1.0 PROJECT SUMMARY SHEET

PROJECT TITLE NAME: Cheyenne River, Phase I TMDL Assessment

NAME AND ADDRESS OF LEAD PROJECT SPONSOR:

South Dakota School of Mines & Technology
501 East St. Joseph Street
Rapid City, SD 57701

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Pierre, SD 57501-3181
PHONE: 605.773.4254
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STATE: South Dakota

WATERSHED: Cheyenne River Watershed
HUC # 101201

PROJECT TYPES: [ ] BASE [x] WATERSHED [ ] GROUNDWATER [x] I&E

WATERBODY TYPES	NPS CATEGORY
[ ] Groundwater	[x] Agriculture
[x] Lakes/Reservoirs	[ ] Urban Runoff
[x] Rivers	[ ] Silviculture
[x] Streams	[ ] Construction
[ ] Wetlands	[ ] Resource Extraction
[ ] Other	[ ] Stowage and Land Disposal
	[ ] Hydrologic Modification
	[ ] Other

PROJECT LATITUDE 44 LONGTIUDE 103

SUMMARIZATION OF MAJOR GOALS:

The goal of the Phase I Cheyenne River Assessment Project is to locate and document sources of nonpoint source pollution (primarily excess sediment loading) in the watershed. This project will identify critical areas of the watershed which will lead to a focused sampling plan for development of a Total Maximum Daily Load (TMDL) assessment project.

PROJECT DESCRIPTION:

The Cheyenne River discharges into the Missouri River reservoir, Oahe Reservoir. The watershed is approximately 24,240 square miles and is located in western South Dakota and crosses into eastern Wyoming. The Cheyenne River basin is diverse, containing Black Hills National Forest and portions of Badlands National Park. Land use is primarily rangeland with some irrigated and dryland farming and a few mining areas. The Cheyenne River Watershed has several lakes and stream segments listed as impaired due to exceedences of standards set for various water quality parameters. A major emphasis of this project will be to identify contributing areas to impairment. This will be accomplished through analysis of historic water quality and stream flow data, along with land use, riparian vegetation, and stream physical habitat analysis. A detailed and focused sampling plan with emphasis on identified critical areas will be the focus of the final report. Feasible restoration recommendation will also be included where possible. Currently, the Belle Fourche River Watershed is in the implementation stage of the TMDL process; therefore, it will not be specifically focused on as part of this project.

PPG Carry Over funds requested	$114,000	Match	$76,000
		Total Project Cost	$190,000

2.0 STATEMENT OF NEED

2.1 The South Dakota Department of Environment and Natural Resources (SD DENR) is responsible for assessing all impaired water bodies listed in the 2004 South Dakota Integrated Report for Surface Water Quality Assessment. SD DENR has identified impairments for the following parameters in the Cheyenne River Watershed:

- Total suspended solids (TSS)
- Fecal coliform bacteria
- Total dissolved solids (TDS)
- Conductivity
- Water temperature
- pH.

In total, 19 stream segments were listed in the Cheyenne River Watershed (excluding the Belle Fourche River Watershed) for impairment in the 2004 Integrated Report. Nine of these segments were listed as in progress for TMDL assessment. All segments listed as in progress are above Angostura Reservoir or in the Rapid Creek tributary basin. Additionally, ten lakes are listed as impaired for Trophic State Index (TSI), four of which were also listed for pH. Four of the listed lakes are listed as in progress. The complete table of listed lakes and stream segments for the Cheyenne River watershed is shown in Appendix A.

Beneficial uses assigned to waters in the Cheyenne River Watershed include:

- Domestic water supply
- Cold-water permanent fish life propagation
- Cold-water marginal fish life propagation
- Warm-water permanent fish life propagation
- Warm-water semipermanent fish life propagation
- Warm-water permanent fish life propagation
- Immersion recreation
- Limited contact recreation
- Fish and wildlife propagation, recreation, and stock watering
- Irrigation.

The water quality standards applicable to each beneficial use, as listed in the 2004 Integrated Report, are presented in Appendix B.

2.2 The Cheyenne River Watershed starts in the Wyoming counties of Campbell, Weston, Natrona, Converse, and Niobrara and flows into the South Dakota counties of Fall River, Shannon, Custer, Pennington, Meade, Haakon, and Ziebach. Other counties in the Cheyenne River Watershed containing tributary rivers and streams are Carter in Montana, Crook in Wyoming, Sioux and Dawes in Nebraska, and Butte and Lawrence in South Dakota (Figure 2-1). Portions of the Pine Ridge and Cheyenne Reservations are within the Watershed as well as Black Hills National Forest, Buffalo Gap, and Thunder Basin National Grasslands, and Badlands National Park.

2.3 The Cheyenne River is approximately 24,240 square miles in size and is identified as Hydrologic Unit 101201. Major rivers include Cheyenne River, Belle Fourche River, Cherry Creek, Elk Creek, Box Elder Creek, Rapid Creek, Spring Creek, Battle Creek, French Creek, Beaver Creek, Fall River, and other small creeks which feed into the Cheyenne River. There are a number of permitted point source discharges within the Watershed, such as wastewater treatment facilities for small communities.

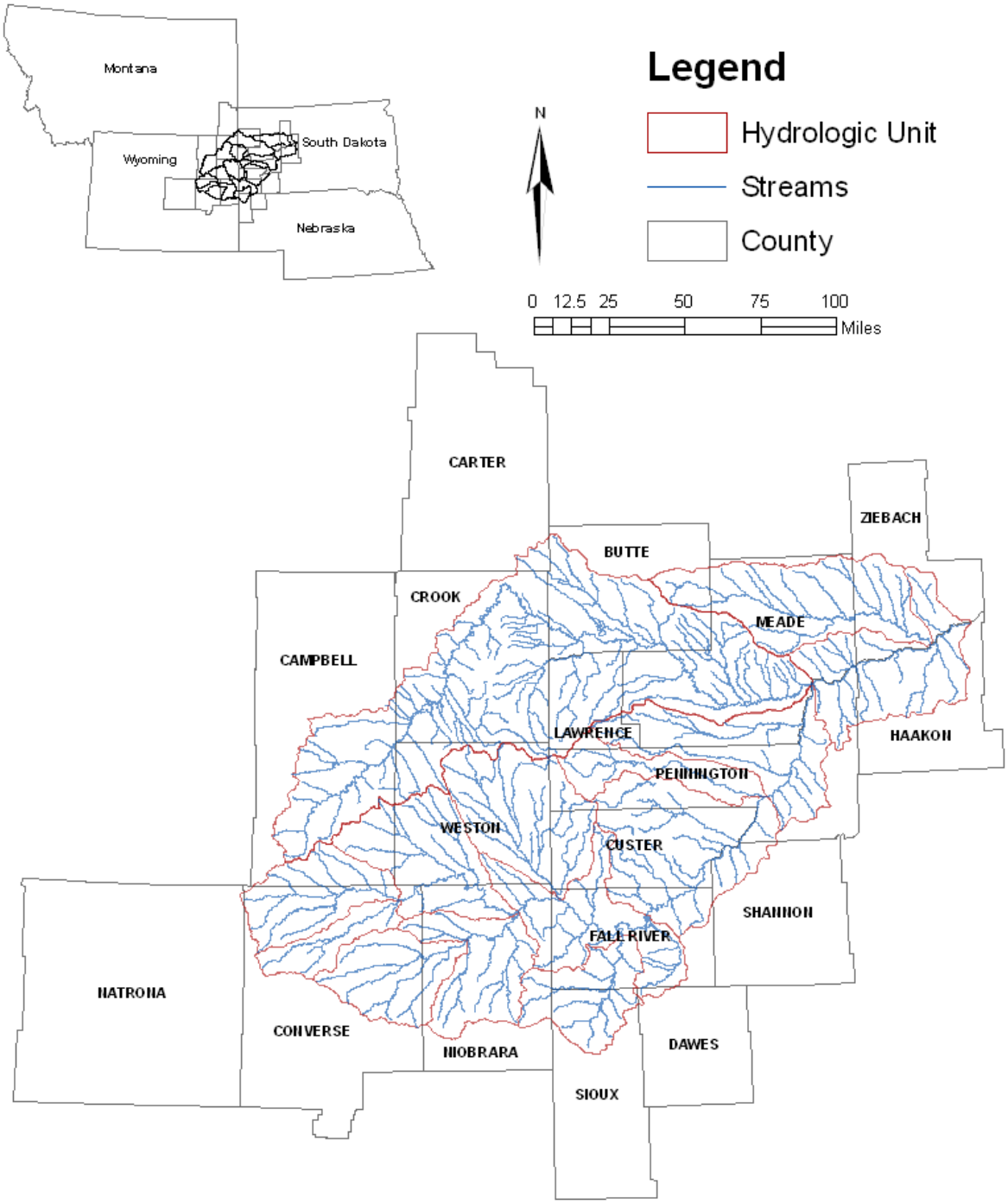

Figure 2-1. Cheyenne River Watershed.

2.4 The Cheyenne River Watershed is within the Northwestern Great Plains ecoregion and contains the Middle Rockies ecoregion. More specifically, the most significant Level IV ecoregions are Semiarid Pierre Shale Plains, Black Hills Plateau, River Breaks, Missouri Plateau, Dense Clay Prairie, Black Hills Foothills, and Sagebrush Steppe. Less significant ecoregions are Subhumid Pierre Shale Plains, Black Hills Core Highlands, Cheyenne River Badlands, and Moreau Prairie.

The Semiarid Pierre Shale Plains physiography is unglaciated, undulating plains. There are steep-sided incised streams. Elevation can range from 1,700 to 2,800 feet. The soils are Millboro, Lakoma, Opal, Promise, Sansarc, Midway, and Ottumwa. The precipitation ranges from 15 to 17 inches. Natural vegetation includes wheatgrass, grama grass, needlegrass, porcupine grass, and needleandthread. Land use and cover includes cattle grazing with some dryland farming for winter wheat, alfalfa, and sorghum.

The Black Hills Plateau physiography is unglaciated, plateau topography with broad ridges and entrenched canyons. Elevation can range from 3,500 to 5,500 feet. The soils are Citadel, Vanocker, Grizzly, Buska, Pactola, Mocmont, Paunsaugunt, and rock outcrop. The precipitation ranges from 16 to 18 inches. Natural vegetation is dominated by Ponderosa Pine forest, with aspen, paper birch, and spruce in drainages and wet areas. Understory includes little bluestem, buffaloberry, chokecherry and snowberry. Land use and cover includes cattle grazing and ranching with urban development in the eastern Black Hills.

The River Breaks physiography is unglaciated, high plains with dissected erosional landscape of conical hills. Mass wasting and slumping is widespread. Most streams are ephemeral. Flowing streams carry heavy sediment loads. Elevation can range from 1,300 to 2,700 feet. The soils are Sansarc, Opal, Bullock, Cabba, Amor, Flasher, Vebar, Temvik, Mandan, Cherry, Chama, Zahl, Lallie, and Mckeen. The precipitation ranges from 16 to 18 inches. Natural vegetation includes blue grama, western wheatgrass, buffalograss, and some bluestem. Juniper and deciduous trees are common on north-facing slopes with Cottonwood gallery forests on floodplains. Land use is mostly limited to cattle grazing because of steep side slopes with rangeland cover consisting of native grasses and remnant woodlands in draws and alluvial flats.

The Dense Clay Prairie physiography is unglaciated, rolling prairie with intermittent streams in shallow valleys. Elevation can range from 2,700 to 3,500 feet. The soils are Kyle, Pierre, Winler, Swanboy, Hisle, and Lismas. The precipitation ranges from 13 to 15 inches. Natural vegetation includes western wheatgrass with no shortgrass understory. Land use and cover includes sheep and cattle grazing with fragile grassland cover.

The Missouri Plateau physiography is unglaciated, moderately dissected level to rolling plains with isolated sandstone buttes. Elevation can range from 1,750 to 3,300 feet. The soils are Vebar, Chama, Amor, Williams, Rhoades, Belfield, Cabba, Flasher, Reeder, Regent, Parshall, Golva, and Zahl. The precipitation ranges from 15 to 17 inches. Natural vegetation includes blue grama, wheatgrass/needlegrass association, little bluestem, and prairie sandreed. Land use and cover includes cattle grazing and dryland farming for spring wheat, barley, oats, and sunflowers.

The Black Hills Foothills physiography is an unglaciated ring of foothills surrounding the Black Hills' mountainous core. Elevation can range from 3,300 to 4,900 feet. The soils are Butche, Canyon, Enning, Nevee, Spearfish, Grummit, Tilford, Vale, and Rekop. The precipitation ranges from 15 to 17 inches. Natural vegetation is dominated by Ponderosa Pine woodlands with grass understory of little bluestem, grama grasses, and leadplant. Land use and cover includes cattle grazing and ranching with urban development in the eastern Black Hills.

The Sagebrush Steppe physiography is unglaciated level to rolling plains with occasional buttes, badland formations, scoria mounds, and salt pans. Elevation can range from 3,000 to 3,475 feet. The soils are Archin, Parchin, Twilight, Zeona, Bullock, Cabbart, Boxwell, Roades, Patent, Maltese, Rhame, and Dilts. The precipitation ranges from 13 to 14 inches. Natural vegetation includes dwarf sagebrush and big sagebrush with western wheatgrass, green needlegrass, blue grama, Sandberg bluegrass, and buffalograss. Land use and cover includes cattle grazing and wildlife habitat with grasslands and shrub cover.

2.5 Water quality data have been collected by the SD DENR at 26 sites in the watershed with samples dating back to the 1960s. This includes stations on the Cheyenne River and many of its tributaries in and around the Black Hills. This offers a large data set for constructing sediment and fecal budgets for the watershed.

2.6 The following threatened-and-endangered species are identified by the South Dakota Game, Fish and Parks as located within the counties of the watershed: Finescale Dace, Longnose Sucker, Lake Chub, Mountain Sucker, Sturgeon Chub, Plains Topminnow, American Dipper, Piping Plover, Baird's Sparrow, Bald Eagle, Barn Owl, Burrowing Owl, Black Backed Woodpecker, Cassin's Finch, Clarks' Nutcracker, Common Merganser, Cooper's Hawk, Ferruginous Hawk, Golden Eagle, Great Blue Heron, Least Tern, Lewis Woodpecker, Long-Billed Curlew, Long-Eared Owl, Northern Goshawk, Northern Saw-Whet Owl, Osprey, Piping Plover, Prairie Falcon, Pygmy Nuthatch, Sharp Shinned Hawk, Silver-Haired Bat, Swainson's Hawk, Three-Toes Woodpecker, Whooping Crane, Black-Footed Ferret, Dwarf Shrew, Fringe-Tailed Myotis, Kit Fox, Least Shrew, Long Eared Myotis, Lynx, Northern Flying Squirrel, Northern Myotis, Northern River Otter, Plains Spotted Skunk, Townsend's Big-Eared Bat, Gray Tree Frog, Lesser Earless Lizard, Sagebrush Lizard, Short-Horned Lizard, Smooth Green Snake, Spiny Softshell Turtle, and Western Box Turtle. The implementation of this project will not impact any of these species.

3.0 PROJECT DESCRIPTION

3.1 GOALS

The goals of the Cheyenne River Watershed Phase I TMDL assessment are to locate and document major areas of impairment using existing data and to determine the need and scope of additional sampling and analysis. The project process is a phased approach. In Phase I, analysis of existing data will be completed along with physical habitat and geomorphologic analysis at 50 sites. This information will be used to support initial guidance for Best Management Practices (BMP) implementation. The Phase I report will present recommendations for additional monitoring and modeling assessment to further refine the identification of nonpoint source pollution in the Watershed and produce feasible restoration recommendations. Phase II will implement the Phase I assessment recommendations such as monitoring and modeling.

Specifically, Phase I will evaluate existing data for fecal coliform and TSS from the United States Geological Survey's (USGS) and the SD DENR's sampling and flow measurements. This project will result in summaries of historical data, water quality statistics, and physical habitat statistics. Products will include a hydrologic budget, as well as water quality budgets for parameters listed for impairments within the Watershed, and will recommend a focused sampling plan and BMPs for implementation where possible. This proposal covers Phase I.

To accomplish the Phase I goals for the Cheyenne River Watershed TMDL, the effort has been divided into five major objectives. These objectives are:

1. Compile and Analyze Historical Flow Data
2. Compile and Analyze Historical Water Quality Data
3. Identify High Potential Sediment Load Contributors Outside the Riparian Zone
4. Collect and Analyze Stream Assessments at 50 Selected Sites.
5. Information and Education Focused on Data Dissemination and the Creation of a Watershed Technical Working Group.

Figure 3-1 presents a conceptual process flow diagram of the approach to the project. Each objective and subtask are discussed in more detail in the following paragraphs.

3.2 OBJECTIVES AND TASKS

OBJECTIVE 1: Compile and Analyze Historical Flow Data

Flow records for this Watershed date back to 1903. Many USGS gage stations started collecting flow information before 1950 with a few newer stations initiated in the 1980s and 1990s. The objective is to compile this data and develop statistical comparisons between stations for the years available.

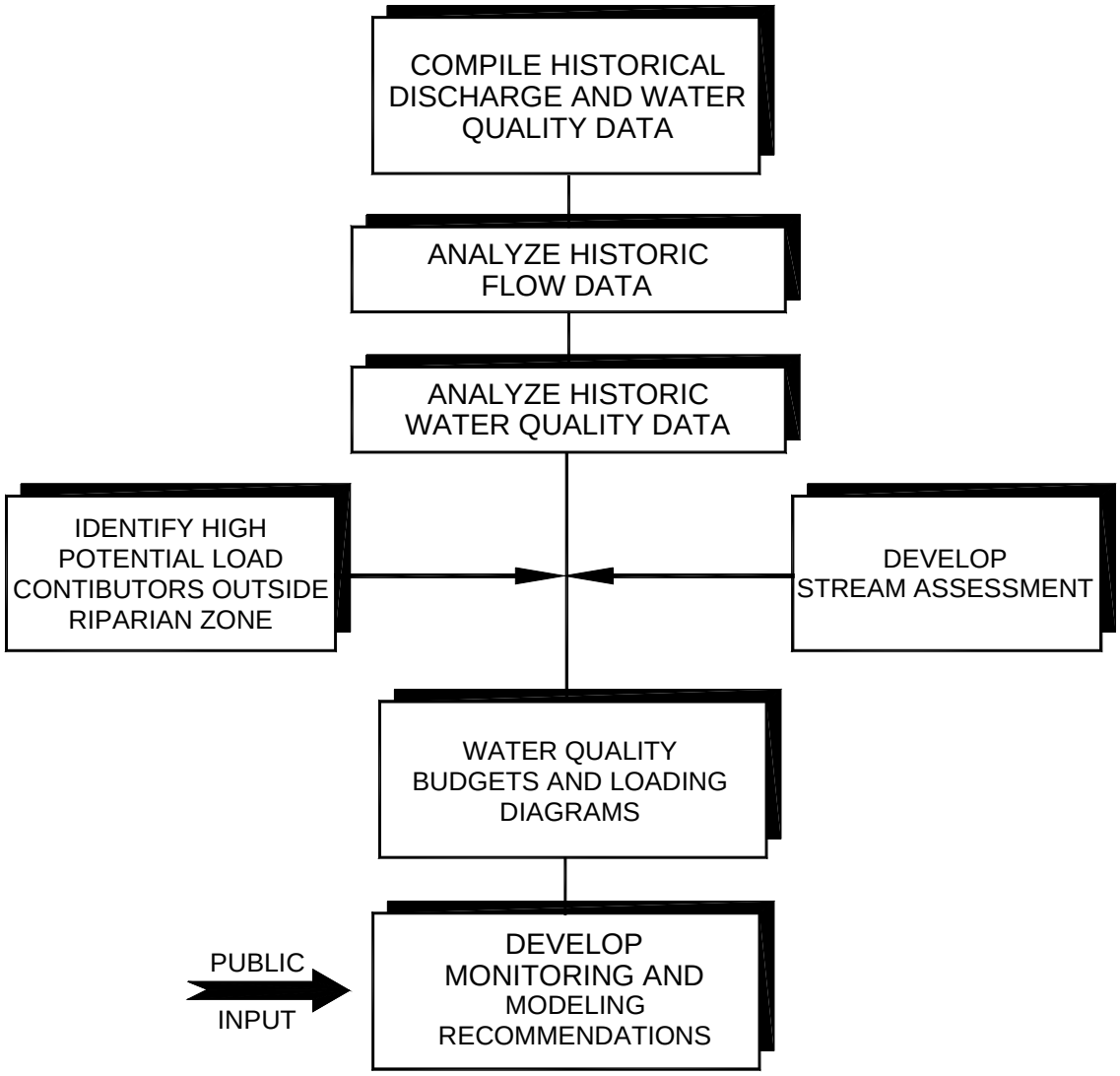

Figure 3-1. Schematic Diagram of the Cheyenne River Phase I Total Maximum Daily Load Assessment Project.

Task 1 **Retrieve and Develop Hydrologic Budget for the Cheyenne River Watershed**

There are numerous long-term and temporary USGS discharge gage stations within the watershed. There are currently 28 active discharge gages with approximately 53 additional sites that have been active for some period of time in the past. The data from these stations will be compiled and evaluated using various statistical methods to determine seasonality and to develop the hydrologic budget for the watershed. Seasonality will be determined by evaluating the monthly flow data and by examining statistical differences using nonparametric techniques, such as Kruskall-Wallis. Regression analysis techniques will be used to look for relationships between USGS flow measurement stations. Data will be normalized to parameters, such as drainage area, to aid in determining the type and source of flow at each station. The hydrologic budget will present the major contributors and, if appropriate, compare their contribution based on seasonality of the flow regime. The focus of this task will be on the contributing drainage area below Angostura Reservoir, with the exception of the Belle Fourche River and Rapid Creek Watersheds. The final report will summarize the contributions of the area above Angostura Reservoir and the Belle Fourche River and Rapid Creek Watersheds based on the previous work completed in these areas.

Flow records at the long-term stations and temporary stations will be analyzed using regression techniques to confirm the flow relationships between stations. This relationship will be critical to understand the water quality data when flows were not measured (majority of the historic SD DENR data does not have associated flows). Using this information, flow will be estimated for the dates and temporary stations when water quality data were collected.

Products: Hydrologic budget with estimated flow for water quality samples taken without flow data.

Cost for Objective 1: $25,640 EPA PPG Carry Over Funds: $15,384

OBJECTIVE 2: Compile and Analyze Historical Water Quality Data

Water samples were collected and analyzed by many organizations in the past. USGS and SD DENR have collected the most samples. USGS and SD DENR have been collecting water quality samples from streams and lakes during different time periods for over 30 years at several locations throughout the Watershed. This incredible data source provides a great foundation to compare other "grab sample type" water quality results within the watershed and to look for relationships that further our understanding of the nonpoint source pollution and potential remediation measures. The focus of this task will be on the contributing drainage area below Angostura Reservoir, with the exception of drainage areas where the TMDL process has already occurred and remediation is already occurring. This includes Belle Fourche River Watershed and most of Rapid Creek Watershed. The final report will summarize the contributions of the area above Angostura Reservoir and Belle Fourche River and Rapid Creek Watersheds based on the previous work completed.

Task 2 **Retrieve Water Quality Data and Develop Statistical Comparisons**

Water quality data will be compiled from the Internet and by contacting the appropriate people at the responsible agencies. There is a great historical record that can be used to develop statistical comparisons of precipitation and flow with water quality monitoring stations similar to the analysis described in Task 1. The cost for this task assumes that the data are available in electronic format and can be easily imported into Excel and MiniTab.

Statistical comparisons will be developed for each water quality parameter listed for impairment in the Integrated Report, versus seasonality and flow. Flow, concentration, and load diagrams will be developed for the period of record at stations with large data sets. Annual trends will be investigated as well as trends over time. Statistical analysis will occur for each parameter beginning at its furthest downstream point of listing and covering the upstream contributing drainage area. For example, TSS and fecal coliform will be analyzed from the mouth of the Cheyenne River and cover the entire watershed, while conductivity will be analyzed from the mouth of Cherry Creek and the upstream drainage area for Cherry Creek, since conductivity is only listed for this area. Nutrient analysis will be

performed upstream of lakes listed in the Integrated Report as impaired, where data are available, and where stream assessments show evidence of impairment due to nutrient loading.

To develop the relationship between flow and concentration, **FLUX**, a computer program developed by United States Army Corps of Engineers (USACE), will be used. **FLUX** is designed for use in estimating the loadings of suspended solids or other water quality components passing a tributary sampling station over a given period of time. A relationship of flow and concentration is developed using the available samples. This relationship is used to develop an extrapolated concentration using the long-term daily flow records for the USGS stations. Finally, a loading estimate is developed by multiplying the daily flow and concentration for the USGS stations resulting in a tons/month estimates. Seasonality and precipitation relationships will be evaluated using a regression analysis. The data analysis at these sites will be a cornerstone for the comparison analysis using the data from other tributary sites. It is expected that there will be seasonality in flow data as well as a good relationship between flow, TSS, fecal coliform, and other water quality parameters. Thus it is expected that there will be a seasonality relationship using the water quality data. The relationship between water quality and precipitation will be evaluated to determine the contribution of surface runoff.

In addition, statistical regression analysis will be performed between various water quality parameters. For example, recent literature has documented cases where a strong relationship between TSS and fecal coliform exists. Stepwise regression analysis will be preformed using the water quality data to investigate a relationship between TSS, fecal coliform, and other water quality parameters.

Based on the analysis and literature from similar studies, qualitative conceptual water quality budget diagrams will be prepared. The diagrams will present potential sources of impairment and relative contributions for each water quality parameter of concern in the system.

Flow, concentration, and load diagrams will be developed for the period of record for the Water Quality Monitoring (WQM) and USGS gage stations where sufficient data exists. A combination of **FLUX** and regression analysis will be used to investigate these relationships.

Products: Electronic file of water quality data and concentration and load diagrams with written results and interpretation.

Cost for Objective 2: $51,860 EPA PPG Carry Over Funds: $31,116

OBJECTIVE 3: Identify High Potential Sediment Load Contributors Outside the Riparian Zone

Using existing geographic information system (GIS) coverages of soil erodibility (USDA-NRCS State Soil and Geographic Database (STATSGO)), slope, distance to the stream, and land use, a soil erosion potential map will be created using the Revised Universal Soil Loss Equation (RUSLE).

Task 3 **GIS Model of Potential Sediment Erosion Within the Watershed**

A map rating the area within the Cheyenne River Watershed for the relative potential to contribute surface soils to the stream system for TSS will be developed. A large number of sites (50) will be sampled using SD DENR Physical Habitat Characterization. This data will be compared to the erosion potential map, correlating areas of high potential erosion to stream physical habitat. This information will be used to evaluate potential riparian BMPs.

Products: Map of high potential surface erosion areas.

Cost for Objective 3: $6,000 EPA PPG Carry Over Funds: $3,600

OBJECTIVE 4: Collect and Analyze Stream Assessment Data at 50 Selected Sites

Stream physical habitat can offer insight into the state of the watershed. Correlations have been found between channel metrics and water quality, especially TSS, as well as watershed activities. Numerous

stream assessments have been performed in the Cheyenne River Watershed above Angostura Reservoir, as well as in Belle Fourche River, Spring Creek, and Rapid Creek Watersheds. This project will sample stream channel and riparian zones throughout the watershed in areas not previously sampled. The complete set of stream assessments can be used to correlate landscape parameters such as geology, soil types, and land use.

Task 4 **Stream Assessment of 50 Sites in the Watershed**

A list of 50 site locations, with sites being preferentially located where USGS gage or WQM stations are currently located or have previously been located, will be developed. Key tributaries without a representative number of gages or WQM stations, especially those currently listed for impairments in the Integrated Report, will have sites added in order to increase resolution of the site distribution. Stream assessments have previously been performed above Angostura Reservoir, in the upper portions of Spring Creek Watershed, in Rapid Creek Watershed, and in Belle Fourche River Watershed. Additional sites in these areas will be limited. Data from the previous work will augment the characterization of the stream physical habitat throughout the entire watershed.

The stream channel at each of the chosen sites will be classified using SD DENR Physical Habitat Characterization, along with additional parameters measured for stream morphology. This assessment will identify seven general physical habitat attributes important in influencing stream ecology:

- Channel Dimensions
- Channel Gradient
- Channel Substrate Size and Type
- Habitat Complexity and Cover
- Riparian Vegetation Cover and Structure
- Anthropogenic Alterations
- Channel-Riparian Interaction.

Based on the assessment data, each sampling site will be classified using Rosgen's Geomorphologic Classification system and Schuum's Channel Evolution model. Some of the parameters used for classification will be calculated using GIS applications based on 1-meter resolution color digital orthoquads (DOQ). Some examples of measurements that will be estimated from DOQs are sinuosity, valley widths, riparian extent.

Based on the metrics calculated during stream assessment, GIS coverage's will be created interpolating the measurements to a watershed scale. Coverages than can be compared to regional geology, ecoregions, soil types, elevation, and slope.

Biological sampling is often collected as part of stream assessment protocols. Biologic indicators can be used to indicate longer-term quality of a water body. Some of the advantages of biologic monitoring are the following:

- Biological communities reflect overall ecological integrity. Thus biosurvey results directly assess the status of a water body relative to the primary goal of the Clean Water Act.
- Biological communities integrate the effects of different stressors and, thus, provide a broad measure of their aggregate impact.
- The status of the biological communities is of direct interest to the public as a measure of a pollution-free environment.

Therefore, biological communities may be a better indication of the overall water quality than grab samples that measure the quality of water at the instant of sampling. Biological samples have been collected at several locations throughout the watershed by the Environmental Protection Agency (EPA), SD DENR, SD Game Fish and Parks (SD GFP), and the USGS. The available biological data will be

compiled and summarized as part of this project. No new biological sampling will occur in Phase I; however, future sampling may be part of a recommended sampling plan for Phase II.

Products: Summary of results and interpretation of stream assessment data.

Cost for Objective 4: $92,300 EPA PPG Carry Over Funds: $55,380

OBJECTIVE 5: Information and Education Focused on Data Dissemination and the Creation of a Watershed Technical Working Group

Working as a watershed, there is a need for information and educational efforts to ensure the success of the project. Dissemination of educational materials, networking data and findings, and providing technical information to the understanding of the whole watershed will be achieved by the formation of the Cheyenne River Watershed Technical Working Group. Outreach meetings at the end of project meetings will allow updates to the public and stakeholders. Development of a Web site will provide access to the data online, providing stakeholders and the group with information throughout the project duration. This will be done in an efficient and acceptable administrative manner.

Task 5 **Formation and Utilization of the Cheyenne River Watershed Technical Working Group**

All stakeholders within the Watershed will share findings of the data and work to protect the environment. We hope to create an open and honest discussion group to network information with the development of a Web site to disseminate information. This will aid the general public, concerned landowners, agricultural producers, municipalities, and participating agencies in making sound decisions. The development and maintenance of the Web site will also produce the opportunity to network and share findings.

Stakeholders within the Watershed will be contacted, have access to the Web site, and be invited to participate in outreach meetings. A compilation of the group's efforts within the Watershed will reduce duplication, network data and findings, and will work toward the common goal of the Watershed. The group will share technology and findings at public meetings with dissemination of minutes, reports, and practical applications and findings.

Products: A Watershed Technical Working Group with a Web site for display of data and results.

Cost for Objective 5: $14,200 EPA PPG Carry Over Funds: $8,520

3.3 SCHEDULE

The schedule is shown in Figure 3-2. The project schedule assumes approval by April 2005, with completion by September 2006. Critical to the project schedule is the collection of physical habitat data in the summer of 2005.

RSI-996-05-003

ID	Task Name	Start	Finish
1	**Lower Cheyene Project**	**Mon 5/2/05**	**Fri 9/29/06**
2	**Obj 1: Historic Flow Data**	Mon 5/2/05	Thu 6/23/05
3	**Obj 2: Historic Water Quality Data**	Mon 5/23/05	Tue 8/2/05
4	**Obj 3: High Potential Erosion Areas**	Mon 9/5/05	Fri 10/21/05
5	**Obj 4: Stream Assessment**	Mon 5/16/05	Fri 9/2/05
6	**Obj 4: Information and Education**	Mon 6/6/05	Fri 6/30/06
7	**Section 4: Public Meetings**	Mon 3/6/06	Fri 3/31/06
8	**Section 5.2 Final Report**	Mon 9/5/05	Fri 9/29/06

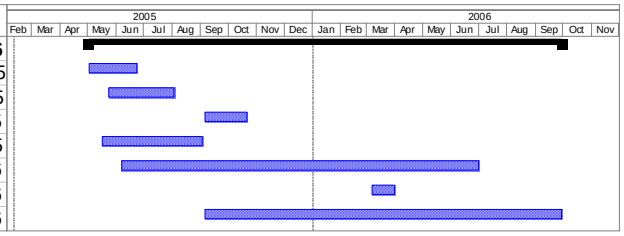

Figure 3-2. Cheyenne River Watershed Phase I Total Maximum Daily Load Schedule.

4.0 COORDINATION PLAN

The South Dakota School of Mines & Technology (SDSM&T) is the sponsor for this project. At the start of the project, Watershed stakeholder agencies will be contacted in writing to describe the project and solicit their participation. In addition to soliciting the participation of interested public agencies, the principal investigators will participate in three public meetings with interested stakeholders to review the results of this study; one at the start of the project and two near the end. The following agencies will be contacted and encouraged to participate in the project by providing data and developing consensus on the methodology and resulting conclusions:

- South Dakota Department of Environment and Natural Resources
- South Dakota Game, Fish and Parks
- United States Army Corps of Engineers
- United States Geological Survey
- United States Fish and Wildlife Service
- Bureau of Reclamation
- Natural Resource Conservation Service
- United States Bureau of Indian Affairs
- Counties of and cities within the Cheyenne River Watershed
- Cheyenne River Sioux Tribe
- Oglala Sioux Tribe
- Western Dakota Water Development District
- Belle Fourche Watershed Partnership
- Resource, Conservation and Development Associations within the Watershed
- Conservation Districts within the Watershed.

5.0 EVALUATION AND MONITORING PLAN

5.1 QUALITY CONTROL AND ASSURANCE

The collection of all field data will be performed in accordance with the *Standard Operating Procedures for Field Samplers, Tributary and In-Lake Sampling Techniques*. Stream assessment data will be recorded in field using electronic field equipment, such as field laptop computers or Personal Digital Assistants (PDA). Ten percent of sites, or five sites, will have field data recorded using both electronic media and paper data sheets. Paper results will be compared to electronic results for QA/QC reporting.

5.2 FINAL REPORT

A final report will be developed with one hard copy and one electric copy supplied at the end of the project. The report will be submitted in May 2006. SD DENR and the EPA will review and approve the final report. The final report will include

- Electronic file of historic discharge measurements and other water quality data from USGS, EPA, and SD DENR.
- Summary of the hydrologic budget for the watershed.

  Flow relationships between gage stations and analytical methodology will be presented. In addition, the method and results of estimating the flow for samples collected without flow measurements will be documented.

- Summary of statistical comparison of TSS, flow, seasonality, and fecal coliforms.
- Summary of flow, concentration, and loading diagrams for water quality parameters listed for impairments.
- Summary of high potential sediment load contributors.
- Summary of stream characteristics data.
- Summary of conceptual water quality budgets.
- Summary of the physical and riparian integrity of the Cheyenne River watershed.
- Recommended Phase II scope, including additional monitoring and modeling recommendations, along with projected cost estimates.
- Recommended BMPs and projected load reductions.

6.0 BUDGET

This project is proposed as a fixed-price contract of $190,000. Tables 6-1 and 6-2 provide a breakdown of the project costs by source. RESPEC is responsible for the project budget, scope, and technical direction. SDSM&T is responsible to provide two graduate students, while Dr. Kenner (Department Chair, Civil and Environmental Engineering) is responsible for providing technical review of the project, final report, and participating in two public meetings. The total project is estimated to take approximately 2,890 hours, with the following allocation: 60 percent SDSM&T and 40 percent RESPEC.

Table 6-1. Cheyenne River Watershed Phase I Budget

Funding Sources	Year 2005
EPA PPG Carry Over Funds	$114,000
State/Local Match	$11,777
DENR Funds (Fee Fund)	$64,223
Total Budget	$190,000

Table 6-2. Cheyenne River Watershed Phase I Budget by Objective

Project Budget	Total Costs	SDSM&T Cost Share	PPG Carry Over Funds	DENR Match
Salary	$39,003	$4,707	$23,587	$10,709
Fringe	$3,713	$377	$2,309	$1,027
Travel	$10,750		$6,450	$4,300
Equipment , Supplies, and Tuition Remission	$20,373	$4,622	$10,471	$5,280
Contractual Services	$99,000		$59,400	$39,600
Facilities and Administrative Costs	$17,161	$2,071	$11,783	$3,307
Total PPG/Nonfederal Budget	**$190,000**	**$11,777**	**$114,000**	**$64,223**

SOUTH DAKOTA NONPOINT SOURCE PROGRAM
QUALITY ASSURANCE PROJECT PLAN

SUBMITTED BY:

SOUTH DAKOTA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF FINANCIAL AND TECHNICAL ASSISTANCE
WATER RESOURCES ASSISTANCE PROGRAM

Prepared by: Robert Smith
February 2001

Project Title: **Cheyenne River, Phase I TMDL Assessment**

APPROVED BY:

South Dakota Watershed Protection Program Environmental Senior Scientist, Assessment Section	Date
South Dakota Watershed Protection Program Project Officer	Date
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APPENDIX A

CHEYENNE RIVER SECTION OF THE 2004 SOUTH DAKOTA INTEGRATED REPORT FOR SURFACE WATER QUALITY ASSESSMENT

Cheyenne River Basin (Figures 14 - 17 , Table 20).

The portion of the Cheyenne River Basin that lies in southwestern South Dakota drains 16,500 square miles within the boundaries of the state. The area in this basin is very diverse. It includes part of the Black Hills and Badlands, rangeland, irrigated cropland, and some mining areas. After traversing the western half of the state from southwest to northeast, the Cheyenne River flows into Lake Oahe, a reservoir on the Missouri River.

Cheyenne River water quality continues to be generally poor. The two downstream river segments did not support their designated fishable uses due to high TSS similar to past reporting periods. Also similar to the last four assessments was impairment of the immersion recreation use because of excessive fecal coliform levels. The two segments below Augustora Reservoir were similarly impaired due to high TSS and/or fecal coliform.

No TSS violations were noted for the upper Cheyenne River (Wyoming border to Angostura Reservoir) during 1994-1995 contrasted with 38% of samples exceeding the standard during 1996-1997. Below average rainfall in the upper drainage during the 1994 water year may have been largely responsible for the decrease in TSS. TDS remained high during both periods (25% and 43% exceedance) for this upper river segment. During the current and last two assessments the upper Cheyenne River was again impaired for high TDS. During the present evaluation, this reach was also impaired for irrigation use by high sodium adsorption ratio (SAR) and the lower river segment was additionally impaired for excessive TSS. The elevated concentrations of TDS and TSS are largely of natural geologic origin from runoff leaching and eroding the extensive shale formations in the upper Cheyenne River drainage. Changes in the other measured parameters were minor between the previous and present reporting cycle.

Large silt loads carried by the Cheyenne River impact Lake Oahe during seasonal periods of high flow. Monitoring records indicate that 11.6 million tons of sediment per year flow from the Cheyenne River into lower Lake Oahe. Severe soil erosion in the Badlands and along much of the river's lower course is the source of the suspended solids problem in the lower reaches. A major transporter of eroded soil is the Sage Creek tributary of the Cheyenne River, which drains a large portion of the northern Badlands.

The lower Cheyenne drainage, in general, contains a high percentage of erodible cropland and rangeland in west-central South Dakota. This cropland may contribute additional amounts of eroded sediment during periods of heavy rainfall.

High fecal coliform counts were recorded at all river sites nearly every reporting period. Likely sources of bacteria are livestock wastes. Irrigation return flows, cropland, and rangeland also contribute to water quality problems, the latter two sources particularly in the lower half of the river course.

A past problem was the presence of excessive levels of mercury in fish and sediments in the Cheyenne River arm of Lake Oahe. Previous studies in the 1970s and 1984 revealed mercury levels in game fish that exceeded recommended FDA levels for consumption. The mercury appeared to originate from gold mining operations in the northern Black Hills region and entered

the Cheyenne via the Belle Fourche River (a tributary of the Cheyenne River). Mining operations had used mercury in their gold recovery process but mercury use was discontinued in 1970. As a result, mercury concentrations seemed to have declined in fish and sediment of the Belle Fourche River, Cheyenne River, and the Cheyenne River arm (Foster Bay) of Lake Oahe between 1970-71 and 1984-88 (Ruelle et at., 1993).

Fairly recent fish flesh samples were collected by EPA (1998). The results of that data were reviewed by the Agency for Toxic Substance and Disease Registry. The conclusions stated mercury detected from fish in the Cheyenne River Basin were not significantly higher than mercury in fish from the Moreau River, and the fish did not pose a health hazard to sport fisherman.

Rapid Creek water quality typically ranges from good to satisfactory in its upper reaches with fair to poor quality downstream of Rapid City. During the current and previous assessments, the creek upstream of Pactola Reservoir supported its assigned uses. The next site downstream and adjacent to the Rapid City limits also fully supported its designated uses.

The segments on Rapid Creek immediately above the Rapid City wastewater treatment facility down to the confluence of the Cheyenne River were nonsupporting due to excessive fecal coliform during the present and last two assessments. A major recurring problem in this area of the creek is excessive fecal coliform bacteria levels.

Fall River in its upper half is often impaired during the warmer seasons of the year due to a natural source. Warmwater springs continually feed creeks and tributaries to the river and cause violations of the coldwater fishery standards for water temperature during late spring and summer. For this reason, the stream is managed as a warmwater fishery during the summer months and as a stocked coldwater (trout) fishery during the colder months. The lower half of Fall River below Hot Springs has not been monitored for water quality since 1990 but DENR reestablished a site (WQM 57) for quarterly sampling in 1999. Water quality data gathered since 1999 indicate the lower half of Fall River is impaired by elevated water temperature.

Black Hills streams other than those mentioned above usually have good to satisfactory water quality and fulfill their fishable/swimmable designated uses. They are, however, relatively small streams vulnerable to losses of flow exacerbated by periodic droughts in the Black Hills and high evapotranspiration rates characteristic of a dense and extensive ponderosa pine and spruce forest canopy. Grazing of streamside vegetation, which increases stream bank erosion, water temperature and nutrient loading, also continues to be a problem in a number of Black Hills streams.

The entire monitored length of French Creek fully supported designated beneficial uses during the present reporting cycle and the last several assessments. Overall water quality has remained in the good to satisfactory range for more than 15 years.

Flynn Creek, a small tributary of the south fork of Lame Johnny Creek, supported its fishable beneficial use during the last three assessments. This small stream has fully supported all its designated uses during earlier reporting cycles, indicating Flynn Creek has consistently good water quality.

Lower Battle Creek was impaired during this and previous assessments due to elevated water temperature and pH. Grace Coolidge Creek, a tributary of Battle Creek, is presently nonsupporting of its coldwater fishery use due to elevated water temperature. Upper Battle Creek is also nonsupporting due to temperature and pH during this evaluation. Generally, in past reporting periods, these streams were moderately impaired by either or both high pH (>8.6) and water temperature. The nonsupport may be caused largely by natural conditions such as low stream flow.

Upper Spring Creek was listed as moderately impaired in two reporting periods of the early 1990s due to excessive fecal coliform. During the current and the last two assessments, the stream rated as fully supporting. This is a reasonably good indication that water quality is now consistently acceptable over the entire length of Spring Creek.

Castle Creek below Deerfield Reservoir supported designated uses during the present as well as the last three assessments. In the past, slightly elevated pH was frequently recorded in the lower reach.

Beaver Creek was added to the WQM monitoring schedule in January 1999 and data shows the creek is nonsupporting for excessive TDS, fecal coliform, SAR, water temperature, TSS, and conductivity.

Cherry Creek, a prairie stream south of Faith, was also recently added to the WQM monitoring network. Limited data collected so far suggest the stream is nonsupporting for conductivity.

Few consistent long-term trends in water quality were evident for the monitored smaller creeks in the Black Hills. Probably for most of these small streams, moderate water quality fluctuations can be expected to occur between monitoring periods largely as a result of natural climatic and hydrologic factors.

The Black Hills region traditionally has some of the best surface water quality in the state. This is due in a large part to a cooler climate and higher rainfall than the surrounding plains as a result of greater elevation and forest cover. Also contributing to the water quality in this region is the nature of local bedrock formations which are much less erodible than the highly erosive and leachable marine shales and badlands on the surrounding plains.

Two reservoirs in this basin, Deerfield, and Pactola Reservoir, were rated as oligotrophic/mesotrophic during previous reporting periods with the former the more productive waterbody. However, the most recent average TSI value obtained for Pactola Reservoir and Deerfield Reservoir are 35 and 45 respectively. Data collected in 1997 suggested moderate nutrient enrichment had taken Deerfield to a higher mesotrophic status from a TSI of 40 in 1996 to 47 in 1997. The significantly higher TSI for Deerfield, relative to 1996, was due in large part to a larger chlorophyll *a* concentration in 1997. More data is needed to establish a trend for the two reservoirs. About a third of the monitored lakes appeared to have undergone a moderate decline in water quality during the mid 1990s, including Angostura Reservoir.

Of the 11 of 16 monitored lakes in the Cheyenne River basin for which sufficient data was available, six registered stable conditions between assessments, four lakes showed moderate improvement, and one, Coldbrook Reservoir, recorded a moderate decline in water quality due to increased chlorophyll levels this reporting period.

Five of the 16 monitored lakes met their ecoregion target water quality criteria (TSI < 45) this assessment. Those waterbodies were Angostura, Deerfield, Pactola, Cottonwood Springs, and Coldbrook Reservoir.

Angostura, Deerfield, and Pactola Reservoirs are sizeable high quality waterbodies vulnerable to nutrient enrichment and sedimentation from natural soil erosion, recreational activities, and various silvicultural activities. Eutrophication and sedimentation of Angostura Reservoir may be hastened by the inflow of often poor quality water from the upper Cheyenne River.

There are presently four ongoing assessment projects in the Cheyenne River basin: Custer State Park Lakes Assessment (Center, Legion, and Sylvan reservoirs), Upper Cheyenne River Assessment (including Angostura Reservoir), Spring Creek Assessment (including Sheridan Lake and Lake Mitchell), and Lower Rapid Creek and Upper Rapid/Castle Creek Assessment.

Category (1) All uses met (2) Some uses met but insufficient data to determine support of other uses (3) Insufficient data (4a) Water impaired but has an approved TMDL (5) Water impaired/requires a TMDL (6a) Water not impaired but requires a new or revised point source TMDL (6b) Water not impaired and has an existing point source TMDL approval

Table 20: Cheyenne River Basin Information

WATERBODY Lakes	LOCATION	MAP ID	BASIS	USE	SUPPORT	CAUSE	SOURCE	EPA Category	On 303(d)? & Priority
Angostura Reservoir	Fall River County	L44	Lake Assessment	Fish/Wildlife Prop, Rec, Stock Waters	Full			2	No
				Immersion Recreation	Full				
				Warmwater Permanent Fish Life	Full				
				Limited Contact Recreation	Full				
				Domestic Water Supply	Unknown				
				Irrigation Waters	Full				
Bismark Lake	Custer County	L45	Lake Assessment	Limited Contact Recreation	Unknown			5	Yes – 2
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
				Coldwater Marginal Fish Life	Non	TSI; pH	Nonpoint Sources		
				Immersion Recreation	Unknown				
Canyon Lake	Pennington County	L46	Lake Assessment	Immersion Recreation	Unknown			3	No [1]
				Domestic Water Supply	Unknown				(See
				Limited Contact Recreation	Unknown				footnote at end of table)
				Coldwater Permanent Fish Life	Insuff Info				
				Fish/Wildlife Prop, Rec, Stock Waters	Insuff Info				
Center Lake	Custer County	L47	Lake Assessment	Limited Contact Recreation	Unknown			5	Yes – 1
				Immersion Recreation	Unknown				
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
				Coldwater Permanent Fish Life	Non	TSI; pH	Nonpoint Sources		
Cold Brook Reservoir	Fall River County	L48	Lake Assessment	Coldwater Permanent Fish Life	Full			2	No
				Domestic Water Supply	Unknown				
				Limited Contact Recreation	Full				
				Immersion Recreation	Full				
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
Cottonwood Springs Lake	Fall River County	L49	Lake Assessment	Immersion Recreation	Unknown			2	No
				Warmwater Permanent Fish Life	Full				
				Limited Contact Recreation	Unknown				
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
				Domestic Water Supply	Unknown				

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WATERBODY Lakes	LOCATION	MAP ID	BASIS	USE	SUPPORT	CAUSE	SOURCE	EPA Category	On 303(d)? & Priority
Curlew Lake	Pennington County	L50	Lake Assessment	Fish/Wildlife Prop, Rec, Stock Waters	Unknown			5	Yes – 2
				Warmwater Permanent Fish Life	Non	TSI	Nonpoint Sources		
				Immersion Recreation	Unknown				
				Limited Contact Recreation	Unknown				
Deerfield Lake	Pennington County	L51	Lake Assessment	Fish/Wildlife Prop, Rec, Stock Waters	Full			2	No
				Coldwater Permanent Fish Life	Full				
				Immersion Recreation	Unknown				
				Limited Contact Recreation	Unknown				
Horsethief Lake	Pennington County	L52	Lake Assessment	Coldwater Permanent Fish Life	Non	TSI; pH	Nonpoint Sources	5	Yes – 2
				Immersion Recreation	Unknown				
				Limited Contact Recreation	Unknown				
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
Lakota Lake	Custer County	L53	Lake Assessment	Limited Contact Recreation	Full			5	Yes – 2
				Coldwater Marginal Fish Life	Non	TSI; pH	Nonpoint Sources		
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
				Immersion Recreation	Full				
Legion Lake	Custer County	L54	Lake Assessment	Fish/Wildlife Prop, Rec, Stock Waters	Full			5	Yes – 1
				Limited Contact Recreation	Full				
				Immersion Recreation	Full				
				Coldwater Marginal Fish Life	Non	TSI	Nonpoint Sources		
New Wall Lake	Pennington County	L55	Lake Assessment	Warmwater Permanent Fish Life	Non	TSI	Nonpoint Sources	5	Yes – 2
				Limited Contact Recreation	Unknown				
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
				Immersion Recreation	Unknown				
Pactola Reservoir	Pennington County	L56	Lake Assessment	Coldwater Permanent Fish Life	Full			2	No
				Domestic Water Supply	Unknown				
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
				Limited Contact Recreation	Full				
				Irrigation Waters	Unknown				
				Immersion Recreation	Full				

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WATERBODY	LOCATION	MAP ID	BASIS	USE	SUPPORT	CAUSE	SOURCE	EPA Category	On 303(d)? & Priority
Lakes									
Sheridan Lake	Pennington County	L57	Lake Assessment	Coldwater Permanent Fish Life	Non	TSI	Nonpoint Sources	5	Yes – 1
				Immersion Recreation	Full				
				Limited Contact Recreation	Full				
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
Stockade Lake	Custer County	L58	Lake Assessment	Immersion Recreation	Unknown			5	Yes – 2
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
				Limited Contact Recreation	Unknown				
				Coldwater Marginal Fish Life	Non	TSI	Nonpoint Sources		
Sylvan Lake	Custer County	L59	Lake Assessment	Coldwater Permanent Fish Life	Non	TSI	Nonpoint Sources	5	Yes – 1
				Limited Contact Recreation	Full				
				Immersion Recreation	Full				
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
Streams									
Battle Creek	Near Horsethief Lake to Teepee Gulch Creek	S57	DENR 460103	Coldwater Permanent Fish Life	Non	Water Temp	Natural Sources	5	Yes – 2 [2]
				Limited Contact Recreation	Full				(See
				Irrigation Waters	Full				footnote at end of table)
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
Battle Creek	Teepee Gulch Creek to SD Hwy 79	S58	DENR 460905	Fish/Wildlife Prop, Rec, Stock Waters	Full		Natural Sources Source Unknown	5	Yes – 2
				Limited Contact Recreation	Full				
				Coldwater Permanent Fish Life	Non	pH			
				Irrigation Waters	Full	Water Temp			
Bear Gulch	Near Hayward	S59	USGS 6405800	Fish/Wildlife Prop, Rec, Stock Waters	Unknown			2	No
				Irrigation Waters	Full				
				Limited Contact Recreation	Unknown				
				Coldwater Marginal Fish Life	Insuff Info				
Beaver Creek	WY border to mouth	S60	DENR 460128	Fish/Wildlife Prop, Rec, Stock Waters	Non	TSS		5	Yes – 2
				Limited Contact Recreation	Full	Water Temp			
				Irrigation Waters	Non	TDS			
				Coldwater Marginal Fish Life	Non	Conductivity			
Box Elder Creek	Headwaters to near Bogus Jim Creek	S61	DENR 460679	Fish/Wildlife Prop, Rec, Stock Waters	Full			1	No
				Irrigation Waters	Full				

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WATERBODY Streams	LOCATION	MAP ID	BASIS	USE	SUPPORT	CAUSE	SOURCE	EPA Category	On 303(d)? & Priority
Box Elder Creek	Above Box Elder to Owanka	S62	DENR 460925	Fish/Wildlife Prop, Rec, Stock Waters	Full			1	No
				Coldwater Permanent Fish Life	Full				
				Irrigation Waters	Full				
				Limited Contact Recreation	Full				
Castle Creek	Deerfield Reservoir to Rapid Creek	S63	DENR 460646	Limited Contact Recreation	Full			1	No
				Coldwater Permanent Fish Life	Full				
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
				Irrigation Waters	Full				
Cherry Creek	Headwaters to mouth	S64	DENR 460131	Warmwater Marginal Fish Life	Insuff Info	Conductivity		5	Yes – 2
			USGS 6439000	Irrigation Waters	Non				
				Limited Contact Recreation	Insuff Info				
				Fish/Wildlife Prop, Rec, Stock Waters	Insuff Info				
Cheyenne River	WY border to Beaver Creek	S65	DENR 460156	Irrigation Waters	Non	TDS		5	Yes – 2
				Warmwater Semipermanent Fish Life	Insuff Info	Conductivity			
				Fish/Wildlife Prop, Rec, Stock Waters	Non	SAR			
				Limited Contact Recreation	Insuff Info				
Cheyenne River	Beaver Creek to Angostura Reservoir	S66	DENR 460875	Limited Contact Recreation	Full		Crop Production	5	Yes – 2
				Fish/Wildlife Prop, Rec, Stock Waters	Non	TDS	Livestock		
				Warmwater Semipermanent Fish Life	Non	Conductivity	Natural Sources		
				Irrigation Waters	Non	TSS			
Cheyenne River	Angostura Reservoir to Rapid Creek	S67	DENR 460132	Irrigation Waters	Full			5	Yes – 2
				Limited Contact Recreation	Full				
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
				Immersion Recreation	Full				
				Warmwater Semipermanent Fish Life	Non	TSS			

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WATERBODY Streams	LOCATION	MAP ID	BASIS	USE	SUPPORT	CAUSE	SOURCE	EPA Category	On 303(d)? & Priority
Cheyenne River	Rapid Creek to Belle Fourche River	S68	DENR 460865	Irrigation Waters	Full		Crop Production	5	Yes – 2
				Fish/Wildlife Prop, Rec, Stock Waters	Full		Irrigated Crop Prod.		
				Immersion Recreation	Non	Fecal Coliform	Livestock		
				Warmwater Semipermanent Fish Life	Non	TSS	Natural Sources		
				Limited Contact Recreation	Full		Rangeland Grazing		
Cheyenne River	Belle Fourche River to Bull Creek	S69	DENR 468860	Limited Contact Recreation	Full		Livestock	5	Yes – 2
				Immersion Recreation	Non	Fecal Coliform	Crop Production		
				Warmwater Permanent Fish Life	Non	TSS	Irrigated Crop Prod.		
				Irrigation Waters	Full		Natural Sources		
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
Cheyenne River	Bull Creek to mouth	S70	DENR 460133	Limited Contact Recreation	Full		Livestock	5	Yes – 2
				Fish/Wildlife Prop, Rec, Stock Waters	Full		Natural Sources		
				Irrigation Waters	Full		Irrigated Crop Prod.		
				Warmwater Permanent Fish Life	Non	TSS	Non-Irrigated Crop Prod.		
				Immersion Recreation	Non	Fecal Coliform	Rangeland Grazing		
Cold Springs Creek	Near SD Hwy 385	S71	USGS	Coldwater Permanent Fish Life	Full			2	No
			433444103295200	Irrigation Waters	Full				
			433451103284000	Fish/Wildlife Prop, Rec, Stock Waters	Full				
			433459103280800	Limited Contact Recreation	Insuff Info				
Elk Creek	Near Roubaix, Rapid	S72	USGS 6424000	Limited Contact Recreation	Insuff Info			2	No
	City, and Elm Spr.		6425100	Fish/Wildlife Prop, Rec, Stock Waters	Insuff Info				
			6425500	Irrigation Waters	Full				
				Warmwater Permanent Fish Life	Full				
Elm Creek	Near Fairpoint, Red	S73	USGS 6437650	Limited Contact Recreation	Unknown			2	No
	Owl		6438800	Fish/Wildlife Prop, Rec, Stock Waters	Insuff Info				
				Irrigation Waters	Full				
				Warmwater Marginal Fish Life	Insuff Info				
Fall River	Hot Springs to mouth	S74	DENR 460657	Coldwater Marginal Fish Life	Non	Water Temp	Natural Sources	5	Yes – 2
				Irrigation Waters	Full				
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
				Limited Contact Recreation	Full				

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Flynn Creek	Near SD Hwy 87 to mouth	S75	DENR 460111	Coldwater Marginal Fish Life	Full			1	No
				Limited Contact Recreation	Full				
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
				Irrigation Waters	Full				
French Creek	Headwaters to Custer	S76	DENR 460102	Fish/Wildlife Prop, Rec, Stock Waters	Full			1	No
				Coldwater Marginal Fish Life	Full				
				Irrigation Waters	Full				
				Limited Contact Recreation	Full				
French Creek	Custer to Stockade Lake	S77	DENR 460653	Irrigation Waters	Full			1	No
				Coldwater Marginal Fish Life	Full				
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
				Limited Contact Recreation	Full				
French Creek	Stockade Lake to SD Hwy 79	S78	DENR 460651	Fish/Wildlife Prop, Rec, Stock Waters	Full			1	No
				Limited Contact Recreation	Full				
				Irrigation Waters	Full				
				Coldwater Marginal Fish Life	Full				
Grace Coolidge Creek	Headwaters to Battle Creek	S79	DENR 460650	Limited Contact Recreation	Full			5	Yes – 1
				Coldwater Permanent Fish Life	Non	Water Temp	Source Unknown		
				Irrigation Waters	Full				
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
Grizzly Bear Gulch	Near Keystone	S80	USGS 6403850	Coldwater Permanent Fish Life	Insuff Info			2	No
				Fish/Wildlife Prop, Rec, Stock Waters	Insuff Info				
				Irrigation Waters	Full				
				Limited Contact Recreation	Unknown				
Hat Creek	Near Edgemont	S81	USGS 6400000	Irrigation Waters	Full			2	No
				Fish/Wildlife Prop, Rec, Stock Waters	Unknown				
				Warmwater Semipermanent Fish Life	Insuff Info				
				Limited Contact Recreation	Unknown				

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Horsehead Creek	At Oelrichs	S82	USGS 6400875	Limited Contact Recreation	Unknown			5	Yes – 2
				Irrigation Waters	Non	Conductivity	Source Unknown		
				Fish/Wildlife Prop, Rec, Stock Waters	Unknown				
				Warmwater Semipermanent Fish Life	Insuff Info				
Lime Creek	At Rapid City	S83	USGS 6413650	Fish/Wildlife Prop, Rec, Stock Waters	Unknown			2	No
				Limited Contact Recreation	Unknown				
				Coldwater Permanent Fish Life	Insuff Info				
				Irrigation Waters	Full				
Lindsey Draw	Near Farmingdale	S84	USGS 6421800	Fish/Wildlife Prop, Rec, Stock Waters	Unknown			5	No
				Irrigation Waters	Non	Conductivity	Source Unknown		
Pass Creek	Near Dewey	S85	USGS 6394450	Fish/Wildlife Prop, Rec, Stock Waters	Unknown			2	No
				Irrigation Waters	Full				
Rapid Creek	Headwaters to Pactola Reservoir	S86	DENR 460647	Immersion Recreation	Full			1	No
				Coldwater Permanent Fish Life	Full				
				Domestic Water Supply	Full				
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
				Irrigation Waters	Full				
				Limited Contact Recreation	Full				
Rapid Creek	Pactola Reservoir to Lower Rapid City	S87	DENR 460669	Domestic Water Supply	Full			1	No
				Coldwater Permanent Fish Life	Full				
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
				Immersion Recreation	Full				
				Limited Contact Recreation	Full				
				Irrigation Waters	Full				
Rapid Creek	Lower Rapid City to RC WWTF	S88	DENR 460110	Limited Contact Recreation	Full		Crop Production	5	Yes – 1
				Irrigation Waters	Full		Livestock		
				Immersion Recreation	Non	Fecal Coliform	Wet Weather Discharges		
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
				Warmwat er Semipermanent Fish Life	Full				

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WATERBODY Streams	LOCATION	MAP ID	BASIS	USE	SUPPORT	CAUSE	SOURCE	EPA Category	On 303(d)? & Priority
Rapid Creek	RC WWTF to above Farmingdale	S89	DENR 460692	Limited Contact Recreation	Full			5	Yes – 1
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
				Warmwater Semipermanent Fish Life	Full				
				Irrigation Waters	Full				
				Immersion Recreation	Non	Fecal Coliform	Animal Feeding Operations (NPS)		
Rapid Creek	Above Farmingdale to mouth	S90	DENR 460910	Fish/Wildlife Prop, Rec, Stock Waters	Full		Livestock	5	Yes – 1
				Limited Contact Recreation	Full				
				Immersion Recreation	Non	Fecal Coliform			
				Irrigation Waters	Full				
				Warmwater Semipermanent Fish Life	Non	TSS			
Rapid Creek, N Fork	Above mouth	S91	BH Natl Forest Data	Irrigation Waters	Unknown			5	Yes – 1
				Coldwater Permanent Fish Life	Non	Water Temp.	Source Unknown		
				Limited Contact Recreation	Unknown				
				Fish/Wildlife Prop, Rec, Stock Waters	Unknown				
Reno Gulch	Near Hill City	S92	USGS 6406760	Irrigation Waters	Full			2	No
				Coldwater Marginal Fish Life	Insuff Info				
				Limited Contact Recreation	Unknown				
				Fish/Wildlife Prop, Rec, Stock Waters	Unknown				
Rhoads Fork	Near Rochford	S93	USGS 6408700	Coldwater Permanent Fish Life	Insuff Info			2	No
				Limited Contact Recreation	Unknown				
				Fish/Wildlife Prop, Rec, Stock Waters	Unknown				
				Irrigation Waters	Full				
Spring Creek	Headwaters to Sheridan Lake	S94	DENR 460654	Limited Contact Recreation	Full			1	No
				Irrigation Waters	Full				
				Immersion Recreation	Full				
				Fish/Wildlife Prop, Rec, Stock Waters	Full				
				Coldwater Marginal Fish Life	Full				

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WATERBODY	LOCATION	MAP ID	BASIS	USE	SUPPORT	CAUSE	SOURCE	EPA Category	On 303(d)? & Priority
Streams									
Spring Creek	Sheridan Lake to SD Hwy 79	S95	DENR 460649	Fish/Wildlife Prop, Rec, Stock Waters	Full			1	No
				Coldwater Marginal Fish Life	Full				
				Immersion Recreation	Full				
				Irrigation Waters	Full				
				Limited Contact Recreation	Full				
Sunday Gulch	Below Johnson	S96	USGS 6406740	Fish/Wildlife Prop, Rec, Stock Waters	Unknown			2	No
	Canyon, near			Irrigation Waters	Full				
	Hill City			Coldwater Permanent Fish Life	Insuff Info				
				Limited Contact Recreation	Unknown				
Victoria Creek	Near Rapid City	S97	USGS 6412220	Irrigation Waters	Full			5	Yes – 2
			6412250	Fish/Wildlife Prop, Rec, Stock Waters	Unknown				
				Limited Contact Recreation	Unknown				
				Coldwater Permanent Fish Life	Non	Water Temp	Source Unknown		
Surface Water Discharge Permits						**PARAMETER**			
Battle Creek	Near Hermosa	P27	SD0022349	Approved TMDL		Ammonia		6b	No
Battle Creek	Near Keystone	P28	SD0024007	Approved TMDL		Ammonia		6b	No
Box Elder Creek	USFS-Box Elder CCC	P29	SD0020834	Approved TMDL		Ammonia		6b	No
Cheyenne River	Near Edgemont	P30	SD0023701	Approved TMDL		Ammonia		6b	No
French Creek	Near Blue Bell Lodge	P31	SD0024228	Approved TMDL		Ammonia		6b	No
Lafferty Gulch	Near Keystone	P32	SD0021610	Approved TMDL		Ammonia		6b	No
Rapid Creek	Near Rapid City	P33	SD0023574	Need to Renew TMDL		Ammonia; Diss. Oxygen		6a	Yes – 1
Willow Creek	Near Sylvan Lake	P34	SD0024279	Approved TMDL		Ammonia		6b	No

[1] One sampling year indicates full support.

[2] This segment was previously listed in the 2002 303(d) list for pH, however new water quality data indicates full support.

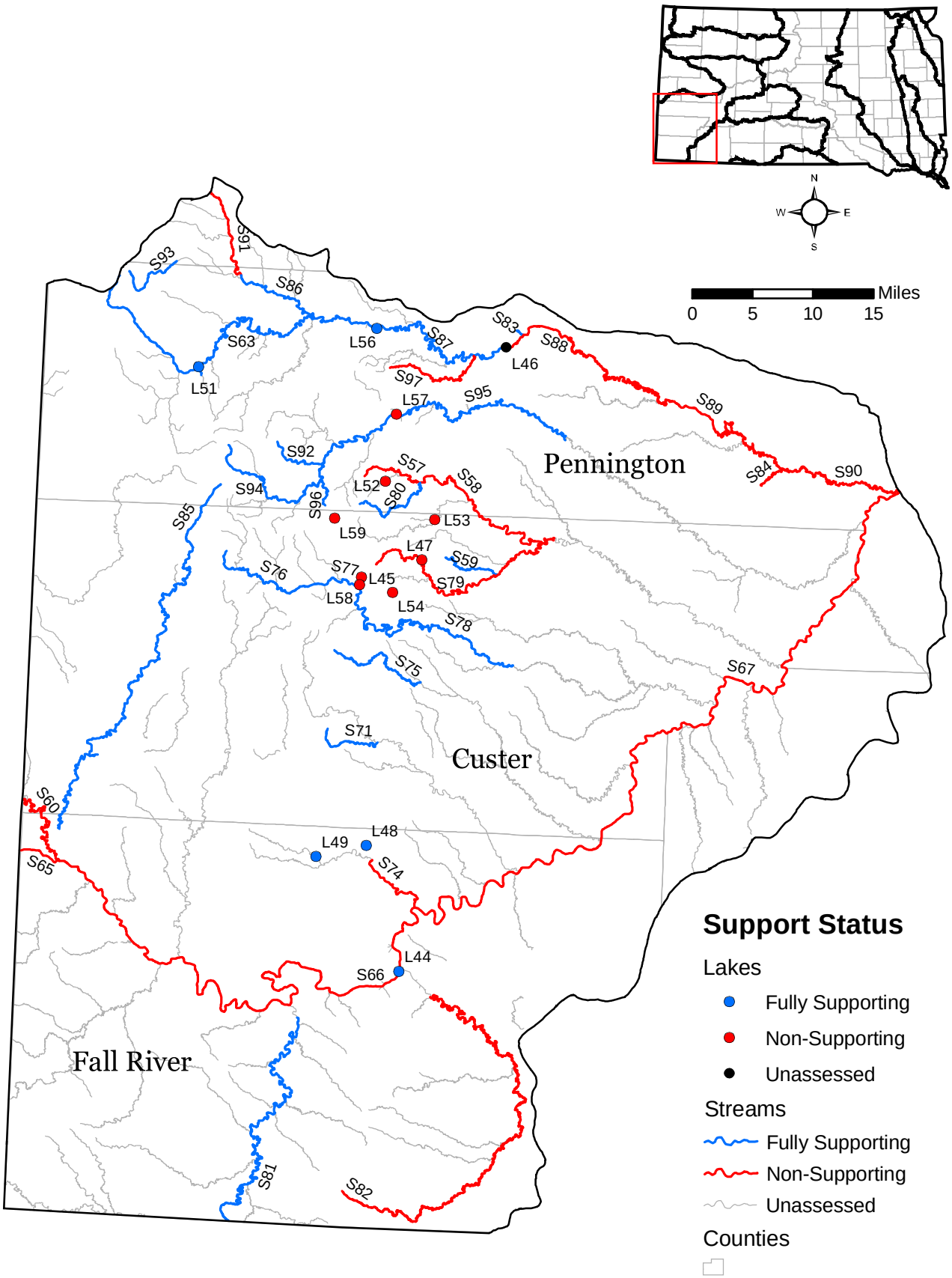

Figure 14: Upper Cheyenne River Basin Waterbody Support Status

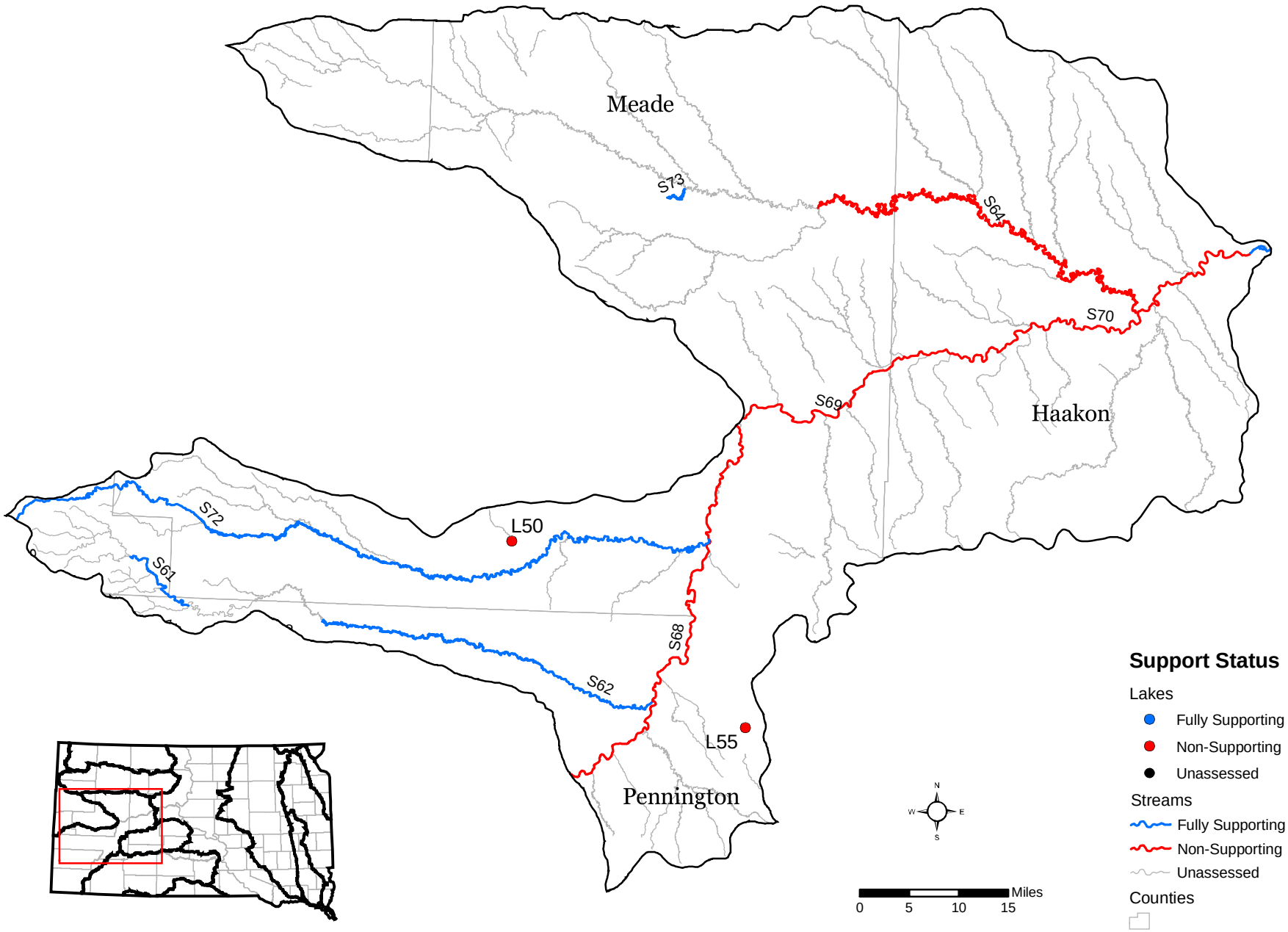

Figure 15: Lower Cheyenne River Basin Waterbody Support Status

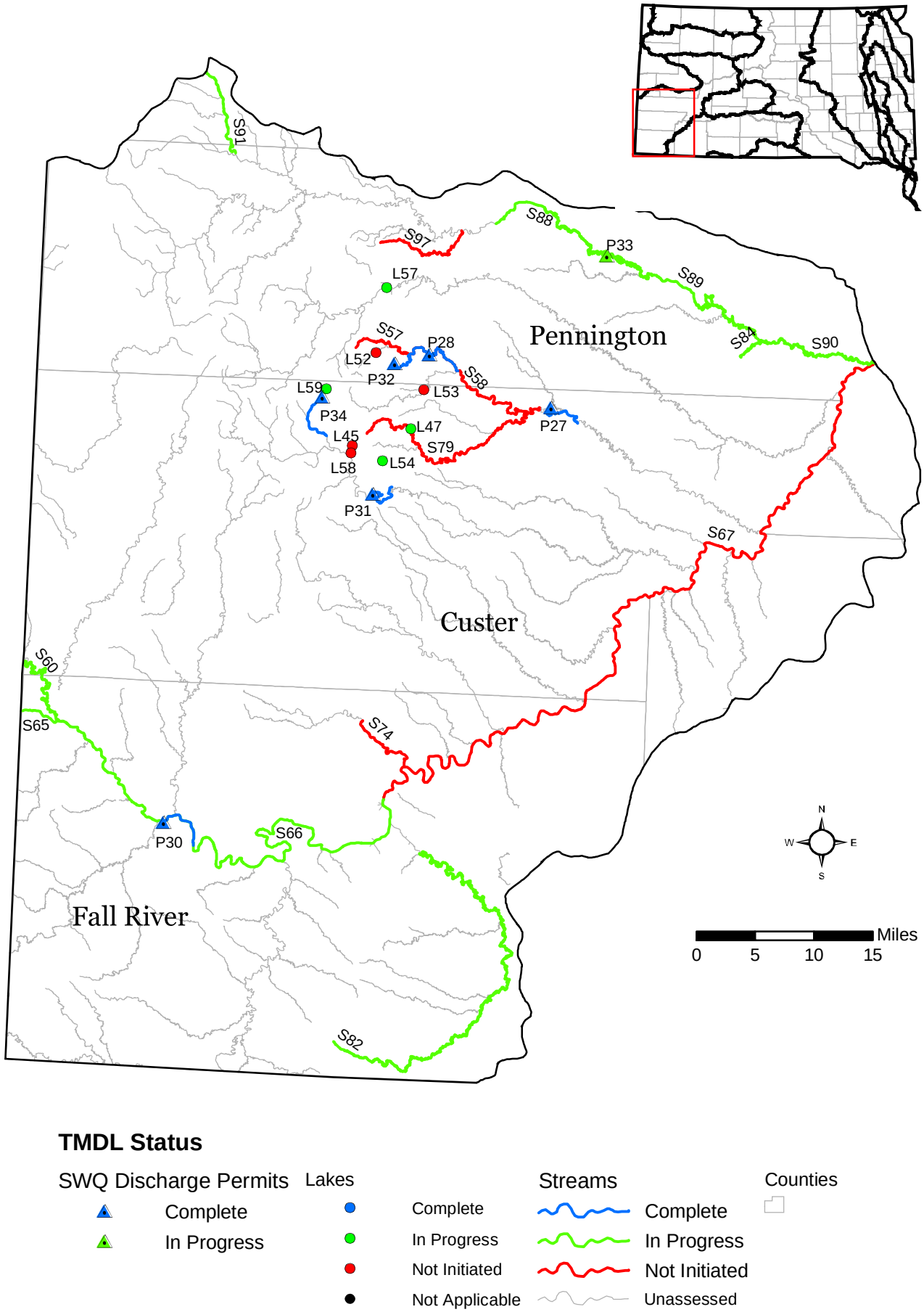

Figure 16: Upper Cheyenne River Basin TMDL Waters

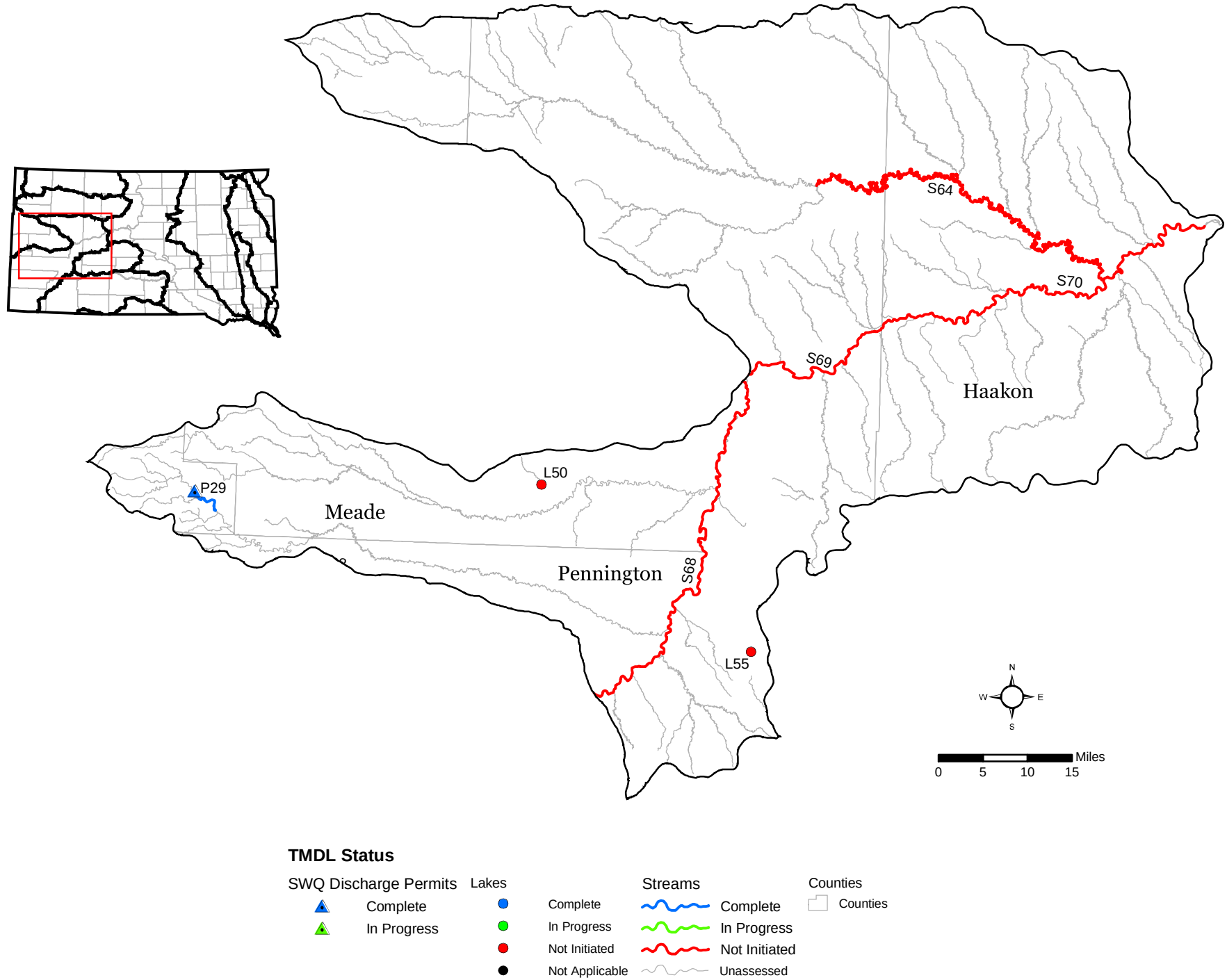

Figure 17: Lower Cheyenne River Basin TMDL Waters

APPENDIX B

WATER QUALITY CRITERIA BY BENEFICIAL USE FROM THE 2004 SOUTH DAKOTA INTEGRATED REPORT FOR SURFACE WATER QUALITY ASSESSMENT

Parameters (mg/L) except where noted	(1) Domestic water supply	(2) Coldwater permanent fish life propagation	(3) Coldwater marginal fish life propagation	(4) Warmwater permanent fish life propagation	(5) Warmwater semipermanent fish life propagation	(6) Warmwater marginal fish life propagation	(7) Immersion recreation	(8) Limited-contact recreation	(9) Fish, wildlife propagation, recreation & stock watering	(10) Irrigation	(11) Commerce and Industry
Alkalinity ($CaCO_3$)									750[1]/1,313[2]		
Barium	1.0										
Chloride	250[1]/438[2]	100[1]/175[2]									
Chlorine, total residual		0.019 acute 0.011chronic	0.019 acute 0.011chronic	0.019 acute 0.011chronic	0.019 acute 0.011chronic	0.019 acute 0.011chronic					
Coliform, total (per 100 mL)	5,000 (mean); 20,000 (single sample)										
Coliform, fecal (per 100 mL)							200 (mean); 400 (single sample)	1,000 (mean); 2,000 (single sample)			
Conductivity (uohms/cm @ 25°C)									4,000[1]/7,000[2]	2,500[1]/ 4,375[2]	
Fluoride	4.0										
Hydrogen sulfide, undisassociated		0.002	0.002	0.002	0.002	0.002					
Nitrogen, unionized ammonia as N		0.02[1]/1.75 x the criterion	0.02[1]/1.75 x the criterion	0.04[1]/1.75 x the criterion	0.04[1]/1.75 x the criterion	0.05[1]/1.75 x the criterion					
Nitrogen, nitrates as N	10.0								50[1]/88[2]		
Oxygen, dissolved		≥ 6.0; ≥ 7.0 (during spawning season)	≥ 5.0	≥ 5.0; ≥ 6.0 (in Big Stone Lk & Lk Traverse during Apr & May)	≥ 5.0	≥ 4.0	≥ 5.0	≥ 5.0			
pH (standard units)	6.5 – 9.0	6.6 – 8.6	6.5 – 8.8	6.5 – 9.0	6.5 – 9.0	6.0 – 9.0			6.0 – 9.5		6.0 – 9.5
Sodium Adsorption Ratio										10	
Solids, suspended		30[1]/53[2]	90[1]/158[2]	90[1]/158[2]	90[1]/158[2]	150[1]/263[2]					
Solids, total dissolved	1,000[1]/1,750[2]								2,500[1]/4,375[2]		2,000[1]/3,500[2]
Sulfate	500[1]/875[2]										
Temperature (°F)		65	75	80	90	90					
Total Petroleum Hydrocarbons	≤ 1.0								≤ 10		
Oil and Grease									≤ 10		

Table 2: Numeric Criteria Assigned to Beneficial Uses of Surface Waters of the State ARSD 74:51:01

[1] 30-day average [2] daily maximum