	35	52	63
Large Acre Parcels > 100 acres (#)	56	158	81	96
Density Areas[3] **Subdivisions**	Bar N Draw		Rocky Hills Sub Hidden Hills Sub Peno Road	Meade Creek Murphy Gulch Upstream I-90
Transportation Corridors	County Roads Railroad Spur	State Highway County Roads Railroad	Interstate 90 US Highway State Highway County Roads Railroad	Interstate 90 US Highways County Roads
Other Activities	CBNG	CBNG	City Landfill	Conoco Tank Farm

[1]Sample sites on tributaries are designated with a T; site PD11 is not included in a subwatershed, nor in the Prairie Dog Creek Watershed Plan, as it lies outside of the geographic boundary of the watershed. Site PD11 was located on Prairie Dog Ditch within the community of Story, Wyoming to determine whether the water diverted through Prairie Dog Ditch into Prairie Dog Creek was affecting water quality in Prairie Dog Creek. Sites designated with an "A" are sites that were added in 2008; these sites are located upstream of the sites with the same number.

[2]Land Use classification are estimated based on best available data and were based upon Sheridan County Assessor parcels ownership data, aerial photos, and local knowledge. Residential land uses include residential lots and rural ranchette land parcels less than 40 acres in size. These areas may also be used for some small scale irrigated or nonirrigated hay production and/or livestock production. Irrigated Hayland may also be used for late season aftermath grazing and/or winter livestock feed grounds. Dry Hayland may also be used as improved pasture land or may include aftermath grazing. Rangeland includes native rangeland and nonirrigated improved pasture and is used primarily for livestock grazing, though may also include small areas used for dryland hay production.

[3]Density Areas and Subdivision information taken from EnTech, 2001.

3.2 Water Quality Summary

Complete results and summary statistics for each monitoring station are available in the Prairie Dog Creek Watershed Assessment Report (SCCD, 2009). Overall, water quality data from the Prairie Dog Creek Watershed Assessment, indicated that water quality in the Prairie Dog Creek watershed is good. The primary regulatory concern is *E. coli* bacteria concentrations in excess of Wyoming Water Quality Standards for primary contact recreation. Although there are no numeric standards for sediment/turbidity, Prairie Dog Creek contains high levels of sediment, which may contribute to bacteria concerns. Water temperatures were recorded in excess of 20^{o} C in portions of the watershed. Dissolved manganese concentrations also exceeded the aesthetic drinking water standard, though levels were not so high as to be of concern for human health or aquatic life. The high concentration of manganese is presumed to be naturally occurring, resulting from the geology of the Prairie Dog Creek watershed (WDEQ, 2002). Because of the many factors affecting water temperature (weather, water quantity, channel geometry, and turbidity), the Prairie Dog Creek Watershed Plan will not attempt to address this parameter directly. However, activities to address bacteria and sediment concerns would also be expected to benefit water temperature.

E. coli samples were taken over seven 30 day periods in 2007 and 2008. Geometric means were calculated for each 5 sample-30 day period. SCCD developed load duration curves for bacteria loads for the Prairie Dog Creek Watershed Plan (Appendix B). All sampled sites had at least one 30 day geometric mean that exceeded the Wyoming Water Quality Standard of 126 colony forming units (cfu) per 100 mL, except the PD11 Piney Creek/Prairie Dog Ditch Diversion site in Story, Wyoming (Appendix C). This site included water from the Piney Creek watershed before it is diverted into the Prairie Dog Creek watershed. Overall, *E. coli* geometric means were highest during July and August when air temperatures were highest. With the exception of PD7 and PD9, samples collected in April 2008 had the lowest *E. coli* geometric means. This may have been related to lower water temperatures or being collected prior to run-off periods.

While there was much variability in the *E. coli* geometric means both between sample sites and between 30-day geometric mean sample periods, the highest geometric means on the Prairie Dog Creek mainstem, generally occurred in the lower areas of the watershed. On four occasions the highest geometric means were from sample sites in the middle reaches of Prairie Dog Creek. The uppermost Prairie Dog Creek site had the greatest number of 30 day geometric means in compliance with the Water Quality Standard of any mainstem site. Four of seven geometric means were below 126 cfu/100 mL.

Geometric means at the sampled tributary sites were also variable. The PD3 Dutch Creek site returned the lowest geometric means of any tributary sample site, with four of seven 30 day geometric means meeting the Wyoming Water Quality Standard. The PD11 Piney Creek/Prairie Dog Ditch Diversion site had the best 30 day geometric means of any sampled site, with no geometric mean from either year of the Watershed Assessment exceeding the Water Quality Standard.

Combined water quality data from all the individual sample sites within a subwatershed also helped to define the areas of greatest concern within the Prairie Dog Creek

Watershed. The greatest number of exceedances of the Wyoming Water Quality Standard for *E. coli* occurred in the Middle Prairie Dog Creek Subwatershed with 80.0% of samples exceeding the Standard. This pattern is similar to those observed in the Goose Creek and Tongue River Watershed Assessments previously conducted by SCCD. The Upper Prairie Dog Creek Subwatershed had 76.1% of samples exceeding the Water Quality Standard, followed by the Lower Prairie Dog Creek Subwatershed with 72.1%. The Dutch Creek Subwatershed had the lowest number of exceedances of the Wyoming Water Quality Standard with 43.3% of samples exceeding the Standard, though to some degree this is the result of a single sample site on the entire Dutch Creek Subwatershed and the lack of significant flow or runoff from this area.

4. POLLUTANT LOADS AND SOURCE IDENTIFICATION

4.1 Estimated Load Reductions

The load duration curve method (Appendix B) was used in this plan both because of the preference for its use in developing EPA Watershed Plans, but also for its ability to quantify water quality parameters at varied flow regimes. This method is described in further detail in Appendix B. SCCD used information and examples from "An Approach for Using Load Duration Curves in the Development of TMDLs" (USEPA 2007), the "DRAFT Handbook for Developing Watershed TMDLs" (USEPA, 2008), the "Handbook for Developing Watershed Plans to Restore and Protect Our Waters" (USEPA, 2008a), and other approved TMDLs and watershed plans. The primary limitation for using this method on the Prairie Dog Creek Watershed is the limited amount of *E. coli* concentration data available. USEPA (2008) recognizes that some TMDLs have been developed with a limited amount of data and recommends developing TMDLs with the "best available data" (USEPA, 2008). The load estimates and reduction estimates in the Prairie Dog Creek Watershed Plan were developed with the information available and will be revised in the future as additional data is collected.

A key benefit of the load duration curve is the visual representation it provides of the relationship between stream flow and *E. coli* load capacity. By plotting actual measured data against the water quality standard at a given flow rate, it is also possible to see in what flow conditions most of the high *E. coli* values occur. The Prairie Dog Creek Plan divides flow conditions into three categories; moist condition flows (10-40% of flows exceeded), midrange flows (40-60% of flows exceeded) and dry condition flows (60-90% of flows exceeded). The high flow (flood) and low flow (drought) conditions (<10% and >90% of flows exceeded) are excluded from load reduction estimates (USEPA, 2007). These are considered the extreme conditions where load reduction efforts would be least effective.

The critical flow condition for a sample site is the flow condition requiring the greatest *E. coli* load reduction. The critical flow conditions correspond to types of run-off and/or precipitation scenarios and provide information about the pollutant sources (Table 4.1).

TABLE 4.1. Potential Load Sources Under Given Critical Flow Condition

Contributing Source Area	Duration Curve Zone		
	Moist Condition Flows	Mid-Range Flows	Dry Condition Flows
Point Source			M
On-site Wastewater (Septic) Systems		H	H
Riparian Areas	H	H	H
Upland Stormwater Runoff	H	M	
Bank Erosion	M		

Note: H: High Priority; M: Medium Priority
Adapted from "An Approach for Using Load Duration Curves in the Development of TMDLs" (USEPA, 2007).

There are two years of monitoring data from the Prairie Dog Creek Watershed Assessment and a few other samples, part of which are single sample instances that are not useful in comparing to 5-sample/30 day period geometric means. The available *E. coli* data allows for some characterization and estimates of the degree of impairment relative to the Water Quality Standard, though the long term perspective is mostly incomplete. However, the PDWG recognized that the method has some value and will make adjustments as additional information becomes available. For this reason, it will be necessary to gather additional *E. coli* concentration data, and adjust loading and reduction estimates to reflect the long term understanding of the Prairie Dog Creek watershed. The incorporation of new *E. coli* data will enable the PDWG to refocus load reduction efforts in order to better address the observed patterns within the watershed.

A load duration curve was developed for each samples station on the Prairie Dog Creek watershed. The curves provide a visual representation of the individual data points in relation to water quality standards. The curves were used to determine the critical flow condition for each station, to designate priority reaches, and demonstrate how daily loads vary across flow regimes.

Estimates of *E. coli* load reductions necessary to meet the Wyoming Water Quality Standard for primary contact recreation of 126 cfu/100 mL plus a 10% margin of safety (MOS) were completed for each sample site as well as for each subwatershed based on 2007 and 2008 sampled *E. coli* data (Table 4.2). For the purpose of this plan, the instantaneous load was converted to a daily load and compared to the daily load at the water quality standards (USEPA, 2007), using the following calculation:

$$\textit{GIGA E. Coli}\ \text{cfu/day} = \frac{(\textit{E. Coli}\ \text{cfu/100 ml} * \text{discharge ft}^3\text{/s} * 24{,}465{,}525\ \text{ml*s / ft}^3\text{*day})}{1{,}000{,}000{,}000}$$

SCCD used GIGA cfu/day for simplicity. For example, 126GIGA is the same as 126,000,000,000. The daily load was determined by multiplying the cfu/100 ml by the discharge (ft^3/s) and a conversion factor (USEPA, 2007). The unit conversion factor (24,465,525) corresponds to the ml per day. The primary contact standard for the 5 day geometric means (126) was used rather than the single sample maximums identified in Chapter 1, Wyoming Water Quality Standards (WDEQ, 2007). The single sample maximums are to be used in advisory postings but not for the purpose of "listing a water body on the State 303(d) list or development of a TMDL or watershed plan (WDEQ, 2007)". To include the 10% MOS, the value of 113 was used within the calculations. The values presented are averages of all of the instantaneous samples collected at each site for the flow conditions at the time of sample collection.

Table 4.2 Summary of load reduction estimates and Critical Flow Conditions necessary to meet primary contact recreation standards

Subwatershed	*E. coli* load sampled	*E. coli* daily load capacity	Reduction required
	(GIGA cfu/day)	(GIGA cfu/day)	(%)
Lower Subwatershed Average (n=2)			
Moist conditions	***546***	***119***	***78%***
Mid range conditions	203	65	68%
Dry conditions	96	45	53%
Dutch Subwatershed Average (n=1)			
Moist conditions	14	8	43%
Mid range conditions	4	2	50%
Dry conditions	***4***	***1***	***75%***
Middle Subwatershed Average (n=5)			
Moist conditions	***533***	***97***	***82%***
Mid range conditions	276	66	76%
Dry conditions	120	38	69%
Upper Subwatershed Average (n=5)			
Moist conditions	391	100	74%
Mid range conditions	***249***	***59***	***76%***
Dry conditions	111	32	71%

4.2 Impaired Segments and Priority Reaches

Prairie Dog Creek was included on the list of impaired waterbodies in 2004 for *E. coli* bacteria (WDEQ, 2004). This listing described the impaired reaches as "Prairie Dog Creek above lower reach" and listed 50.3 stream miles as impaired, essentially implicating the entire watershed as impaired for *E. coli* bacteria.

Sampled *E. coli* and flow data were used to develop load duration curves to identify Critical Flow Conditions for each sample site (USEPA, 2007). This identification assisted in assessing potential source categories and in determining mitigation efforts that may have the greatest effect in effectively reducing *E. coli* bacteria load in watershed streams.

Priority reaches for *E. coli* bacteria load reduction were established to represent the areas of the watershed that would benefit the most from mitigation efforts. To determine priority reaches, SCCD considered a variety of factors, including sample data, necessary load reductions, critical flow conditions, and land use patterns. *E. coli* bacteria concentrations were generally highest in the middle portions of the watershed, required the highest reduction percentage, and had a high population density, relative to the lower reaches. Lower reaches of Prairie Dog Creek as well as reaches in the upper portion of the watershed also exceeded the water quality standard on multiple occasions and also had large reduction requirements (Appendix A).

4.3 Potential Pollutant Sources

By definition, nonpoint source pollution problems are difficult to associate with any single source or point of origin. Nonpoint source pollution, including bacteria, enters waterbodies through surface water run-off, such as rainfall or snowmelt. As such, it is difficult, if not impossible, to quantify specific pollution sources with any confidence. It is possible, perhaps beneficial, to make qualitative assumptions on the probable sources for a given area based on an understanding of the watershed features and land uses. Results derived from a set of calculations or other quantitative approach need to be viewed and, if necessary, adjusted, to reflect the qualitative assessment of the watershed residents. Evaluating potential sources can provide some information on the relative contributions to ensure that funds and resources are being directed efficiently.

The PDWG identified septic systems, domestic animals and livestock from large and small acreages, and wildlife as the more direct bacteria contributors in the watershed. Additionally, the PDWG identified indirect sources, including irrigation wastewater/run-off, instream sediment through unstable eroding streambanks and irrigation diversions, and stormwater run-off. To estimate the relative priority for each pollutant source, SCCD used information from the Wyoming State Engineer's Office, the Wyoming Agriculture Statistics, the Wyoming Game and Fish Department, the USDA Natural Resources Conservation Service, and knowledge of the watershed from landowners, residents, and others. The figures presented are estimates based on the best available data; there have been no studies to determine the actual contributions from these sources to bacteria loads in the Prairie Dog Creek watershed.

Septic Systems. Septic systems have the potential to contribute *E. coli* bacteria and other pollutants to the stream courses in the watershed. Potential contributing septic systems are those that discharge directly into Prairie Dog Creek or tributaries, those that are improperly installed due to insufficient size or treatment capacity (leachfield too small, system overloads treatment media), inadequate or antiquated design (systems lacking leachfields, septic system smaller that needed for present demand), poorly or improperly installed (leachfield not on grade, leachfield above tank elevation, system installed in flood prone area), or systems installed that have interface with seasonal groundwater or subterranean flows.

To estimate potential load contributions from septic systems, SCCD determined the number and location of domestic wells and assumed that each domestic well serviced a residence that was also connected to a septic system. Septic systems within a 500 foot distance from the priority stream reaches were considered potential contributors (Table 4-3). The 500 foot distance was based on the WDEQ requirement for a system to be considered eligible for funding assistance. Systems outside of this distance are considered to be less of a contributor "due to infiltration, UV radiation exposure, and residence time in an inhospitable environment (WDEQ, 2008a). The potential contribution was calculated by multiplying the number of systems within the 500' buffer with 6.6GIGA cfu/day.

Table 4-3. Potential E. coli contribution from septic systems in the Prairie Dog Creek Watershed

Subwatershed	Area (Acres)	Total Systems (#)	System Density (#/acre)	Systems within 500' (%)	Systems within 500' (#)	Potential Contribution (GIGA cfu/day[1)]
Lower	32,000	45	0.0014	13%	6	40
Dutch	119,000	90	0.0008	7%	6	40
Middle	40,000	141	0.0035	24%	34	224
Upper	39,000	225	0.0058	35%	79	521

[1]The potential contribution from septic systems is based on 2.5 persons per house at 265 liters/day (Horsley and Witten, 1996 *in* Indiana Department of Environmental Management, 2004), and 1,000,000 col/100 ml (Powelson and Mills, 2001 *in* Indiana Department of Environmental Management, 2004).

In the Prairie Dog Creek Watershed, the density of septic systems increases in the upper reaches of the watershed and along waterways. This is consistent with the increase of small rural subdivisions and the numbers of parcels less than 40 acres, which is greater in the Upper and Middle subwatersheds.

Domestic animals and livestock. Animal wastes from domestic animals and livestock can contribute *E. coli* bacteria through direct discharges (water gaps, etc) or through run-off from corrals or feed grounds. Areas adjacent to stream courses as well as upland areas are potential source areas. Extended livestock occupation on areas adjacent to streams, especially those without vegetative buffer areas, stock water gaps, corrals and concentrating areas with inadequate runoff mitigation, winter feed areas, and upland livestock occupation in areas with significant runoff can all potentially be sources or contributors of *E. coli* to the watershed's streams.

E. coli contributions from livestock in the Prairie Dog Creek watershed are difficult, if not impossible, to quantify; accurate information on the number of any type of livestock, specific to the watershed is not available. In addition, many of the cattle spend a portion of the summer recreation season away from the watershed on permitted allotments in the Bighorn National Forest or in other watersheds. Residents within the watershed also have horses, sheep, llamas, goats, hogs/pigs, chickens, and others. The number of animals per resident varies. For the purposes of this plan, SCCD used the 2009 Wyoming Agriculture Statistics and the 2007 US Census of Agriculture to estimate a per acre density for beef cattle (0.06/acre), sheep (0.01/acre), and horses (0.003/acre). There were no documented numbers for the other types of animals. These estimated numbers were used to calculate the potential loads from those sources using documented loading rates for those animals (Table 4-4). Because the loading rates were for fecal coliform instead of *E. coli*, SCCD used 63% of the referenced rate (126 cfu/day *E. coli* is 63% of 200 cfu/day of fecal coliform). *E. coli* is a subset of fecal coliform and site-specific correlation among the two parameters can be made; an *E. coli* value of 126 cfu/day and a fecal coliform value of 200 cfu/day are expected to result in approximately 8 illnesses/1000 swimmers at freshwater beaches (USEPA, 1986).

SCCD used the areas for different sized parcels in each subwatershed, defined as follows:

- Large Acreages are parcels of land greater than 100 acres;
- Small Acreages are parcels of land between 40 and 100 acres;
- Rural Ranchettes are parcels between 5 and 40 acres; and
- Residential lots are parcels smaller than 5 acres.

Table 4-4. Potential *E. coli* contribution from domestic animals, excluding pets, in the Prairie Dog Creek Watershed.

		Beef Cattle (0.06/acre[1])		Sheep (0.01/acre[1])		Horses (0.003/acre[1])	
Sub-watershed	**Acres**	**Estimated Number**	**Potential Contribution 69.3 GIGA cfu/day[2]**	**Estimated Number**	**Potential Contribution 7 GIGA cfu/day[3]**	**Estimated Number**	**Potential Contribution 0.3 GIGA cfu/day[4]**
Large Acreage Parcels (>100 acres)							
Lower	29,120	1747	121,081	291	2038	87	26
Dutch	115,430	6926	479,958	1154	8080	346	104
Middle	34,000	2040	141,372	340	2380	102	31
Upper	31,200	1872	129,730	312	2184	94	28
Small Acreage Parcels (40-100 acres)							
Lower	1920	115	7983	19	134	6	2
Dutch	2580	155	10,728	26	181	8	2
Middle	3200	192	13,306	32	224	10	3
Upper	4290	257	17,838	43	300	13	4
Ranchette Acreage Parcels (5-40 acres)							
Lower	438	26	1821	4	31	1	0
Dutch	595	36	2474	6	42	2	1
Middle	1708	102	7102	17	120	5	2
Upper	2087	125	8678	21	146	6	2

[1] Animals per acre estimated from information in the 2009 Wyoming Agricultural Statistics (USDA NASS, 2009) for 2007 and 2008 for cattle and calves, sheep, and the 2007 Census of Agriculture (USDA NASS, 2007) for horses and ponies.

[2] The potential *E. coli* contribution from beef cattle is based on 63% of 110 fecal coliform GIGA cfu/day per cow (ASAE 1998 in USEPA, 2001).

[3] The potential *E. coli* contribution from sheep is based on 63% of 12 fecal coliform GIGA cfu/day per sheep (ASAE 1998 in USEPA, 2001).

[4] The potential *E. coli* contribution from horses is based on 63% of 0.42 fecal coliform GIGA cfu/day per horse (ASAE 1998 in USEPA, 2001).

The number of acres was estimated by applying the percentage of different sized parcels within a subwatershed area to the total acres in the subwatershed. Parcels with less than 5 acres were considered to be rural residential; it was assumed that these acreages do not contain livestock, though that may not always be true. Although treated the same, it should be recognized that large acreage parcels may have less of an impact than the small acreage or rural ranchettes. Smaller parcels do not provide sufficient space to manage livestock use without diligent oversight and often are characterized by more bare ground than larger parcels. Additionally, compared to larger landowners, a higher percentage of small acreage landowners are less knowledgeable and/or less dependent upon basic natural resource processes. The lifestyle benefits connected with small acreage livestock often outweigh the resource degradation that occurs, especially when not dependent upon the resource to provide household income.

Because of the variability and unreliability of the numbers, SCCD chose to convert the numbers of individual animals to animal units (Table 4-5). The animal units from cattle, sheep, and horses are used to represent all of the domestic animals, excluding pets, in the watershed. The animal units presented are based on the combined individual numbers for cattle, horses, and sheep where a cow/calf pair is equivalent to 1.0 AU, a horse is equivalent to 1.25 AU, and a sheep is equivalent to 0.2 AU (NRCS, 1997). This way of reporting and tracking, will allow the SCCD and PDWG to include improvements to address any domestic livestock including llamas, hogs/pigs, goats, etc.

Table 4-5. Conversion from number of Cattle, Sheep, and Horses to animal units.

Sub-watershed	Beef Cattle		Sheep		Horses		Total Animal Units
	Estimated Number	Animal Units (@ 1.0)	Estimated Number	Animal Units (@ 0.2)	Estimated Number	Animal Units (@ 1.25)	
Large Acreage Parcels (>100 acres)							
Lower	1747	1747	291	58	87	109	1914
Dutch	6926	6926	1154	231	346	433	7590
Middle	2040	2040	340	68	102	128	2236
Upper	1872	1872	312	62	94	118	2052
Small Acreage Parcels (40-100 acres)							
Lower	115	115	19	4	6	8	127
Dutch	155	155	26	5	8	10	170
Middle	192	192	32	6	10	13	211
Upper	257	257	43	9	13	16	282
Ranchette Acreage Parcels (5-40 acres)							
Lower	26	26	4	1	1	1	28
Dutch	36	36	6	1	2	3	40
Middle	102	102	17	3	5	6	111
Upper	125	125	21	4	6	8	137

Note: It is recognized that the relative number of horses on small acreage and ranchette parcels is greater than the number estimated using the density estimates and relative land area.

Wildlife. The Prairie Dog Creek watershed is home to a variety of large and small mammals and birds, including waterfowl (Table 4-6). As warm-blooded animals, wildlife can also be potential contributors of *E. coli* bacteria. Riparian areas frequently offer the greatest amount of habitat and food for wildlife and thus, much of a watershed's wildlife habitation occurs in close proximity to streams. SCCD attempted to estimate contributions from wildlife, but encountered several difficulties. Some wildlife numbers exist through Wyoming Game and Fish Big Game Job Completion Reports and Migratory Bird Job Completion Reports. As with the information for livestock, the numbers presented are not confined to the watershed boundary. Information is presented on a statewide or hunt area/herd unit basis. Species included in these reports include elk, pronghorn antelope, mule deer, whitetail deer, sage grouse, ducks, and geese. The most likely big-game animals that may contribute to bacteria loads in the Prairie Dog Creek Watershed are Pronghorn Antelope, Mule Deer, and White tailed Deer (personal communication from Tim Thomas, Wyoming Game and Fish). Although there are no herd units/hunt areas identified for elk within the watershed, there are scattered pockets of resident elk (personal communication from Tim Thomas, Wyoming Game and Fish). There did not appear to be any Sage-grouse leks within the watershed as identified by the

Northeast Wyoming Sage Grouse Local Working Group. In addition, the watershed is home to a variety of small mammals and other wildlife for which there are no population estimates.

Table 4-6. Wildlife species present in the Prairie Dog Creek Watershed

Big Game/Large Mammal	Birds	Small Mammal
Pronghorn Antelope	Puddle Ducks	Skunk
Mule Deer	Geese	Raccoon
White-tailed Deer	Pheasant	Beaver
Elk-scattered pockets	Sharp-tailed grouse	Muskrat
Moose-few, non-resident	Sage-grouse	Rabbit
Bear-visitor, non-resident	Partridge	Prairie Dog
Mountain Lion-visitor, non-resident	Cormorant	Badger
	Grebe	Coyote
	Coot	Fox
	Shorebirds	Bobcat
	Heron	Mink
	Migrant & Resident Songbirds	Other small rodents/mammals
	Hawks	
	Owls	
	Eagles	

While wildlife species are potential contributors to bacteria concerns in the Prairie Dog Creek Watershed, there is little that can be done to directly affect their populations or behavior. However, any projects that improve vegetation cover /filtration, encourage off-site watering, and reduce run-off will also reduce wildlife impacts.

Sediment. Though not completely understood, there is some indication that sediment can affect bacteria levels in stream channels. Sediment can trap heat, which can improve reproductive conditions for bacteria in the water column. There is some evidence that bacteria can survive longer in the bottom sediments of the channel. Rangeland studies in Idaho have shown that *E. coli* concentrations can be 2 to 760 times greater in bottom sediment than in the water column (Stephenson and Rychert, 1982). SCCD observed up to 3-fold increases in fecal coliform bacteria when disturbing the bed sediment on the Goose Creek watershed in Sheridan County (SCCD, 2003). Although Prairie Dog Creek is not currently listed for sediment or turbidity, the SCCD and PDWG considers sediment to be a contributing factor to bacteria levels in Prairie Dog Creek.

A Wyoming Water Development Commission Level 1 study, sponsored by the SCCD on behalf of three ditch companies was initiated in 1999 (Entech, 2001). This study was based on concerns with sediment, erosion, stability, and declining real estate values due to land damage. Additional flow resulting from the three trans-basin diversions through Tunnel Hill is suspected to be responsible for habitat and stream channel degradation and sediment concerns (EnTech, 2001). This study resulted in the formation of the Meade Creek Irrigation District and the replacement of one of the three erosive diversions through Tunnel Hill.

Streambank erosion is expected to be the most immediate source of in-stream sediment. This can result from unstable streambanks due to natural changes in channel alignment,

removal of riparian vegetation, excessive livestock occupation, manipulation of stream channels by humans, and stream readjustments due to increased flows where streams are used as irrigation conveyances. Resuspension of in-channel sediment is also a source of sediment, and can be a result of natural or human induced events. Heavy storm or snowmelt runoff, augmentation of streamflow beyond its natural capacity, disturbance of channel bed material, construction of temporary irrigation diversions, and natural changes in channel shape or alignment can all result in resuspension of in-channel sediment.

The Prairie Dog Creek watershed contains roads, railroads, construction areas and homesites, and limited amounts of dry cropland, which may become sediment sources during certain high run-off periods. EnTech (2001) identifies 17 diversions on Jenks Creek and Prairie Dog Creek (known collectively as the Prairie Dog Canal) that may contribute to sediment concerns. In the Level 1 study, Entech (2001) identified several problem areas that contribute sediment to the system, including:

- Erosion on Jenks Creek;
- Erosion at the Piney Cruse Ditch Diversion on Tunnel Hill;
- Erosion at the Meade Creek Ditch Diversion on Tunnel Hill (replaced in 2008);
- Erosion within the Piney Cruse and Meade Creek Ditch delivery systems at the drops and in locations of "increased velocity or at bends in the channels"; and
- Channel instability in Prairie Dog Creek, including irrigation diversion structures and loss of bank vegetation.

Irrigation. Irrigation waste water and irrigation induced runoff can also be a contributor of sediment to streams. This can be the result of inefficient irrigation systems, poorly managed irrigation systems (excessive application, improper timing, or inadequate experience), lands that are difficult to adequately water with present irrigation systems, or the failure of irrigation conveyances or watering equipment. These irrigation systems can also transport bacteria and other pollutants through overland run-off in areas where animal waste is present. The Prairie Dog Creek Watershed has approximately 15,250 acres of irrigated lands. Historically, up to 180 cfs has been added to the Prairie Dog Creek system through trans-basin irrigation diversions. Most of these have been conveyed to their points of use through natural streams and draws. The additional water that is used for irrigation also returns to the stream as irrigation wastewater.

Small Acreages. Contributions from septic systems, domestic animals, and irrigation return flows can come from large acreages as well as smaller parcels. As with many areas of Sheridan County, the Prairie Dog Creek watershed continues to grow. Some of these "small acreage" landowners also have full-time jobs and have limited experience related to agriculture or managing the land. This is made even more difficult through the smaller land-units; there is not enough space to properly manage grazing or provide enough forage for even a small number of animals. This results in more bare ground that contributes to run-off concerns. While small acreages are not being considered a separate category with separate programs, the PDWG recognizes that some special efforts will be needed to educate small acreage landowners about issues and improvement opportunities.

4.4 Prioritization of Pollutant Sources

Ultimately, the purpose of quantifying and allocating potential pollutant sources in a TMDL or watershed plan is to ensure that financial and personnel resources are being applied in the most effective manner. While this process is more difficult with a variable, non-point source pollutant such as *E. coli*, there is some value to prioritizing the potential sources using all of the available information and common sense. For example, in watersheds where the most obvious source may be related to septic systems, it does not make sense to direct all of the available resources to developing grazing management plans. On the other hand, if there is an obvious, contribution from livestock or a septic system, it should be addressed, regardless of the source allocation.

To estimate the potential contribution for each source in the Prairie Dog Creek watershed, SCCD used a variety of quantitative and qualitative information to characterize and prioritize the potential sources in each subwatershed, including:

- the potential load calculations for septic systems and domestic animals (cattle, horse, and sheep);
- the number and size of parcels within each subwatershed;
- critical flow conditions, priority reaches, and measured bacteria loads; and
- other information including land cover, soil types, grazing patterns, precipitation.

Within each subwatershed, each source category was assigned a high, medium, or low priority based on its potential contribution to the overall pollutant load (Table 4-7) similar to the method used in TMDLs for Total Dissolved Solids in Utah (UDEQ, 2007). In addition, a numeric priority ranking was assigned to the top six priorities within the entire watershed. It is important to recognize that all individual projects will be evaluated on their potential to benefit water quality. Thus, a better project in a "medium or low priority" area or category may be done prior to a marginal or poor project in a "high priority" area or category.

Table 4-7. Summary Table of Pollutant Sources and Priority Ranking

Subwatershed	Critical Condition	Pollutant Sources	Priority
Lower	Moist	Large Acre Domestic Animals	High-5
		Septic Systems	Medium
		Irrigation/Stormwater Run-off	Medium
		Sediment-Streambanks	Low
		Sediment-Diversions	Low
Dutch	Dry	Septic Systems	Low
		Domestic Animals	Low
Middle	Moist	Small Acre Domestic Animals	High-1
		Septic Systems	High-2
		Large Acre Domestic Animals	Medium-6
		Irrigation/Stormwater Run-off	Medium
		Sediment-Streambanks	Medium
		Sediment-Diversions	Medium
Upper	Mid-range	Small Acre Domestic Animals	High-3
		Septic Systems	High-4
		Large Acre Domestic Animals	Medium-6
		Sediment Streambanks	Medium
		Sediment-Diversions	Medium
		Irrigation/Stormwater Run-off	Medium

Because the potential sources of bacteria and sediment in the Prairie Dog Creek watershed are solely from natural background and nonpoint sources, implementation of the watershed plan and Best Management Practices (BMPs) is strictly voluntary. While there is some assistance available, there will also be instances where improvements will be made by individuals on their own. SCCD, NRCS, and the PDWG will continue to provide information on potential BMPs to address pollution sources (Table 4-8).

Table 4-9. Potential Best Management Practices (BMPs) to address pollutant sources.

Potential Contributor	Issue	Potential BMPs
Septic Systems	No Tank/Leachfield; discharge to stream	Permit and install system
	System located too close to stream	Replace system
	System located within groundwater table	Replace system
	System not functioning	Maintain /replace system
	System not maintained	Provide Information/Education Maintain system
Domestic Animals and Livestock	Corrals/Feedgrounds located on stream	Relocate or buffer facilities Provide off-channel water
	Run-off from corrals and/or feedgrounds discharges to stream	Divert run-off to filtration area Retain run-off (ponds) Maintain well-vegetated buffer
	Poor grazing distribution	Develop Grazing Plans Develop Management Guidelines Provide stockwater/fencing Provide Information/Education
Irrigation Diversions	Temporary; requires in-channel construction	Replace w/ permanent
	Erosion/cutting at diversion	Replace diversion Bank stabilization w/ vegetation Direct flow w/ structures
Bank/Channel Erosion	Unstable channel dimensions	Structural enhancements Bank shaping/revegetation
Run-off	Irrigation wastewater run-off	Irrigation system upgrades Irrigation Water Mgt Plans Provide Information/Education
	Rural Residential/Stormwater run-off	Maintain well-vegetated buffers Divert run-off to filtration areas Information/Education

5. WATERSHED IMPROVEMENT ACTIONS AND RECOMMENDATIONS

5.1 NPS Measures/Action items

This section describes several factors that have been organized into broad categories that may be directly or indirectly responsible for affecting the overall health of the Prairie Dog Creek watershed. For each of the concerns identified, the PDWG developed objectives and action items. The action items include providing incentives for on-the-ground improvements, information and education activities, and other activities. Each action item includes information on the subwatershed priority, the entity responsible for the completion of the activity, and the approximate amounts and sources of funding needed. The subwatershed priority is to be used as a way to direct information/education activities and as a tool for prioritization of projects when resources (funding and technical) are limited. It is not intended to be used as a way to discourage improvement projects in other subwatersheds. Any project will be considered based on its potential to benefit water quality.

It is difficult to quantify strong positive correlations between individual improvement projects, practices, or educational activities and water quality improvements in the short term. Because the bacteria impairments on the watershed are the result of a combination of sources, including humans, domestic animals, and wildlife, it is impossible to address the impairments by focusing on a single source. For tangible improvements in water quality, it is necessary to address as many potential contributors as possible. This is best accomplished through an incentive-based, voluntary program that encourages widespread cooperation and participation from landowners and residents. The education that comes from individual projects may do more, in the long term, than short term monitoring can demonstrate.

To fully achieve the primary contact recreation standard, bacteria levels would need to be reduced by over 70%. The PDWG did not feel this was reasonably achievable, in the short term. The secondary contact standard was selected as a starting point because there is a limited amount of public land along the waterbodies and recreational activities are infrequent. The secondary contact recreation standard would require a reduction of 0-9% across the watershed. The PDWG developed this watershed plan to reduce bacteria loads by 10% in the next five years, with full attainment achieved in 35 years.

Figure 5-1. Prairie Dog Creek Watershed Plan Implementation Timeline

Year	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Targeted percent reduction	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**
Interim monitoring/evaluation	2011 2014	2017 2020	2023	2026 2029	2032 2035	2038	2041 2044	2047 2050
Begin Watershed Plan Update	2014	2019	2024	2029	2034	2039	2044	2049

The PDWG also recognized the limitations in the reduction estimates as presented. To fully understand the dynamics of the watershed, especially for bacteria, many more years of data, encompassing many different flow and climate conditions, are needed. The PDWG will continue to adjust load and load reduction estimates as additional data are collected. At some point in the future, it may also be necessary to consider the standards and whether they are appropriate for the watershed. This would require careful coordination with WDEQ, USEPA, and other entities on the watershed.

Table 5-1. Estimated contribution reductions needed to meet 10% E. coli load reduction

	Lower	Dutch	Middle	Upper
Critical Condition	Moist	Dry	Moist	Mid
Reduction required to meet standards at critical condition	75%	75%	82%	76%
Phase I targeted reduction	10%	10%	10%	10%
Direct contributions				
Septic systems to be addressed (10%)	1	1	3	8
Large Acre animal units to be addressed (10%)	191	759	224	205
Small Acre animal units to be addressed (10%)	13	17	21	28
Rural Ranchette animal units to be addressed (10%)	3	4	11	14
Indirect contributions				
In-Stream Irrigation Diversions	TBD	TBD	TBD	TBD
Bank erosion and channel instability	TBD	TBD	TBD	TBD
Riparian corridors	TBD	TBD	TBD	TBD
Inefficient irrigation systems	TBD	TBD	TBD	TBD

Note: The percent reduction for Domestic Animals is based on animal units rather than individual animals to account for the variability in the types of animals present in the watershed. The animal units presented are based on the combined individual numbers for cattle, horse, and sheep where a cow/calf pair is equivalent to 1.0 AU, a horse is equivalent to 1.25 AU, and a sheep is equivalent to 0.2 AU.

5.1.1 Watershed Plan Implementation

The PDWG and SCCD intend to implement the action items contained within this plan. However, SCCD and the USDA NRCS have been impacted by reductions in staffing and limited personnel resources. Full implementation of this watershed plan will require coordination with and assistance from other resources, such as County government and University of Wyoming Cooperative Extension, and the private sector. Establishing and maintaining partnerships with these outside entities will be needed to provide technical assistance and/or engineering services for projects and conservation planning.

As implementation proceeds, some action items may not be necessary or may not be able to be completed as planned, or there may be others items that have not yet been considered. In addition, as more information becomes available, SCCD may need to adjust load information and reduction estimates. Therefore, the plan needs to be dynamic and ever-changing to meet the needs of current and future watershed issues.

Objective: Maintain a viable watershed improvement program for the Prairie Dog Creek watershed.

Action 1. Maintain an on-going, active, steering committee to provide leadership and project oversight and to coordinate with other cooperating entities.

Subwatershed priority: All
Responsible party: PDWG, SCCD, NRCS
Funding needed: $5000
Potential funding sources: Section 319 of Clean Water Act

Action 2. Conduct interim and follow-up monitoring, including project follow-up, photo documentation, and water quality monitoring to evaluate long-term trends in water quality and determine whether changes to load estimates and reductions are needed.

Subwatershed priority: All
Responsible party: SCCD with assistance from NRCS
Funding needed: $30,000
Potential funding sources: Section 319 of Clean Water Act

Action 3. Review and update (if necessary) the Prairie Dog Creek Watershed Plan annually.

Subwatershed priority: All
Responsible party: PDWG, SCCD, NRCS
Funding needed: $1000
Potential funding sources: Section 319 of Clean Water Act

Action 4. Identify ways to improve delivery for cost-share programs offered through the SCCD to encourage participation and ensure funds continue to be directed appropriately.

Subwatershed priority: All
Responsible party: PDWG, SCCD, NRCS
Funding needed: $1000
Potential funding sources: Section 319 of Clean Water Act

5.1.2 Water Quality

The PDWG and SCCD recognize levels of bacteria are a concern from a regulatory and human health standpoint and are committed to reducing contributions of bacteria from various sources in the watershed using a voluntary, incentive-based program. Whether or not Wyoming Water Quality Standards are attainable, there is room for improvement. Bacteria contributions in the watershed come from non-point pollutant sources; there are no municipal point sources in the watershed. These non-point sources of bacteria include septic systems, small and large livestock operations (though no permitted operations), and wildlife. In 2007 there were two active Wyoming Pollutant Discharge Elimination System (WYPDES) storm water discharge permits within the Prairie Dog Creek watershed, in addition to one active temporary discharge permit. Other WYPDES permits for CBM Discharges, few of which discharge water directly into Prairie Dog Creek, are not considered bacteria sources, but may contribute small quantities of sediment or other constituents. Although not a concern from a regulatory standpoint,

sediment was identified as a concern on the watershed. Prairie Dog Creek, as many of the waterbodies in Sheridan County, has been subject to years of physical and hydrologic modification. During the irrigation season, as much as 180 cfs can be diverted from the Piney Creek drainage into Prairie Dog Creek. These additional flows and the resulting channel instability and bank erosion contribute sediment. Other potential sediment sources include seasonal run-off and irrigation returns. Because of the potential relationship between sediment and bacteria levels, the PDWG will also address sources of sediment, where appropriate.

Objective. Reduce bacteria contributions 10% by 2015 (five years).

Action 5. Provide financial and technical assistance to replace/repair **13** septic systems that affect water quality through direct discharge to Prairie Dog Creek or tributaries or through indirect discharge through poor soils or seasonal groundwater interaction (Note: systems must meet eligibility requirements as directed by the Wyoming Department of Environmental Quality).

Subwatershed priority: Upper and Middle
Responsible party: SCCD, Sheridan County (permitting)
Funding needed: $75,000
Potential funding sources: Section 319 of Clean Water Act, Wyoming Department of Agriculture, and landowner match

Action 6. Evaluate/Research alternative wastewater treatment technologies such as cluster systems that may be appropriate in more densely populated areas.

Subwatershed priority: Upper
Responsible party: SCCD
Funding needed: $1000
Potential funding sources: Section 319 of Clean Water Act, Wyoming Department of Agriculture, local in-kind

Action 7. Provide financial and/or technical assistance to relocate facilities (e.g. corrals, winter feed-grounds), improve run-off management, improve grazing management/grazing plans, and/or provide off-channel stock water to address **1490** animal units.

Subwatershed priority: Middle and Upper
Responsible party: SCCD with assistance from NRCS
Funding needed: $125,000
Potential funding sources: Section 319 of Clean Water Act, Wyoming Department of Agriculture, USDA-EQIP, and landowner match

Objective. Reduce sediment contributions from within the stream channels.

Action 8. Identify reaches where bank stabilization efforts may be successful in returning a more natural hydrologic function to the system.

Subwatershed priority: All
Responsible party: SCCD with assistance from NRCS
Funding needed: $1000
Potential funding sources: Section 319 of Clean Water Act, Wyoming Department of Agriculture

Action 9. Provide technical and financial assistance to stabilize and protect streambanks and/or repair/replace irrigation diversions to eliminate the need for in-channel, push-up dams/structures, and annual channel disturbance.

Subwatershed priority: Contingent upon Action 8
Responsible party: SCCD with NRCS and other technical authorities
Funding needed: Unknown, contingent upon Action 8
Potential funding sources: To be determined

Objective. Reduce sediment contributions from stormwater/seasonal run-off and/or irrigation run-off

Action 10. Provide technical and financial assistance to improve vegetative density, diversity, and health in riparian corridors to reduce run-off, improve filtering and infiltration capacity, and increase shade.

Subwatershed priority: Middle, Lower, Upper, Dutch
Responsible party: SCCD with assistance from NRCS
Funding needed: $50,000
Potential funding sources: Section 319 of Clean Water Act, USDA-EQIP, Wyoming Department of Agriculture, landowner

Action 11. Provide technical and financial assistance to improve irrigation system efficiency and reduce irrigation return flows.

Subwatershed priority: Middle, Lower, Upper, Dutch
Responsible party: SCCD with assistance from NRCS
Funding needed: $200,000
Potential funding sources: Section 319 of Clean Water Act, Wyoming Department of Agriculture, USDA-EQIP, landowner

5.1.3 Awareness and Education

For a watershed improvement effort to be successful in the long term, there must be watershed-wide support and participation. A watershed program must include not only education on potential watershed impacts, but also awareness of the watershed improvement effort itself, including opportunities for improvement. Successful improvement projects are the most effective way to encourage additional participation; however, without an understanding of the issues and opportunities, people will not be motivated to participate. Many people may not be interested in or qualify for financial

assistance programs; education activities can ensure they are aware of the potential impacts and of practical solutions they can do on their own.

As with many areas of Sheridan County and Wyoming, the Prairie Dog Creek Watershed is seeing continued growth and development and an increase in the amount of small acreage landowners. These smaller acreages are more difficult to manage, especially for those with limited experience in land management and irrigation practices. The small acreage does not have sufficient space for grazing distribution. Small acreage subdivisions can result in a high density of septic systems. There is little room to disperse and filter run-off or excess irrigation water, prior to entering the stream channel. An awareness and education campaign will be critical for reaching these landowners.

Objective. Increase awareness and encourage participation in the watershed improvement effort.

Action 12. Develop and maintain a Prairie Dog Creek Watershed Progress Register that documents completed improvement projects and other activities to demonstrate progress in the short-term and to identify where additional work is needed.

Subwatershed priority: All
Responsible party: SCCD with assistance from NRCS
Funding needed: $3000
Potential funding sources: Section 319 of Clean Water Act

Action 13. Develop and distribute an annual watershed newsletter to promote participation and provide updates on progress and publicize completed projects.

Subwatershed priority: All
Responsible party: SCCD
Funding needed: $6000
Potential funding sources: Section 319 of Clean Water Act, Wyoming Department of Agriculture

Objective. Increase awareness and understanding about water quality impacts and relationships among water quality parameters.

Action 14. Research and provide information to residents on Wyoming water quality standards (primary and secondary contact) and the relationship among water quality parameters (e.g. bacteria, sediment, flow, temperature, etc).

Subwatershed priority: All
Responsible party: SCCD with assistance from NRCS
Funding needed: $1000
Potential funding sources: Section 319 of Clean Water Act, Wyoming Department of Agriculture

Action 15. Provide information and education to small acreage landowners on water quality and land management principles.

Subwatershed priority: Upper, Middle, Lower, and Dutch
Responsible party: SCCD
Funding needed: $5000
Potential funding sources: from Section 319 of Clean Water Act, Wyoming Department of Agriculture

Action 16. Provide information and education on potential impacts from and improvement opportunities for septic systems, domestic animals, and wildlife.

Subwatershed priority: Upper, Middle, Lower, and Dutch
Responsible party: SCCD
Funding needed: $2500
Potential funding sources: Section 319 of Clean Water Act, Wyoming Department of Agriculture

Action 17. Provide information and education about the importance of maintaining natural stream channels, the potential negative effects of improper streambed manipulation, and the potential regulatory impacts of performing non-permitted stream channel construction.

Subwatershed priority: All
Responsible party: SCCD with assistance from NRCS
Funding needed: $2500
Potential funding sources: Section 319 of Clean Water Act, Wyoming Department of Agriculture

Action 18. Provide information and education on the benefits of riparian buffers/management and water-use practices, efficiency, for addressing impacts from stormwater and/or irrigation run-off.

Subwatershed priority: All
Responsible party: SCCD with assistance from NRCS
Funding needed: $2500
Potential funding sources: Section 319 of Clean Water Act, Wyoming Department of Agriculture

5.2 Technical and Financial Assistance

The estimated amount needed to implement this plan is $511,500 over the next five years. This is based on cost estimates of previous projects completed. The SCCD currently has a grant through section 319 of the Clean Water Act for $449,310 to be used on the Prairie Dog Creek, Tongue River, and Goose Creek watersheds. Additional funding will have to be secured, either through additional 319 grants, landowner match or other sources to fully implement this plan. Additional funding sources may include:

- Grants from the US EPA/WDEQ through section 319 of the Clean Water Act;
- Grants from the Wyoming Department of Agriculture;
- USDA Program Funds, including Environmental Quality Incentives Program (EQIP), Wetland Reserve Program (WRP), Agriculture Management Assistance (AMA), and Wildlife Habitat Incentives Program (WHIP);
- Grants from the Wyoming Game and Fish Department, Fish Passage Program;
- Grants from the Wyoming Wildlife and Natural Resource Trust; and
- Local assistance and appropriations from Sheridan County, City of Sheridan, Sheridan County Weed and Pest, and others.

No single funding source is perfectly suited for each project or activity. A combination of funds makes projects more feasible for landowners and encourages additional participation. Federal and State grants can fund components that are not eligible for funding through USDA program funds and vice versa. Grants administered through SCCD can be more flexible, especially in terms of projects that do not fit within sign-up dates/timelines of USDA programs. State and Local grants and appropriations, as well as contributions from landowners, provide the non-federal match necessary for the federal grant funds provided through US EPA and WDEQ.

The amount of funding available for improvement projects or watershed programs is typically not the limiting factor in Sheridan County. SCCD-NRCS has been able to secure funding for most, if not all, eligible projects. The biggest shortfall in local watershed improvement efforts is the lack of technical assistance to initiate and complete projects in a timely manner. Regulatory programs and permitting processes are necessary; however, they do not provide the technical expertise and support to complete a project. The SCCD and NRCS have tried to fill this void, but do not always have the resources to do so. There is a need for on-the-ground planning and other assistance to landowners and homeowners.

5.3 Information and Education

The most effective strategy to encourage participation is the neighbor-neighbor discussions that occur after successful completion of a project. For this to occur, however, SCCD and PDWG need to be able to generate enough interest and awareness about the programs and watershed issues. SCCD will continue to use a combination of efforts to publicize the program and encourage participation. The Prairie Dog Watershed Plan includes a variety of information and education activities that have been successful on other Sheridan County watersheds, including information on SCCD's website and watershed newsletters that provide information on water quality impacts and improvement opportunities.

6. SCHEDULE FOR COMPLETION

6.1 Implementation Schedule

The PDWG has developed this plan to achieve a 10% reduction in bacteria levels in a five year period. This 10% estimated reduction is necessary for waterbodies to meet secondary contact recreation standard for the State of Wyoming. The PDWG developed a timeline for completion of the action items needed to meet this goal (Table 6.1).

6.2 Interim Milestones

Because water quality changes may not be a useful indicator of progress in the short term, the PDWG developed interim milestones or tasks to be completed and assessed for each action item (Table 6.1). The process for evaluating progress is described in section 7.

Table 6.1 Milestone Table

Objective: Maintain a viable watershed improvement program for the Prairie Dog Creek watershed.					
Action Item/Interim Item	**2011**	**2012**	**2013**	**2014**	**2015**
Action 1. Maintain committee					
annual meetings	Feb	Feb	Feb	Feb	Feb
Action 2. Interim and follow-up monitoring					
photo documentation/project follow-up	May	May	May	May	May
interim water quality monitoring plan	Jan				Jan
sample collection	May				May
data report	Oct				Oct
Action 3. Review/update plan					
track interim milestones	Feb	Feb	Feb	Feb	Feb
update/renew plan					Dec
Action 4. Improve delivery of programs					
evaluate application process	Jan				
identify difficulties/shortfalls	Jan				
identify technical assistance options	Jan				

Objective: Reduce bacteria contributions 10% by 2015.					
Action Item/Interim Item	**2011**	**2012**	**2013**	**2014**	**2015**
Action 5. Replace/repair septic systems					
evaluate/restructure program	Jan				
replacements per year	1	3	3	3	3
Action 6. Evaluate wastewater treatment options					
list of possibilities with information	Jan				
meet with County Public Works Engineers	Mar				
Action 7. Relocate/improve livestock facilities					
animal units addressed per year	298	298	298	298	298

Table 6.1(continued). Milestone Table

Objective: Reduce sediment contributions from within the stream channels.					
Action Item/Interim Item	**2011**	**2012**	**2013**	**2014**	**2015**
Action 8. Identify areas					
evaluate previous/existing requests for assistance		Mar			
assess soils and channel characteristics		Aug			
Action 9. Stream projects					
projects -contingent on Action Item 8			Cont	Cont	Cont

Objective: Reduce sediment contributions from stormwater/seasonal run-off and/or irrigation run-off.					
Action Item/Interim Item	**2011**	**2012**	**2013**	**2014**	**2015**
Action 10. Riparian Buffers					
projects –To be determined	TBD	TBD	TBD	TBD	TBD
Action 11. Irrigation upgrades					
projects –To be determined	TBD	TBD	TBD	TBD	TBD

Objective: Increase awareness and encourage participation in the Prairie Dog Creek watershed effort.					
Action Item/Interim Item	**2011**	**2012**	**2013**	**2014**	**2015**
Action 12. Progress register					
develop GIS layer	Jan				
review for areas that need more work	Feb	Feb	Feb	Feb	Feb
update annually with new projects	Mar	Mar	Mar	Mar	Mar
Action 13. Annual Newsletter					
develop template/format	Jan				
distribute to watershed residents	July	July	July	July	July

Table 6.1 (continued) Milestone Table

Objective: Increase awareness and understanding about water quality impacts and relationships among water quality parameters.					
Action Item/Interim Item	**2011**	**2012**	**2013**	**2014**	**2015**
Action 14. Information on water quality standards					
information to committee	Feb				
standards/water quality info in newsletter	July				
Action 15. Information to small acreage owners					
explore partnership with Cooperative Extension	Jan				
survey interest in "Barnyards and Backyards"	Feb				
host small acreage management workshop		April			
consider separate mailing to small acreage owners			Feb		
consider brochure on horse management			Feb		
Action 16. Information on bacteria impacts					
explore partnership with Cooperative Extension	Jan				
initiate watershed column in Sheridan Press	Jan				
develop/distribute Streamside Stewardship Booklet		Aug			
Streamside stewardship workshop		April			
overall impacts topic in newsletter/column	July				
septic system topics in newsletter/column		July			
domestic animals/pet topics in newsletter/column			July		
horse/livestock management topic in newsletter			July		
manure management topic in newsletter			July		
wildlife feeding/concentration topic in newsletter					July
Action 17. Information on stream channels					
explore partnership with Cooperative Extension	Jan				
host streamside stewardship workshop		April			
streambank discussion in newsletter				July	
Action 18. Information on run-off management					
explore partnership with Cooperative Extension	Jan				
host streamside stewardship workshop		April			
riparian buffers topic in newsletter				July	
irrigation management topic in newsletter					July

7. MONITORING AND EVALUATION PLAN

7.1 Criteria for evaluation

While water quality changes may not be observed in the short term, the PDWG will review progress towards plan completion and meeting water quality standards in a variety of ways.

The PDWG will meet annually and review the action items and interim milestones in the watershed plan. If planned tasks or interim milestones have not been completed, the PDWG will discuss the reasons and take one of the following actions:

a) extend the action item or milestone into the next year or adjust the timing;
b) abandon the action item or milestone completely if not possible or practical; or
c) modify the action item or milestone so it can be completed.

The PDWG will track the types and number of improvement projects being requested, initiated, and/or completed, annually during the review of the watershed plan. If the desired numbers/types of projects are not being requested/completed, the PDWG will discuss the reasons and take one of the following actions:

a) if the types of projects are not being requested, the group may consider additional information and education;
b) if the types of projects are not being requested, but the group feels that enough information and education has been completed, the group may consider adjusting the numbers to something more reasonable; or
c) if the types of projects are being requested but not initiated or completed in a timely manner, the group will consider whether it is from a lack of technical or financial assistance and look for sources to fill the gaps.

The PDWG will collect additional water quality samples during and following the implementation of this plan. The PDWG expects to see a minimum 10% reduction. If this reduction is not observed, the PDWG will consider the following actions during future plan revisions:

a) increase the number of improvement projects in areas not meeting the goals, which may require additional information and education; or
b) adjust the percent reduction expected and/or load estimates.

If minor modifications are needed, the PDWG will make the changes and notify watershed residents, landowners, and WDEQ. Minor modifications include adjusting the number of projects, information and education activities, and changes to the schedule within the 5 year timeline. If changes are more extensive, such as changes to the loads and reduction estimates, potential sources, and the overall timeline, the revised plan will be subject to the 45 day public comment period and submitted to WDEQ for approval.

7.2 Monitoring Plan

The PDWG recognized that it may be several years before any changes in water quality can be observed, especially with the limited data presently available and the limitations in the reduction estimates as presented. To fully understand the dynamics of the watershed,

especially for bacteria, many more years of data, encompassing many different flow and climate conditions, are needed. The PDWG will continue to adjust load and load reduction estimates as additional data are collected. Continued monitoring will also enable the PDWG to evaluate long term trends in water quality. Currently SCCD conducts water quality monitoring on a three year rotation, with monitoring scheduled for 2011 and 2014. This interim monitoring focuses on bacteria, turbidity, macroinvertebrates, and field parameters (discharge, pH, conductivity, DO and temperature). Prior to each monitoring season, SCCD develops a detailed Sampling Analysis Plan (SAP). At WDEQ's recommendation, SCCD plans to do a two-year follow-up monitoring. This will likely occur in 2014-2015; however specific details on the timeframe, sampling frequency, parameters etc. have yet to be determined. This additional monitoring will have to be coordinated with other County watershed efforts.

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APPENDICES

APPENDIX A

MAPS

APPENDIX B

2007-2008 WATER QUALITY DATA COLLECTED BY THE SHERIDAN COUNTY CONSERVATION DISTRICT

APPENDIX C

LOAD DURATION CURVES