THE 2000 SOUTH DAKOTA REPORT TO CONGRESS

305(b) WATER QUALITY ASSESSMENT

Protecting South Dakota's Tomorrow ...Today

Prepared By

SOUTH DAKOTA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

Nettie H. Myers, Secretary

SOUTH DAKOTA WATER QUALITY
WATER YEARS 1995-1999

The 2000 Report to Congress of the United States

by the State of South Dakota pursuant to

Section 305(b) of the Federal Water Pollution Control Act

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Environment and Natural Resources
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INTRODUCTION

This document, commonly called the 305(b) report, was prepared by the South Dakota Department of Environment and Natural Resources (DENR) pursuant to Section 305(b) of the Clean Water Act Amendments of 1977 (P.L. 95-217).

The purpose of this report is to provide an assessment of the water quality of South Dakota's water resources and to summarize state programs established to prevent and control water pollution. It is the intent of this report to inform the citizens of South Dakota and the US Environmental Protection Agency (EPA) on the quality of state water resources, and to serve as the basis for management decisions by government staff and officials for the protection of water quality.

EPA uses information from 305(b) documents to report the states' progress in meeting and maintaining Clean Water Act goals for the ecological health of the nation's waters and their domestic, commercial and recreational uses. DENR will use the information in this report along with population data, economic analyses, program capability assessments, and other appropriate information sources to plan and prioritize water pollution control activities. The 305(b) document is also used to prepare the state 303(d) list of impaired waterbodies.

South Dakota DENR uses the 305(b) report as a tool to stimulate formulation of nonpoint source (NPS) projects and to produce a priority water body list for the program. The 305(b) report is routinely sent to all state conservation districts and water development districts. Each looks at watershed information for their geographical area of interest. This helps them focus on the location, nature and severity of water problems in their areas. This generally leads to public discussions which start the long process towards nonpoint source pollution control implementation.

The 305(b) report is also shared with the Nonpoint Source Task Force. This helps them focus their efforts and provides information used in the priority water body ranking system. The NPS program also uses the 305(b) document to supplement news articles released through the state Information and Education (I&E) program. Finally, the report is currently being utilized by the US Forest Service to screen grazing permits that require detailed National Environment Policy Act (NEPA) reviews before reissuance.

The water quality assessment in this report relies heavily on the statistical analyses of data generated by DENR, EPA, US Geological Survey, and the US Army Corps of Engineers along with the personal observations of field samplers, the results of many specialized investigations and best professional judgement. While this assessment is as comprehensive as resources permit, undoubtedly some of the state's water quality problems, particularly localized ones, do not appear in this report.

South Dakota Law (SDCL 34A-2-4 and 34A-2-6) authorizes the Department's Secretary to provide this assessment of current state water quality to Congress and to the people of the State of South Dakota.

II.
EXECUTIVE SUMMARY

SOUTH DAKOTA 2000 305(b) REPORT
EXECUTIVE SUMMARY

It is the purpose of this report to assess the water quality of South Dakota's water resources and to summarize ongoing programs to control water pollution. This report meets the requirements of Section 305(b) of the Clean Water Act which mandates a biennial report on water quality to Congress. This report is also intended to inform the citizens of South Dakota on the status of the quality of their water resources and to serve as the basis for management decisions by government staff and local officials for the protection of water quality. DENR will use the information in this report along with population data, economic analyses, program capability assessments, and other appropriate sources to plan and prioritize water pollution control activities.

<u>Surface Water Quality</u>

South Dakota has a total of 9,937 miles of rivers and major streams (Table 1). Of this total, 3,800 miles are presently managed as fisheries by the state Department of Game, Fish and Parks (GF&P). For the 2000 305(b) document, approximately 3,564 miles have been assessed and reported by DENR for water quality for a period covering five years (October 1994 to September 1999). This continues a major change from past 2-year reporting. Over this 5-year interval, 50% of assessed stream miles were found to support all their assigned beneficial uses, 9% partially supported their uses, and 41% were non-supporting of their designated uses.

For the five year monitoring period, 3,250 designated river miles were assessed for goal attainment of fishable and aquatic life use support and 1,043 miles for swimmable goal attainment. Forty-eight percent of assessed stream miles fully met fishable/aquatic life criteria, whereas 12% partly met, and 40% did not meet fishable/aquatic life criteria. Fifty-eight percent of stream miles designated for immersion recreation supported swimmable uses; 3% partly met swimmable criteria; and 39% did not meet swimmable criteria.

Similar to previous reporting periods, nonsupport for fishable/aquatic life uses was caused primarily by total suspended solids (TSS) from agricultural nonpoint sources (NPS) and natural origin. Water and wind erosion from croplands, gully erosion from rangelands, stream bank and channel erosion and other natural erosion areas (e.g. badlands) were primary contributors of TSS to state streams. In terms of stream miles affected, the second most important cause of impairment this reporting period was elevated fecal coliform bacteria (FC) concentrations. Recently revised figures indicate that non-support due to FC decreased from 64% of swim-rated stream miles for 1991-93 to 53% (1993-95) then increased to 67% for the 1995-97 assessment period. This compares to 53% non-support for the last monitoring cycle and 39% for the present monitoring summation (1994-1999). The primary sources of this high degree of non-support can be traced to elevated bacterial levels found in the lower reaches of the Cheyenne and Big Sioux Rivers.

Less important causes of impairment this reporting period included elevated total dissolved solids concentration (TDS), low dissolved oxygen (DO), elevated stream pH and water temperature in approximate order of importance. Natural pollutant sources for dissolved and suspended solids are exemplified by badland areas and weathered shale outcrops adjacent to streams that occur in western South Dakota and along the Missouri River, and by erosive loess soils in extreme southeastern South Dakota.

In contrast to dry conditions that characterized 1988 and 1989, large parts of South Dakota experienced above average annual rainfall during the last eight years. Unusually heavy rainfall during most of the decade of the 1990s created flood conditions over most of eastern South Dakota particularly in the spring and summer of 1993, 1995, and 1997. Annual precipitation and accumulations of soil moisture are the highest reported in the state for any extended period since the 1940s to early 1950s (A. R. Bender, state climatologist report, 1995). An increased number of large runoff events in the state from 1991 to 1998 produced a greater incidence of severe TSS exceedances during the present and previous reporting periods.

TABLE 1. ATLAS

State population (1995 est.)	739,000
State surface area (sq. mi.)	77,047
No. of water basins (according to State Subdivisions)	14
Total no. of river miles	9,937
No. of perennial river miles (subset)	1,932
No. of intermittent stream miles (subset)	8,005
No. of border river miles of shared rivers/streams (subset)	360*
Miles of ditches and canals (man-made waterways)	424*
No. of lakes/reservoirs/ponds	799
Acres of lakes/reservoirs/ponds	750,000
Square miles of estuaries/harbors/bays	0
No. of ocean coastal miles	0
No. of Great Lakes shore miles	0
Acres of freshwater wetlands	1,780,000
Acres of tidal wetlands	0
Name of border rivers: Missouri River, Big Sioux River, Bois de Sioux River.	

* (EPA, 1991)

In addition, runoff waters percolating through the alkaline soils of normally semi-arid parts of the state may have produced elevated water pH and dissolved solids concentration in some monitored river basins. Although the dilutional effects of increased stream flows were probably instrumental in producing a drop in major swimming use violations due to fecal coliform in some state rivers and streams, apparently a greater opposite effect occurred in lakes with swimming facilities where there was an increased incidence of excessive fecal coliform (>200/100 ml) in swimming areas during 1993, 1995, 1997, and 1998 compared to 1992, 1994, 1996, and 1999.

It has become evident that higher than average annual precipitation can produce considerable suspended sediment problems over large areas of the state, particularly in the west and southeast. It is also apparent that the number of fecal coliform violations in state swimming areas increases significantly during years of above normal rainfall.

The Department of Environment and Natural Resources continues to conduct special chemical/physical/biological stream surveys as well as routine ambient monitoring to assess the quality of receiving streams and to document water quality problem sources.

In addition to rivers and streams, South Dakota has 799 publicly owned lakes and reservoirs according to a past GF&P survey, totaling approximately 750,000 acres. Four Missouri River mainstem reservoirs make up 548,000 surface acres or 73% of estimated total lake acreage. Approximately 565 waterbodies are listed in Administrative Rules of South Dakota (ARSD) 74:51:02 and classified for a variety of beneficial uses. GF&P presently manages 450 state lakes for fish.

Approximately 98% of use nonsupport for lakes can be attributed to nonpoint sources. Excluding the four mainstem reservoirs, 16% of the lake acreage assessed from 1989 to 1999 is considered to support all designated uses. Thirty percent of total lakes acreage partially supports uses, and 54% does not support uses. The results obtained during recent assessments show moderate improvement in lake use support over data gathered during the late 1980s. This can be partially attributed to the beneficial effects on lake water levels and water quality produced by increased annual rainfall in many parts of the state during the last decade. However, those high water conditions may have been largely responsible for an increase in fecal coliform levels at monitored swimming beaches.

Most lakes in the state are characterized as eutrophic to hypereutrophic. Runoff, carrying sediment and nutrients from agricultural land, is the major nonpoint pollution source. Smaller waterbodies are more severely impacted by nonpoint sources than the larger lakes. For example, many small stockwater dams in west-central South Dakota were reported during the late 1990s to be filling rapidly with sediment due primarily to the effect of heavier than normal rainfall the past five years on the erodible soils of this semi-arid region (NRCS communication). However, incoming sediments from several major and many minor tributaries are also shortening the useful lives of the four large mainstem reservoirs. Sedimentation rates for Lake Oahe and Lake Sharpe are now estimated to be higher than previously projected by the Corps of Engineers (COE). Downstream reservoirs Francis Case and Lewis and Clark have lost more than 10% and 15%, respectively, of their original water holding capacity to sediment as of 1995 (COE, 1995).

Conversely, recent heavy rains over large areas of the state appeared to have, at least temporarily, improved the general water quality of many of our monitored lakes that suffered from low water levels during the late 1980s. Some were left in the same or worse condition, however, presumably due to their being resupplied with poor quality water from their respective watersheds. Unfortunately, the high water conditions that prevailed in South Dakota particularly during 1993, 1995, and 1997 increased watershed erosion and sedimentation to state lakes and streams.

Wetlands

According to recent estimates issued by the US Fish and Wildlife Service (USFWS), South Dakota originally had approximately 2.7 million acres of wetlands. Today, there are roughly 1.8 million acres remaining which represents a loss of one-third attributable to both natural and human causes. Highest losses were recorded for small temporary wetland basins less than two acres in area. In the second half of the last decade, the rate of wetland destruction within the state appeared to have slowed considerably. All of the reasons are not known, but one major influence was probably the "Swampbuster" provisions of the 1985 Farm Bill. This Act effectively reduced or removed certain incentives for producers to drain and convert wetlands to agricultural use. Another factor may have been that many of the remaining wetlands are very difficult and/or economically unfeasible to drain and utilize for crop production.

South Dakota made substantial progress in the past several years toward developing appropriate wetland water quality standards and establishing an integrated state wetland protection program.

On December 3, 1992, South Dakota adopted, through the South Dakota Surface Water Quality Standards, that wetlands be included as "waters of the state". Wetlands were also designated for beneficial use of fish and wildlife propagation, recreation and stock watering which provides protection under existing narrative and numeric water quality standards. All definitions within state regulations were made consistent with the definition as stated previously.

Ground Water Quality

Ground water quality is highly variable but is generally suitable for domestic, industrial, and agricultural (including irrigation) use. Many of the deeper aquifers contain higher concentrations of dissolved salts. Shallow aquifers are generally more easily contaminated. Ground water degradation results from improperly located and/or constructed wells, wastewater treatment lagoons, septic systems, feedlots, landfills, improperly sealed wells, leaking aboveground and underground chemical storage tanks and hazardous materials spills. Petroleum products and nitrate are the major contaminants.

The substance in ground water most frequently occurring in concentrations above the EPA Maximum Contaminant Level (MCL) is nitrate as nitrogen. There are several potential sources of nitrate, including nonpoint sources such as commercial and manure fertilizer use. Three studies conducted in South Dakota during the 1980s and early 1990s confirmed that in selected areas elevated nitrate as nitrogen concentrations were a concern. Approximately 10-20% of the samples collected from these studies had concentrations exceeding 10 mg/l, the South Dakota Ground Water Quality Standard for Nitrates.

Impacts to ground water from application of pesticides were also examined in these studies. Pesticides were detected in 10-15% of the ground water samples collected, but less than 1% of the samples collected were found to be over the Maximum Contaminant Level (MCL) or Life Time Health

Advisory (LTHA) limit, indicating limited impact to ground water from labeled use. Most pesticide detections were sporadic or non-recurring.

In 1994, South Dakota initiated a Statewide Ground Water Quality Monitoring Network to systematically assess ambient ground water quality and monitor for nonpoint source pollutants in a number of shallow aquifers across the state. Nitrate and pesticides continue to be sampled through this network along with a number of other inorganic ions, trace elements, radionuclides, and volatile organic compounds. The initial well installation phase is complete with 80 monitoring sites established, consisting of 145 water quality monitoring wells in 24 aquifers.

Petroleum products were involved in 80% of reported spills during this reporting cycle. Leaking underground storage tanks (UST) were responsible for 45% of incidents, involving mainly petroleum products. The percentage of spills caused by leaking USTs increased slightly from the last reporting period. Recent increases in the number of reported UST releases have occurred because of the facility upgrade deadline of 1998. In addition, petroleum spills from previous years continue to be remediated and monitored. Petroleum components such as benzene, toluene, ethylbenzene, and xylene render water unpalatable at very low concentrations and constitute potential health risks at higher concentrations. There were no violations of drinking water standards due to petroleum products recorded this reporting cycle.

Accidental releases of fertilizers and pesticides contribute to South Dakota's point source ground water contamination. Damaged equipment and improper handling and disposal of containers and rinsate have resulted in agricultural chemicals reaching the ground water. The total number of reported agricultural chemical spill cases has remained steady in recent years.

Public and Private Water Supply Systems:

South Dakota has approximately 729 public water systems (PWS). A public water system is defined as any water system that has 15 or more service connections or serves at least 25 people a day for at least 60 days per year. Community PWS make up 474 of the total PWS and serve residential populations. Most South Dakota water systems (85%) rely totally on ground water.

From January 1997 through September 1999, 30,113 routine samples were submitted for testing by state public water systems. Of these, 918 or 3.1% were declared unsafe due to the presence of coliform bacteria. This compares with 4.5% of samples found to be unsafe during the last reporting cycle (State Health Laboratory).

In terms of secondary drinking water standards, much of the water quality of public drinking water supplies within South Dakota is poor. Many PWS have very hard water. Numerous PWS exceed the recommended standards for total dissolved solids, iron, manganese, sodium, chlorides, and sulfates. Only 1 system is in violation of the primary water standard for nitrate and 10 systems are in violations of the radium standard.

Organic chemicals are regularly sampled by all systems and the Maximum Contaminant Levels (MCLs) have never been violated. MCLs are the highest level at which a chemical or a bacteriological parameter can be consumed without ill effects.

Specific problems found in unregulated private wells throughout the state are primarily high nitrate levels and coliform bacteria. During the present reporting period 13% of 1,915 tested domestic wells exceeded the Federal Drinking Water Standard of 10 mg/l nitrate-nitrogen. By contrast, only one PWS out of 756 tested was found to exceed the nitrate standard. Exceedances of the drinking water standard for total coliform bacteria (i.e. the mere presence of coliforms) were found in 27% of 2,705 private wells. This is approximately six times the frequency reported in regulated state public water systems (4.1%) over a comparable period of time.

Information supplied by domestic well owners during sampling of their wells indicates that feedlots, corrals, and septic tanks are the major sources of nitrate contamination that is exacerbated by runoff from flooding and heavy rains. This survey revealed the following practices to be particularly prevalent: 1) placement of a well within a feedlot or downgradient of a feedlot; 2) placement of a well downgradient from a septic tank or drainfield; and most importantly 3) poor well construction allowing for entrance of contaminants into the well.

Water Pollution Control Programs

The water quality goals of the state are to: identify water quality problems; set forth effective management programs for water pollution control; alleviate water quality problems; and achieve and preserve water quality for all intended uses.

Surface Water Discharge System:

The department continues to implement the National Pollutant Discharge Elimination System (NPDES) program in South Dakota, referred to as the Surface Water Discharge program.

The Clean Water State Revolving Fund (SRF) was established by the 1987 Clean Water Act Amendments to replace the Construction Grants Program. This is a low-interest loan program for wastewater, storm water, and nonpoint source pollution control projects. The state of South Dakota made the first loan in 1989. As of April 1, 2000, the program has made 106 loans totaling over $99.4 million to 56 entities. Approximately one-third of the total loan amount has been to address secondary treatment needs. In addition, since the quality of finished water or wastewater is highly dependent on the skill of the plant operator, the state assures that training for these operators is continually upgraded.

Interest rates for the SRF program must be at or below market rate and are set annually by the Board of Water and Natural Resources. Rates are currently 4.5% for a 10-year loan, 4.75 % for a 15-year loan, and 5.0% for a 20-year loan. Disadvantaged communities are eligible for subsidized rates from 0% to 3% under the Drinking Water SRF Program.

The Drinking Water SRF Loan Program was created by the Safe Drinking Water Act Amendments of 1996. This program provides low-interest loans to communities and non-profit corporations for drinking water projects. The state of South Dakota made its first loan in January of 1998. As of April 1, 2000, seventeen loans have been made totaling $20.08 million.

The federal 1996 Safe Drinking Water Act requires each state develop a Source Water Assessment and Protection Program which is designed to protect public water supply systems from potential contaminant sources. A source water assessment must be completed for each of the 760 public water supply systems in South Dakota. This includes delineating a contributing area to the water supply, inventorying potential pollution sources within the area, and evaluating the susceptibility of the water supply to each pollution source.

South Dakota has set aside 10% of its FY1997 Drinking Water Revolving Fund allotment for source water assessment and protection. This is $1,255,880. Other funding sources will be used to supplement this effort. These potential funds include Public Water System Supervision, Nonpoint Source 319, 106 Ground Water and potentially other environmental funding sources.

Nonpoint Source Pollution Control:

Nonpoint Source Pollution is that which originates from diverse sources. Nonpoint pollution controls must reflect this by using all of the resources available from the various state, federal, and local organizations plus have landowner support and participation. South Dakota primarily uses voluntary measures for the implementation of Best Management Practices to control NPS pollution. Over the past 20 years, the program has initiated many development and implementation projects throughout the state. The Clean Water Act section 319 program is the focal point for a majority of the existing NPS control programs. However, the technical and financial assistance currently available is not sufficient to solve all of the NPS pollution problems in the state. Other solutions must be explored. Landowners have the capability to accomplish much if they understand the problems and the ways to solve them. Many of the solutions involve land management changes that benefit the landowner by making their lands more productive and sustainable. Educating the public about NPS pollution issues has been effective in prompting many landowners to voluntarily implement activities to control NPS pollution. In some cases, however, enforcement may be needed to increase compliance with state and federal requirements.

To help guide NPS activities in the state, a NPS Task Force comprised of state and federal agencies, local groups and citizens, producer groups and any others interested in NPS pollution, was formed and continues to meet regularly. They are responsible for providing advice and recommendations to the agencies on all NPS activities in the state. The continuation of this ad hoc task force, coupled with expansion and the addition of innovative new programs will ensure that South Dakota remains a leader in nonpoint source pollution control.

Ground Water Protection Program:

South Dakota has an active ground water protection program. A statewide ground water quality monitoring network has been established to monitor the general quality of the state's ground water and to identify problem areas and contaminants. Other ongoing DENR ground water activities include: the primary enforcement authority for Underground Injection Control (UIC) Program (Section 1425); the delegation of the Underground Storage Tank (UST) program under RCRA Subtitle I; the delegation of a state Aboveground Storage Tank (AST) program; ground water quality standards; SARA Title III, state Superfund/Federal Facilities program (state CERCLA program); increased involvement in assessment, enforcement, and cleanup activities resulting from accidental releases of potential pollutants; an EPA-approved wellhead protection program; initiation of a major source water protection program; the development of a pesticide and ground water state management plan; and a ground water discharge permit program. The Comprehensive State Ground Water Protection Program is currently underway.

Pesticide and fertilizer contamination of ground water due to point source releases is evident in South Dakota. Numerous cleanup efforts continue in response to ground water contamination resulting from equipment damage or human error. Reduction of these incidents and their severity continues to be addressed. Bulk pesticide containment regulations went into effect July, 1989. To further address potential point sources of pesticides or fertilizers, chemigation equipment regulations are also in effect. South Dakota Department of Agriculture requirements now in effect for chemical loading and rinsing containment pads required facilities to have fertilizer containment pads in place by 1992 and all secondary containment structures constructed by 1996. All pesticide operational area containment systems were in place by 1995. The fertilizer management plan is in development and the generic pesticide management plan has been completed by DENR and South Dakota Department of Agriculture. They are designed to reduce potential impacts to ground water from land application of agricultural chemicals.

III.
SURFACE WATER QUALITY ASSESSMENT

A. SURFACE WATER QUALITY MONITORING PROGRAM

General Discussion

South Dakota DENR monitors the surface water in the state through an established ambient water quality sampling program, special intensive water quality surveys, intensive fish surveys, total maximum daily loads, surface water discharge (SWD) permits, and individual state and federal lakes/nonpoint source projects. Aside from DENR, the United States Geological Survey, the Corps of Engineers and the US Forest Service also conduct routine monitoring throughout the state. All data resulting from these monitoring efforts are available from the responsible agency. Much of the data has been entered into the United States Environmental Protection Agency STORET computer system.

Water samples are analyzed for physical, chemical, biological, and bacteriological parameters to provide baseline data for the determination of potential effects of point and nonpoint sources of pollution. Baseline data are also used as a management tool to determine the effectiveness of control programs on existing point and nonpoint sources and for directing future control activities. Water samples show whether or not a waterbody is meeting its assigned water quality beneficial uses. Water quality standards were first established for all surface waters by the state's Committee on Water Pollution in 1967. The Water Management Board completed the final steps of its most recent triennial review and revisions in December 1998 and the US EPA formally approved South Dakota's Standards on March 29, 2000. These standards consist of beneficial use classifications and water quality criteria necessary to protect these uses.

All surface waters in the state are classified for one or more of the following beneficial uses:

(1) Domestic water supply waters;

(2) Coldwater permanent fish life propagation waters;

(3) Coldwater marginal fish life propagation waters;

(4) Warmwater permanent fish life propagation waters;

(5) Warmwater semipermanent fish life propagation waters;

(6) Warmwater marginal fish life propagation waters;

(7) Immersion recreation waters;

(8) Limited contact recreation waters;

(9) Fish and wildlife propagation, recreation, and stock watering;

(10) Irrigation waters; and

(11) Commerce and industry waters.

All streams in South Dakota are assigned the beneficial uses (9) and (10) unless otherwise stated in ARSD 74:51:03. Lakes listed in Uses Assigned to Lakes 74:51:02 are assigned the beneficial uses of (7) and (8) unless otherwise specified. All lakes in South Dakota are assigned the beneficial use (9) unless otherwise stated in the same reference. Table 2 contains a summary of the established beneficial uses and a partial listing of assigned criteria to protect them. Current State Toxic Pollutant Standards for human health and aquatic life are presented in Table 3.

Fixed Station Ambient Monitoring

The DENR Water Quality Monitoring program consisted of 94 active instream stations for most of this reporting period (Appendix A). However, the network was expanded in 1999 to a total of 134 stations. Sampling station locations are determined by assessing areas located within high quality beneficial use classifications, located above and below municipal/industrial discharges, or within problem watersheds. Currently, the department collects these samples on a monthly, quarterly, or bi-annual basis. This type of water sampling is invaluable for monitoring historical information, natural background conditions, possible runoff events, and acute or chronic water quality problems.

Typically, grab samples are collected mid-stream, either from a bridge or by wading. Some stations may have to be sampled from the bank depending on the conditions. Every station is sampled in the same manner and location each time. When the sample has been collected, the sampler immediately obtains the water and air temperatures, pH reading, and dissolved oxygen content. Water depth and width as well as other visual observations are also recorded. The samples are properly preserved and transported to the laboratory for analysis. Sample test results are entered into STORET.

The most commonly sampled parameters include fecal coliform, conductivity, hardness, BOD_5, alkalinity, residue (TS, TSS, TDS), pH, ammonia, nitrates, and phosphorous (total and dissolved). Several stations are sampled for sodium, calcium, and magnesium during the irrigation season. Stations which are located along streams that receive mine drainages are also analyzed for cyanide, cadmium, lead, copper, zinc, chromium, mercury, nickel, silver, and arsenic.

Ambient station locations, descriptions, and schedules are included in Appendix A. More detailed descriptions of individual stream sites are available from DENR on request.

Intensive Water Quality Monitoring (Point Sources)

Water quality monitoring surveys are performed by the Surface Water Quality Program to document stream improvement areas, stream degradation areas, develop TMDLs, or to provide data for verifying SWD limits.

TABLE 2. NUMERIC CRITERIA ASSIGNED TO BENEFICIAL USES OF SURFACE WATERS OF THE STATE ARSD 74:51:01

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 & 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 0.011 chronic	0.019 acute 0.011 chronic	0.019 acute 0.011 chronic	0.019 acute 0.011 chronic	0.019 acute 0.011 chronic					
Coliform, total (per 100 mL)	5,000 (mean); 20,000 (one sample)										
Coliform, fecal (per 100 mL) May 1 - Sept. 30							200 (mean); 400 (single sample)	1,000 (mean); 2,000 (single sample)			
Conductivity (umhos/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]/ 1.75X the criterion[2]	0.02[1]/ 1.75X the criterion[2]	0.04[1]/ 1.75X the criterion[2]	0.04[1]/ 1.75X the criterion[2]	0.05[1]/ 1.75X the criterion[2]					
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 Lake & Lake Traverse during April & 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. CONTINUED

[1] 30-day average
[2] daily maximum
[3] There may be no induced temperature change over spawning beds. No discharge or discharges may affect the temperature by more than 4^{o} F in streams classified for the beneficial use of coldwater permanent or marginal fish life propagation or warmwater permanent fish life propagation; by more than 5^{o} F in streams classified for the beneficial uses of warmwater semipermanent or marginal fish life propagation; or by more than 3^{o} F in lakes or impoundments classified for the beneficial use of fish life propagation. Exceptions to this criterion may be granted if the discharge will not impair the designated beneficial use of fish life propagation. In addition, the maximum incremental temperature may not exceed 2^{o} F per hour.

TABLE 3. SOUTH DAKOTA SURFACE WATER QUALITY STANDARDS [1] FOR TOXIC POLLUTANTS – ARSD 74:51:01

Pollutant	Human Health Value Concentrations in ug/L Use 1[3] / Uses 2-3-4-5-6[4]	Aquatic Life Value Concentrations in ug/L Uses 2-3-4-5-6 Acute (CMC)/ Chronic (CCC)	Pollutant	Human Health Value Concentrations in ug/L Use 1[3] / Uses 2-3-4-5-6[4]	Aquatic Life Value Concentrations in ug/L Uses 2-3-4-5-6 Acute(CMC)/ Chronic (CCC)
Acenaphthene	1,200/2,700		Cadmium	-/-	3.7[9]/1.0[9]
Acenaphthylene (PAH)[6]	-/-	-/-	Carbon Tetrachloride[5] (Tetrachloromethane)	0.25/4.4	-/-
Acrolein	320/780	-/-	Chlordane[5]	0.00057/0.00059	2.4/0.0043
Acrylonitrile[5]	0.059/0.66	-/-	Chlorine	-/-	19/11
Aldrin[5]	0.00013/0.00014	3.0/-	Chlorobenzene (monochlorobenzene)	680/21,000	-/-
Anthracene (PAH)[6]	9,600/110,000	-/-	Chlorodibromomethane (HM)[6]	0.41/34	-/-
Antimony	14/4,300	-/-	Chloroform (HM)[5] (Trichloromethane)	5.7/470	-/-
Arsenic[5]	0.018/0.14	360/190	2-Chloronaphthalene	1,700/4,300	
Asbestos[5]	7,000,000 fibers/L	-/-	2-Chlorophenol	120/400	
BHC (alpha)[5] (Hexachlorocyclohexane-alpha)	0.0039/0.013	-/-	Chromium(III)	-/-	550[9]/180[9]
BHC (beta)[5] (Hexachlorocyclohexane-beta)	0.014/0.046	-/-	Chromium(VI)	-/-	15/10
BHC (gamma) (Lindane)[5] (Hexachlorocyclohexane-gamma)	0.019/0.063	2.0/0.08	Chrysene (PAH)[5]	0.0028/0.031	-/-
Benzene[5]	1.2/71	-/-	Copper	1,300/-	17[9]/11[9]
Benzidine[5]	0.00012/0.00054	-/-	Cyanide (weak acid dissociable)	700/220,000	22/5.2
Benzo (a) Anthracene (PAH)[5] (1,2 Benzanthracene)	0.0028/0.031	-/-	4,4'-DDD[5]	0.00083/ 0.00084	-/-
Benzo (a) Pyrene (PAH)[5] (3,4 Benzopyrene)	0.0028/0.031	-/-	4,4'-DDE[5]	0.00059/ 0.00059	-/-
Benzo (b) Fluoroanthene (PAH)[5] (3,4 Benzofluoroanthene)	0.0028/0.031	-/-	4,4'-DDT[5][7]	0.00059/ 0.00059	1.1/0.001
Benzo (k) Fluoroanthene (PAH)[5] (11,12 – Benzofluoroanthene)	0.0028/0.031	-/-	Dibenzo (a,h) Anthracene (PAH)[C] (1,2,5,6-Dibenzanthracene)	0.0028/0.031	-/-
Benzo (g,h,i) Perylene (PAH)[6] (1,12 Benzoperylene)	-/-	-/-	1,2 Dichlorobenzene	2,700/17,000	-/-
Beryllium[5]	-/-	-/-	1,3 & 1,4-Dichlorobenzene	400/2,600	-/-
Bis (2-chloroethyl) Ether[5]	0.031/1.4	-/-	3,3'-Dichlorobenzidine[5]	0.04/0.077	-/-
Bis (2-chloroisopropyl) Ether	1,400/170,000	-/-	Dichlorobromomethane (HM)[6]	0.27/22	-/-
Bis (2-ethylhexyl) Phthalate[5]	1.8/5.9	-/-	1,2-Dichloroethane[5]	0.38/99	-/-

TABLE 3. CONT. SOUTH DAKOTA SURFACE WATER QUALITY STANDARDS [(1)] FOR TOXIC POLLUTANTS - ARSD 74:51:01 (Continued)

Pollutant	Human Health Value Concentrations in ug/L Use 1[(3)] / Uses 2-3-4-5-6[(4)]	Aquatic Life Value Concentrations in ug/L Uses 2-3-4-5-6 Acute (CMC)/ Chronic (CCC)	Pollutant	Human Health Value Concentrations in ug/L Use 1[(3)] / Uses 2-3-4-5-6[(4)]	Aquatic Life Value Concentrations in ug/L Uses 2-3-4-5-6 Acute (CMC)/ Chronic (CCC)
Bromoform (HM)[(6)] (Tribromomethane)	4.3/360	-/-	1,1-Dichloroethylene[(5)]	0.057/3.2	-/-
Butyl Benzene Phthalate	3,000/5,200		2,4-Dichlorophenol	93/790	-/-
1,2-Dichloropropane	0.52/39		Mercury	0.14/0.15	2.1/0.012[(10)]
1,3-Dichloropropylene, Cis & Trans (1,3-Dichloropropene)	10/1,700	-/-	Methyl Bromide (HM) (Bromomethane)	48/4,000	-/-
Dieldrin[(5)]	0.00014/0.00014	2.5/0.0019	Methyl Chloride (HM)[(6)] (Chloromethane)	-/-	-/-
Diethyl Phthalate	23,000/120,000	-/-	Methylene Chloride (HM)[(5)](Dichloromethane)	4.7/1,600	-/-
2,4-Dimethylphenol	540/2,300		N-Nitrosodimethylamine[(5)]	0.00069/8.1	-/-
Dimethyl Phthalate	313,000/2,900,000	-/-	N-Nitrosodi-n-Propylamide	0.005/1.4	
Di-n-butyl Phthalate	2,700/12,000	-/-	N-Nitrosodiphenylamine[(5)]	5.0/16.0	-/-
4,6-Dinitro-o-cresol (4,6-Dinitro-2-methylphenol)	13.4/765	-/-	Nickel	610/4,600	1,400[(9)]/160[(9)]
2,4-Dinitrophenol	70/14,000	-/-	Nitrobenzene	17/1,900	-/-
Dioxin (2,3,7,8-TCDD)[(5)]	0.000000013/ 0.000000014	-/-	PCB-1016, 1221, 1232, 1242, 1248, 1254, 1260 (Arochlor 1016, 1221, 1232, 1242, 1248, 1254, 1260)[(2)(5)(7)]	0.000044/ 0.000045	-/0.014
1,2-Diphenylhydrazine[(5)]	0.040/0.54	-/-	Pentachlorophenol	0.28/8.2	20 [(8)]/13[(8)]
2,4-Dinitrotoluene[(5)]	0.11/9.1	-/-	Phenanthrene (PAH)[(6)]	-/-	-/-
Endosulfan (alpha & beta)	0.93/2.0	0.22/0.056	Phenol	21,000/4,600,000	-/-
Endosulfan Sulfate	0.93/2.0	-/-	Pyrene (PAH)[(6)]	960/11,000	-/-
Endrin	0.76/0.81	0.18/0.0023	Selenium[(7)]	-/-	20/5
Endrin aldehyde	0.76/0.81	-/-	Silver	-/-	3.4[(9)]/-
Ethylbenzene	3,100/29,000	-/-	1,1,2,2-Tetrachloroethane[(5)]	0.17/11	-/-
Fluoranthene	300/370	-/-	Tetrachloroethylene[(6)]	0.8/8.85	-/-
Fluorene (PAH)[(6)]	1,300/14,000	-/-	Thallium	1.7/6.3	-/-
Heptachlor[(5)]	0.00021/0.00021	0.52/0.0038	Toluene	6,800/200,000	-/-
Heptachlor epoxide[(5)]	0.00010/0.00011	0.52/0.0038	Toxaphene[(5)]	0.00073/0.00075	0.73/0.0002
Hexachlorobenzene[(5)]	0.00075/0.00077	-/-	1,2-Trans-Dichloroethylene	700/-	
Hexachlorobutadiene[(5)]	0.44/50	-/-	1,1,1-Trichloroethane	-/-	-/-
Hexachlorocyclopentadiene	240/17,000	-/-	1,1,2-Trichloroethane[(5)]	0.60/42	-/-
Hexachloroethane[(5)]	1.9/8.9	-/-	Trichloroethylene[(5)]	2.7/81	-/-
Indeno (1,2,3-c,d) pyrene (PAH)(c)	0.0028/0.0311	-/-	2,4,6-Trichlorophenol[(5)]	2.1/6.5	-/-

TABLE 3. CONT. SOUTH DAKOTA SURFACE WATER QUALITY STANDARDS [(1)] FOR TOXIC POLLUTANTS - ARSD 74:51:01 (Continued)

Pollutant	Human Health Value Concentrations in ug/L Use 1[(3)] / Uses 2-3-4-5-6[(4)]	Aquatic Life Value Concentrations in ug/L Uses 2-3-4-5-6 Acute (CMC)/ Chronic (CCC)	Pollutant	Human Health Value Concentrations in ug/L Use 1[(3)] / Uses 2-3-4-5-6[(4)]	Aquatic Life Value Concentrations in ug/L Uses 2-3-4-5-6 Acute (CMC)/ Chronic (CCC)
Isophorone[(5)]	8.4/600	-/-	Vinyl chloride[(5)] (Chloroethylene)	2.0/525	-/-
Lead	-/-	65[(9)]/2.5[(9)]	Zinc	-/-	110[(9)]/100[(9)]

SOUTH DAKOTA
Surface Water Quality Standards[(1)]
for Toxic Pollutants

(1) The aquatic life values for arsenic, cadmium, chromium (III), chromium (VI), copper, lead, mercury (acute), nickel, selenium, silver and zinc given in this document refer to the dissolved amount of each substance unless otherwise noted. All surface water discharge permit effluent limits for metals shall be expressed and measured in accordance with 74:52:03:16.

(2) Apply to the beneficial uses as designated but do not supersede those standards for certain toxic pollutants as previously established in §§ 74:51:01:31, 74:51:01:32, 74:51:01:44 to 74:51:01:54, inclusive, and §§ 74:51:01:56 and 74:51:01:57.

(3) Based on two routes of exposure - ingestion of contaminated aquatic organisms and drinking water.

(4) Based on one route of exposure - ingestion of contaminated aquatic organisms only.

(5) Substance classified as a carcinogen with the value based on an incremental risk of one additional instance of cancer in one million persons (10^{-6}).

(6) Chemicals which are not individually classified as carcinogens but which are contained within a class of chemicals with carcinogenicity as the basis for the criteria derivation for that class of chemicals; an individual carcinogenicity assessment for these chemicals is pending.

(7) Also applies to all waters of the state.

(8) pH-dependent criteria. Value given is an example only and is based on a pH of 7.8. Criteria for each case must be calculated using the following equation taken from Quality Criteria for Water 1986 (Gold Book):

Pentachlorophenol (PCP), ug/L

Chronic = $e^{[1.005(pH) - 5.290]}$ Acute = $e^{[1.005(pH) - 4.830]}$

(9) Hardness-dependent criteria in ug/L. Value given is an example only and is based on a $CaCO_3$ hardness of 100 mg/L. Criteria for each case must be calculated using the following equations taken from Quality Criteria for Water 1986 (Gold Book):

Cadmium, ug/L

Chronic = (*0.909)e(0.7852[ln(hardness)]-3.490) Acute = (*0.944)e(1.128[ln(hardness)]-3.828)

*Conversion factors are hardness-dependent. The values shown are with a hardness of 100 mg/L as calcium carbonate ($CaCO_3$). Conversion factors (CF) for any hardness can be calculated using the following equations:

Chronic: CF = 1.101672 - [(ln hardness)(0.041838)]
Acute: CF = 1.136672 - [(ln hardness)(0.041838)]

Chromium (III), ug/L

Chronic = (0.860)e(0.8190[ln(hardness)]+1.561) Acute = (0.316)e(0.8190[ln(hardness)]+3.688)

Copper, ug/L

Chronic = (0.960)e(0.8545[ln(hardness)]-1.465) Acute = (0.960)e(0.9422[ln(hardness)]-1.464)

Lead, ug/L

Chronic = (*0.791)e(1.273[ln(hardness)]-4.705) Acute = (*0.791)e(1.273[ln(hardness)]-1.460)

*Conversion factors are hardness-dependent. The values shown are with a hardness of 100 mg/L as calcium carbonate ($CaCO_3$). Conversion factors (CF) for any hardness can be calculated using the following equations:

Acute and Chronic: CF = 1.46203 - [(ln hardness)(0.145712)]

Nickel, ug/L

Chronic = (0.997)e(0.8460[ln(hardness)]+1.1645) Acute = (0.998)e(0.8460[ln(hardness)]+3.3612)

Silver, ug/L

Acute = (0.85)e(1.72[ln(hardness)]-6.52)

Zinc, ug/L

Chronic = (0.986)e(0.8473[ln(hardness)]+0.7614) Acute = (0.978)e(0.8473[ln(hardness)]+0.8604)

(10) These criteria are based on the total-recoverable fraction of the metal.

The major intent of the water quality assessment program is to monitor instream water quality at critical points to ensure protection of the assigned beneficial uses.

The water quality surveys are also utilized to verify existing SWD limits and develop TMDLs. Any facilities needing treatment greater than secondary treatment are evaluated by conducting an intensive water quality survey both before and during a wastewater discharge. These wasteload allocations are the basis for future treatment needs and SWD limits.

With increased emphasis on water quality improvements to justify federal expenditures, the monitoring program will concentrate on showing water quality improvements from the upgrading of wastewater treatment facilities. After wastewater treatment facilities are upgraded, monitoring is still utilized to verify SWD limits developed through computer modelling.

Surveys provide an evaluation of whether or not the wastewater treatment is adequate to protect the beneficial use. All survey data is compiled in reports which basically follow the same format.

Typical parameters analyzed or measured on water quality surveys are as follows:

1. Biochemical oxygen demand
2. Conductivity
3. pH
4. Alkalinity (T)
5. Total solids
6. Suspended solids
7. Ammonia as N
8. NO_3-NO_2 as N
9. TKN as N
10. Total PO_4 as P
11. Dissolved PO_4 as P
12. Fecal coliform
13. Stream flow

Intensive Water Quality Monitoring (Special Studies)

Intensive water quality monitoring is sometimes initiated to assess special problem areas, to obtain data for use in site-specific criteria modification studies, or to provide an updated database for a waterbody.

Intensive Fish Survey Monitoring

Fish surveys are occasionally conducted by GF&P and the Surface Water Quality Program to evaluate the impact of wastewater on the receiving stream and to evaluate the fishery classification. The fish survey results, although they are qualitative in nature, are used in conjunction with the water quality surveys to evaluate the impact of pollutants on stream water quality.

Biological Sampling Program

Biological samples are often included as part of a watershed assessment study or a special study. The state Water Resources Assistance Program includes aquatic plant and algae surveys, either as chlorophyll *a* concentration or identified and counted as parameters to be estimated.

Toxicity Testing Program

Priority toxic pollutants are relatively expensive to analyze and are not routinely monitored except for special situations. Whole effluent toxicity tests have been included as permit limits in many municipal and industrial SWD permits.

Total Maximum Daily Loads (TMDL) and Section 303(d)

Overview of TMDLs:

In recent years, TMDLs have become an important tool for the management of state water quality. The goal of TMDLs is to ensure that waters of the state attain water quality standards. EPA defines a TMDL as "the sum of the individual waste load allocations for point sources and load allocations for both nonpoint sources and natural background sources established at a level necessary to achieve compliance with applicable surface water quality standards." In simple terms, a TMDL is the amount of pollution a waterbody can receive and still maintain water quality standards.

TMDLs must be developed for waters that still do not meet water quality standards after technology-based requirements have been applied to point source dischargers. Each TMDL should address a specific waterbody or watershed, and specify quantifiable targets and associated actions that will enable a given waterbody to attain and maintain applicable water quality standards.

Section 303(d) of the federal Clean Water Act (CWA) requires states to develop and submit for approval a list of waters targeted for TMDL development in the next two years. This is referred to as the 303(d) list. Items that must accompany this list include targeted pollutants; timeframes for TMDL development; and priority ranking for completion of TMDLs

Summary of Section 303(d) of the Federal Clean Water Act:

Section 303(d) of the federal CWA requires states to identify waters that do not or are not expected to meet applicable water quality standards with technology-based controls alone. The Act also specifies that states must establish a priority ranking for these waters, taking into account the pollution severity and designated uses of the waters. States must submit to EPA the "waters identified and loads established" for review and approval. The 303(d) list fulfills the first part of this requirement (identifying the waters).

Once identification and priority ranking of TMDL waters are completed, states are to develop TMDLs at a level necessary to achieve the applicable state water quality standards. TMDLs must allow for seasonal variations and a margin of safety that accounts for any lack of knowledge concerning the relationship between effluent limits and water quality.

Summary of the State 1998 303(d) TMDL Waterbody List:

Using the methodologies, data, information, and public input described, DENR has developed a list of waterbodies for the 1998 303(d) list. This list includes waterbody names, pollutants of concern, basis for listing, prioritizations, and other information. A total of approximately 171 different waterbodies are listed. Each waterbody may contain several different pollutants and thereby may constitute several TMDLs for that waterbody. In addition, some streams are listed more than once due to TMDLs identified for different segments of the same stream (even for the same pollutant).

For planning, prioritizing, and scheduling TMDL development, as well as assessing what additional resources (if any) are necessary to complete the projected TMDLs, an effort was made to determine the total number of TMDLs implicated by the 1998 list. Tables 4 and 5 respectively summarize federal regulations for Section 303(d) and the projected number of TMDLs, grouped by basin. For example, if a specific waterbody required a TMDL for several different pollutants, all pollutants were grouped into one TMDL for that waterbody. In reality, it may not be possible to incorporate each pollutant into a single TMDL for each waterbody segment, but this assumption was made merely for planning purposes. There may be other cases where widespread support for water quality improvement, large single-entity landholders (federal lands, state lands, etc.), or other factors allow several waterbodies to be targeted for improvement under a single TMDL. Possible scenarios such as these make TMDL numbers difficult to project. Notwithstanding this fact, the implications of the list are that a monumental work effort will be required to complete the number of TMDLs in the time frame suggested by the list.

TABLE 4. SUMMARY OF 40 CFR 130.7

Chapter 40 of the Code of Federal Regulations (CFR), Part 130.7, relates to water quality management and planning. This regulation, which is the implementing regulatory language for section 303(d) and other sections of the Clean Water Act, requires states to do the following:

1. Identify waterbodies requiring TMDLs;
2. Set priorities for developing these loads;
3. Submit lists of waterbodies identified to EPA for approval;
4. Establish these loads for waterbodies identified;
5. Implement the TMDLs through discharge permits, Water Quality Management Plans, 319 nonpoint source projects, and other means; and
6. Involve the public, dischargers, agencies, and local governments in the process.

Waters required to be listed are those where pollution control requirements (technology-based permit limits or other prohibitions required by state, local, or federal authorities) are not stringent enough to implement applicable water quality standards.

Specific requirements for content of the lists are as follows:

1. Priority ranking of all listed waters;
2. Pollutants causing or expected to cause violations of water quality standards; and
3. Identification of waters targeted for TMDLs over the next two years.

Additional items required by regulation or guidance include the following:

1. A schedule for the development of TMDLs for all waterbodies on the list;
2. A description of data and methodology used to develop the list;
3. Rationale for any decision not to use readily available data;
4. An identification of waters taken off the most recent list and a reason for de-listing;
5. Any request for “rolling over” certain targeted waters to the next biennium; and
6. A summary of comments received during the public review period.

Each state must "demonstrate good cause" for not listing a waterbody and justify the exclusion of any waterbody. All existing and readily available water quality data must be used to prepare the list. At a minimum, this includes:

1. Waters on the most recent 305(b) report identified as “partially meeting”, “not meeting”, or “threatened”;
2. Waters for which modeling indicates nonattainment of water quality standards;
3. Waters for which water quality problems have been reported by local, state, or federal agencies; the general public; or academic institutions. These organizations should be actively solicited for information; and
4. Waters identified by the state as impaired or threatened in a nonpoint assessment submitted to EPA under section 319 of the federal CWA.

Resource Implications of 1998 303(d) List:

TMDL issues span a wide range of activities within DENR. Nonpoint source assessments, clean lakes assessments, discharge permitting, water quality monitoring, water quality standards, water rights, feedlot regulations, and other areas are involved in, or affect TMDL development and implementation. Because of this fact, TMDLs complement other ongoing water quality management activities, such as:

- Past assessments under the Clean Lakes program (314 program) can qualify as TMDLs;
- 319 nonpoint source assessment projects can qualify as TMDLs; or
- Water quality-based effluent limits in National Pollutant Discharge Elimination System (NPDES) (referred to as Surface Water Discharge in South Dakota) permits are based on TMDLs developed by the state.

The development and implementation of TMDLs will likely rely on existing programs, resources, and activities. Effective TMDL development will only occur with strong coordination within all DENR water programs. In addition, the development and implementation of effective TMDLs that will result in improving the quality of South Dakota's waters must have the support, input, and coordination of affected government agencies, local groups, and citizens. As such, the TMDL effort will involve the coordination of many diverse groups and diverse interests with the common goal of improving water quality.

It is not possible to develop TMDLs for every listed waterbody within two years. The time frame to develop TMDLs for each waterbody on the 1998 303(d) list is 13 years, in accordance with EPA guidelines.

TABLE 5. 1998 303(D) SUMMARY OF TMDLS BY BASIN

Basin	Projected Number of TMDLs required	Pollutants of Concern	Number of TMDLs Planned for 1998-2000 Biennium
Bad River Basin	7	Ammonia, dissolved oxygen, nutrients, accumulated sediment, total suspended solids	3
Belle Fourche River Basin	11	Ammonia, bacteria, metals, pH, accumulated sediment, temperature, total suspended solids	5
Big Sioux River Basin	40	Ammonia, bacteria, dissolved oxygen, nutrients, accumulated sediment, total suspended solids	17
Cheyenne River Basin	22	Ammonia, bacteria, nutrients, pH, accumulated sediment, total suspended solids	7
Grand River Basin	5	Bacteria, dissolved oxygen, nutrients, accumulated sediment, temperature, total suspended solids	1
James River Basin	35	Ammonia, bacteria, dissolved oxygen, nutrients, accumulated sediment, total suspended solids	15
Little Missouri River Basin	0	-	0
Minnesota River Basin	7	Ammonia, bacteria, dissolved oxygen, nutrients, accumulated sediment	3
Missouri River Basin	21	Ammonia, bacteria, dissolved oxygen, nutrients, accumulated sediment	2
Moreau River Basin	5	Ammonia, bacteria, nutrients, accumulated sediment, total suspended solids	1
Niobrara River Basin	2	dissolved oxygen, nutrients, accumulated sediment, total suspended solids	0
Red River Basin	2	Dissolved oxygen, nutrients	0
Vermillion River Basin	9	Ammonia, bacteria, dissolved oxygen, nutrients, accumulated sediment, total suspended solids	3
White River Basin	5	Ammonia, bacteria, accumulated sediment, total suspended solids	1
Totals	**171**		**58**

B. METHODOLOGY

Two major types of assessments were used to determine use support status of waterbodies; one based on monitoring and the other based on qualitative evaluations. Monitoring data were primarily obtained from South Dakota Department Environment and Natural Resources (DENR), United States Geological Survey (USGS), and Corps of Engineers (COE) fixed station monitoring networks, but operational/intensive survey data, where appropriate, supplemented fixed station monitoring data. Three major sources of quantitative and qualitative lake assessment data were the 1979 DENR Clean Lakes Classification Report (Koth,1981), the 1989 and the 1991-99 DENR Lake Water Quality Assessments (Stewart and Stueven, 1996; 1994).

The DENR maintains a Quality Assurance Program (QA) to ensure that all environmental water quality measurement data generated or processed meets standard accepted requirements for precision, accuracy, completeness, representativeness, and comparability. This entails the preparation and periodic review and revision of the DENR Quality Assurance Program and individual Project Plans. It also includes the preparation of periodic reports to DENR management and USEPA; the review of contracts, grants, agreements, etc., for consistency with QA requirements; and the administration of QA systems and performance audits. The latter activity requires the establishment of schedules for the collection of the duplicate and spike samples, periodic testing of field sampling techniques and liaison with contracted labs to ensure compliance with QA objectives. In 1991, the then Office of Resources Management created a QA document and protocol for its Clean Lakes and NPS programs. An updated QA document (SOP manual) was completed and published January 2000 by Water Resources Assistance Program.

The ambient monitoring station assessment network provides useful information on overall stream water quality. However, because of station locations, sampling frequencies and limited funds, some significant water quality problems may not be monitored. Most ambient monitoring is done during periods when precipitation events are not occurring. This hinders the full effect of nonpoint sources from being known. Only a brief summary of water quality is included because of the large volume of data and reports. A more detailed description of the stream ambient monitoring program is found in the preceding Surface Water Quality Monitoring Program chapter of this document. Additional information concerning any particular aspect of this assessment is available from the DENR.

Fixed station monitoring data were assessed by dividing major streams into segments which contain the same or similar designated beneficial uses, water quality standards criteria, and environmental and physical influences. Data obtained during the current reporting period were analyzed by utilizing the USEPA STORET data storage/retrieval system. The data for each monitored segment were compared to state water quality standards applicable to the beneficial uses assigned to the segment in question (Tables 2 and 3).

For this report, monitored stream course mileages were remeasured using EPA Reach Indexing Tool software. All partially supporting and non-supporting stream segments for which the data was available are also listed in the 1998 303(d) list as requiring Total Maximum Daily Loads. The exact stream segment descriptions may vary somewhat between the 303(d) list and the 305(b) report, but the segments generally coincide with each other.

Specific criteria were developed to define how data for streams would be evaluated to determine the status of each stream segment (waterbody). The following criteria were utilized:

Description	Criteria Used
Number of observations (samples) required to consider data representative of actual conditions	20 samples for any one parameter required at any site. If greater than 25% of samples exceed water quality standards, this threshold was reduced to 10 samples, since impairment is more likely. In addition, the sample threshold was reduced to five samples if 100% of the samples indicated full support for that parameter.
Required percentage of samples exceeding water quality standards in order to consider segment water quality-limited	>10% (>25% if less than 20 samples available).
Data age	Data must be less than five years old (1994 and newer) unless there is justification that data is representative of current conditions. While a data age of two years matches the 305(b) listing cycle, it does not allow for enough samples to accurately portray variability.
Quality Assurance/Quality Control	There must be a consensus that the data meets QA/QC requirements similar to those outlined in DENR protocols. QA/QC data was encouraged to be submitted.

Deviations from the above criteria were allowed in specific cases, and are generally discussed in the tables listing the 1998 TMDL waterbodies (The 1998 South Dakota 303(d) Waterbody List and Supporting Documentation, 1998).

Use support assessment for all assigned uses was based solely on frequency of violation of water quality standards for any one worst-case of the following parameters: total suspended solids, total dissolved solids, pH, water temperature, dissolved oxygen, unionized ammonia, fecal coliform (May 1 - September 30), metals and others. Violations of more than one parameter were not considered additive in determining overall use-support status for any given waterbody. A stream segment with only a slight exceedance (< 10% violations for one or more parameters) is considered fully supporting. Complete listings of relevant parameters appear in Tables 2 and 3. EPA established the following general criteria in the 1992 305(b) Report Guidelines suitable for determining use support of monitored streams:

Fully supporting	1 - 10% of values violate standards
Partially supporting	11 - 25% of values violate standards
Not supporting	>25% of values violate standards

Use support assessment for fishable (fish and aquatic life propagation) use primarily involved monitoring levels of the following major parameters: dissolved oxygen, unionized ammonia, water temperature and pH, and suspended solids.

State water quality parameters pertinent to assessment of swimmable use (immersion recreation) are the following: fecal coliform (May 1 - September 30) and dissolved oxygen. The pH criterion (pH:6.5 - 8.3) was deleted from state immersion standards in 1993 due to the high natural pH values ($\geq$ 8.0) that characterize most state waters and the rarity of low pH readings

(<7.0) in those same swimmable waterbodies. Fecal coliform and dissolved oxygen are also used to estimate use-support status of limited contact recreation (or secondary contact) waters (Table 2).

Lakes assessed for water quality and trophic state were normally sampled once in spring and summer (June through September) at one to three established sites, dependent on lake size. Separate surface and bottom water samples were collected at each site for determination of 17 standard water quality parameters. Air and water temperature, D.O., pH, and secchi disk visibility were measured on site. Chlorophyll *a* was extracted from 100-400 ml of lake water and analyzed as described by Strickland and Parsons (1968). The remaining parameters were determined at the State Health Laboratory, Pierre, South Dakota, from water samples properly preserved and shipped in ice coolers within 24 hours of collection.

Beginning with the present document, the support status of lakes and reservoirs will be evaluated according to the ecoregions (Level III) in which they are located (Figure 1 and Table 6). The methodology applied to arrive at the use-support determinations shown in Table 6 is found in a recent DENR report (currently under review) entitled <u>Ecoregion Targeting for Impaired Lakes in South Dakota.</u>

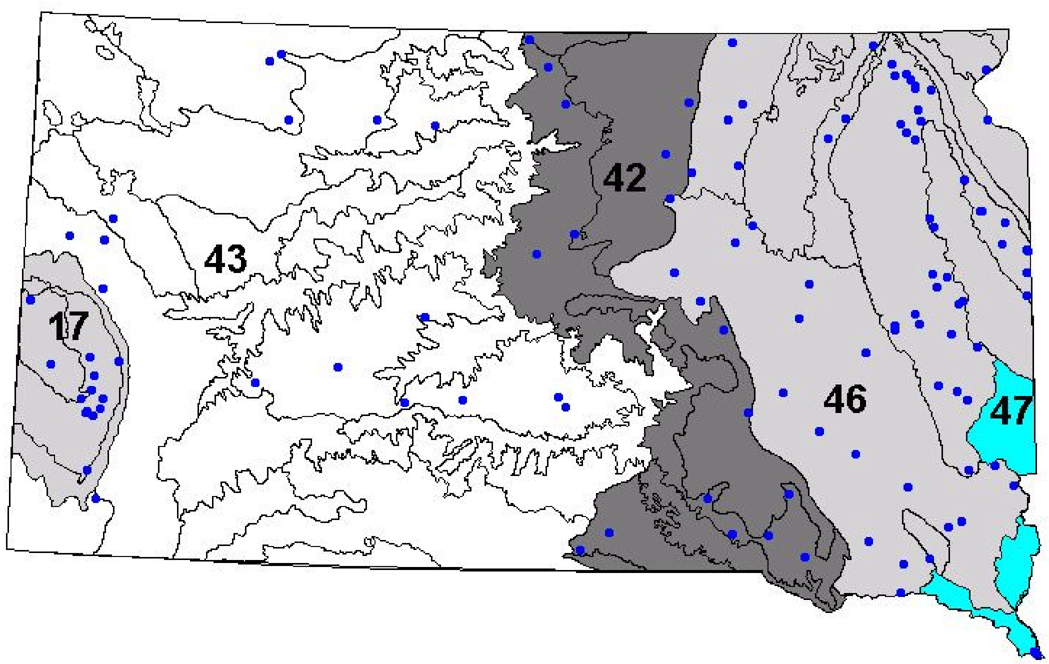


Figure 1. Location and distribution of lakes and reservoirs in South Dakota ecoregions.

Trophic assessment of state lakes was based on trophic status as determined by combining Carlson's (1977) Trophic State Indices (TSI) for secchi depth, total phosphorus and chlorophyll *a*. Use support status of assessed lakes was determined by establishing the following ranges of TSI values to correspond to full, partial, and non support for each ecoregion:

TABLE 6. SOUTH DAKOTA ECOREGIONS SUPPORT DETERMINATION RANGE FOR LAKES.

Ecoregion Support Determination			
TSI Range			
Ecoregion	Fully Supporting	Partially Supporting	Non Supporting
46N (east river natural lakes)	≤ 65.00	≥ 65.01 – ≤ 70.00	≥ 70.01
46R (east river reservoirs)	≤ 65.00	≥ 65.01 – ≤ 75.00	≥ 75.01
42 (Missouri River)	≤ 65.00	≥ 65.01 – ≤ 75.00	≥ 75.01
43 (west river)	≤ 55.00	≥ 55.01 – ≤ 70.00	≥ 70.01
17 (Black Hills)	≤ 45.00	≥ 45.01 – ≤ 60.00	≥60.01

Trends in lake trophic status (short and long term) were estimated primarily by comparison of TSI values and data gathered during the 1989 and 1991-99 DENR lake assessments (Stewart and Stueven, 1996; 1994).

Short term trends for assessed lakes since 1994 were tabulated in the River Basins assessment chapter of this section. A difference of five units or more between respective TSI values was arbitrarily selected as signifying a change in lake water quality between monitoring periods. Long term trends covering the period from 1989 through 1999 are summarized in the Lake Water Quality Assessment chapter of this section.

Long term trends for individual lakes appear in the 1995 South Dakota Lake Assessment Final Report (1996) and Table 15.

In order to ensure a sufficient number of samples was available for each stream segment (usually 20) to arrive at an assessment that would be statistically acceptable, the period of record considered for this 305(b) document was from October 1, 1994 to September 30, 1999 (5 years).

Much of the waterbody information is summarized in Tables 5 through 15. More detailed information on each river basin and the assessed lakes within each drainage is presented in Tables 16 through 30.

For convenience, lake-specific information gathered during the present lake water quality assessment was included in the River Basin Assessments chapter of this section. The lake assessment was based primarily on a state-wide lake survey conducted by DENR from 1994 to 1999. Lakes were chosen on the basis of public ownership, public access, and their inclusion in the 1979 South Dakota Clean Lakes Classification Report (Koth, 1981) and annual DENR Lake Water Quality Assessments from 1989 through 1999 (Stewart and Stueven, 1996; 1994).

C. STATEWIDE SURFACE WATER QUALITY SUMMARY

South Dakota has a total of 9,937 miles of rivers and major streams (Table 1). Major or significant streams in this context are waters that have been assigned aquatic life use support in addition to the beneficial uses of fish and wildlife propagation, recreation, stockwatering and irrigation (9, 10). This definition includes primary tributaries and, less frequently, subtributaries of most state rivers and larger perennial streams. In a few cases, lower order tributaries may be included, for example in the Black Hills area, which has a relatively large number of permanent streams. If all existing and mostly waterless stream channels and gullies are to be included as state waters, the great majority of which serve only to carry snowmelt or stormwater runoff for a week or two during an average year, total stream mileage within South Dakota would greatly exceed the above quoted figure (EPA, 1991).

Approximately 3,564 miles have been assessed, and resulting data evaluated and reported, by DENR, to determine water quality status for an extended period covering the last 5 years (October 1994 to September 1999). Data needed to be evaluated over this longer time span to ensure enough data points were available for each stream segment (usually 20) to properly characterize existing stream conditions. Since for some stream segments only 4 (or fewer) samples were available per year, evaluation of a set of data covering at least 5 years of sampling was required to adequately portray the natural variability in water quality that is typical of stream environments. Moreover, due to recent changes in EPA policy guidelines, the present 305(b) document will be the last such full hard-copy report produced by the state and should therefore serve as a benchmark or reference for future annual electronic reports and abbreviated biennial hard-copy documents recommended in the 1997 guidelines.

Currently, 50% of the assessed stream miles fully support their assigned beneficial uses, 9% are partially supporting, and 41% do not support their uses. The high percentage (50%) of moderate and severe impairment can be attributed largely to high levels of total suspended solids (TSS) present in many of the monitored streams this reporting period as a result of persistent high water conditions in many areas of the state.

During this reporting cycle, 3,250 designated miles were assessed for goal attainment of fishable (aquatic life) use which includes 1,043 miles also assessed for swimmable goal attainment. During this assessment period, 48% of assessed stream miles fully met fishable/aquatic life criteria, whereas 12% partly met, and 40% did not meet fishable/aquatic life criteria. Fifty-eight percent of 1,043 stream miles fully supported swimmable uses, 3% partly met and 39% did not meet swimmable criteria.

Nonsupport was again caused primarily by total suspended solids from agricultural nonpoint sources and natural origin. In terms of total stream miles affected, the second most important cause of impairment this reporting period was elevated fecal coliform (FC) bacteria concentrations. Recently revised figures indicate that non-support due to FC decreased from 64% of swim-rated stream miles for the years 1991-93 to 53% (1993-95) then increased to 67% for 1995-1997. This compares to 53% non-support last monitoring cycle and 39% for the present monitoring period.

Less important causes of impairment this reporting cycle included elevated total dissolved solids concentration (TDS), low dissolved oxygen (DO), elevated stream pH and water temperature, in approximate order of importance. Natural pollutant sources of dissolved and suspended solids are exemplified by erosive soils that occur in western South Dakota and along the Missouri River (including considerable exposed marine shale formations) and in extreme southeastern South Dakota (including large areas of highly erodible loess soils).

In contrast to frequent dry periods that characterized the years 1988 and 1989, large parts of South Dakota experienced above average annual rainfall for most of the past decade. Unusually heavy rainfall and snowmelt runoff during the present and previous reporting periods produced flood conditions over much of eastern South Dakota in the spring and summer of 1993, 1995, and 1997. An increased number of large runoff events in the state from 1991 to 1997 continued to produce a high incidence of severe TSS exceedances during this reporting period. In addition, runoff waters percolating through leachable calcareous soils of normally semi-arid parts of the state also resulted in elevated water pH and dissolved solids concentrations in some monitored river basins. Although the dilutional effects of increased stream flows were probably instrumental in producing a drop in major swimming use violations due to fecal coliform in a few state rivers and streams, apparently a greater opposite effect occurred in lakes with swimming facilities where there was an increased incidence of excessive fecal coliforms in swimming areas during the wet years 1993, 1995, 1997, and 1998.

It has become evident that higher than average annual precipitation can produce considerable suspended sediment problems over large areas of the state particularly in the west and southeast. It is also apparent that fecal coliform concentrations increase significantly in a number of state lakes during times of above normal rainfall. Appropriate best management practices should be applied to treat the sources of these and other impacts whose effects are likely to be masked during periods of low precipitation.

In addition to rivers and streams, South Dakota has 799 publicly owned lakes and reservoirs according to a past GF&P survey, totaling approximately 750,000 acres. Four Missouri River mainstem reservoirs make up 548,000 surface acres or 73% of estimated total lake acreage. Approximately 565 waterbodies are considered significant lakes that are listed in ARSD 74:51:02 and classified for aquatic life and recreation beneficial uses. GF&P presently manages 450 state lakes for fish. Total state water area has been estimated by the South Dakota Conservation Districts as approximately 1.6 million acres.

Approximately 98% of use nonsupport for lakes can be attributed to nonpoint sources. Excluding the four mainstem reservoirs, 16% of the lake acreage assessed is presently considered to support all designated uses. Thirty percent of total lakes acreage partially supports uses, and 54% does not support uses. The results obtained during assessments of the 1990s show moderate improvement in lake use support over data gathered during the late 1980s. This can be partially attributed to the beneficial effects on lake water levels and water quality produced by increased annual rainfall in many parts of the state during the past decade.

Most lakes in the state are characterized as eutrophic to hypereutrophic. They tend to be shallow and turbid and are well-supplied with dissolved salts, nutrients, and organic matter from often sizeable watersheds of nutrient-rich glacial soils that are extensively developed for agriculture. Runoff, carrying sediment and nutrients from agricultural land, is the major nonpoint pollution source.

The water quality of assessed surface waters in South Dakota during this monitoring period is summarized in Tables 7 through 13.

TABLE 7. DESIGNATED OVERALL USE SUPPORT STATUS FOR RIVERS AND STREAMS IN SOUTH DAKOTA

Type of Waterbody: Rivers and Streams (miles)			
Degree of Use Support	Assessment Basis		Total Assessed
	Evaluated	Monitored	
Size fully supporting	-	1,786	1,786
Size partially supporting	-	333	333
Size not supporting	-	1,445	1,445
TOTAL	-	3,564	3,564

TABLE 8. AQUATIC LIFE USE SUPPORT (ALUS) STATUS FOR WADABLE STREAMS AND RIVERS IN SOUTH DAKOTA

Degree of ALUS	Miles Assessed Based on B/H[a] Data Only	Miles Assessed Based on P/C[b] Data Only	Miles Assessed Based on B/H and P/C Data	Total Miles Assessed for ALUS
Fully Supporting	-	1,092	-	1,092
Partially Supporting	-	390	-	390
Not Supporting	-	1,286	-	1,286

Wadable rivers and streams: Missouri River excluded (482 miles)
[a]B/H = Biological/Habitat Data
[b]P/C = Physical/Chemical Water Quality Data
dash (-) = category applicable no data available

TABLE 9. DESIGNATED OVERALL USE SUPPORT STATUS FOR LAKES AND RESERVOIRS IN SOUTH DAKOTA

Type of Waterbody: Lakes and Reservoirs (acres)			
Degree of Use Support	Assessment Basis		Total Assessed
	Evaluated	Monitored	
Size fully supporting	-	22,831	22,831
Size partially supporting	-	41,562	41,562
Size not supporting	-	74,464	74,464
TOTAL	-	138,857	138,857

TABLE 10. INDIVIDUAL USE SUPPORT SUMMARY FOR RIVERS AND STREAMS

Type of Waterbody: Rivers and Streams

Goals	Use	Size Assessed (Miles)	Size Fully Supporting (Miles)	Size Fully Supporting but Vulnerable (mi)	Size Partially Supporting (Miles)	Size Not Supporting (Miles)	Size Not Attainable (Miles)
Protect & Enhance Ecosystems	Aquatic Life[a]	3,250	1,574	*	390	1,286	0
	State Defined	*	*	*	*	*	*
Protect & Enhance Public Health	Fish Consumption	170	170	*	-	-	-
	Shellfishing	*	*	*	*	*	*
	Swimming	1,043	342	*	291	410	0
	Secondary Contact	2,619	2,104	*	232	283	0
	Drinking Water[b]	923	923	*	0	0	0
	State Defined	*	*	*	*	*	*
Social and Economic	Agricultural	3,514	3,397	*	18	99	0
	Cultural or Ceremonial	-	-	*	-	-	-
	State Defined	*	*	*	*	*	*

[a] Waterbodies assessed using chemical/physical data. Frequency of exceedance of individually designated water quality standards (pp. 16 and 28) determines support status for fish and aquatic life in general.

[b] Waterbody meets goal of supplying safe drinking water with conventional treatment.

asterisk (*) = category not applicable
dash (-) = category applicable no data available
zero (0) = category applicable, but size of waters in the category is zero.

TABLE 11. INDIVIDUAL USE SUPPORT SUMMARY FOR LAKES AND RESERVOIRS

Type of Waterbody: Lakes and Reservoirs

Goals	Use	Size Assessed (Acres)	Size Fully Supporting (Acres)	Size Fully Supporting but Vulnerable (A)	Size Partially Supporting (Acres)	Size Not Supporting (Acres)	Size Not Attainable (Acres)
Protect & Enhance Ecosystems	Aquatic Life[a]	138,777	27,444	*	36,934	74,399	0
	State Defined	*	*	*	*	*	*
Protect & Enhance Public Health	Fish Consumption	31,438	31,438	*	0	0	0
	Shellfishing	*	*	*	*	*	*
	Swimming[b]	48,468	48,468	*	0	0	0
	Secondary Contact[c]	48,468	48,468	*	0	0	0
	Drinking Water[d]	5,975	5,975	*	0	0	0
	State Defined	*	*	*	*	*	*
Social and Economic	Agricultural	4,693	-	*	4,693	0	0
	Cultural or Ceremonial	-	-	*	-	-	-
	State Defined	*	*	*	*	*	*

[a] Waterbodies assessed using physical /chemical data and chlorophyll a analysis. Degree of eutrophication (TSI values) determines support status for fish and other aquatic life.
[b] Based on frequency of exceedance of 400/100 ml for fecal coliform.
[c] Based on frequency of exceedance of 2000/100 ml for fecal coliform.
[d] Waterbody meets goal of supplying safe drinking water with conventional treatment.

asterisk (*) = category not applicable
dash (-) = category applicable no data available
zero (0) = category applicable, but size of waters in the category is zero

TABLE 12. TOTAL SIZES OF WATERS IMPAIRED BY VARIOUS CAUSE CATEGORIES IN SOUTH DAKOTA

Type of waterbody: Rivers and Streams (miles)

Cause Category	Size of Waters by Contribution to Impairment (miles)			
	Number of Segments	Major	Moderate	Very Slight (non-impairing)
Cause unknown	-	-	-	-
Unknown toxicity	-	-	-	-
Pesticides	-	-	-	-
Priority organics	-	-	-	-
Nonpriority organics	-	-	-	-
PCBs	-	-	-	-
Dioxins	-	-	-	-
Metals	1	0	2	0
Arsenic	-	-	-	-
Cadmium	1	0	2	0
Cooper	1	0	2	0
Chromium	-	-	-	-
Lead	-	-	-	-
Mercury	-	-	-	-
Selenium	-	-	-	-
Zinc	1	0	2	0
Unionized Ammonia	0	0	0	0
Chlorine	-	-	-	-
Cyanide	1	0	0	4
Sulfates	-	-	-	-
Other organics	-	-	-	-
Nutrients	*	*	*	*
Phosphorus	*	*	*	*
Nitrogen	*	*	*	*
Nitrate	-	-	-	-
Other	-	-	-	-
PH	23	18	25	590
Siltation	-	-	-	-
Organic enrichment/low DO	21	0	71	639
Salinity/TDS/chlorides	5	72	0	275
Elevated temperature	19	10	17	519
Flow alteration	0	0	0	0
Other habitat alterations	0	0	0	0
Pathogen indicators (fecal)	32	636	46	365

TABLE 12. CONTINUED

Type of waterbody: Rivers and Streams (miles)

Cause Category	Size of Waters by Contribution to Impairment (miles)			
	Number of Segments	Major	Moderate	Very Slight (non-impairing)
Radiation	*	*	*	*
Oil and grease	-	-	-	-
Taste and odor	0	0	0	0
Suspended solids (TSS)	54	1259	294	450
Noxious aquatic plants	-	-	-	-
Algal growth/Chlorophyll a	-	-	-	-
Total toxics	-	-	-	-
Turbidity	-	-	-	-
Exotic species	0	0	0	0
Conductivity	4	97	2	52
Alkalinity	1	0	0	89

asterisk (*) = category not applicable
dash (-) = category applicable no data available
zero (0) = category applicable, but size of waters in the category is zero.

TABLE 12. CONTINUED

Type of waterbody: Lakes and Reservoirs (acres)

Cause Category	Size of Waters by Contribution to Impairment (acres)		
	Number of Lakes	Major	Moderate
Cause unknown	-	-	-
Unknown toxicity	-	-	-
Pesticides	-	-	-
Priority organics	-	-	-
Nonpriority organics	-	-	-
PCB's	-	-	-
Dioxins	-	-	-
Metals	1	65	0
Arsenic	-	-	-
Cadmium	-	-	-
Cooper	-	-	-
Chromium	-	-	-
Lead	-	-	-
Mercury	-	-	-
Selenium	1	65	-
Zinc	-	-	-
Unionized Ammonia	0	0	0
Chlorine	-	-	-
Cyanide	-	-	-
Sulfates	-	-	-
Other organics	-	-	-
Nutrients	99	62,869	48,464
Phosphorus	*	*	*
Nitrogen	-	-	-
Nitrate	1	65	0
Other	-	-	-
PH	-	-	-
Siltation	98	62,869	48,399
Organic enrichment/low DO	-	-	-
Salinity/TDS/chlorides	1	0	4,693
Thermal Modifications	-	-	-
Flow alteration	3	0	15,481
Other habitat alterations	0	0	0
Pathogen indicators (fecal)	0	0	0
Radiation	*	*	*

TABLE 12. CONTINUED

Type of waterbody: Lakes and Reservoirs (acres)

Cause Category	Size of Waters by Contribution to Impairment (acres)		
	Number of Lakes	Major	Moderate
Oil and grease	-	-	-
Taste and odor	0	0	0
Suspended solids (TSS)	13	0	11,470
Noxious aquatic plants	10	249	2,160
Algal growth/Chlorophyll a[2]	99	70,752	8,878
Total toxics	-	-	-
Turbidity	13	0	11,470
Exotic species	-	-	-
Conductivity	-	-	-
Alkalinity	-	-	-

asterisk (*) = category not applicable
dash (-) = category applicable no data available
zero (0) = category applicable, but size of waters in the category is zero.
[2]very slight (non-impairing) = 36,286 acres

TABLE 13. TOTAL SIZES OF WATERS IMPAIRED BY VARIOUS SOURCE CATEGORIES IN SOUTH DAKOTA

Type of waterbody: Rivers and Streams (miles)

Source Category	Contribution to Impairment (miles)			
	Number of segments	Major[a]	Moderate	Very slight (non-impairing)
INDUSTRIAL POINT SOURCES	1	0	2	0
MUNICIPAL POINT SOURCES	0	0	0	0
COMBINED SEWER OVERFLOWS	1	1	0	0
AGRICULTURE	48	1036	664	416
-Crop-related Sources	24	946	167	0
--Nonirrigated Crop Production	17	642	92	0
--Irrigated Crop Production	6	285	75	0
-Grazing related Sources	33	874	543	146
--Pasture grazing-Riparian and/or Upland	14	319	92	18
--Range grazing-Riparian and/or Upland	15	547	425	97
-Intensive Animal Feeding Operations	6	196	0	0
OFF-FARM ANIMAL HOLDING/MANAGEMENT AREA	19	394	401	23
SILVICULTURE	6	0	26	99
CONSTRUCTION	1	0	0	5
-Land Development	1	0	0	5
URBAN RUNOFF/STORM SEWERS	10	25	27	61
RESOURCE EXTRACTION	4	0	2	8
LAND DISPOSAL	-	-	-	-
-Onsite Wastewater Systems (Septic Tanks)	0	0	0	0
HYDROMODIFICATION	2	0	0	11
HABITAT MODIFICATION (Other than Hydromodification)	9	200	0	0
-Bank or Shoreline Modification/Destabilization	9	200	0	0
CONTAMINATED SEDIMENTS[b]	1	89	0	0
WATERFOWL	4	0	70	35
RECREATION & TOURISM ACTIVITIES (other than boating)	2	83	0	12
NATURAL SOURCES	35	1,051	124	466
OTHER	-	-	-	-

[a] asterisk (*) = category not applicable
dash (-) = category applicable no data available
zero (0) = category applicable, but size of waters in the category is zero.

[b] bottom sediments contaminated with toxic or nontoxic pollutants; includes historical contamination from sources that are no longer actively discharging.

TABLE 13. CONTINUED

Type of waterbody: Lakes and Reservoirs (acres)

Source Category	Contribution to Impairment		
	Number of Lakes	Major[a]	Moderate[a]
INDUSTRIAL POINT SOURCES		0	0
MUNICIPAL POINT SOURCES		0	0
COMBINED SEWER OVERFLOWS		0	0
AGRICULTURE	88	61,462	39,360
-Crop-related Sources	8	21,889	1,167
--Nonirrigated Crop Production	7	21,749	1,167
--Irrigated Crop Production	1	140	0
-Grazing related Sources	15	7,445	925
--Pasture grazing-Riparian and/or Upland	8	1,907	34
--Range grazing-Riparian and/or Upland	3	0	210
-Intensive Animal Feeding Operations	14	17,224	13,953
OFF-FARM ANIMAL HOLDING/MANAGEMENT AREA	13	18,665	4,049
SILVICULTURE	5	25	414
URBAN RUNOFF/STORM SEWERS	4	1,320	147
-Non-industrial Permitted	1	72	0
RESOURCE EXTRACTION	-	-	-
LAND DISPOSAL	16	8,806	12,312
-Onsite Wastewater Systems (Septic Tanks)	16	8,806	12,312
HYDROMODIFICATION	-	-	-
HABITAT MODIFICATION (Other than Hydromodification)	-	-	-
MARINAS		0	0
HIGHWAY MAINTENANCE AND RUNOFF	4	63	9
CONTAMINATED SEDIMENTS[b]	1	0	16
WATERFOWL	1	0	27
RECREATION & TOURISM ACTIVITIES (Other than Boating)	4	69	9
GROUNDWATER LOADINGS	1	65	0
UNKNOWN SOURCE	1	1,248	0
NATURAL SOURCES	22	8,587	6,633
OTHER		-	-

[a] asterisk (*) = category not applicable
dash (-) = category applicable no data available
zero (0) = category applicable, but size of waters in the category is zero.

[b] bottom sediments contaminated with toxic or nontoxic pollutants; includes historical contamination from sources that are no longer actively discharging.

D. LAKE WATER QUALITY ASSESSMENT

Two major types of assessments were used to determine water quality and use support status of state lakes; one based on current and previous field monitoring (Stewart and Stueven, 1999-1998; 1996; 1994); and the other based on qualitative evaluations, for example, when monitoring data is incomplete or fragmentary from DENR or other agencies, as in the case of the Missouri River mainstem reservoirs.

South Dakota DENR is currently developing a strategy to evaluate lake water quality on an ecoregion basis. This ecoregion effort will require the determination of reference lakes for comparative purposes.

A total of 120 lakes have been sampled in spring and summer from 1989 through 1999. Of the 120 waterbodies assessed, 20 (17%) fully supported their designated uses, 39 (32%) partially supported, and 61 (51%) failed to support their assigned uses. In recent years, water quality of the four mainstem Missouri River Reservoirs has been monitored by the US Army Corps of Engineers. Lack of adequate recent data had precluded continuation of their assessment for 305(b) reporting. The monitoring status of the mainstem reservoirs and downstream Missouri River waters remains undetermined at the present time. In 1999, DENR resumed quarterly sampling of powerhouse effluents of the four mainstem reservoirs. This report will treat both the mainstem reservoirs and their downstream reaches of flowing water as lengths of river totaling 482 miles within the state. The remaining lakes in Table 14 (710) do not meet the criteria for assessment listed below.

The lakes included in lake assessment sampling include all lakes in the state that meet the following criteria:

1. A lake must be publicly owned.
2. A lake must have public access.

Privately owned lakes are currently not being assessed by DENR.

The mainstem Missouri River Reservoirs have a total combined surface area of 548,000 acres. Five other lakes in South Dakota with a surface area greater than 5,000 acres have a combined surface area of 61,279 acres. The total surface acreage of assessed lakes less than 5000 acres in area amounted to 81,229 acres in the previous 305(b) report.

Carlson's (1977) Trophic State Indices (TSI) were used to determine trophic status of the lakes which were assessed from 1989 through 1999. The parameters used included Secchi depth, total phosphorus and chlorophyll *a*. Carlson's Indices were selected because of ease of use and to ensure continuity with past 305(b) reports. Carlson's Indices were also used to determine short term (5-year) trends in lake water quality.

Of 89 lakes monitored during the last five years (Table 14) none were rated as oligotrophic and 10 as mesotrophic. Thirty-one lakes in Table 14 were considered to be eutrophic and forty-eight were hyper-eutrophic.

TABLE 14. TROPHIC STATUS OF SIGNIFICANT PUBLICLY OWNED LAKES

	Number of Lakes	Acreage of Lakes
Total	799	750,000
Assessed*	89	109,468
Oligotrophic	0	0
Mesotrophic	10	20,576
Eutrophic	31	14,276
Hypereutrophic	48	74,616
Dystrophic	0	0
Unknown	710	640,532

*October 1, 1994 to September 30, 1999

The major problems of South Dakota lakes continue to be excessive nutrients, algae, and siltation due to nonpoint source pollution (primarily agricultural). Water quality degradation due to acid precipitation, acid mine drainage, or toxic pollutants does not presently appear to be a significant problem in South Dakota lakes. Lake-specific data is tabulated in the River Basin Assessments section.

Clean Lakes Program

The South Dakota Clean Lakes Program is a two-phased effort designed to first identify sources of pollution and determine alternative restoration methods; and second to control the sources of pollution and restore the quality of impacted lakes. Both phases of the program are state and local efforts, with supplemental technical and financial assistance from EPA and other federal agencies used whenever possible.

The Lake/Watershed Assessment phase of the program encompasses a series of procedures to assess the current condition of selected water bodies. Included in this phase are water quality, water quantity and watershed data collection sub-programs. The state provides the local sponsor with technical assistance, training, and equipment to conduct the assessment portion of the project. Generally, the local project sponsor is responsible for collecting the data using 319 and state grant funding and existing local resources. Following the collection of sufficient data, the state evaluates the data and prepares a report which details baseline information, identifies sources of pollution, describes alternative pollution control methodologies and outlines implementation costs. A TMDL is developed using this information.

Prior to the implementation of specific pollution control and restoration alternatives, the project sponsor is responsible for the preparation of a complete pollution control and lake restoration plan based on recommendations from the assessment. Technical assistance for this process is provided by the state. If the plan is approved, the project sponsors are eligible to apply for appropriate state and federal funding.

The vast majority of the pollution sources affecting the lakes in South Dakota are agricultural nonpoint sources. The methods used to control these sources are selected on a case-by-case basis. The selection of methods is based on the evaluation of individual watersheds using the Agricultural Nonpoint Source Model (USDA-ARS, 1994) or a manual inventory of land use, soil type and nonpoint sources. The AGNPS model delineates critical cells within the watershed and is then used to predict which control methods would be the most effective.

Following this evaluation, coordination with state and federal agricultural agencies is solicited to verify the critical nature of the identified cells and the selected control methods. For those areas targeted as critical, the owner/operators are contacted to request their voluntary participation in the control program. The state does have in effect the Sediment and Erosion Control Act of 1976 which is implemented by individual state conservation districts. However, any action under the Act is based strictly in response to complaints. There are no provisions for forcing compliance on identified problem areas. Specific practices currently recommended for nonpoint source pollution control include the full range of Best Management Practices (BMP) both mechanical and managerial, large and small sediment control structures, shoreline erosion control and the installation of manure management systems. The SD DENR Surface Water Discharge program (SWD) prohibits discharge to lakes. The Department monitors communities and ensures compliance. In the instances where point source pollution may occur, Best Available Technology is applied to correct the problem.

Lake management in South Dakota is dependent upon many resource management programs and agencies. The Department of Agriculture, Surface Water Quality Program, Petroleum Release Program, Ground Water Quality Program, U.S. Natural Resources Conservation Service, Department of Game, Fish and Parks and many local agencies and special purpose districts are all crucial to the protection or restoration of lakes in the state. All of the above mentioned programs have linkages to components of many different types of projects. Land use ordinances exist in South Dakota as local and county zoning ordinances. These vary from comprehensive to nonexistent in the state and are considered local issues.

In conjunction with the development of recommended pollution control alternatives, the diagnostic/feasibility study data evaluation is also designed to provide recommendations for in-lake restoration alternatives. The primary recommendations provided for lake restoration range from natural flushing, reducing or eliminating sources of pollution, to sediment removal by dredging, depending on what is appropriate. Restoration methods employed in the past include aeration, sediment removal, weed harvesting and chemical weed control and some preliminary attempts at biomanipulation. For a complete list of restoration methods that have been employed to date, refer to Table 15.

TABLE 15. LAKE REHABILITATION TECHNIQUES

Rehabilitation Technique	Number of Lakes Where Technique Has Been Used	Acres of Lakes Where Technique Has Been Used
IN-LAKE TREATMENTS		
Phosphorus Precipitation/Inactivation	0	0
Sediment Removal/Dredging	15	4,275
Artificial Circulation to Increase Oxygen	5	3,471
Aquatic Macrophyte Harvesting	5	16,137
Application of Plant Herbicides (including copper sulfate)	9	17,353
Lake Level Drawdown	5	386
Hypolimnetic Withdrawal of Low DO Water	0	0
Dilution/Flushing	0	0
Shading/Sediment Covers or Barriers	0	0
Destratification	0	0
Sand or Other Filters to Clarify Water	0	0
Food Chain Manipulation	1	9
Biological Controls	2	44
Other In-lake Treatment (Specify) Community Collection Wastewater Systems	10	19,645
Other In-lake Treatment (Specify) Rough Fish Harvesting	13	50,295
WATERSHED TREATMENTS		
Sediment Traps/Detention Basins	2	1,359
Shoreline Erosion Controls/Bank Stabilization	15	37,728
Diversion of Nutrient Rich In-Flow	0	0
Conservation Tillage Used	All Lakes	750,000
Integrated Pest Management Practices Applied	0	0
Animal Waste Management Practices Installed	18	39,040
Porous Pavement Used	0	0
Redesign of Streets/Parking Lots to Reduce Runoff	0	0
Road or Skid Trail Management	4	14,285
Land Surface Roughening for Erosion Control	0	0
Riprapping Installed	4	17,510
Unspecified Type of Best Management Practice Installed	All Lakes	750,000

TABLE 16. LIST OF SECTION 314 CLEAN LAKES PROGRAM PROJECTS

Name of Project	Type of Project	Federal Funding ($)	Problems Assessed	Management Measures Proposed or Undertaken
Lake Cochrane	Phase II	$20,500	Sedimentation	Access road management and sediment traps
Oakwood Lakes	Phase II	$35,000	Shoreline Erosion	Rip-Rap on lakeshore
Lake Kampeska	Phase II	$70,000	Shoreline Erosion	Rip-Rap on lakeshore
Lake Herman	Phase II	$475,126	Sedimentation	Dredged Lake
Big Stone Lake	Phase I	$100,000	Nonpoint Source Sediment/nutrient	BMP's, Feedlot, Municipal sewage
Big Stone Lake	Phase II	$381,500	Nonpoint Source Sediment/nutrient	BMP's, Animal Waste, Municipal sewage
1989 Lake Water Quality Assessment	LWQA	$100,000	Statewide Assessment	Statewide Assessment
Lake Hendricks	Phase I	$100,000	Nonpoint Source Sediment/nutrient	BMP's, Animal Waste
Lake Campbell	Phase I	$100,000	Nonpoint Source Sediment/nutrient	BMP's, Animal Waste
Swan Lake	Phase I	$100,000	Nonpoint Source Sediment/nutrient	Dredge, channel diversion
McCook Lake	Phase II	$110,422	Sedimentation	Dredge
Burke Lake	Phase II	$35,000	Sedimentation	Dredge
Wall Lake	Phase II	$303,310	Sedimentation	Dredge
1991-92 Lake Water Quality Assessment	LWQA	$60,000	Statewide Assessment	Statewide Assessment
Punished Woman Lake	Phase II	$240,000	Sedimentation	Dredge
Lake Kampeska	Phase I	$100,000	Nonpoint Source Sediment/nutrient	BMP's, Animal Waste
Lake Poinsett	Phase I	$94,890	Nonpoint Source Sediment/nutrient	BMP's, Animal Waste
1993 Lake Water Quality Assessment	LWQA	$50,000	Statewide Assessment	Statewide Assessment
1994 Lake Water Quality Assessment	LWQA	$52,000	Statewide Assessment	Statewide Assessment
Lake Madison /Brant	Phase I	$100,000	Nonpoint Source Sediment/nutrient	BMP's, Animal Waste
Elm Lake	Phase I	$100,000	Nonpoint Source Sediment/nutrient	BMP's, Animal Waste

Active 319 Lake Assessment projects in South Dakota include the following lakes:

Lake Cochrane/Oliver - federally funded
Lake Louise/Cottonwood Lake - federally funded
Mina Lake - federally funded
Lake Alvin - federally funded
White Lake Dam – federally funded
Loyalton Dam – federally funded
Cresbard Lake – federally funded
Dante Lake – federally funded
Lake Andes – federally funded
Platte Lake – federally funded
Geddes Lake – federally funded
Academy Lake – federally funded
Corsica Lake – federally funded
Fate Dam – federally funded
Brakke Dam – federally funded
Jones Lake – federaly funded
Rosehill Lake – federally funded
Oakwood Lakes – federally funded

Clean Lakes implementation is accomplished by many different funding sources, as described above (Table 16).

Impaired Lakes

A description of impaired lakes is included in the section of this report titled River Basin Assessments. The lakes are listed by their location in each major river basin in the state.

The South Dakota Surface Water Quality Standards (SD SWQS) ARSD Article 74:51 do apply to 799 lakes in the state. Each of the lakes is named in the standards and assigned beneficial uses. The beneficial uses assigned to lakes include at least one of the following:

Domestic Water Supply
Coldwater Permanent Fish Life Propagation
Coldwater Marginal Fish Life Propagation
Warmwater Permanent Fish Life Propagation
Warmwater Semipermanent Fish Life Propagation
Warmwater Marginal Fish Life Propagation
Immersion Recreation
Limited Contact Recreation
Fish and Wildlife Propagation, Recreation and Stock Watering
Irrigation
Commerce and Industry

Standards for toxic substances are in accordance with the SD SWQS.

Acid Effects on Lakes

During the Lake Water Quality Assessment, each lake was measured for field pH. As a result of this monitoring, no lakes have been found to have pH levels less than 7.00 SU (standard units). The state is not aware of any lakes in South Dakota that are currently being impacted by acid deposition (Table 17). This is attributed to a lack of industrialization and a natural buffering capacity of the soils.

TABLE 17. ACID EFFECTS ON LAKES

	Number of Lakes	Acreage of Lakes
Assessed for Acidity	112	132,159
Impacted by High Acidity	-0-	-0-
Vulnerable to Acidity	-0-	-0-

Trends in Lake Water Quality

Trends were determined for South Dakota lakes using information collected during the 1989 - 1999 Lake Water Quality Assessments. Chlorophyll *a*, total phosphorus, and Secchi depth were used to calculate trophic state using Carlson's Trophic State Index. A mean annual TSI was calculated for each year the lakes were sampled with information from the 1979 South Dakota Lakes Survey as a base. The trophic state indices were plotted on a graph and a regression calculated for the data points to determine trends. Table 18 is a summary of trends in water quality of South Dakota public lakes. Approximately 565 state lakes are presently listed in ARSD 74:51:02 as having been assigned beneficial uses other than stock watering and wildlife propagation (9).

TABLE 18. TRENDS IN PUBLIC LAKES (1989-1999)

	Number of Lakes	Acreage of Lakes
Assessed for Trends	136	169,291
Improving	44	59,515
Stable	43	44,061
Degrading	24	28,980
Trend Unknown	25	36,735

E. RIVER BASIN ASSESSMENTS

<u>Introduction</u>

South Dakota has fourteen major river basins, most of which drain into the Missouri River (Figure 2). The following sections contain brief narratives that discuss noteworthy waterbodies and pollution problems. A detailed state map showing assessed lakes and streams provides general use support information (Figure 3). More specific information is provided in the accompanying river basin tables for the monitored waterbodies in each river basin that is identified in Figure 2 and shown in outline in Figure 3.

Much of the information necessary for River Basin Assessments is obtained from the state stream ambient monitoring program. This fixed ambient network presently consists of 134 active in-stream stations. The collected data is evaluated to define water quality in the state, identify pollution, and report changes in the state's water quality.

Sampling station locations are determined by assessing areas located within high quality beneficial use classifications, located above and below municipal/industrial discharges, or within problem watersheds. Currently, DENR collects samples at those locations on either a monthly or quarterly basis for nutrient, bacterial, and general physical and chemical parameters. Stations which are located along mine drainages are also analyzed for cyanide and ten metals including arsenic. Several stations are sampled for sodium, calcium, and magnesium during the irrigation season. The samples are shipped in ice containers to the laboratory for analysis. Sample test results are then entered into STORET. This type of water sampling is used to monitor historical information, natural background conditions, possible runoff events, and as an indication of possible acute or chronic water quality problems.

Lake monitoring within each river basin is conducted in conjunction with the Watershed Assessment Program, diagnostic/feasibility studies, and special lake studies. Many of the standard parameters measured in streams are also evaluated for state lakes with the addition of secchi disk visibility, chlorophyll *a* level, oxygen/water temperature profiles, total phosphorus, and total volatile solids. Similarly, in the course of sampling lakes as well as streams, any pollution sources or environmental conditions which may affect water quality are noted by field personnel. Unlike stream evaluations, however, lake trophic state and trends in lake trophic condition are estimated with Carlson's (1977) Trophic State Indices (TSI). Short term (5-year) trends in lake trophic status are summarized in Tables 20 to 33.

Baseline data show whether or not a waterbody is meeting its assigned water quality beneficial uses. A description of the procedure involved is found in the methodology section of this document. Baseline data evaluations are used as a management tool to determine the effectiveness of control programs on existing point and nonpoint sources and for directing future control activities.

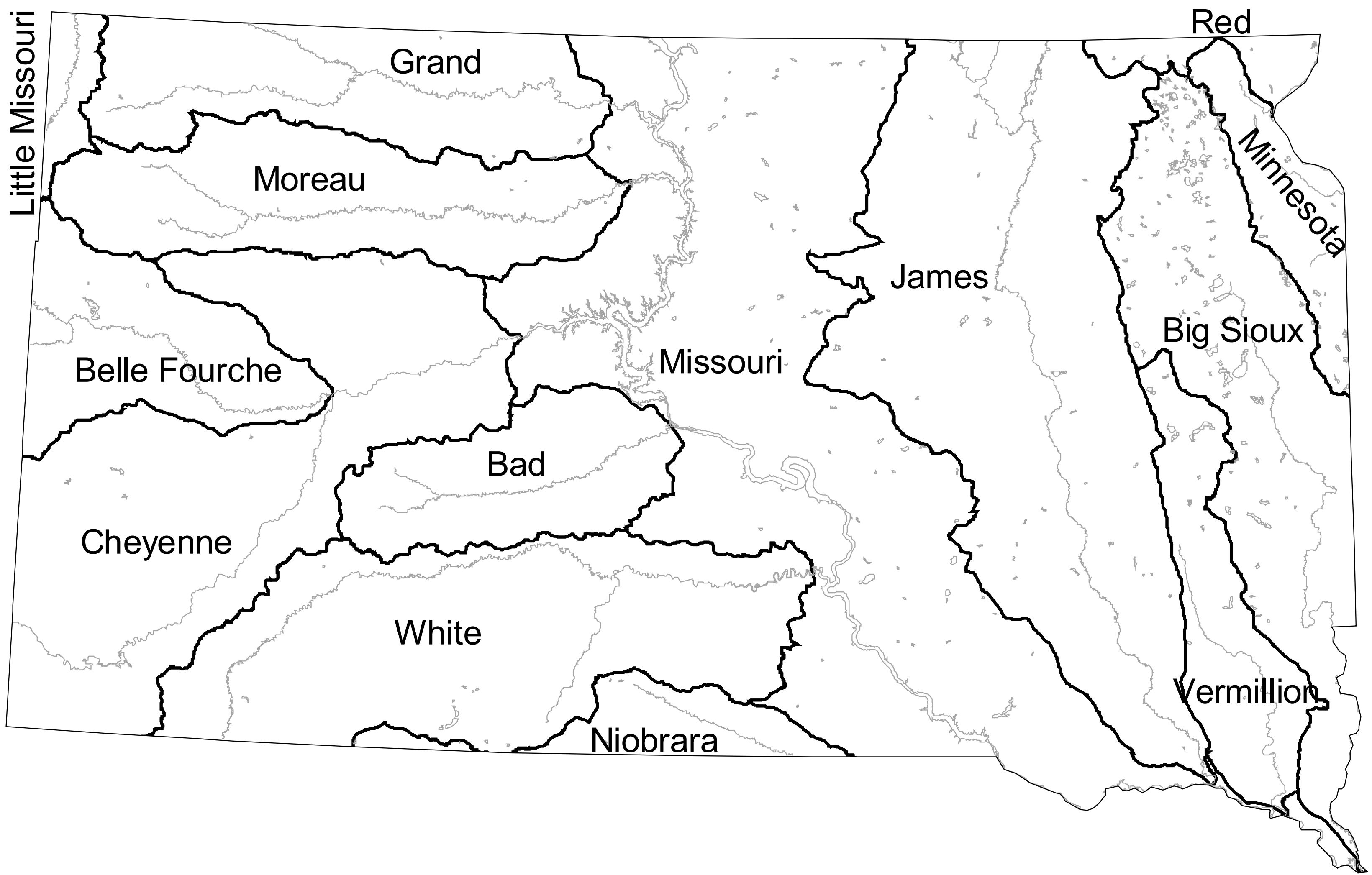
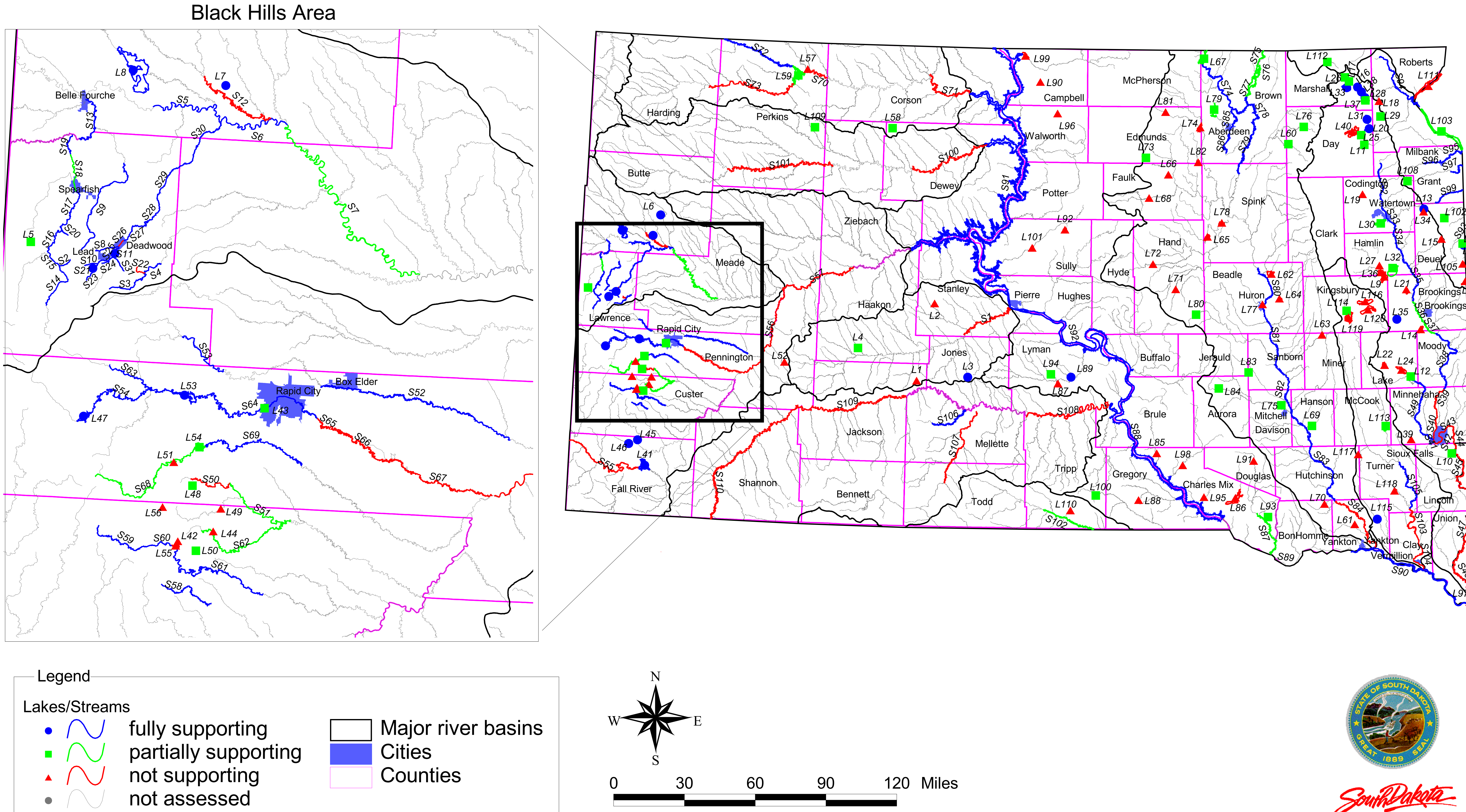


Figure 2. Major River Basins in South Dakota

2000 South Dakota Waterbody Support Status



Created: 03/21/2000 by LWS, South Dakota DENR

Figure 3

BACK OF FOLDOUT MAP

TABLE 19. KEYS FOR RIVER BASIN INFORMATION TABLES

Name -	Name of waterbody
Location -	Best available description
Size -	Best available estimate of entire waterbody size, lakes in acres and rivers in miles. (Impacts were assumed to affect the entire waterbody unit).
Assessment method -	M = monitored
Basis -	Monitoring agency/program and sampling site identification/WQM number.

Cause for impaired uses -		
	Unknown toxicity	Phosphorus
	Pesticides	Nitrogen
	Atrazine	Nitrate
	Priority organics	Other
	Nonpriority organics	pH
	Dioxins	Siltation
	Metals	Organic enrichment/DO
	Arsenic	Salinity/TDS/chlorides
	Cadmium	Thermal modifications
	Copper	Flow alteration
	Chromium	Other habitat alterations
	Lead	Pathogens
	Mercury	Radiation
	Selenium	Oil and grease
	Zinc	Taste and odor
	Ammonia	Suspended solids
	Chlorine	Noxious aquatic plants
	Cyanide	Algal growth/chlorophyll a
	Sulfates	Total toxics
	Other inorganics	Turbidity
	Nutrients	Exotic species
		Conductivity
	H = High relative contribution (non support)	
	M = Moderate relative contribution (partial support)	
	T = Very slight relative contribution (full support)	

TABLE 19. CONTINUED.

Source categories -

Point Sources
- Controlled by permit
- Industrial
- Municipal
- Municipal Pretreatment (indirect dischargers)
- Combined sewer (end-of-pipe)
- Storm sewers (end-of-pipe)

Nonpoint Sources (unspecified)

Agriculture
- Non-irrigated crop production
- Irrigated crop production
- Specialty crop production (e.g., truck farming and orchards)
- Pasture land
- Range land
- Feedlots - all types
- Aquaculture
- Animal holding/management areas

Silviculture
- Harvesting, restoration, residue management
- Forest management
- Road construction/maintenance

Construction
- Highway/road/bridge
- Land Development

Urban Runoff
- Storm sewers
- Combined sewers
- Surface runoff

Resource Extration/Exploration/Development
- Surface mining
- Subsurface mining
- Dredge mining
- Petroleum activities
- Mill tailings
- Mine tailings

TABLE 19. CONTINUED.

Land Disposal (Runoff/Leachate from Permitted Areas)
- Sludge
- Wastewater
- Landfills
- Industrial land treatment
- On-site wastewater systems (septic tanks, etc.)
- Hazardous waste

Hydromodification
- Channelization
- Dredging
- Dam construction
- Flow regulation/modification
- Bridge construction
- Removal of riparian vegetation
- Streambank modification/destablization

Other
- Atmospheric deposition
- Waste storage/storage tank leaks
- Highway maintenance and runoff
- Spills
- In-place contaminants
- Natural
- Recreational activities
- Source Unknown

Magnitude: H = High, M = Moderate, T = Very Slight

Trend (5-year):
S = stable, D = degrading, I = improving, V = vulnerable, U = unknown

Support status (lakes and streams):
full = full support, partial = partial support, non = non-support

Trophic Status for Lakes:

Carlson's TSI	Trophic Status
00-35	oligotrophic = O
36-50	mesotrophic = M
51-55	moderately eutrophic = ME
56-65	eutrophic = E
66-100	hypereutrophic = H

The Vermillion River Basin (Figures 2 and 3, Table 20).

The Vermillion River basin covers an area of 2,652 square miles in southeastern South Dakota. The basin is about 150 miles in length and varies in width from 12 miles in the north to 36 miles in the south. Much of the lower 22 miles of the river is channelized. The major economic pursuit is agriculture. It is estimated that 96 percent of the total surface area is devoted to agriculture. That leaves the remaining areas for municipalities, sand and gravel operations, lowland areas, and other uses.

The Vermillion River basin experienced extended periods of above normal rainfall from 1992 through 1998 that resulted in flooding during spring and summer of 1993, 1995, and to some extent, in 1997 and 1998. These high water conditions produced increased siltation and sedimentation to local waterbodies.

The water quality of the basin is usually marginal for designated beneficial uses, most often the result of elevated total suspended solids (TSS). During the early 1990s (1991-1995) the warmwater fishery use continued to be impacted by excessive TSS which represented the sole cause of non-support for the entire drainage. Moderate increases in TSS were noted during 1995-1997 which was a similarly wet period in the watershed. Total dissolved solids (TDS) showed a moderate decline during the course of the decade although there was little change in water pH between reporting cycles. A moderate impairment for secondary contact was noted in the upper and lower reach of the river due to elevated fecal coliform numbers in the second half of the 1990s. This rating resulted from an increase in bacteria numbers after September 1995.

Overall water quality in the basin has remained relatively stable since 1986 with moderate fluctuations in TSS during most years and a decline in fecal coliform concentrations from the levels reported in 1986. The present evaluation of the lower fifth of the river course (Table 17) covered the last 5 years of accumulated data and resulted in a rating of non-support due to excessive TSS and moderate impairment owing to elevated fecal coliform bacteria concentrations similar to last assessment. This reporting period, the upper half of the river course recorded no impairments, and the middle reach (34 miles) failed to meet water quality standards due to high TSS. Elevated fecal coliform was a minor impairment in this segment.

Eight lakes in the basin have been assessed during the last decade: Lake Preston, Whitewood Lake, Swan Lake, Silver Lake, Lake Thompson, Lake Vermillion, Lake Marindahl and Lake Henry. All but one lake are highly eutrophic (TSI: 67-85) with algae, nutrient enrichment and siltation being major causes of nonsupport. Lake Marindahl currently ranks as eutrophic (TSI: 59). Siltation and sedimentation problems are particularly severe at Lake Vermillion (TSI: 70) owing to its large watershed (>260,000 acres) comprised mostly of cropland. Although Lake Vermillion showed comparatively little change in annual TSI values in the mid 1990s, fecal coliform bacteria levels at Lake Vermillion swimming areas exceeded 200 colonies/100ml twelve times in 1993 but only three times for 1994-1995 and six times from 1996 to 1997 (1996 and 1998 305(b). Only one exceedance was recorded from 1998 through 1999 (Tables 37 and 38). According to the most recent TSI value (70), Lake Vermillion is partially supporting designated beneficial uses.

Resident response within this basin indicated local lakes were not meeting their swimmable uses due to excessive algal/macrophyte growth and deterioration of beaches by siltation. Eutrophication in this river basin is accelerated by a large number of feedlots and/or animal holding/management areas, erosion runoff from fertilized cropland, and stream bank erosion.

An implementation Phase II project, which included hydraulic dredging of lake sediments and watershed management measures, has been completed at Swan Lake. The volume of sediment removed by the end of 1997 totaled 345,000 cubic yards with another 45,000 cu. yds. estimated to have been removed in 1998.

TABLE 20 : VERMILLION RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Streams								
Vermillion River	Turkey Ridge Creek to Baptist Creek	S103	33.7 miles	non	DENR460755	Pathogens [T] Suspended solids [H]	Agriculture [H] Crop-related Sources [H] Nonirrigated Crop Production [H] Grazing related Sources [H] Pasture grazing - Riparian and/or Upland [H] Off-farm Animal Holding/Management Area [H] Habitat Modification [H] Bank or Shoreline Modification/Destabilization [H]	D
	Baptist Creek to mouth	S104	19.4 miles	non	DENR460745	Pathogens [M] Suspended solids [H]	Agriculture [H] Crop-related Sources [H] Nonirrigated Crop Production [H] Grazing related Sources [H] Pasture grazing - Riparian and/or Upland [H] Off-farm Animal Holding/Management Area [H] Habitat Modification [H] Bank or Shoreline Modification/Destabilization [H]	S
	Headwaters to Turkey Ridge Creek	S105	43.9 miles	full	DENR460149			U
Lakes								
East Vermillion Lake	McCook County	L113	550.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M]	Agriculture [M]	D

TABLE 20 : VERMILLION RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Lakes								
East Vermillion Lake	McCook County	L113	550.0 acres	partial/H	Lake assessment	Algal Grwth/Chlorophyll a [M]		D
Lake Henry	Kingsbury County	L114	1156.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [M]	Agriculture [M]	U
Marindahl Lake	Yankton County	L115	139.0 acres	full/E	Lake assessment			S
Lake Preston	Kingsbury County	L116	5222.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Suspended solids [M] Algal Grwth/Chlorophyll a [H] Turbidity [M]	Agriculture [H] Intensive Animal Feeding Operations [H]	I
Silver Lake	Hutchinson County	L117	393.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [H]	Agriculture [H]	D
Swan Lake	Turner County	L118	208.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Suspended solids [M] Algal Grwth/Chlorophyll a [M] Turbidity [M]	Agriculture [H] Land Disposal [H] Onsite Wastewater Systems [H]	U
Lake Thompson	Kingsbury County	L119	16236.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [H]	Agriculture [H] Crop-related Sources [H] Nonirrigated Crop Production [H] Off-farm Animal Holding/Management Area [H]	U
Whitewood Lake	Kingsbury County	L120	4967.0 acres	non/H	Lake assessment	Nutrients [H]	Agriculture [H] Crop-related Sources [H] Nonirrigated Crop Production [H] Intensive Animal Feeding Operations [H]	U

TABLE 20 : VERMILLION RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Lakes								
Whitewood Lake	Kingsbury County	L120	4967.0 acres	non/H	Lake assessment	Siltation [H] Algal Grwth/Chlorophyll a [H]		U

Big Sioux River Basin (Figures 2 and 3, Table 21).

The Big Sioux River basin is located in eastern South Dakota. The lower portion of the river forms the Iowa-South Dakota border. The basin drains an approximate 4,280 square miles in South Dakota and an additional 3,000 square miles in Minnesota and Iowa. The adjacent Big Sioux Coteau contains an additional non-contributing 1,970 square miles. The basin's primary source of income is agriculture, but it also contains a majority of the state's light manufacturing, food processing, and wholesaler industries. Four state education institutions, many vocational schools, and Sioux Falls, the state's largest city, are located within this basin making this the heaviest populated region in the state.

DENR presently maintains 17 active water quality sampling sites on the Big Sioux River and one site on the lower Skunk Creek tributary in Sioux Falls. Most of the fixed stations are representative of the various segments of the 395-mile length of the monitored river and are located from Watertown in Codington County south to Richland in Union County, the last downstream site.

The lower half of the Big Sioux River is not supporting its fishable (aquatic life) and/or swimmable beneficial uses at the present time. Major impairments have been total suspended solids (TSS) and fecal coliform bacteria. About 42% of the upper river is fully supporting and 8% partially supporting due to excessive TSS.

The upper reach of the Big Sioux River, from the headwater to the vicinity of Volga, SD, fully supported its assigned beneficial uses during the present and previous assessment. Minor exceedances in this 105-mile reach (27% of total river mileage) were TSS, FC, pH, and DO.

The next stream segment downstream (32 miles) centered on Brookings, SD, partially supported beneficial uses due to excessive TSS. The next reach (BS18) covering 61 miles above Dell Rapids, SD, fully supported uses although TSS may also be a moderate concern in this reach. Since BS18 is a newly established site, more samples will have to be collected in the future to properly evaluate use-support status.

Downstream, from Dell Rapids to Sioux Falls, excessive fecal coliform was the cause of major impairment (non-support). In addition, elevated total suspended solids were a source of moderate impairment in this 44-mile reach. The same type and level of impairment were noted last assessment period in this stream segment.

In the Sioux Falls area and immediately downstream (from approximately 1 mile below the Morrell and Sioux Falls diversion ditch discharges to above Brandon, SD) the 23-mile representative segment was non-supporting due to high fecal coliform levels. TSS concentrations were a moderate impairment.

The downstream 35-mile segment from Lake Alvin to Fairview, SD is monitored by site WQM 65 located about 3 miles upstream of Canton, SD. This reach failed to support its beneficial uses due to excessive TSS and fecal coliform bacteria.

The lowermost segment of the Big Sioux River from approximately 15 miles downstream of Canton, South Dakota, to the Missouri River confluence, a distance of 95 river miles, continues to be non-supporting of its assigned uses due to excessive TSS and excessive fecal coliform. Sources of fecal coliform in the lower Big Sioux (Lincoln/Union County) may be discharges of wastewater from upstream city sewers, individual rural farmsteads/dwellings and runoff from feedlots/animal holding sites. During periods of high precipitation discharges from storm sewers and emergency bypasses of municipal wastewater facilities may be contributors of fecal coliforms to the Big Sioux River.

Sediment sources are overland runoff from nearby croplands and feedlots, inflow from tributaries, and considerable streambank erosion. Potential for severe soil erosion appears to be particularly high in a 50-mile reach of the Big Sioux south of Canton, SD, where the river channel borders an extensive hilly area of highly erosive soils. This situation promotes bank erosion and high sediment runoff in the Big Sioux and tributaries in the area.

Skunk Creek near Sioux Falls is presently supporting its beneficial uses. Last reporting period, Skunk Creek was also fully supporting.

With one or two possible exceptions, lakes in the Big Sioux River basin are eutrophic to varying degrees due to algae, nutrient enrichment, and siltation. Seventy-five percent of the monitored lakes can be considered hypereutrophic (highly eutrophic) at the present time. Moreover, trends point to continued and noticeable nutrient enrichment for the long term due to several factors: the moderate size of some of the waterbodies but particularly the shallow average depth of most of the basin lakes makes them more susceptible to rapid changes produced by large nutrient and sediment loads from often sizeable agricultural watersheds comprised of nutrient-rich glacial soils.

Forty-four percent of the 32 monitored lakes in the Big Sioux River basin are presently considered non-supporting for assigned beneficial uses. Thirty-one percent are partially supporting and 25% are fully supporting of designated uses. Comparison of lake TSI values with those of the previous assessment (available for 12 lakes) indicated that only two lakes, Blue Dog Lake and East Oakwood Lake, had perceptably improved in water quality since the early to mid 1990s. Three lakes showed an apparent decline (higher TSI values) – Enemy Swim Lake, Lake Campbell, and Lake Alvin. Water quality in seven lakes (58%) remained comparatively stable over the second half of the last decade.

Watershed management programs are attempting to reduce sediment and nutrient loads from both cultural and natural sources within the basin. Completion of the Watertown WWTP upgrade in late 1997 has eliminated yet another significant source of ammonia and bacteria to the Upper Big Sioux River.

Projects currently underway include a watershed and lakeshore stabilization for Lake Kampeska in the Upper Big Sioux Watershed Project (Phase I); and expansion of a completed central wastewater collection system for the residents of Lake Poinsett. In addition, an assessment has been completed for this large lake and its drainage. Four assessments have also been completed for Lakes Pelican, Madison/Brant, Blue Dog Lake, and Clear Lake (Deuel Co.). Pelican Lake has been included with Lake Kampeska in the Upper Big Sioux River Watershed Project (Phases I and II) with availability of funding from 319 grants. The Lake Pelican project has recently completed construction of an inlet control structure whose purpose is to prevent poor quality water from the

Big Sioux River from entering the lake during peak flows (>1000 cfs) of flooding events. The construction of a similar structure for Lake Kampeska is presently under discussion among several agencies. The Lake Campbell/Battle Creek Watershed Implementation Project has also been completed. A four-year sediment removal (dredging) project in Wall Lake was completed in late October 1993. More than 1.6 million cubic yards of sediment were removed from 90% of the lake basin.

TABLE 21 : BIG SIOUX RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Streams								
Big Sioux River	SE of Ortley to Lake Kampeska	S32	31.3 miles	full	DENR46BSA1			S
	Lake Kampeska to Willow Creek	S33	9.6 miles	full	DENR460655	Organic enrichment/Low DO [T]	Off-farm Animal Holding/Management Area [T] Natural Sources [T]	S
						Pathogens [T]		
	Willow Creek to Stray Horse Creek	S34	22.4 miles	full	DENR460740	pH [T]	Urban Runoff/Storm Sewers [T]	S
						Organic enrichment/Low DO [T]		
						Suspended solids [T]		
	Stray Horse Creek to near Volga	S35	42.0 miles	full	DENR46BS08	Suspended solids [T]	Agriculture [T]	S
	Near Volga to Brookings	S36	16.6 miles	partial	DENR460662	Organic enrichment/Low DO [T]	Agriculture [M] Crop-related Sources [M] Nonirrigated Crop Production [M] Grazing related Sources [M] Pasture grazing - Riparian and/or Upland [M] Off-farm Animal Holding/Management Area [M]	S
						Suspended solids [M]		
	Brookings to I-29	S37	15.2 miles	partial	DENR460702	Organic enrichment/Low DO [T]	Agriculture [M] Crop-related Sources [M] Nonirrigated Crop Production [M] Grazing related Sources [M] Pasture grazing - Riparian and/or Upland [M] Off-farm Animal Holding/Management Area [M]	S
						Pathogens [T]		
						Suspended solids [M]		
	I-29 to near Dell Rapids	S38	61.5 miles	full	DENR46BS18			S
	Near Dell Rapids to below Baltic	S39	17.0 miles	non	DENR460703	Pathogens [H]	Agriculture [H]	S

TABLE 21 : BIG SIOUX RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Streams								
Big Sioux River	Near Dell Rapids to below Baltic	S39	17.0 miles	non	DENR460703	Suspended solids [T]		S
	Below Baltic to Skunk Creek	S40	16.9 miles	non	DENR46BS23	Pathogens [H] Suspended solids [M]	Agriculture [H] Crop-related Sources [H] Nonirrigated Crop Production [H] Grazing related Sources [H] Pasture grazing - Riparian and/or Upland [H] Off-farm Animal Holding/Management Area [H]	S
	Skunk Creek to diversion return	S41	10.0 miles	non	DENR460664	Pathogens [H] Suspended solids [M]	Urban Runoff/Storm Sewers [H] Habitat Modification [H] Bank or Shoreline Modification/Destabilization [H]	S
	Diversion return to SF WWTF	S42	2.5 miles	non	DENR46BS29	pH [T] Pathogens [H] Suspended solids [M]	Urban Runoff/Storm Sewers [H] Habitat Modification [H] Bank or Shoreline Modification/Destabilization [H]	S
	SF WWTF to above Brandon	S43	5.0 miles	non	DENR460117	Pathogens [H] Suspended solids [M]	Urban Runoff/Storm Sewers [H] Habitat Modification [H] Bank or Shoreline Modification/Destabilization [H]	S
	Above Brandon to Nine Mile Creek	S44	15.5 miles	non	DENR460831	Pathogens [H]	Agriculture [H] Crop-related Sources [H] Nonirrigated Crop Production [H] Grazing related Sources [H] Pasture grazing - Riparian and/or Upland [H] Intensive Animal Feeding Operations [H]	S

TABLE 21 : BIG SIOUX RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Streams								
Big Sioux River	Above Brandon to Nine Mile Creek	S44	15.5 miles	non	DENR460831	Suspended solids [M]		S
	Nine Mile Creek to near Fairview	S45	34.8 miles	non	DENR460665	pH [T]	Agriculture [H] Crop-related Sources [H] Nonirrigated Crop Production [H] Grazing related Sources [H] Pasture grazing - Riparian and/or Upland [H] Intensive Animal Feeding Operations [H] Off-farm Animal Holding/Management Area [H] Habitat Modification [H] Bank or Shoreline Modification/Destabilization [H]	S
						Organic enrichment/Low DO [T] Pathogens [H] Suspended solids [H]		
	Fairview to near Alcester	S46	19.3 miles	non	DENR460666	Organic enrichment/Low DO [T]	Agriculture [H]	I
							Agriculture [H] Crop-related Sources [H] Nonirrigated Crop Production [H] Grazing related Sources [H] Pasture grazing - Riparian and/or Upland [H] Intensive Animal Feeding Operations [H] Off-farm Animal Holding/Management Area [H] Habitat Modification [H] Bank or Shoreline Modification/Destabilization [H]	

TABLE 21 : BIG SIOUX RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Streams								
Big Sioux River	Fairview to near Alcester	S46	19.3 miles	non	DENR460666	Pathogens [H] Suspended solids [H]		I
	Near Alcester to Indian Creek	S47	17.4 miles	non	DENR460667	Pathogens [H]	Agriculture [H] Crop-related Sources [M] Nonirrigated Crop Production [M] Grazing related Sources [M] Pasture grazing - Riparian and/or Upland [M] Intensive Animal Feeding Operations [H] Off-farm Animal Holding/Management Area [H] Habitat Modification [H] Bank or Shoreline Modification/Destabilization [H]	S
						Suspended solids [H]		
	Indian Creek to mouth	S48	57.9 miles	non	DENR460832	pH [T]	Agriculture [H] Agriculture [H] Crop-related Sources [H] Nonirrigated Crop Production [H] Grazing related Sources [H] Pasture grazing - Riparian and/or Upland [H] Intensive Animal Feeding Operations [H] Off-farm Animal Holding/Management Area [H] Habitat Modification [H] Bank or Shoreline Modification/Destabilization [H]	S
						Pathogens [H] Suspended solids [H]		
Skunk Creek	Brandt Lake to mouth	S49	59.1 miles	full	DENR460121	Suspended solids [T]	Agriculture [T]	S

TABLE 21 : BIG SIOUX RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Lakes								
Lake Albert	Kingsbury County	L9	3610.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [H]	Agriculture [H]	S
Lake Alvin	Lincoln County	L10	90.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [H]	Agriculture [M] Crop-related Sources [M] Nonirrigated Crop Production [M] Intensive Animal Feeding Operations [M] Land Disposal [M] Onsite Wastewater Systems [M] Natural Sources [M]	D
Blue Dog Lake	Day County	L11	1502.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M] Suspended solids [M] Algal Grwth/Chlorophyll a [T] Turbidity [M]	Agriculture [M]	I
Brant Lake	Lake County	L12	1000.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [M]	Agriculture [M] Crop-related Sources [M] Nonirrigated Crop Production [M] Intensive Animal Feeding Operations [M] Off-farm Animal Holding/Management Area [M] Land Disposal [M] Onsite Wastewater Systems [M]	S
Bullhead Lake	Deuel County	L13	341.0 acres	full/E	Lake assessment			S

TABLE 21 : BIG SIOUX RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Lakes								
Lake Campbell	Brookings County	L14	796.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [H]	Agriculture [H]	D
Clear Lake	Deuel County	L15	532.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Noxious aquatic plants [M] Algal Grwth/Chlorophyll a [H]	Agriculture [H] Crop-related Sources [H] Nonirrigated Crop Production [H]	S
	Marshall County	L16	1087.0 acres	full/E	Lake assessment			S
Cottonwood Lake	Marshall County	L17	338.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [H]	Agriculture [M]	U
Lake Drywood North	Roberts County	L18	918.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [H]	Agriculture [H]	U
Dry Lake	Codington County	L19	146.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [H]	Agriculture [H]	U
Enemy Swim Lake	Day County	L20	2146.0 acres	full/E	Lake assessment			D
East Oakwood Lake	Brookings County	L21	928.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [M]	Agriculture [H] Land Disposal [H] Onsite Wastewater Systems [H]	I
Lake Herman	Lake County	L22	1351.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [H]	Agriculture [H]	U
Lake Kampeska	Codington County	L23	4817.0 acres	non/H	Lake assessment	Nutrients [H]	Agriculture [H] Intensive Animal Feeding Operations [H]	U

TABLE 21 : BIG SIOUX RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Lakes								
Lake Kampeska	Codington County	L23	4817.0 acres	non/H	Lake assessment	Siltation [H] Flow alteration [M] Algal Grwth/Chlorophyll a [H]		U
Lake Madison	Lake County	L24	2799.0 acres	non/H	Lake assessment	Nutrients [H]	Agriculture [H] Land Disposal [H] Onsite Wastewater Systems [H]	S
						Siltation [H] Algal Grwth/Chlorophyll a [H]		
Minnewasta Lake	Day County	L25	601.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [M]	Agriculture [M]	S
Nine Mile Lake	Marshall County	L26	282.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [M]	Agriculture [M]	U
Lake Norden	Hamlin County	L27	747.0 acres	non/H	Lake assessment	Nutrients [H]	Agriculture [H] Off-farm Animal Holding/Management Area [H] Land Disposal [H] Onsite Wastewater Systems [H]	U
						Siltation [H] Algal Grwth/Chlorophyll a [M]		
North Buffalo Lake	Marshall County	L28	421.0 acres	full/E	Lake assessment			U
Oneroad Lake	Roberts County	L29	276.0 acres	partial/H	Lake assessment	Nutrients [M]	Agriculture [M] Grazing related Sources [M] Natural Sources [M]	U
						Siltation [M] Algal Grwth/Chlorophyll a [H]		
Pelican Lake	Codington County	L30	2796.0 acres	partial/H	Lake assessment	Nutrients [M]	Agriculture [M] Land Disposal [M] Onsite Wastewater Systems [M]	U

TABLE 21 : BIG SIOUX RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Lakes								
Pelican Lake	Codington County	L30	2796.0 acres	partial/H	Lake assessment	Siltation [M] Flow alteration [M] Algal Grwth/Chlorophyll a [H]		U
Pickerel Lake	Day County	L31	931.0 acres	full/ME	Lake assessment			D
Lake Poinsett	Hamlin County	L32	7868.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M] Flow alteration [M] Algal Grwth/Chlorophyll a [T]	Land Disposal [M] Onsite Wastewater Systems [M]	U
Roy Lake	Marshall County	L33	1694.0 acres	full/E	Lake assessment			S
School Lake	Deuel County	L34	324.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Suspended solids [M] Algal Grwth/Chlorophyll a [M] Turbidity [M]	Agriculture [H]	S
Lake Sinai	Brookings County	L35	646.0 acres	full/E	Lake assessment			U
Lake St. John	Hamlin County	L36	1248.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [H]	Urban Runoff/Storm Sewers [H] Source Unknown [H]	U
South Buffalo Lake	Marshall County	L37	1780.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [H]	Agriculture [M]	D
South Red Iron Lake	Marshall County	L38	610.0 acres	full/E	Lake assessment			D
Wall Lake	Minnehaha County	L39	208.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [T]	Agriculture [H]	S
Waubay Lake	Day County	L40	5538.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H]	Agriculture [H] Grazing related Sources [H] Natural Sources [H]	U

TABLE 21 : BIG SIOUX RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Lakes								
Waubay Lake	Day County	L40	5538.0 acres	non/H	Lake assessment	Algal Grwth/Chlorophyll a [H]		U

Minnesota River Basin (Figures 2 and 3, Table 22).

The Minnesota River basin is found at the northeastern corner of the state. It is bordered on the north by the Red River tributaries, on the west by the undrained Prairie Coteau Pothole region, on the south by the Big Sioux River, and on the east by the South Dakota/Minnesota border. The basin drains an area of 1,572 square miles within South Dakota. Agriculture remains the number one economic mainstay, while manufacturing and quarrying also contribute significantly.

Water quality within the basin continues to be good to satisfactory. During the last assessment two minor exceedances were recorded for excessive TSS and elevated pH in the Lac Qui Parle and South Fork Yellowbank Rivers, respectively. During 1992-1993, slight to moderate impairments were noted in the main branch of the Whetstone River, the Little Minnesota River, and the north fork of the Yellowbank River due to elevated total suspended solids (TSS). During 1994-1995, two instances of elevated TSS, 102 and 100 mg/l, were noted in the Little Minnesota and Whetstone Rivers, respectively. Impairments detected were for the most part sporadic and isolated events probably caused alternately by brief periods of heavy localized runoff and periods of dry weather. No violations of any water quality standards were detected this reporting cycle for any of the monitored streams and rivers in this basin.

The South Fork of the Whetstone River continues to support its assigned beneficial uses. In the past, water quality degradation in this reach occurred during low river flow (decreased dilution) in the form of increases in water conductivity, low DO, and fecal coliform exceedances. During dry periods Milbank WWTF discharges make up most or all of the flow volume of the lower South Fork. There were no exceedances of water quality standards observed in the South Fork this assessment period.

Six of seven lakes in the basin that have been monitored are highly eutrophic due to algae, nutrient enrichment, and siltation (TSI: 66-77). The one exception, Lake Cochrane, has the best water quality of the monitored waterbodies with a current (1999) TSI of 60. Cochrane is the only lake of the seven that is currently fully supporting. Punished Woman and Big Stone Lake have been particularly impacted by siltation from their watersheds and shorelines. No improvement in water quality since last assessment is indicated for the seven monitored lakes. Possible short-term decline in water quality has occurred in Lake Alice, Lake Cochrane, and Lake Oliver.

A major lake restoration measure at Punished Woman Lake begun several years ago is the removal of large amounts of accumulated bottom sediments by dredging. The initially funded dredging project has been completed. Additional dredging may be conducted at a later date pending availability of funding. In addition, plans have been drawn up for watershed and shoreline stabilization measures which should greatly reduce sediment input to this lake in the future. In Lake Cochrane, a sanitary district sewer project has been completed around the periphery of the lake which is substantially decreasing nutrient levels entering that waterbody.

In the past, Whetstone River had carried large loads of sediment into the south end of Big Stone Lake during high water years. The construction and subsequent modification of a diversion dam and sediment barrier immediately south of the lake outlet, has resulted in a substantial reduction in sedimentation to the lake. This river flow management system, which includes a control structure, was designed to divert approximately 80% of peak river flows with attendant sediment from lower Big Stone Lake to the Minnesota River.

Potential pollutant sources of sediment, nutrients and bacteria to lakes in this basin continue to be nonirrigated crop land, pasture land, feedlots, and animal holding/management areas.

A number of completed implementation projects in this basin are expected to significantly reduce pollutant loads to Big Stone Lake and tributaries in the near future. Lake Farley, near Milbank, South Dakota, has been renovated to restore its sediment trapping capacity which should further reduce the amount of sediment as well as nutrients entering the lower Whetstone River. Sisseton, Veblen, and Peever, South Dakota and Browns Valley, Minnesota, wastewater facilities have been upgraded to reduce the volume and improve the quality of wastewater discharges to the Little Minnesota River. Thirty-four feedlot projects have been completed in the Big Stone Lake watershed and a number of lake shore stabilization and watershed improvement projects are currently underway or nearing completion. Funding to continue the Little Minnesota River subwatershed portion of the Big Stone Lake restoration effort has been shifted from Section 319 of the Clean Water Act to Public Law 566 (PL566) Watershed Project through the USDA.

TABLE 22 : MINNESOTA RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Streams								
Lac Qui Parle River, W Br	Above Gary to Minnesota border	S93	3.2 miles	full	DENR460645			I
Little Minnesota River	Near Claire City to Minnesota border	S94	50.2 miles	full	DENR460710			S
Whetstone River	Headwaters to Minnesota border	S95	12.0 miles	full	DENR460700			S
Whetstone River, S Fork	Headwaters to Lake Farley	S96	13.5 miles	full	DENR460690			S
	Lake Farley to mouth	S97	9.1 miles	full	DENR460691			S
Yellow Bank River, N Fork	Grant County Hwy 35 to Minnesota border	S98	15.8 miles	full	DENR460688			S
Yellow Bank River, S Fork	Near Caine Creek to Minnesota border	S99	19.8 miles	full	DENR460687			I
Lakes								
Lake Alice	Deuel County	L102	974.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [H]	Agriculture [M]	D
Big Stone Lake	Roberts County	L103	12360.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [T]	Agriculture [M] Intensive Animal Feeding Operations [M]	U
Lake Cochrane	Deuel County	L104	366.0 acres	full/E	Lake assessment			D
Fish Lake	Deuel County	L105	738.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [H]	Agriculture [H]	S
Lake Hendricks	Brookings County	L106	1497.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H]	Agriculture [H] Off-farm Animal Holding/Management Area [H] Land Disposal [H] Onsite Wastewater Systems [H]	U

TABLE 22 : MINNESOTA RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Lakes								
Lake Hendricks	Brookings County	L106	1497.0 acres	non/H	Lake assessment	Algal Grwth/Chlorophyll a [T]		U
Lake Oliver	Deuel County	L107	175.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [M]	Agriculture [M] Natural Sources [M]	D
Punished Woman Lake	Codington County	L108	477.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M] Suspended solids [M] Algal Grwth/Chlorophyll a [M] Turbidity [M]	Agriculture [M]	S

Red River Basin (Figures 2 and 3, Table 23).

The Red River basin covers the extreme northeastern corner of the state. The only tributaries to the river located in South Dakota drain a total of 600 square miles. Once again, agriculture, with all its activities, is the main economic industry.

During 1990-91, discussions were held among local organizations to form a lake restoration district for the Lake Traverse/Mud Lake area. This resulted in the formation of the Lake Traverse Association Corporation in 1991. Organizational activities began in 1992 that resulted in the award of a Minnesota Clean Water Partnership grant for a Phase I Diagnostic/Feasibility study for the Lake Traverse Improvement Project by the Minnesota Pollution Control Agency (MPCA) in early 1993. The Lake Traverse watershed assessment conducted by the Bois De Sioux Watershed District and MPCA was carried out in the mid 1990s. A final report was scheduled to be completed in 1999. DENR conducted water quality monitoring of the Jim Creek tributary for this study. A Red River Basin Board was formed this reporting period for the purpose of flood control and river management. No streams have been assessed in the Red River basin during this monitoring period.

Water quality monitoring confirmed that Lake Traverse and White Lake Dam are highly eutrophic. Lake Traverse has a history of dense blue-green algal blooms and periodic attempts to treat the blooms in some of the lake embayments with copper sulfate. Observation and comparison with past monitoring data suggested that this large lake had attained relative stability at a high trophic level during the 1980s and early 1990s. The water quality of White Lake Dam may have degraded somewhat from 1980 to 1990, although past annual TSIs for this lake show little change from 1989 through 1993 (TSI: 69-72). No recent data is available for this reservoir.

In 1991, Lake Traverse received a respite in the form of sufficient rain to maintain good lake water levels and to exert a diluting and flushing effect on the lake. Local residents reported that algal blooms were less severe and water clarity had improved during 1991. Lake Traverse again benefited from abundant rainfall during the last reporting period (1993-94) and a similar improved lake status was observed by residents. During 1995, local weather conditions apparently returned to a more “normal” pattern with less rainfall and more sunshine during spring and summer. Unfortunately, this more pleasant weather resulted in higher water temperatures and illumination that may have triggered an increase in the size of the summer blue-green algal bloom that was noted by lake residents in 1995. A recent high TSI reading for chlorophyll a (79) suggests blue-green blooms continue to be a regular feature in summer for this large natural lake. A combined TSI of 74 placed the lake in a non-support category for this reporting period.

White Lake Dam, an alternate drinking water supply for the City of Britton, is impacted by agricultural fertilizers, livestock operations, and by siltation.

TABLE 23 : RED RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Streams								
No Streams Assessed								
Lakes								
Lake Traverse	Roberts County	L111	11530.0 acres	non/H	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [H]	Agriculture [M]	S
White Lake	Marshall County	L112	187.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [M]	Agriculture [M] Intensive Animal Feeding Operations [M] Off-farm Animal Holding/Management Area [M]	U

James River Basin (Figures 2 and 3, Table 24).

The James River basin is the second largest river basin in the state. It drains approximately 12,000 square miles stretching from the northern to the southern borders. It is located in east-central South Dakota. Agriculture and related businesses are the predominant sources of income. There are numerous industries in the basin, most of which are related to agriculture.

Water quality in the James River basin has shown steady improvement over the last ten years. Better water quality may have resulted in a large part due to completed and ongoing projects for the construction and rehabilitation of WWTFs for small municipalities and the city of Huron. Completion of an upgrade of the Huron wastewater facility should prevent further emergency discharges which in the past have been responsible for fish kills in the James River. However, river turbidity (cloudy or muddy water) may remain a persistent problem in the James River due to the considerable silt and sediment periodically brought in by its many small tributaries and the large amount of previously accumulated material on the river bottom.

This assessment, 71 miles of the upper half of the James River from the North Dakota border to the Columbia Rd. Reservoir Dam, partially supported beneficial uses due to low dissolved oxygen (DO). Last assessment, moderate DO depletion extended downstream for another 93 miles to the vicinity of Lake Byron. Low oxygen levels were recorded as the major impairment in the upper half of the river course from 1991 to 1993 when there were more frequent oxygen depletions recorded than more recently. Decay of excessive organic matter accumulations in slough-like conditions during winter and under ice cover may have temporarily depleted river oxygen supplies. A source of this organic matter may be waste from concentrations of migrating waterfowl on the Sand Lake Refuge. Excessive organic loading may also have occurrred during periods of runoff in this part of the river. Winter and summer oxygen deficits have not been uncommon in the slow-flowing upper reach of the James River for the past two decades. The above mentioned 93-mile downstream segment fully supported beneficial uses this reporting period.

The 56-mile segment immediately upstream of Huron, South Dakota, supported its fishery uses during the present reporting period. A minor impairment noted was low DO in winter under ice cover. A concern for drinking water use, also mostly in winter, are elevated TDS concentrations which may approach 1500 mg/l in this reach. Another concern is high TSS during spring runoff (100-150 mg/l).

Most of the lower James River basin fully supported its beneficial uses during the current assessment. Major (non-support) impairment was caused by elevated total suspended solids (TSS) in the lowest reach. Minor/moderate impacts over most of the lower half of the river course were mainly elevated TSS. Minor impairments were fecal coliform, TDS, pH, and low DO. Oxygen levels in the lower river appeared to have improved since previous assessments whereas instances of elevated TSS increased after 1993. More rainfall and greater river flows in the area during the last half of the 1990s may have increased stream turbidity at that time.

The upper reach of Moccasin Creek is not classified as a fishery resource, its classification being limited to fish and wildlife propagation, recreation, stockwatering, and irrigation use (9,10). The upper segment of the creek as a whole is at present supporting these designated beneficial uses.

Two existing Turtle Creek WQM stations were inactivated October 1990 since that stream no longer received surface discharges from the Redfield WWTF which had been upgraded to a total retention facility. Water quality monitoring at nearby Lake Redfield and upstream tributaries was completed under the Clean Lakes Program. A diagnostic/feasibility study was published May 1993. Implementation projects for the rehabilitation of Lake Redfield and its watershed have been underway for the last several years. In 1999, a single monitoring site (WQM 148) was established on Turtle Creek, 3 miles south and 4 miles west of Redfield, SD (Figure 8).

Lakes in the basin are highly eutrophic because of nutrient enrichment and siltation. Agricultural activities, including livestock operations, are considered major pollution sources.

Twenty-four of 25 lakes monitored in this basin over the last decade are presently classified as hyperutrophic (TSIs: 66-86). Only Lake Mitchell is rated as borderline eutrophic (TSI: 65). Of the 17 lakes for which limited recent data is available, only Cottonwood Lake and Elm Lake seemed to show moderate improvement in water quality over the past five or six years. Of the remainder, eight lakes registered a moderate decline in quality and four were relatively stable over the same period. Jones Lake registered the largest difference (a decline) in water quality, but this was near the range of values reported for this small reservoir from 1989 to 1993.

An assessment has been completed (1998) in Elm Lake. Assessments in Lake Mitchell and Lake Faulkton were completed last reporting cycle. Assessments for Lakes Byron, Redfield, and Ravine were completed prior to 1994 and those waterbodies have been undergoing lake and watershed restoration measures as part of their Phase II implementation projects. Implementation activities in Ravine Lake, which lies within the city limits of Huron, SD, will involve lake sediment removal by water-borne hydraulic dredge since a previous attempt at draining this small reservoir and removing accumulated sediment with land-based equipment had proved unsuccessful due to unfavorable natural conditions in winter (Lake Water Quality Assessment chapter: 1996 305(b) Report).

TABLE 24 : JAMES RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Streams								
Elm River		S74	50.7 miles	full	Drinking Water			S
James River	ND border to Mud Lake Reservoir	S75	14.9 miles	partial	DENR460805	pH [T] Organic enrichment/Low DO [M]	Natural Sources [M] Waterfowl [M]	I
	Mud Lake Reservoir	S76	25.6 miles	partial	DENR460112	Organic enrichment/Low DO [M]	Natural Sources [M] Waterfowl [M]	S
	Columbia Road Reservoir	S77	30.4 miles	partial	DENR460113	pH [T] Organic enrichment/Low DO [M]	Natural Sources [M] Waterfowl [M]	S
	Columbia Road Reservoir to near US Hwy 12	S78	35.3 miles	full	DENR460733	pH [T] Organic enrichment/Low DO [T]	Natural Sources [T] Waterfowl [T]	I
	US Hwy 12 to Mud Creek	S79	58.2 miles	full	DENR460734	Organic enrichment/Low DO [T]	Natural Sources [T]	I
	James River Diversion Dam to Huron 3rd Street Dam	S80	56.8 miles	full	DENR460735	Organic enrichment/Low DO [T]	Natural Sources [T]	S
	Huron 3rd Street Dam to Sand Creek	S81	40.8 miles	full	DENR460736	Organic enrichment/Low DO [T]	Natural Sources [T]	D
	Sand Creek to I-90	S82	49.9 miles	full	DENR460737	pH [T] Organic enrichment/Low DO [T] Salinity/TDS/chlorides [T]	Agriculture [T] Natural Sources [T]	D
	I-90 to Yankton County line	S83	85.0 miles	full	DENR460707	Organic enrichment/Low DO [T]	Agriculture [T] Natural Sources [T]	D
	Yankton County line to mouth	S84	52.0 miles	non	DENR460761	pH [T]	Agriculture [H] Crop-related Sources [H] Nonirrigated Crop Production [H] Grazing related Sources [H] Pasture grazing - Riparian and/or Upland [H] Intensive Animal Feeding Operations [H] Off-farm Animal Holding/Management Area [H]	D

TABLE 24 : JAMES RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Streams								
James River	Yankton County line to mouth	S84	52.0 miles	non	DENR460761	Organic enrichment/Low DO [T] Pathogens [T] Suspended solids [H]		D
Moccasin Creek	Headwaters to Aberdeen	S85	23.2 miles	full	DENR460694			S
	Aberdeen to Warner	S86	20.2 miles	full	DENR460695			S
Lakes								
Amsden Dam	Day County	L60	235.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [T]	Agriculture [M] Intensive Animal Feeding Operations [M]	D
Beaver Lake	Yankton County	L61	72.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [H]	Agriculture [H]	D
Lake Byron	Beadle County	L62	1749.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Suspended solids [M] Algal Grwth/Chlorophyll a [T] Turbidity [M]	Agriculture [H] Intensive Animal Feeding Operations [H] Land Disposal [H] Onsite Wastewater Systems [H]	U
Lake Carthage	Miner County	L63	203.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [T]	Agriculture [H] Natural Sources [H]	U
Lake Cavour	Beadle County	L64	236.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [H]	Agriculture [H]	U

TABLE 24 : JAMES RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Lakes								
Cottonwood Lake	Spink County	L65	1650.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [H]	Agriculture [H] Natural Sources [H]	I
Cresbard Lake	Faulk County	L66	67.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [T]	Agriculture [H]	D
Elm Lake	Brown County	L67	1209.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M] Noxious aquatic plants [M] Algal Grwth/Chlorophyll a [T]	Off-farm Animal Holding/Management Area [M] Natural Sources [M]	I
Lake Faulkton	Faulk County	L68	93.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Noxious aquatic plants [H] Algal Grwth/Chlorophyll a [H]	Agriculture [H]	D
Lake Hanson	Hanson County	L69	55.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M] Noxious aquatic plants [M] Algal Grwth/Chlorophyll a [T]	Agriculture [M] Off-farm Animal Holding/Management Area [M] Land Disposal [M] Onsite Wastewater Systems [M]	U
Lake Henry	Bon Homme County	L70	38.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [M]	Off-farm Animal Holding/Management Area [H] Natural Sources [H]	U

TABLE 24 : JAMES RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Lakes								
Jones Lake	Hand County	L71	101.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [M]	Agriculture [H] Off-farm Animal Holding/Management Area [H] Natural Sources [H]	D
Lake Louise	Hand County	L72	163.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [H]	Agriculture [H] Grazing related Sources [H] Pasture grazing - Riparian and/or Upland [H] Intensive Animal Feeding Operations [H] Natural Sources [H]	D
Loyalton Dam	Edmunds County	L73	10.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [T]	Agriculture [M]	U
Mina Lake	Edmunds County	L74	806.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Suspended solids [M] Algal Grwth/Chlorophyll a [H] Turbidity [M]	Agriculture [H] Land Disposal [H] Onsite Wastewater Systems [H] Natural Sources [H]	S
Lake Mitchell	Davison County	L75	671.0 acres	partial/E	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [T]	Agriculture [M] Off-farm Animal Holding/Management Area [M]	S

TABLE 24 : JAMES RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Lakes								
Pierpont Lake	Day County	L76	77.0 acres	partial/H	Lake assessment	Nutrients [M]	Agriculture [M] Crop-related Sources [M] Nonirrigated Crop Production [M]	U
						Siltation [M] Algal Grwth/Chlorophyll a [M]		
Ravine Lake	Beadle County	L77	72.0 acres	non/H	Lake assessment	Nutrients [H]	Agriculture [H] Intensive Animal Feeding Operations [H] Urban Runoff/Storm Sewers [H] Non-industrial Permitted [H] Land Disposal [H] Onsite Wastewater Systems [H]	D
						Siltation [H] Algal Grwth/Chlorophyll a [H]		
Lake Redfield	Spink County	L78	170.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Noxious aquatic plants [M] Algal Grwth/Chlorophyll a [M]	Agriculture [H]	U
Richmond Lake	Brown County	L79	829.0 acres	partial/H	Lake assessment	Nutrients [M]	Agriculture [M] Off-farm Animal Holding/Management Area [M]	D
						Siltation [M] Algal Grwth/Chlorophyll a [T]		
Rosehill Lake	Hand County	L80	34.0 acres	partial/H	Lake assessment	Nutrients [M]	Agriculture [M] Grazing related Sources [M] Grazing related Sources [M] Pasture grazing - Riparian and/or Upland [M] Range grazing - Riparian and/or Upland [M] Natural Sources [M]	S

TABLE 24 : JAMES RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Lakes								
Rosehill Lake	Hand County	L80	34.0 acres	partial/H	Lake assessment	Siltation [M] Algal Grwth/Chlorophyll a [M]		S
Rosette Lake	Edmunds County	L81	15.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [M]	Agriculture [H]	S
North Scatterwood Lake	Edmunds County	L82	543.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [M]	Agriculture [H]	U
Twin Lakes	Sanborn County	L83	252.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [T]	Agriculture [M]	U
Wilmarth Lake	Aurora County	L84	104.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [T]	Agriculture [M] Natural Sources [M]	D

Missouri River Basin (Mainstem) (Figures 2 and 3, Table 25).

The Missouri River is the largest body of water in South Dakota. It makes a definite cut down the middle of the state to form what is commonly referred to as either "east or west" river country. The river enters the state on the north from North Dakota and flows south until it reaches the vicinity of Pierre. It receives significant flows from the Grand, Moreau, and Cheyenne River basins. From Pierre onward the river generally flows east-southeast until it exits the state on the southeast tip. It receives contributing flows from the Bad, White, James, Vermillion, Niobrara, and Big Sioux River basins. During its course through the state, the Missouri River, excluding its major tributaries, drains an approximate 16,610 square miles; 2,580 square miles of this is located within the Missouri Coteau and is considered non-contributing.

The dominant feature of the Missouri River in South Dakota is the presence of four impoundments; Lake Oahe at Pierre (Oahe Dam), Lake Sharpe at Fort Thompson (Big Bend Dam), Lake Francis Case at Pickstown (Ft. Randall Dam), and Lewis and Clark Lake at Yankton (Gavins Point Dam). The largest of these is Lake Oahe with 22,240,000 acre-feet of storage capacity. The impoundments serve for flood control, downstream navigation, hydroelectric generation, irrigation, municipal water use, and water related recreation. The 70-mile reach from the Gavins Point Dam to Sioux City is the last major free-flowing segment of the Missouri River in the state.

Water quality, for the most part, remains good, although exceedances in surface water temperature and elevated pH may occur from time to time. In 1999, DENR resumed quarterly sampling of the Missouri River at former DENR sites (power station discharges). More extensive monitoring is required for this large waterbody to properly characterize present water quality upon which reliable use-support determinations can be based.

Reservoir problems that deserve serious consideration are the erosion occurring along shorelines due to extreme fluctuations in water levels, and the large amount of sediment deposited in the reservoir basins mostly by five major western tributaries (nearly 40 million tons per year by a 1987 COE estimate) especially the Bad, White and Cheyenne Rivers.

Water turbidity caused by suspended clay and other sediment particles has persisted for most of the open water season in the upper half of Lake Sharpe from 1991 through 1997 (also see Bad River Basin section). However, those have been years of above average rainfall in the region. Moderate improvement in water clarity can be expected once precipitation in the Bad River basin returns to more normal levels. It must be noted that the already accumulated sediment in shallower areas will be subject to resuspension by strong winds during the greater part of each year and erodible high banks composed of weathered marine shale will provide sediment water turbidity released by rainfall runoff, changing reservoir water levels and wind/wave action. A number of small tributaries are a seasonal source of sediment to Lake Sharpe.

Lake Francis Case in the Lower Missouri basin is similarly impacted by sediment - laden inflows from the White River primarily derived from natural erosion processes in the western Badlands. Additional sediments are provided to Lake Francis Case by a number of smaller tributaries that enter various embayments throughout the length of this mainstem reservoir from the east and west.

During 1992-93, Charles Mix County Conservation District reported that sediments from the Cedar and Platte Creeks were severely impacting the embayments into which they emptied. Platte Creek Bay and Cedar Creek Bay are popular fishing and recreational areas with the latter bay also serving as the site of an intake for the Randall Community Rural Water system. The area affected by siltation was estimated at 120 acres. Less severe sediment impacts were noted in three other bays on the eastern shore of Lake Francis Case with a total area in excess of 300 acres. Similar siltation impacts were probably taking place during the present reporting period, since rainfall amounts in southeastern South Dakota were above normal for most of the late 1990s.

Downstream of this reservoir, the sediment-free water discharged from Lake Francis Case exerts a considerable erosive force on the banks of the Missouri River. Nearly two miles of high banks on the eastern shore of the unchannelized river between Lake Francis Case and Lewis and Clark Lake were reported to be severely affected. Riverside cropland has been continually lost to bank erosion for the past two decades at two separate stretches near Marty and Greenwood, SD (Charles Mix County Conservation District, written communication). Shoreline erosion was severe for most of the past decade due to significant increases in water released from all of the large mainstem reservoirs upstream during summer, fall, and winter of 1995-97. The unusually large discharges were made necessary to free up sufficient reservoir storage space for the 1996-98 spring runoffs. Major erosion problems similar to those noted above developed during late 1997 in the Missouri shoreline downstream of Lewis and Clark Lake due to high reservoir discharges. Recent drier conditions in the middle of the state (1999-2000) and in upstream reservoirs will at least temporarily alleviate those erosion problems.

Most lakes in the basin are highly eutrophic because of nutrient enrichment and siltation. Water quality of these lakes has generally declined in the past decade. Agricultural activities are the problem sources. A dredging project has been active in McCook Lake since 1991 to remove large accumulations of sediment. By 1995, more than 1.4 million cubic yards had been removed. The project goal was to dredge the entire lake basin by the end of 1999. Two other dredging projects that were completed during the last reporting period included East Lake Eureka and Lake Hiddenwood.

Lake Yankton in the southeast Lower Missouri Basin continues to have the best water quality of the assessed basin lakes (TSI: 50.8). Burke Lake near the upper basin's southern border had been experiencing sedimentation, nuisance growths of blue-green algae and macrophytes, odor problems and fish kills. Results of a 1991 assessment indicated that tributaries to the lake experienced contamination with high levels of fecal coliform bacteria and nutrients. Watershed sources of bacteria and nutrients included a dairy farm and animal pastures. During 1993, a dredging project was carried to completion in Burke Lake. Various lake improvement activities were subsequently carried out around the lake shore and the immediate watershed (Lake Water Quality Assessment chapter, 1996 305(b) Report). So far, the lake has shown only moderate improvement in water quality. The annual TSI improved from 84.9 in 1991 to 82.3 in 1994. No further improvement in water quality was recorded for the remainder of the decade.

Short-term trends (5-yr) available for a total of nine lakes within this basin, indicated that six had stable water quality and the remaining three lakes had somewhat worse water conditions since the previous assessment.

TABLE 25 : MISSOURI RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Streams								
Choteau Creek	Wagner to mouth	S87	40.3 miles	partial	DENR460134	Suspended solids [M]	Agriculture [M]	S
Missouri River	Big Bend Dam to Fort Randall Dam	S88	105.0 miles	full	DENR460673			S
	Fort Randall Dam to Gavins Point Dam	S89	65.0 miles	full	DENR460674			S
	Gavins Point Dam to North Sioux City	S90	70.0 miles	full	DENR460674			S
	North Dakota Border to Oahe Dam	S91	160.0 miles	full	DENR460671			S
	Oahe Dam to Big Bend Dam	S92	82.0 miles	full	DENR460672			S
Lakes								
Academy Lake	Charles Mix County	L85	31.0 acres	non/H	Lake assessment	Nutrients [H]	Agriculture [H] Intensive Animal Feeding Operations [H]	U
						Siltation [H] Algal Grwth/Chlorophyll a [H]		
Lake Andes	Charles Mix County	L86	235.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [M]	Agriculture [H]	U
Brakke Dam	Lyman County	L87	130.0 acres	non/H	Lake assessment	Nutrients [H]	Agriculture [H] Grazing related Sources [H] Pasture grazing - Riparian and/or Upland [H]	U
						Siltation [H] Algal Grwth/Chlorophyll a [T]		
Burke Lake	Gregory County	L88	27.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [H]	Agriculture [H]	S
Byre Lake	Lyman County	L89	80.0 acres	full	Drinking Water			S
Lake Campbell	Campbell County	L90	46.0 acres	non/H	Lake assessment	Nutrients [H]	Agriculture [H] Off-farm Animal Holding/Management Area [H]	S

TABLE 25 : MISSOURI RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Lakes								
Lake Campbell	Campbell County	L90	46.0 acres	non/H	Lake assessment	Siltation [H] Noxious aquatic plants [H] Algal Grwth/Chlorophyll a [H]		S
Corsica Lake	Douglas County	L91	110.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Noxious aquatic plants [H]	Agriculture [H] Grazing related Sources [H] Pasture grazing - Riparian and/or Upland [H]	D
Cottonwood Lake	Sully County	L92	454.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Suspended solids [M] Algal Grwth/Chlorophyll a [T] Turbidity [M]	Agriculture [H]	S
Dante Lake	Charles Mix County	L93	19.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [H]	Agriculture [M]	S
Fate Dam	Lyman County	L94	150.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [T]	Agriculture [M]	U
Geddes Lake	Charles Mix County	L95	70.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Suspended solids [M] Algal Grwth/Chlorophyll a [H] Turbidity [M]	Agriculture [H] Grazing related Sources [H] Pasture grazing - Riparian and/or Upland [H]	D
Lake Hiddenwood	Walworth County	L96	28.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [M]	Agriculture [H]	U
Mccook Lake	Union County	L97	273.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H]	Agriculture [H]	S

TABLE 25 : MISSOURI RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Lakes								
Mccook Lake	Union County	L97	273.0 acres	non/H	Lake assessment	Suspended solids [M] Algal Grwth/Chlorophyll a [T] Turbidity [M]		S
Platte Lake	Charles Mix County	L98	140.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Suspended solids [M] Algal Grwth/Chlorophyll a [H] Turbidity [M]	Agriculture [H] Crop-related Sources [H] Irrigated Crop Production [H]	D
Lake Pocasse	Campbell County	L99	1378.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [T]	Agriculture [H] Grazing related Sources [H] Pasture grazing - Riparian and/or Upland [H]	U
Roosevelt Lake	Tripp County	L100	86.0 acres	partial/H	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [T]	Agriculture [M] Grazing related Sources [M] Range grazing - Riparian and/or Upland [M]	U
Sully Lake	Sully County	L101	205.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [T]	Agriculture [H]	U

Grand River Basin (Figures 2 and 3, Table 26).

The Grand River basin covers 5,680 square miles within northwest South Dakota and southwest North Dakota. This is a sparsely populated region with a population density of approximately 1 person per square mile. The major income is derived from agriculture (83%). However, this basin possesses energy resources in commercially exploitable quantities. As of June 1995 there were 121 producing oil wells and 54 gas wells concentrated primarily in north central and southwest Harding County, respectively. The combined daily output of these well fields averaged 3,445 barrels of oil and 23.3 million cubic feet of natural gas.

In past decades, water quality within the North Fork Grand River drainage fluctuated widely but was usually adequate to partially support designated beneficial uses. Last reporting period slight impairment in the North Fork was due to elevated total suspended solids concentration and conductivity (full support). During 1994 and 1995, cause of moderate impairment was elevated conductivity. This reporting period the North Fork was fully supporting with only one exceedance for TSS.

Apparently, high water conductivity and TDS concentration are more or less typical of both north and south fork drainages. The north fork watershed drains the southern periphery of the North Dakota Badlands which may be a major source of high levels of TDS and TSS to this branch of the Grand River. Much of the suspended sediment is normally deposited in Bowman Haley Reservoir upstream of Shadehill Reservoir whereas dissolved salts may be concentrated by evaporation while water is held in storage. The most common dissolved salts in the Shadehill Reservoir drainage are sodium sulfate and sodium bicarbonate.

The South Fork drainage contains erosive soils which contribute sediment and suspended solids that often produce high TSS levels in the South Fork Grand River. These problems are aggravated by agricultural and grazing practices. Past observations indicated agricultural practices such as streamside grazing and cropping are continuing in the South Fork drainage. The years 1993 to 1995 were generally periods of above average waterflows in the Grand River basin. Similar to past reporting periods, the South Fork drainage did not support its beneficial uses last assessment due to excessive TSS. Moderate impairments noted in previous assessments were from high conductivity, elevated dissolved solids, low dissolved oxygen, and elevated pH. This assessment the South Fork was non-supporting again due to elevated TSS. There were no other impairments observed.

The Grand River from the Shadehill Reservoir tailwaters to 18 miles downstream was nonsupporting of its coldwater marginal fishery designation due solely to elevated stream temperature (>75^{0}F) (moderate impairment) and pH (>8.8) similar to last assessment. One or both of these parameters were typically the cause of non-support for this reach in previous assessments. As noted in the 1994 report, water pH, conductivity, and total dissolved solids had been increasing steadily in this reach and presumably in Shadehill Reservoir during the late 1980s and early 1990s. Values for these parameters during 1990-92 were some of the highest recorded in a decade. However, during the middle 1990s the above parameters declined to concentrations present at the start of the above-mentioned increases. This was probably the beneficial result of increased rainfall (dilution) within the basin after 1992. Nonetheless it should be noted again that the major tributaries to Shadehill Reservoir are typically high in total dissolved solids (TDS). The remaining length of the Grand River of nearly 84 miles was also rated as non-supporting this reporting cycle due again to excessive total suspended solids concentration (TSS).

Last reporting cycle, a watershed improvement project funded by the 319 nonpoint source program was undertaken in the Shadehill Reservoir drainage. The overall goal of the project was to maintain the high water quality of the reservoir and to improve the beneficial use support of the North Fork Grand River to fully supporting and the South Fork to partially supporting. In order to accomplish this goal, the following objectives were established: reduce cropland erosion on 20,000 watershed acres by 1997, and improve 60,000 acres in poor to fair condition to fair or good condition by 1997. Accomplishments as of November, 1997 include:

1) production of a watershed map to direct reservoir activities and to guide watershed best management practices on a voluntary basis,
2) completion of a reservoir sediment survey,
3) Great Plains Conservation program contracts have been written on 116,000 acres,
4) 64,000 acres are managed by a grazing management plan,
5) 4,000 acres are managed under conservation tillage systems,
6) two animal waste management systems have been installed,
7) 48 acres of tree plantings have been installed,
8) 2,350 acres of grass seeding have been planted,
9) one sediment basin and 4 dugouts have been constructed,
10) 92,000 feet of pipeline have been installed,
11) 27.4 miles of fence have been installed.

The North Fork has been fully supporting for the present and previous assessment, whereas only minor/moderate improvement in TSS levels is evident so far in South Fork samples.

Two lakes within the basin that were monitored under Clean Lakes Assessment include Shadehill Reservoir (4,693 acres) and Flat Creek Lake (203 acres). Shadehill Reservoir is presently supporting all but one of its assigned beneficial uses and has maintained a mesotrophic status for most of the past decade. The reservoir is partially supporting its irrigation use due to natural limitations imposed by local soil-water incompatibility where high sodium concentration in stored water combined with the clayey characteristics of most soils in this region significantly reduces the acreages suitable for continuous irrigation.

During 1993, the lake trophic index indicated what proved to be a temporary decline in Shadehill Reservoir water quality (TSI:61). This was due to an increase in lake phosphorus concentration probably brought about by increased watershed runoff in 1993. Probably as a response to this sudden nutrient influx, a dense bloom of blue-green *Aphanizomenon* developed during July and August in the north arm of the reservoir and reappeared in summer of 1994 (WRI report 1995). A larger summer algal biomass in the reservoir was also indicated by the annual chlorophyll *a* TSI which nearly doubled from 31 in 1992 to 60 in 1993 and 1994. In 1995, water quality returned to conditions similar to those that prevailed in the reservoir prior to 1993 (mesotrophic status). These conditions were maintained in 1996 and 1997. A slight increase in combined TSI took place from 43 in 1995 and 1996 to 44 in 1997. However, a noticeable decline in water clarity was observed in 1996 and 1997, most of which may have been due to sediment turbidity.

Sedimentation, suspended solids and, to a lesser extent, nutrient concentration appear to be gradually increasing in the main body of this large reservoir. Sedimentation at the two major reservoir inlets, particularly at the South Fork inlet, is progressing at a more rapid rate and may affect the recreational potential of the upper reservoir in a few years.

Water quality in nearby Flat Creek Dam improved from a combined TSI of 76 in 1991 (non-support status) to 63 (partially supporting) in 1994. This improvement may have been largely due to increased runoff in 1993, which may have exerted a diluting and flushing effect on this normally, hypereutrophic artificial lake, in contrast to the temporary nutrient enrichment produced in the much less productive Shadehill Reservoir. Causes of pollution to this small reservoir include nutrient enrichment and siltation. Unspecified agricultural activities are the problem sources in this drainage. Recent combined TSI (72) indicates some deterioration in water quality had taken place during the latter 1990s and the reservoir had reverted to a non-support status.

Lake Isabel is eutrophic (TSI:65) and partially supported its fishable/swimmable uses for the past decade. The lake serves as the drinking water supply for the nearby town of Isabel and has frequently been treated with copper sulfate to temporarily alleviate algae/macrophyte problems during the summer months. The municipality has been engaged in finding an alternate water supply since the drinking water quality of Lake Isabel is poor especially in dry years. Several years ago the town of Isabel participated in a feasibility project to be included in an expansion of the Tri-County Rural Water System.

TABLE 26 : GRAND RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Streams								
Grand River	Shadehill Reservoir to Corson County line	S70	18.0 miles	non	DENR460640	pH [H]	Agriculture [H] Crop-related Sources [H] Grazing related Sources [H] Range grazing - Riparian and/or Upland [H] Natural Sources [H]	D
	Bullhead to mouth	S71	83.6 miles	non	DENR460945	Thermal modifications [T] Pathogens [T] Suspended solids [H]	Agriculture [H] Crop-related Sources [H] Irrigated Crop Production [H] Grazing related Sources [H] Range grazing - Riparian and/or Upland [H] Natural Sources [H] Recreation and Tourism Activities [H]	I
Grand River, N Fork	ND border to Shadehill Reservoir	S72	65.1 miles	full	DENR460677	Suspended solids [T]	Agriculture [T] Grazing related Sources [T] Range grazing - Riparian and/or Upland [T] Natural Sources [T]	S
Grand River, S Fork	Skull Creek to Shadehill Reservoir	S73	65.4 miles	non	DENR460678	Suspended solids [H]	Agriculture [H] Crop-related Sources [H] Nonirrigated Crop Production [H] Grazing related Sources [H] Range grazing - Riparian and/or Upland [H] Natural Sources [H]	S
Lakes								
Flat Creek Lake	Perkins County	L57	203.0 acres	non/H	Lake assessment	Nutrients [H]	Agriculture [H] Intensive Animal Feeding Operations [H]	U

TABLE 26 : GRAND RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Lakes								
Flat Creek Lake	Perkins County	L57	203.0 acres	non/H	Lake assessment	Siltation [H] Suspended solids [M] Algal Grwth/Chlorophyll a [M] Turbidity [M]		U
Lake Isabel	Dewey County	L58	81.0 acres	partial/E	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [M]	Agriculture [M] Intensive Animal Feeding Operations [M]	U
Shadehill Reservoir	Perkins County	L59	4693.0 acres	partial/M	Lake assessment	Salinity/TDS/chlorides [M] Algal Grwth/Chlorophyll a [T]	Natural Sources [M]	S

Moreau River Basin (Figures 2 and 3, Table 27).

This basin is located in the northwest part of South Dakota and drains an area of 5,037 square miles. As with the Grand River basin to the north, agriculture is the mainstay of this sparsely populated basin. Approximately two-thirds of the basin's land is devoted to pasture and ranching operations. There was in past years considerable gas, oil, and coal exploration conducted in this river basin but few energy resources were discovered. At present there is only one producing oil well in the basin located near the western boundary of Dewey County. Average production is 13 barrels a day.

Water quality within this basin is marginal. Much of the sediment in the drainage comes from erosive Cretaceous shales which also mineralize the water. As in the adjoining Grand River basin to the north, this leads to high levels of total dissolved solids (TDS) in the water of local streams, primarily sulfate, iron, manganese, sodium, and other metals and minerals.

During the winter months the Moreau River often freezes to the bottom following seasonal periods of low or no flow during late summer and fall. Water quality data from past assessments indicated that three-fourths of the river basin has at least partially supported its designated uses for most of the 1980s. Moderate impairment was usually due to suspended or dissolved solids and fecal coliforms. The lower basin was impaired by suspended solids derived from the highly erosive soils that occur in this area.

During the previous four reporting periods and the present assessment the Moreau River basin was nonsupporting of its beneficial uses due to suspended solids (TSS). Higher than average runoff from 1991 through 1998 was probably responsible for excessive TSS levels over the entire basin in the 1990s. A secondary problem in the lower drainage was elevated fecal coliform numbers which constituted a moderate impairment last assessment and a minor one this reporting cycle.

Two small lakes in the river basin, Coal Springs Dam and Dewberry Lake were assessed several years ago. At that time, both waterbodies were found to be highly eutrophic (hypereutrophic) with TSIs of 71 and 81, respectively. No recent data is available for Dewberry Lake but Coal Spring Dam appears to have moderately improved in water quality over the last decade and is presently rated as partially supporting its assigned uses (TSI: 66). Both lakes were impacted by unspecified agricultural activities probably livestock grazing, nutrient enrichment and siltation problems.

TABLE 27 : MOREAU RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Streams								
Moreau River	Green Grass to mouth	S100	74.3 miles	non	DENR460935	Organic enrichment/Low DO [T]	Agriculture [H]	I
							Crop-related Sources [H] Nonirrigated Crop Production [H] Grazing related Sources [H] Range grazing - Riparian and/or Upland [H] Natural Sources [H]	
						Pathogens [T] Suspended solids [H]		
	Headwaters to near Iron Lightning	S101	102.0 miles	non	DENR460039	Suspended solids [H]	Agriculture [H]	S
							Crop-related Sources [H] Nonirrigated Crop Production [H] Grazing related Sources [H] Range grazing - Riparian and/or Upland [H] Natural Sources [H]	
Lakes								
Coal Springs Reservoir	Perkins County	L109	90.0 acres	partial/H	Lake assessment	Nutrients [M]	Agriculture [M]	I
							Agriculture [M] Grazing related Sources [M] Range grazing - Riparian and/or Upland [M]	
						Siltation [M] Algal Grwth/Chlorophyll a [M]		

Bad River Basin (Figures 2 and 3, Table 28).

The Bad River basin lies in west-central South Dakota between the Cheyenne and White River Basins. The basin drains an approximate 3,151 square mile area. Historically, a main feature of the basin has been a general lack of surface water flow. The upper portion of the Bad River receives water from several artesian wells in the Philip area so that water is present most of the year. There are prolonged periods of low flow in the reach from Midland to the Missouri River. This flow pattern has not held up for most of the 1990s due to above average rainfall.

In past reporting periods the Bad River had not supported its beneficial uses due to elevated suspended solids concentration. Monitoring during the 1987-89 cycle failed to detect high suspended solids concentrations but only indicated moderately elevated conductivity. These results were obtained because of very low river flows prior to and during sampling. However, monitoring during the 1990s again indicated high levels of TSS (4000 - 21860 mg/l) were entering Lake Sharpe with increased rainfall in the Bad River basin from 1995 through 1999. This resulted in ratings of non-support for the previous and the present assessment (1995-1999).

During past monitoring periods an apparent pattern of poor water quality was noted in the lower Bad River. Exceedances of suspended solids (TSS) standards occurred during high river flows (the last two reporting periods and the present cycle) while during minimal flows, elevated dissolved solid concentrations (>2500 mg/l) and excessively high conductivity readings (>2500 umhos/cm) were recorded. However, it has become evident that the erodible marine shales that underlie much of the drainage supply large quantities of dissolved salts in addition to suspended solids to the river during major watershed runoff events. Water conductivity in the Bad River has averaged 2752 µmhos/cm for the period from 1968 to 1999. Fecal coliform levels appeared to have declined from levels recorded before 1994, and no exceedances were recorded last or this assessment. However, exceedances for TSS (29%) were again recorded this reporting period.

During years of above normal runoff, sufficient Bad River sediment is deposited on the Missouri River bed below Lake Oahe to restrict the main river channel causing local water levels to fluctuate and present a potential flooding problem for riverside residences in the southeast area of Pierre, South Dakota. This often necessitates a reduction in the volume of water released from Oahe Dam which serves to interrupt power generation producing a negative economic impact. Winter flooding in the developed flood plain has occurred on an irregular basis since 1979 caused by the formation of ice jams during periods of icing. Dredging the accumulated river sediments has been proposed as a remedial measure. However, initial considerations indicate this to be a costly proposition requiring the initial removal and disposal of more than 3 million cubic yards of sediment. Periodic maintenance dredging may also be necessary in the long term unless some means are found to drastically reduce the amount of sedimentation from the Bad River. A limited dredging project to deepen boat channels near two river islands below Pierre was completed in 1998. A 1996 COE project designed to flush sediments downstream has met with moderate success. This involved lowering waterlevels in the Missouri River below the Bad River confluence and then sharply increasing Oahe Reservoir water releases for a period of time.

The deposited sediments are restricting boat navigation on the Missouri River in the vicinity of the growing Bad River delta. In addition, suspended sediment from the Bad River has perceptibly increased water turbidity in Lake Sharpe for more than 30 miles downstream of the confluence.

Incoming sediments and resulting turbidity have a negative impact on sport fishing, recreation, and tourism in this area. Water quality data for the past 35 years have indicated that erosion in the Bad River basin and subsequent sediment yield to the Missouri River are on-going problems that first became evident shortly after the filling of the mainstem reservoirs in the early 1960s.

Rangeland in this area is on a relatively steep topography overlain by shallow, erosive Pierre Shale soils whose structure may deteriorate even under what is considered normal grazing pressure. Past field observations indicated that large acreages of range in the lower watershed were in poor condition and that increased snowmelt or rainfall such as occurred in recent years would very likely produce even more severe erosion and sedimentation events than were noted in the last decade. In fact, many small stockwater dams in the Bad River basin were reported to be rapidly filling with eroded sediment during the middle and late 1990s.

In 1989, a sediment monitoring program was established in the Bad River drainage to determine the sources of sedimentation; quantify the extent of sediment transport into Lake Sharpe on the Missouri River; and to develop alternate remedial methods of watershed management to reduce sediment loads impacting the Bad River and Lake Sharpe. Previous studies have indicated that until 1980 approximately 3.2 million tons of sediment was deposited in the Missouri from the Bad River each year. Since the application of extensive conservation measures in the Bad River watershed (e.g. CRP) sediment loads are reported to have dropped by as much as 40% in selected watersheds. While this reduction is appreciable, there remains a considerable volume of sediment (approx. 2.8 million tons) still entering upper Lake Sharpe on a yearly basis at the present time. The 1989 monitoring study determined that rangeland in the lower half of the drainage was the major erosion contributor and 80 to 85% of the sediment came from channel and gully erosion. The study also determined that two-thirds of the total sediment load to Lake Sharpe was being produced in the lower one-third of the Bad River watershed.

Based on information gained from this study, Phase II of the Bad River Water Quality Project was initiated on March 12, 1990. This stage of the project was designed to identify and assess cost effective, landowner-acceptable Best Management Practices (BMPs) that will reduce sediment loading and serve as a model for similar projects in the entire Missouri River Basin. Grazing management practices that reduce the dependence of livestock on riparian areas were targeted as the main thrust of the project.

BMPs presently being applied include rotational grazing systems, construction and rehabilitation of sediment dams, and restoration of wildlife and riparian areas among others. At the same time, vegetative responses to different implemented grazing systems and the effect of various grazing strategies on development of gully erosion (gully headcut advance) are being investigated. Other Best Management Practices being promoted to reduce sediment loading of the Bad River include the use of conservation tillage and no-till farming on cropland and the construction of wind protection fences in the uplands that will allow moving animal feeding areas out of riparian zones.

The Phase II Project ended in 1994 and a final report is available. This project has demonstrated that significant erosion and sediment reduction can be accomplished with the implementation of conservation practices. Over 90 percent of the landowners in selected project areas have applied some form of BMP and about 95 percent of the project area has been treated. Preliminary data indicate a 50 percent reduction in sediment delivery from the Plum Creek subwatershed. Although these results are promising, much remains to be done to significantly reduce the sediment loads to Lake Sharpe.

Other similar projects are currently being implemented in the Bad River Basin. A Phase III Project is continuing the efforts of the Phase II Project by promoting BMPs in additional areas of the watershed, especially in the lower third of the watershed where the erosion problems are most severe. A Demonstration Project in the upper portions of the watershed is also being implemented. This project is demonstrating to landowners the various BMPs that were successful during the Phase II Project. Both projects ended in 1999. It is hoped that these projects convince landowners that it is worth their effort to implement certain BMPs, for environmental reasons and to improve their own farm/ranch operations.

Two of the four small lakes monitored in this basin were rated as hypereutrophic and two as eutrophic last reporting cycle. Freeman Dam and Hayes Lake appear to have undergone a moderate decline in water quality from the late 1980s to the early 1990s. The most recent data suggest Hayes Lake water quality has remained relatively stable whereas that of Freeman Lake has shown moderate improvement during the second half of the last decade as measured by chlorophyll[a], phosphorus, and secchi disk depth. However, Freeman Lake water remains high in selenium and nitrate. Similarly, of the two eutrophic waterbodies, Lake Waggoner water quality remained stable while Murdo Dam had moderately improved.

Causes for impairment in these lakes include algae, macrophytes, nutrient enrichment, and siltation. Problem sources may be livestock operations, lakeside farmland, and septic systems.

TABLE 28 : BAD RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Streams								
Bad River	Stanley County line to mouth	S1	52.4 miles	non	DENR460850	Suspended solids [H] Conductivity [T]	Agriculture [H] Grazing related Sources [H] Range grazing - Riparian and/or Upland [H] Natural Sources [H]	I
Lakes								
Freeman Lake	Jackson County	L1	65.0 acres	non/E	Lake assessment	Metals [H] Selenium [H] Nutrients [M] Nitrate [H] Algal Grwth/Chlorophyll a [M]	Agriculture [H] Groundwater Loadings [H]	I
Hayes Lake	Stanley County	L2	74.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Noxious aquatic plants [M] Algal Grwth/Chlorophyll a [M]	Agriculture [H]	U
Murdo Dam	Jones County	L3	41.0 acres	full/ME	Lake assessment			I
Waggoner Lake	Haakon County	L4	98.0 acres	partial/E	Lake assessment	Nutrients [M] Siltation [M] Noxious aquatic plants [M] Algal Grwth/Chlorophyll a [T]	Agriculture [M] Off-farm Animal Holding/Management Area [M] Land Disposal [M] Onsite Wastewater Systems [M]	S

White River Basin (Figures 2 and 3, Table 29).

The White River basin is the most southern of the five major drainages, which enter the Missouri River from the west. The total drainage area of the basin, in South Dakota, is 8,250 square miles. Agriculture dominates the basin's economy with the majority of the land used as rangeland or cropland. There are a few sand and gravel operations in the area.

Water quality within this basin is extremely poor. It is the most severely impacted basin in the state. The single most important source of this poor quality is the highly erosive soil within the river drainage. This basin receives the majority of the runoff and drainage from the Badlands. The exposed Badlands are a major natural source of both suspended and dissolved solids to the river. Severe erosion and leaching of soils occurs in the Badlands and throughout the entire length of the basin. Suspended sediments in the White River leaving the Badlands area averaged nearly 4000 mg/l this reporting period (October 1994 to September 1999). Last reporting cycle, TSS averaged more than 5100 mg/l. In sharp contrast, river water entering the Badlands drainage averaged less than 250 mg/l last assessment and 814 mg/l this reporting period. Total dissolved solids concentrations followed a similar pattern, increasing from 738 mg/l upstream of the badlands, to 1788 mg/l downstream (WQM 11) this assessment. Apparently, heavy rainfall in the upper White River basin (vic. Oglala, SD) upstream of the Badlands had increased TSS concentrations there from an average of 250 mg/l (1989 – 93) to 814 mg/l for the present assessment.

Suspended sediment is deposited in Lake Francis Case at an average rate of 11,800,000 tons per year. Largely as a result of these appreciable sediment loads from the White River watershed, Lake Francis Case has lost an estimated >10% of reservoir water capacity to siltation since its creation in 1952. In the reservoir, sediment turbidity may be evident as far as 77 miles downstream of the White River/Missouri River confluence. Deposited sediment that forms a White River delta impedes boat navigation between the upper and lower reservoir.

Present water quality monitoring showed no improvement over conditions observed for the past decade in this basin. Extremely high exceedances of suspended solids were again noted in the entire White River drainage. There were no impairments this reporting period caused by elevated total dissolved solids. Fecal coliform was the cause of major impairment in the middle and lower reaches of the White River.

Owing to generally higher than normal runoff and riverflows in this basin during most of the last decade, TSS concentrations were also excessive in the upper White River and the Little White tributary for most of the 1990s. There were two fecal coliform exceedances during the current reporting period for the latter tributary, but they amounted to <10% of total samples. There is one previously assessed lake within this basin, Snow Dam, which was rated as hypereutrophic.

TABLE 29 : WHITE RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Streams								
Cottonwood Creek	Headwaters to White River	S106	39.2 miles	full	DENR460153			U
Little White River	Rosebud Creek to mouth	S107	56.0 miles	non	DENR460840	Pathogens [T] Suspended solids [H]	Agriculture [M] Grazing related Sources [M] Range grazing - Riparian and/or Upland [M] Natural Sources [H]	D
White River	Oak Creek to mouth	S108	116.2 miles	non	DENR460825	Salinity/TDS/chlorides [T] Thermal modifications [T] Pathogens [H] Suspended solids [H]	Agriculture [M] Grazing related Sources [M] Range grazing - Riparian and/or Upland [M] Off-farm Animal Holding/Management Area [M] Natural Sources [H]	D
	Interior to Black Pipe Creek	S109	109.3 miles	non	DENR460835	pH [T] Salinity/TDS/chlorides [T] Pathogens [H] Suspended solids [H]	Agriculture [M] Grazing related Sources [M] Range grazing - Riparian and/or Upland [M] Off-farm Animal Holding/Management Area [M] Natural Sources [H]	D
	Nebraska border to Interior	S110	143.8 miles	non	DENR460842	Suspended solids [H]	Agriculture [M] Grazing related Sources [M] Range grazing - Riparian and/or Upland [M] Off-farm Animal Holding/Management Area [M] Natural Sources [H]	D
Lakes								
No Lakes Assessed								

Niobrara River Basin (Figures 2 and 3, Table 30).

The tributaries of this basin that lie in South Dakota are located in the very south-central part of the state. These tributaries include the Keya Paha River and the Minnechadusa River. These streams drain approximately 2,000 square miles in South Dakota. Agriculture is the leading source of income to the basin.

Water quality in this basin was rated fair to satisfactory for most of the 1980s due to total suspended solids and occasional fecal coliform exceedances but supported its beneficial uses during the 1987-89 period. Improved water quality at that time may have been mainly the result of low stream flow. Increased stream flows from 1990 to 1995 and after were instrumental in increasing suspended solids concentrations in the Keya Paha River. This resulted in downgrade of basin water quality to a partial support status during the last assessment (1992-1997) though TSS levels were not as high as those found in most other eastern South Dakota streams. Past impacts, mainly before 1988, may have been caused by stream bank erosion as well as bacteria from sporadic wastewater discharges from the communities of Mission and Antelope. This reach must be monitored more closely to better determine all the major pollution sources contributing to the overall degradation (e.g. sedimentation) of this high quality stream during periods of normal or heightened stream flow. In recent years the support status of the Keya Paha River seems to have been inversely dependent on the amount of runoff and stream flow. Last assessment the river was partially supporting due to excessive TSS. Minor impairments were due to elevated pH and ammonia concentration. This reporting period in the river was also partially supporting due to high levels of TSS. Minor impairments noted were elevated water temperature, pH and fecal coliform.

Rahn Lake, the only lake in the basin that was assessed, is hypereutrophic due to nutrient enrichment and siltation. These problems are caused by agricultural activities.

TABLE 30 : NIOBRARA RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Streams								
Keya Paha River	Keyapaha to Nebraska border	S102	42.8 miles	partial	DENR460815	pH [T] Thermal modifications [T] Suspended solids [M]	Agriculture [M] Crop-related Sources [M] Nonirrigated Crop Production [M] Grazing related Sources [M] Pasture grazing - Riparian and/or Upland [M]	D
Lakes								
Rahn Lake	Tripp County	L110	14.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [M]	Crop-related Sources [H] Nonirrigated Crop Production [H] Grazing related Sources [H] Pasture grazing - Riparian and/or Upland [H]	U

Cheyenne River Basin (Figures 2 and 3, Table 31).

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 total drainage for the basin is 32,600 square miles. The area in this basin is very diverse. It includes the Black Hills, part of the Badlands, rangeland, irrigated cropland, and many 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 monitored two lower river segments did not support their designated fishable uses due to high total suspended solids (TSS) similar to past reporting periods. Also similar to the last two assessments was impairment of the swimmable use owing to excessive fecal coliform levels. No TSS violations were noted for the upper Cheyenne River during 1994-1995 assessment 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. Total dissolved solids (TDS) remained high during both periods (25% and 43% exceedance) for this upper river segment and were responsible for ratings of partial and non-support respectively. This assessment the Upper Cheyenne River was again not supporting for TDS. It is probable the elevated concentrations of TDS are mainly of natural geologic origin being derived from runoff leaching 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 this normally shallow prairie stream 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 in the former 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 which may contribute additional large amounts of eroded sediment carried by numerous small tributaries during periods of heavy rainfall that occurred with increasing frequency from 1991-95 and 1997. Many small stockwater dams in the lower watershed had been reported to be rapidly filling with sediments during the mid 1990s as a result of this increased precipitation even though large acreages of rangeland and cropland were enrolled in the Conservation Reserve Program (CRP) in this region of the state.

High fecal coliform counts were commonly recorded at all river sites nearly every reporting period. Likely sources of bacteria are livestock wastes and partially treated wastewater carried by overland runoff during periods of high precipitation in this basin. 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. The river frequently carries relatively high concentrations of nitrate (>1.00 mg/l) at the lowermost site near Bridger, South Dakota. Possibly, one source is irrigation return flows entering the tributary Belle Fourche River.

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 tributary Belle Fourche 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 habitat 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) (Sowards et al., 1991).

Recent (1998) tests carried out on fish flesh samples collected (by EPA) from the lower Cheyenne River and Foster Bay by the U.S. Department of Health and Human Services, Atlanta, Georgia, supported those results. Mercury (methyl mercury) in fish flesh of several species was found to have declined to nominal concentrations

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 present and previous assessments, the creek upstream of Pactola Reservoir supported its assigned uses. Minor impairments noted were elevated pH, TSS, and fecal coliform. The next site downstream and adjacent to the Rapid City limits also fully supported its designated uses. Elevated water pH and TSS were minor exceedances recorded. The 8-mile reach above the Rapid City WWTP was non-supporting due to excessive fecal coliform.

The two stream segments (54 miles) downstream of the Rapid City WWTP to the Cheyenne River confluence (WQM 92 and 19) were non-supporting of their swimmable use during this and previous assessment. A major recurring problem in this reach appears to be excessive fecal coliform bacteria levels. Minor impairments over the 1992-1997 assessment period were elevated ammonia and low DO in order of importance. A moderate impairment in the lower segment this reporting period, as well as the previous, was TSS.

Fall River in its upper half is often impaired during the warmer seasons of each 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. There was visible improvement in the general water quality of this waterbody following upgrade of the Hot Springs WWTF to a total retention facility a number of years ago. Both DENR sampling sites on the Fall River were subsequently inactivated in October 1990. Limited USGS monitoring data indicated that the upper half of the river is supporting both its coldwater marginal fishery and warmwater permanent fishery designations with regard to stream temperature standards. The lower half of Fall River below Hot Springs, SD has not been monitored for water quality since 1990 but DENR reestablished this site (WQM 57) for quarterly sampling in 1999.

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 the increase in the size and density of the ponderosa pine forest canopy; the latter being the natural result of forest fire suppression in the long term. Recent studies suggest a management regime that would maintain an intermediate level (e.g. 40-60% canopy cover) rather than a dense or open ponderosa pine canopy would benefit soil moisture, ground water, and therefore, improve stream flow during drier years. Establishing this level of forest cover would represent a good compromise between maintaining a forest ecosystem and increasing the water production potential of the Black Hills (South Dakota Farm and Home Research, winter 1995, SDSU) (South Dakota Horizons, August 1995, SDSU).

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 its designated beneficial uses the last several assessments. There were very few violations noted in the measured stream parameters. During the last decade, minor impairments noted were elevated TSS and FC and one instance of low DO. This stream was also fully supporting of uses during the 1987-89 monitoring period. Overall water quality has remained in the good to satisfactory range for more than 10 years.

Flynn Creek, a small tributary of the south fork of Lame Johnny Creek, supported its fishable (aquatic life) beneficial use during this assessment with minor impairments due to elevated TSS and water pH (>8.8) similar to the last reporting period. This small stream had fully supported all its designated uses during earlier reporting cycles, indicating Flynn Creek has fairly consistent good water quality.

Lower Battle Creek was moderately impaired this and previous assessment due to elevated water temperature and pH. Grace Coolidge Creek partially supported its coldwater fishery use with elevated water temperature a moderate impairment. Upper Battle Creek also partially supported its designated uses with elevated temperature a moderate exceedance. Generally, in past reporting periods, these streams were moderately impaired by either or both high pH (>8.6) and water temperature. Those moderate exceedances may be attributed to natural conditions.

Upper Spring Creek was moderately impaired this period due to excessive fecal coliform similar to last reporting period. However, Spring Creek had supported its assigned uses during previous reporting periods. There was no significant violation of standards detected in the waters of the lower creek flowing out of Sheridan Lake for the last eight years. This is a reasonably good indication that water quality is consistently acceptable over the entire length of Spring Creek. Minor impairments infrequently noted were elevated pH and TSS.

Castle Creek below Deerfield Reservoir supported designated uses this as well as last assessment. Elevated TSS was a minor impairment in both assessments. In the past, slightly elevated pH also frequently occured in the lower reach.

Box Elder Creek supported its uses in the upper reach for the present and previous three reporting periods. Lower Box Elder Creek also supported beneficial uses. The monitored segment of the lower creek is classified for (9, 10) only.

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 hydrological 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 during the growing season, and higher rainfall than the surrounding plains as a result of greater elevation and forest cover. Also contributing importantly to better 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 artificial lakes 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 TSI value (mean) obtained for Pactola Reservoir is 38, and for Deerfield Reservoir, 40. 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 combined TSI for Pactola increased from 34 to 39 between the last two reporting periods. 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 connected 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. The less favorable conditions were due primarily to higher measured in-lake phosphorus levels during 1995 compared to 1992. In Angostura Reservoir, higher combined TSIs during 1996 and 1997 were due to sediment turbidity. The increases in algae in the larger Black Hills lakes, as a result of more available phosphorus, were small except in Stockade Lake (120 surface acres). In two small Black Hills reservoirs (<20 acres), Lake Lakota and Horsethief, higher TSIs calculated in 1994 were primarily the result of larger algal biomass (higher chlorophyll *a* concentration) while at the same time their in-lake phosphorus showed only small increases or declined against phosphorus values measured in 1991.

Of the 16 monitored lakes in the Cheyenne River basin, nearly 69% are presently rated as eutrophic or hypereutrophic with 3 lakes in the latter category – Mitchell, New Wall, and Stockade Lake (borderline hypertrophic). Five of the 16 lakes, or 31%, are fully supporting beneficial uses, four are partially supporting, and seven (44%) non-supporting.

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

TABLE 31 : CHEYENNE RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Streams								
Battle Creek	Near Horsethief Lake to Teepee Gulch Creek	S50	9.5 miles	non	DENR460103	Thermal modifications [H]	Natural Sources [H]	D
	Teepee Gulch Creek to SD Hwy 79	S51	16.8 miles	partial	DENR460905	pH [M] Thermal modifications [M]	Urban Runoff/Storm Sewers [M] Natural Sources [M]	S
Box Elder Creek	Above Box Elder to Owanka	S52	50.3 miles	full	DENR460679			D
	Headwaters to near Bogus Jim Creek	S53	12.2 miles	full	DENR460925	pH [T] Thermal modifications [T] Suspended solids [T]	Agriculture [T]	S
Castle Creek	Deerfield Reservoir to Rapid Creek	S54	21.6 miles	full	DENR460646	Suspended solids [T]	Agriculture [T] Grazing related Sources [T] Silviculture [T]	D
Cheyenne River	Wyoming Border to Angostura Reservoir	S55	69.6 miles	non	DENR460875	Salinity/TDS/chlorides [H] Suspended solids [H] Conductivity [H]	Agriculture [H] Grazing related Sources [H] Pasture grazing - Riparian and/or Upland [H] Natural Sources [H]	S
	Rapid Creek to Belle Fourche River	S56	62.2 miles	non	DENR460865	Pathogens [H] Suspended solids [H]	Agriculture [H] Crop-related Sources [H] Crop-related Sources [H] Nonirrigated Crop Production [H] Irrigated Crop Production [H] Grazing related Sources [H] Range grazing - Riparian and/or Upland [H] Natural Sources [H]	S
	Belle Fourche River to Bull Creek	S57	89.5 miles	non	DENR468860	Thermal modifications [T]	Agriculture [H] Crop-related Sources [H] Crop-related Sources [H] Nonirrigated Crop Production [H] Irrigated Crop Production [H] Grazing related Sources [H] Range grazing - Riparian and/or Upland [H]	I

TABLE 31 : CHEYENNE RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Streams								
Cheyenne River	Belle Fourche River to Bull Creek	S57	89.5 miles	non	DENR468860	Thermal modifications [T]	Off-farm Animal Holding/Management Area [H] Contaminated Sediments [H] Natural Sources [H]	I
						Pathogens [H] Suspended solids [H] Alkalinity [T]		
Flynn Creek	Near SD Hwy 87 to mouth	S58	12.5 miles	full	DENR460111	pH [T]	Agriculture [T] Grazing related Sources [T] Silviculture [T]	S
						Suspended solids [T]		
French Creek	Headwaters to Custer	S59	12.8 miles	full	DENR460102	pH [T]	Silviculture [T] Recreation and Tourism Activities [T]	S
						Organic enrichment/Low DO [T] Pathogens [T] Suspended solids [T]		
	Custer to Stockade Lake	S60	4.0 miles	full	DENR460653			I
	Stockade Lake to SD Hwy 79	S61	30.1 miles	full	DENR460651			I
Grace Coolidge Creek	Headwaters to Battle Creek	S62	23.0 miles	partial	DENR460650	Suspended solids [M]	Agriculture [M]	D
Rapid Creek	Headwaters to Pactola Reservoir	S63	15.6 miles	full	DENR460647	Pathogens [T]	Agriculture [T] Grazing related Sources [T] Silviculture [T]	S
						Suspended solids [T]		
	Pactola Reservoir to Lower Rapid City	S64	37.0 miles	full	DENR460669	pH [T]	Silviculture [T]	S
							Urban Runoff/Storm Sewers [T]	
						Suspended solids [T]		
	Lower Rapid City to RC WWTF	S65	7.6 miles	non	DENR460110	Pathogens [H]	Agriculture [H] Grazing related Sources [H] Urban Runoff/Storm Sewers [H]	D
						Suspended solids [T]		
	RC WWTF to above Farmingdale	S66	22.8 miles	non	DENR460692	Organic enrichment/Low DO [T]	Agriculture [H]	I
							Crop-related Sources [H] Irrigated Crop Production [H] Off-farm Animal Holding/Management Area [H]	

TABLE 31 : CHEYENNE RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Streams								
Rapid Creek	RC WWTF to above Farmingdale	S66	22.8 miles	non	DENR460692	Pathogens [H] Suspended solids [T]		I
	Above Farmingdale to mouth	S67	30.9 miles	non	DENR460910	Organic enrichment/Low DO [T] Pathogens [H] Suspended solids [M]	Off-farm Animal Holding/Management Area [H]	S
Spring Creek	Headwaters to Sheridan Lake	S68	26.2 miles	partial	DENR460654	pH [T] Thermal modifications [T] Pathogens [M] Suspended solids [T]	Agriculture [M] Grazing related Sources [M] Silviculture [M] Natural Sources [M]	S
	Sheridan Lake to SD Hwy 79	S69	27.0 miles	full	DENR460649	pH [T]	Natural Sources [T]	S
Lakes								
Angostura Reservoir	Fall River County	L41	4830.0 acres	full/M	Lake assessment			D
Bismark Lake	Custer County	L42	25.0 acres	non/E	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [H]	Agriculture [H] Highway Maintenance and Runoff [H] Natural Sources [H] Recreation and Tourism Activities [H]	U
Canyon Lake	Pennington County	L43	27.0 acres	partial/ME	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [H]	Urban Runoff/Storm Sewers [M] Natural Sources [M] Waterfowl [M]	U
Center Lake	Custer County	L44	27.0 acres	non/E	Lake assessment	Nutrients [H]	Highway Maintenance and Runoff [H] Natural Sources [H] Recreation and Tourism Activities [H]	D

TABLE 31 : CHEYENNE RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Lakes								
Center Lake	Custer County	L44	27.0 acres	non/E	Lake assessment	Siltation [H] Algal Grwth/Chlorophyll a [H]		D
Cold Brook Reservoir	Fall River County	L45	32.0 acres	full/M	Lake assessment			S
Cottonwood Springs Lake	Fall River County	L46	2.0 acres	full/M	Lake assessment			U
Deerfield Lake	Pennington County	L47	414.0 acres	full/M	Lake assessment			D
Horsethief Lake	Pennington County	L48	16.0 acres	partial/E	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [H]	Contaminated Sediments [M] Natural Sources [M]	S
Lakota Lake	Custer County	L49	11.0 acres	non/E	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [M]	Agriculture [H] Highway Maintenance and Runoff [H] Natural Sources [H]	I
Legion Lake	Custer County	L50	9.0 acres	partial/E	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [H]	Silviculture [M] Highway Maintenance and Runoff [M] Natural Sources [M] Recreation and Tourism Activities [M]	S
Mitchell Lake	Pennington County	L51	8.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [H]	Silviculture [H] Natural Sources [H]	U
New Wall Lake	Pennington County	L52	42.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Suspended solids [M]	Agriculture [H] Grazing related Sources [H] Pasture grazing - Riparian and/or Upland [H]	I

TABLE 31 : CHEYENNE RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Lakes								
New Wall Lake	Pennington County	L52	42.0 acres	non/H	Lake assessment	Algal Grwth/Chlorophyll a [M] Turbidity [M]		I
Pactola Reservoir	Pennington County	L53	785.0 acres	full/M	Lake assessment			D
Sheridan Lake	Pennington County	L54	383.0 acres	partial/ME	Lake assessment	Nutrients [M] Siltation [M] Algal Grwth/Chlorophyll a [M]	Agriculture [M] Grazing related Sources [M] Silviculture [M] Land Disposal [M] Onsite Wastewater Systems [M]	D
Stockade Lake	Custer County	L55	120.0 acres	non/H	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [H]	Urban Runoff/Storm Sewers [M]	S
Sylvan Lake	Custer County	L56	17.0 acres	non/E	Lake assessment	Nutrients [H] Siltation [H] Algal Grwth/Chlorophyll a [M]	Silviculture [H] Natural Sources [H] Recreation and Tourism Activities [H]	I

Belle Fourche River Basin (Figures 2 and 3, Table 32).

Upper Belle Fourche River from the Whitewood Creek to the Willow Creek (17 miles) confluence was supporting its fishery use this reporting period. Minor impairment was caused by elevated fecal coliform and total suspended solids (TSS). A major natural source of occasional elevated TDS and TSS to this reach of the river may be the extensive exposed shale beds that lie along the river's course upstream of the city of Belle Fourche. Agricultural/rangeland activities are likely additional sources of occasional impairment. The lower Belle Fourche River was moderately impaired by excessive TSS and slightly impaired by occasional elevated fecal coliform and water temperature.

Horse Creek was moderately impaired during the 1985-1987 reporting period by high water conductivity probably from irrigation return flows. Recent USGS monitoring data (1993-95) indicated Horse Creek is partially supporting its irrigation use due to conductivity in excess of 3000 mg/l. Irrigation return flows may be contributing to the high conductivity in this stream at this time. Limited past data also suggest that total suspended solids (TSS) may be frequently excessive in this stream.

Redwater River fully supported its assigned uses during this assessment and most previous reporting periods. Minor impairment this reporting cycle came from elevated total suspended solids.

The middle reach of Spearfish Creek was partially impaired by elevated stream pH this assessment period (1992-1997). The 12-mile segment between Elmore and Maurice, SD recorded non-support due also to high pH. It is suggested that higher pH may be due largely to the limestone formations located along the course of the stream. Minor exceedances were elevated water temperature, ammonia, and TSS, in order of importance.

Commerical streamside placer mining activities are no longer a significant source of water quality problems in Black Hills streams within the Belle Fourche and Cheyenne River Basins. During 1996 and 1997, Homestake Mining and Brightwater Inc., an affiliate of the Dunbar Resort, reclaimed the Red Placer that was previously mined by Dakota Placers under South Dakota Mining Permit No. 208. Homestake and Brightwater jointly own the Red Placer claim and developed an extensive reclamation and stream rehabilitation plan for the minesite. Approximately 16 acres of mine-affected lands along Whitewood Creek were reclaimed, and the stream channel was reconstructed and stabilized throughout the site. At the present time, only recreational gold panners are exerting a limited impact on a few segments on other creeks (e.g. upper Rapid Creek) in both Black Hills river basins.

A 23-mile reach of Bear Butte Creek from the headwaters to the Lawrence County line was historically severely impaired by heavy metals and moderately impacted by elevated TSS. The sources of excessive heavy metals are old streamside mine tailings along Strawberry Creek and in-place contaminants in the Bear Butte streambed. Bear Butte Creek is currently meeting heavy metals criteria.

Strawberry Creek, approximately 5 miles southeast of Deadwood, South Dakota, is a western tributary of upper Bear Butte Creek. In past years, upper Strawberry Creek was severely impacted by local mine tailings; seepage and runoff from which produced conditions of low water pH (avg. 4.1) and excessive TSS in this stream during the period (1993-95). In addition, there was moderate impairment due to elevated TDS and water conductivity. However, there was dramatic improvement in stream pH (avg. 7.2) and conductivity starting with the November 1994 samples and some improvement in TDS although not in total suspended solids (TSS). During 1996-1997, water quality in Strawberry Creek declined. Non-support was caused by TDS, conductivity, elevated TSS, and low pH. Average water pH fell to 6.85 for this recent period. This reporting period average pH improved slightly to 7.0 and TSS decreased to acceptable levels. However, the stream is presently non-supporting due to high TDS and zinc concentrations.

Last reporting period, Whitewood Creek partially supported its swimmable beneficial use from the headwaters to its confluence with Gold Run Creek at Lead, South Dakota, due to high fecal coliform. Another moderate impairment consisted of high pH. This reporting cycle, the upper reach fully supported beneficial uses. Minor exceedances were elevated water temperature, FC and TSS.

Downstream of Gold Run Creek, water quality of middle Whitewood Creek routinely declines for the next eight to ten miles. During the present and last reporting period, non-support of this reach was attributable solely to high fecal coliform levels. Causes of minor impairment last assessment were elevated pH and TSS. The lower half of Whitewood Creek fully supported its assigned uses this reporting period as during past assessments. Minor impairments noted in the lower creek were due to elevated fecal coliform, TSS, pH, and cyanide. Monitored heavy metals levels showed no violations. Water quality data from 1992 and 1997 indicated that from one half to three quarters of Whitewood Creek stream miles supported their assigned uses.

A principal source of high fecal coliform numbers to the stream's middle reach may be faulty segments of the Deadwood, SD, wastewater collection system in the vicinity of the creek. Sewage pipes in this area have deteriorated with age and are gradually being repaired or replaced. Another source of coliform to the creek may be the Lead, South Dakota combined sewer overflow (CSO). A Surface Water Discharge permit has been issued to the city of Lead and the Lead-Deadwood Sanitary District for their CSOs, requiring compliance with EPA's nine minimum controls for CSOs.

In past assessments (1989-1993), West Strawberry Creek, a southeastern tributary of upper Whitewood Creek, was moderately impaired by elevated water temperatures (>65^0F), TSS and high pH. Lack of adequate flows may have been a major contributing factor for these conditions. Increased flows during the mid 1990s resulted in one exceedance of the TSS standard for this stream. All other parameters measured were within designated limits. West Strawberry Creek fully supported assigned beneficial uses during the present and previous assessment. Minor impairments were elevated pH, water temperature, and TSS.

Annie Creek, Squaw Creek, False Bottom Creek, Stewart Gulch Creek, Fantail Creek, Deadwood Creek, and Whitetail Creek are seven small tributaries investigated this assessment. These are tributaries of Spearfish Creek, Redwater River, and Whitewood Creek, respectively. All of those tributaries supported their assigned uses. Squaw Creek, a tributary of Spearfish Creek, was slightly impaired (10%) by elevated pH. Other common minor impairments noted in three of the six streams were elevated TSS and water temperature.

Belle Fourche Reservoir (Orman Dam) continued to support its assigned uses for the last three reporting periods with TSI values in the mesotrophic range (combined TSIs: 42 to 46). However, inorganic turbidity has been a moderate water quality problem in Belle Fourche Reservoir particularly in the early 1990s (Secchi visibility TSIs: 57 - 58). The latest calculated Secchi visibility TSI is 51. Much of this turbidity may be attributed to the previously mentioned surface shale formations within this drainage. Crow Creek, Owl Creek and water diversions from the Belle Fourche River transport large quantities of TSS into the reservoir during high-water periods. Agricultural activities may at times be a major source of nutrients and siltation to this large reservoir.

Newell Lake fully supported its beneficial uses during the last two reporting periods. Partial support in a previous assessment was largely due to heavy summer rains and runoff in the watershed during 1993, which brought high levels of TSS and phosphorus into the lake. A similar situation may have occurred during 1996 but the lake remained fully supporting by a slight margin (combined annual TSI = 55) for that year. The 1997 TSI calculated was 43, which placed Newell Lake in the mesotrophic range. Mesotrophic status has been maintained in the lake from 1989 to 1997, with the exception of 1993 and 1996. The current calculated combined TSI for Newell Lake (1998-2000) is 52, which places the lake in the moderately eutrophic range.

Three of the four monitored lakes in the Belle Fourche River basin are presently rated as moderately eutrophic (TSIs: 51-54) and one (Orman Dam) as mesotrophic. Three fully support beneficial uses and one (Iron Creek Lake) partially supports assigned uses at the present time.

TABLE 32 : BELLE FOURCHE RIVER BASIN

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Streams								
Annie Creek	Headwaters to Spearfish Creek	S2	2.1 miles	full	DENR46MN31			S
Bear Butte Creek	Headwaters to Strawberry Creek	S3	8.0 miles	full	DENR460126	Thermal modifications [T]	Hydromodification [T]	I
	Strawberry Creek to near Bear Den Mountain	S4	3.7 miles	full	DENR460125	Thermal modifications [T]	Hydromodification [T]	I
Belle Fourche River	Near Fruitdale to Whitewood Creek	S5	18.8 miles	full	DENR460683	Thermal modifications [T] Suspended solids [T]	Agriculture [T] Grazing related Sources [T] Pasture grazing - Riparian and/or Upland [T] Range grazing - Riparian and/or Upland [T] Natural Sources [T]	S
	Whitewood Creek to Willow Creek	S6	17.0 miles	full	DENR460681	Thermal modifications [T] Suspended solids [T]	Agriculture [T]	S
	Willow Creek to Alkali Creek	S7	75.1 miles	partial	DENR460880	Thermal modifications [T] Suspended solids [M]	Agriculture [M] Crop-related Sources [M] Irrigated Crop Production [M]	S
Deadwood Creek	Rutabaga Gulch to Whitewood Creek	S8	3.7 miles	full	DENR460127			U
False Bottom Creek	Headwaters to Saint Onge	S9	19.2 miles	full	DENR46MN38			S
Fantail Creek	Headwaters to Nevada Gulch	S10	2.0 miles	full	DENR460119	Suspended solids [T]	Resource Extraction [T]	S
Gold Run Creek	Headwaters to mouth	S11	1.0 miles	full	DENR460659			S
Horse Creek	Indian Creek to mouth	S12	27.7 miles	non	USGS06436760	Conductivity [H]	Agriculture [H] Crop-related Sources [H] Irrigated Crop Production [H]	S
Redwater River	US Hwy 85 to mouth	S13	13.1 miles	full	DENR460895	Suspended solids [T]	Agriculture [T] Grazing related Sources [T] Range grazing - Riparian and/or Upland [T] Natural Sources [T]	S
Spearfish Creek	Intake Gulch to Annie Creek	S14	8.2 miles	full	DENR46MN32			I
	Annie Creek to McKinley Gulch	S15	0.5 miles	full	DENR46MN33			I
	McKinley Gulch to Squaw Creek	S16	7.6 miles	full	DENR46MN34			I
	Squaw Creek to Fish Hatchery Gulch	S17	8.2 miles	full	DENR46MN35			I
	Fish Hatchery Gulch to Higgens Gulch	S18	6.4 miles	partial	DENR460900	pH [M]	Urban Runoff/Storm Sewers [M] Natural Sources [M]	S

TABLE 32 : BELLE FOURCHE RIVER BASIN

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Streams								
Spearfish Creek	Fish Hatchery Gulch to Higgens Gulch	S18	6.4 miles	partial	DENR460900	Suspended solids [T]		S
	Higgens Gulch to mouth	S19	4.5 miles	full	DENR460689	Thermal modifications [T] Suspended solids [T]	Urban Runoff/Storm Sewers [M] Natural Sources [M]	S
Squaw Creek	Confluence with East Branch Squaw Creek to mouth	S20	1.3 miles	full	DENR46MN39	Thermal modifications [T]	Resource Extraction [T] Natural Sources [T]	S
Stewart Gulch	Headwaters to mouth	S21	2.0 miles	full	DENR460124			S
Strawberry Creek	Headwaters to mouth	S22	2.1 miles	non	DENR460116	Metals [M] Cadmium [M] Copper [M] Zinc [M] pH [M] Organic enrichment/Low DO [T] Salinity/TDS/chlorides [H] Suspended solids [T] Conductivity [M]	Industrial Point Sources [M] Resource Extraction [M] Mine Tailings [M] Acid Mine Drainage [M]	I
Whitetail Creek	Headwaters to mouth	S23	5.2 miles	full	DENR460118	pH [T] Pathogens [T]	Construction [T] Land Development [T] Resource Extraction [T]	S
Whitewood Creek	Whitetail Summit to Gold Run Creek	S24	3.4 miles	full	DENR460686	Thermal modifications [T] Suspended solids [T]	Natural Sources [T]	I
	Gold Run Creek to Deadwood Creek	S25	1.8 miles	full	DENR460122	Pathogens [T]	Urban Runoff/Storm Sewers [T]	S
	Deadwood Creek to Spruce Gulch	S26	1.2 miles	non	DENR460123	Pathogens [H]	Combined Sewer Overflow [H]	S
	Spruce Gulch to Sandy Creek	S27	5.3 miles	full	DENR460685			I
	Sandy Creek to I-90	S28	4.9 miles	full	DENR460684	Cyanide [T]	Agriculture [T] Off-farm Animal Holding/Management Area [T]	S

TABLE 32 : BELLE FOURCHE RIVER BASIN

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Cause [Magnitude]	Source [Magnitude]	Trend
Streams								
Whitewood Creek	Sandy Creek to I-90	S28	4.9 miles	full	DENR460684	pH [T] Thermal modifications [T] Pathogens [T]		S
	I-90 to Crow Creek	S29	10.8 miles	full	DENR460652			S
	Crow Creek to mouth	S30	9.0 miles	full	DENR460682	Thermal modifications [T] Suspended solids [T]	Off-farm Animal Holding/Management Area [T]	S
W Strawberry Creek	Headwaters to mouth	S31	2.6 miles	full	DENR460675	Thermal modifications [T]	Natural Sources [T]	I
Lakes								
Iron Creek Lake	Lawrence County	L5	22.0 acres	partial/ME	Lake assessment	Nutrients [M] Siltation [M] Noxious aquatic plants [M] Algal Grwth/Chlorophyll a [M]	Agriculture [M] Grazing related Sources [M] Silviculture [M] Land Disposal [M] Onsite Wastewater Systems [M]	S
Newell Lake	Butte County	L6	183.0 acres	full/ME	Lake assessment			S
Newell City Pond	Butte County	L7	20.0 acres	full/ME	Lake assessment			S
Orman Dam	Butte County	L8	8063.0 acres	full/M	Lake assessment			S

Little Missouri River Basin (Figures 2 and 3, Table 33).

The Little Missouri River Basin is a small basin located in the northwestern corner of the state. The river enters the state from southeast Montana and drains some 605 square miles before exiting into North Dakota. The basin's economy is dominated by agriculture with approximately 90 percent of the land being used for agricultural production. The majority of this land is used for rangeland, as limited water supplies reduce the amount of land available for crops. The basin mineral industry is limited to the extraction of sand and gravel. However, thin beds of lignite coal do exist and test holes for oil have been drilled. At the present time, neither the coal nor the oil are commercially produced.

The Department of Environment and Natural Resources discontinued monitoring water quality of the Little Missouri River in 1979. Data from previous samples showed that the water quality was generally suitable for the designated beneficial uses although minor violations of the Water Quality Standards criteria for TDS, TSS, and conductivity were occasionally noted. Conductivity exceedances occurred primarily during winter when formation of ice cover tends to concentrate salts in the remaining flow. The violations were generally attributed to agricultural nonpoint sources in Montana/South Dakota and naturally occurring erosion and soluble minerals. There are no significant point source discharges in the South Dakota portion of the basin. In 1999, DENR resumed quarterly monitoring of the Little Missouri River at site WQM 26 (Figure 8).

Limited monitoring by USGS during the 1990s suggested that the Little Missouri River continues to support its designated beneficial uses. Stream flow during 1991-92 was relatively low compared to previous years. Flows ranged from 0 to 29 cfs averaging 6 cfs. Flows increased significantly after 1992 due to greater rainfall and snowfall in the drainage. In 1996 and 1997, late winter thaws and spring flows produced discharges in excess of 1000 cfs. During the winter months of 1996-98 five high conductivity readings (>2500 mg/l) were recorded. However, no major impairments were noted this assessment. Because of the lack of recent water quality data, this stream has not been rated for this monitoring cycle. There are no monitored lakes within this river basin.

TABLE 33 : LITTLE MISSOURI RIVER BASIN INFORMATION

Waterbody	Location	ID (See Fig.3)	Size	Overall Support Status/Trophic Status	Basis	Trend
Streams						
Little Missouri River	WY border to ND border	N/A	86.0 miles	full	USGS 06334500	S
Lakes						
No Lakes Assessed						

F. WETLANDS

In South Dakota, wetlands are defined as “those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.” (ARSD 74:51:01) For purposes of federal 404 identification and delineation, wetlands must have each of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes, (2) the substrate is predominantly hydric soil, and (3) the substrate is saturated with water or covered by shallow water at some time during the growing season of each year.

There are many types of wetlands, but the most prevalent type in South Dakota is the Palustrine Emergent Wetland, commonly referred to as the prairie pothole. One of the functions of these prairie potholes is the production of waterfowl. Researchers have found an average of 140 ducks produced per square mile per year in eastern South Dakota (US Department of the Interior, 1984). Other major functions of wetlands in the state are the improvement and maintenance of water quality, ground water recharge, and recreation.

Still another important function of the prairie pothole is flood control. A common agricultural practice has been to drain these pothole areas by open ditching and thus eliminate water storage areas. This drainage leads to the concentration of waterfowl breeding populations at the remaining wetlands as well as increased flooding in certain river basins. This has been documented in the James River Basin of North Dakota according to J.G. Sidle in the North Dakota Outdoors publication of August, 1983 (US Department of the Interior, 1984). In the upper James River Basin of South Dakota a 1989 US FWS survey found that at least 5.5% of total wetland acres had been impacted by drainage as well as 6% of the acreage in the Vermillion River drainage and as much as 40% of the acreage in the Upper Big Sioux River watershed (US Department of the Interior, 1991).

In 1989, 19% of total wetland acreage in the upper James River basin had been impacted by dugouts, whereas 36% and 33% of total wetland acres had been affected in the Vermillion and Big Sioux drainages, respectively (US Department of the Interior, 1991). By 1994, through the efforts of the landowners, United States Fish & Wildlife Service (US FWS), the Natural Resources Conservation Service (NRCS), Ducks Unlimited, and Conservation Districts, South Dakota had increased the total area of wetlands by 4,500 acres. These wetlands were all newly created and served to add to the habitat of South Dakota's wildlife.

Due to being located in the Prairie Pothole Region, South Dakota has approximately 2.7 million acres of hydric soils. Small wetland areas were densely distributed over most of eastern (east-river) South Dakota where they were formed by retreating glaciers (Figure 4). Today, there are roughly 1.8 million acres of wetlands remaining (Dahl, 1990). This represents a one-third loss due to both natural and human causes. These figures are available in the 1990 US Fish and Wildlife Service Report to Congress entitled Wetlands Losses in the US 1780s to 1980s. Natural losses result from natural succession, sedimentation, erosion, the hydrologic cycle, and fire.

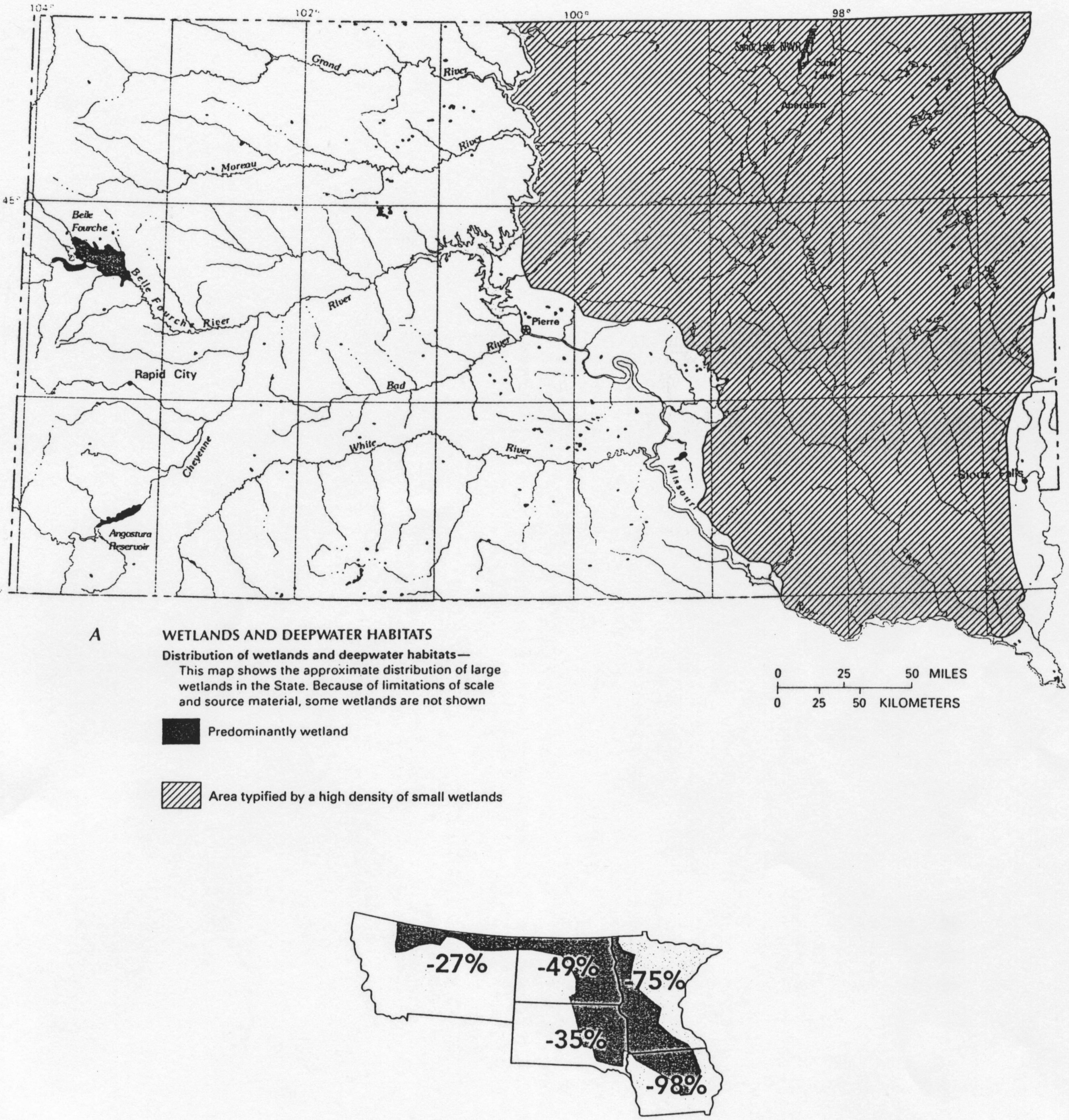


Figure 4. The prairie pothole region in South Dakota and wetland losses in the prairie pothole region in SD and adjoining states (USGS Supply Paper 2425).

TABLE 34. EXTENT OF WETLANDS, BY TYPE

Wetland Type Cowardin et al. (1979)	Historical Extent (acres) 1982 NRI	Most Recent Acreage 1992 NRI	% Change
Marine	0.0	0.0	0.0
Estuarine	0.0	0.0	0.0
Riverine	105,100	104,300	-0.8
Lacustrine	756,100	792,500	+4.8
Palustrine	2,108,700	2,107,600	-0.05
Total	2,969,900	3,004,400	+1.2

Human induced impacts may include agricultural drainage, flood control, channelization, filling, dredging, reservoir construction, oil and gas extraction, groundwater extraction, and various waste disposal sources. The impact rate on individual wetland basins (all types) in eastern South Dakota was estimated at 4.5% between 1983/84 and 1989. Highest loss rates were recorded for small temporary wetland basins less than 2 acres in area (US Department of the Interior, 1991).

By contrast, the National Resources Inventory (NRI) in 1982, located 2,969,900 acres of wetlands in South Dakota. Since heavy emphasis was placed on the hydric soils criterion, the number of wetlands found reflects the previously mentioned number of acres of hydric soils in South Dakota. The National Resources Inventory was again conducted in 1992 and 3,004,400 acres of wetlands were found in South Dakota, reflecting an increase in wetland acreage of 34,500 acres (Table 34).

Wetlands are protected by several agencies in South Dakota. Counties are responsible for control of wetland drainage. The US Army Corps of Engineers is responsible for the control of activities which place fill in wetlands. The Corps' authority stems from Section 404 of the Clean Water Act. Before exercising its authority on a particular action, the COE issues a public notice, taking into consideration the comments of the US Environmental Protection Agency, US Fish and Wildlife Service, S.D. Department of Game, Fish and Parks, S.D. Department of Environment and Natural Resources, and other resource agencies. Projects must receive certification from DENR under Section 401 of the Clean Water Act that the project will not violate South Dakota Surface Water Quality Standards. DENR regulates the discharge of pollutants to wetlands under the Surface Water Discharge permitting program.

Approximately 49,000 acres of wetlands are currently owned by the South Dakota Department of Game, Fish and Parks and managed as State Game Production Areas and Public Shooting Areas. The present total area includes a recent acquisition by GF&P of 3,000 acres of lakeshore wetlands in Lake Thompson, Kingsbury County. The US Fish and Wildlife Service (FWS) has 423,800 acres under perpetual easement, 17,348 acres under easement with FmHA, and another 65,000 acres under fee titles. This represents an increase of 42,305 acres or 9.1% over the FWS acreage reported prior to 1993.

“<u>Swampbuster” Provisions</u>

On December 23, 1985, President Reagan signed the Food Security Act of 1985. The Wetland Conservation or “Swampbuster” Provision of the Act was included because of an increased awareness of wetland values and public concern over diminishing wetland resources. Swampbuster's purpose was to remove the incentives for persons to produce agricultural commodities on converted wetlands and to thereby:

*Reduce soil loss due to wind and water erosion;

*Protect the Nation's long-term capability to produce food and fiber;

*Reduce sedimentation and improve water quality;

*Assist in preserving the Nation's wetlands;

*Curb production of surplus commodities.

Swampbuster provisions provide that anyone who, after December 23, 1985, produces an agricultural commodity on a converted wetland shall be determined to be ineligible for certain benefits provided by the US Department of Agriculture (USDA) and agencies of the Department. The 1990 Farm Bill tightened this provision to include the conversion of any land, which had the potential to produce an agriculture commodity.

The benefits under this provision include:

* Any type of price support or payment made available under the Agricultural Act;

* Farm storage facility loans under the CCC Chapter Act;

* Disaster payments under the Agricultural Act of 1949;

* Crop insurance under the Federal Crop Insurance Act;

* Farm loans made, insured, or guaranteed by FmHA; and

* Payment for storage of an agricultural commodity under the CCC Charter Act.

Swampbuster determinations and decisions are made by the Natural Resources Conservation Service (NRCS). The agency plays an integral role in determining ineligibility for benefits under swampbuster provisions.

In South Dakota, the NRCS established four wetland inventory teams to accelerate wetland identification on existing croplands as required by swampbuster. These teams completed about 80% of the statewide inventory by the end of 1991. At that time, resumption of the survey was delayed until new federal guidelines could be incorporated into survey procedure. Maps of designated wetlands found on agricultural lands in eastern South Dakota are available through the

Farm Service Agency or NRCS. Similar maps covering the western half of the state are in the draft stage and nearing completion.

Since the advent of the swampbuster program, annual losses of wetland acreages in the state due to drainage, excavation, or fill, have been estimated to have been reduced by more than 50 percent and in some instances has led to an increase in wetland acreage.

Development of a State Wetland Protection Program.

The state has made progress during 1992-99 toward inventorying indigenous wetlands (Table 34), developing appropriate wetland water quality standards and establishing an integrated state wetland protection program (Table 35).

On December 3, 1992, South Dakota adopted, through the South Dakota Surface Water Quality Standards, that wetlands be included as "waters of the state". Wetlands were also designated for beneficial use of wildlife propagation and stock watering which provides protection under existing narrative and numeric water quality standards. All definitions within state regulations were made consistent with the definition as stated previously.

TABLE 35. DEVELOPMENT OF STATE WETLAND WATER QUALITY STANDARDS

	In Place	Under Development	Proposed
Use Classification	X		
Narrative Biocriteria	X		
Numeric Biocriteria			
Antidegradation	X		

It was found that many of the best management practices that reduce stream, lake, and groundwater pollution, have a similar positive impact on wetlands. Nutrients, pathogens, pesticides, and sediments are all primarily delivered by runoff from agricultural lands. When runoff is controlled, wetlands and water quality are often maintained or enhanced. Some of the prescribed BMPs that would accomplish this purpose included strip cropping, chisel plowing, no-till or minimum-till, ridge-plant, fertilizer/pesticide management and others. Those BMPs help maintain the quality of croplands to which they are applied and at the same time also benefit water quality of nearby wetlands in the path of agricultural runoff.

The EPA issued Section 401 certification for projects in South Dakota until July, 1993. South Dakota began issuing Section 401 Water Quality Certification in July, 1993. The federal permits to which the state applies Section 401 are Section 404/Section 10 permits, NPDES permits, and FERC licenses. The state informally reviews Surface Water Discharge permits. All Solid Waste Subtitle D facilities undergo an informal review for compliance with water quality standards prior to permitting. The state presently has regulations that implement Section 401 activities.

Within South Dakota, a number of federal and state agencies, as well as local governmental units and other organizations have shared various wetlands concerns and responsibilities, as previously mentioned. The Department of Transportation has entered into a mitigation banking agreement with the Department of Game, Fish and Parks, and the US Fish & Wildlife Service for road construction projects.

G. PUBLIC HEALTH/AQUATIC LIFE CONCERNS

Although toxic pollutants are of concern in South Dakota, the cost of routinely monitoring most toxic pollutants is prohibitive. At present, priority toxins (heavy metals) are routinely monitored at several WQM stream sites located near historic or current mining activities in the northern Black Hills. Ammonia, which is a 307(a) toxic pollutant, is frequently monitored throughout the DENR fixed station monitoring network (Table 36).

TABLE 36. TOTAL SIZE AFFECTED BY TOXICS

WATERBODY	SIZE MONITORED FOR TOXICS*	SIZE WITH ELEVATED LEVELS OF TOXICS**
Rivers (miles)	3,080	163
Lakes (acres)	548,000	0
Estuaries (miles)	N/A	N/A
Coastal waters (miles)	N/A	N/A
Great Lakes (miles)	N/A	N/A
Freshwater wetlands (acres)	0	Unknown
Tidal wetlands (acres)	N/A	N/A

* Ammonia, cyanide, chlorine, and metals including arsenic.
** Elevated levels are defined as exceedances of state water quality standards, 304(a) criteria, and/or FDA action levels, or levels of concern (where numeric criteria do not exist).

<u>Aquatic Life (Fish Kills)</u>

There were fifteen separate aquatic life concern incidents investigated from October 1997 to October 1999 and each involved a fish kill. Last reporting period, twelve fish kill incidents were investigated (1998 305(b) report).

The US Fish and Wildlife Service Field Manual for the Investigation of Fish Kills, offers the following guide for reporting fish kills:

Minor Kill: less than 100 fish
Moderate Kill: 100 to 1,000 fish in 1.6 km of stream or equivalent lentic area.
Major Kill: more than 1,000 fish in 1.6 km of stream or equivalent lentic area.

By these standards, there were 5 minor kills, 6 moderate kills and 1 major fish kill in South Dakota streams or lakes. The numbers of fish killed in the remaining three incidents were undetermined.

It is extremely important to conduct the initial phases of fish kill investigations at the earliest indication of a die-off. The need for such urgency is due to the fact that fish degrade quite rapidly and the cause of death may disappear or become unidentifiable within minutes. Unfortunately, DENR is often notified days after an incident has occurred, which hampers the ability to positively identify pollution sources or events that may have caused the event.

On May 28, 1998, a walleye kill of unknown size was reported at Lake Madison. Investigators from DENR did not find any dead or dying walleyes. However, they did find anoxic conditions on the bottom of the lake.

On May 29, 1998, mine tailings containing cyanide were released into Whitewood Creek. The spill resulted in a major kill, estimated at 2,000 fish. The spill occurred when tailings eroded through the floor of a process building and entered an old storm sewer line that emptied directly into Gold Run Creek which flows into Whitewood Creek. Approximately 10,000 gallons of tailings were released.

On June 9, 1998, there was a release of 1,000-2,000 gallons of liquid fertilizer into Plum Creek, Hutchinson County. The spill occurred when children opened a valve on a storage tank. The spill was reported by a downstream landowner on the 16th of June. The farmer reported between 75-100 dead carp and chubs.

On July 22, 1998, South Dakota Game, Fish and Parks personnel investigated a moderate fish kill involving yellow perch at Green Lake, Lake County. The incident was determined to be caused by low dissolved oxygen due to turnover.

A minor fish kill was reported in Bear Butte Creek on August 25, 1998. The kill occurred approximately a week previous to being reported. The person reporting the kill noticed 3-4 dead trout while fishing. DENR personnel investigated and could not find any dead fish, nor could a cause for the kill be determined.

A moderate fish kill occurred from July 12 to July 14, 1998 on the North Fork Yellow Bank River. A train derailment resulted in approximately 4,500 bushels of corn being dumped into the river. The resulting oxygen deficiency killed seven walleyes, numerous minnows, crayfish and clams.

A second moderate fish kill was reported on the North Fork Yellow Bank River on August 30, 1998. Northern pike and minnows were reported as being killed. The reason for the die-off was determined to be ammonia toxicity and oxygen deficiency. This was caused by manure being washed off a cattle feedlot during a heavy rainfall.

On September 9, 1998, a moderate fish kill of suckers and carp was reported at Dawn Lake in Sioux Falls. About 600 fish were killed. Water quality samples showed the kill to be a result of ammonia toxicity. The source of the ammonia was not determined.

In December 1998, South Dakota Game, Fish and Parks investigated a fish kill in Enemy Swim Lake. Only bluegills were affected, but it was not reported how many were killed. The cause was bacterial infection due to an unknown environmental stressor.

In June 1999, a small fish kill occurred in Silver Creek, which flows from Lake Herman to Lake Madison. Approximately a dozen dead fish, including bullheads, smallmouth bass and chubs, were observed by DENR personnel during the initial investigation. Lake Herman was experiencing a massive algae bloom at the time, and large amounts of algae were flowing from Lake Herman into Silver Creek. These algae started to die off as it became caught in the bulrushes and backwaters of the creek. The resulting dissolved oxygen deficiency and high ammonia levels were responsible for the kill.

On July 13, 1999, a small fish kill was reported in Horsethief Lake. The lake was severely stratified and a combination of high surface temperatures, low dissolved oxygen at depth, and high pH values at the surface, a result of the photosynthetic activity of the algae, were the factors responsible for the kill.

A moderate kill occurred at Whitewood Lake in Kingsbury County. The summer kill, attributed to low dissolved oxygen levels, resulted in a kill of about 50 small bullheads, 10 suckers, 30 small perch, 20 walleye and 5 pike.

DENR personnel responded to a report of a fish kill on August 25, 1999. Between 25 and 30 dead trout were seen on Grizzly Bear Gulch Creek, but water quality samples showed good water quality. The cause of the kill was not determined.

Unsafe Beaches

Recent monitoring data compiled for swimming beaches by the DENR Drinking Water Program appear in Tables 37 and 38. Monitoring of the approximately 59 designated beach areas in the state is conducted weekly during the swimming season from May to September. Water quality samples are collected by the municipality or governmental agency charged with managing the given waterbody. The South Dakota Department of Game, Fish and Parks is most often the monitoring agency responsible for managing lake swimming beaches in the state. Following analysis of such samples by an approved lab, the Drinking Water Program will close a beach area if bacteria concentrations exceed Beach Closure Standards. Beach closings are controlled by the entity regulating the swimming areas.

The number of instances of excessive fecal coliform concentration (>200/100 ml) reported at state beaches nearly doubled from 45 in 1992 to 85 in 1993. This result was attributed mainly to increased nonpoint source runoff and severe flooding during spring and summer of 1993. Decreases in rainfall during 1994 in the monitored swimming areas resulted in a more than 50% drop in reported excessive fecal coliform counts. The following year saw another increase in annual precipitation over eastern South Dakota and a consequent rise in the number of fecal coliform exceedances from 36 in 1994 to 55 in 1995. It was noted that flooding in 1995 was not as severe as that experienced two years earlier during spring and summer. This may largely explain why the number of incidents of high fecal coliform levels was appreciably smaller than reported in 1993 although similar numbers of waterbodies and public beaches were affected in both years (1994 and 1996 305(b) Reports). Similarly, greater rainfall in 1997 compared to 1996 may have resulted in the increase of excessive fecal counts from 36 in 1996 to 57 in 1997. Heavier rainfall in 1998 compared to 1999 may have resulted in the decrease of incidents of high fecal coliform (>200/100ml) from 50 in 1998 to 34 in 1999, (Tables 37 and 38).

Surface Drinking Water and Fish Consumption Restrictions

The Surface Water Quality Program, in partnership with the South Dakota Department of Game, Fish and Parks, conducted a series of fish flesh analyses throughout the state in 1998 and 1999.

In 1998, the following lakes were sampled for total PCBs, organochlorine pesticides, total cadmium, total selenium and total mercury:

Lake	**County**
Brakke Dam	Lyman
Brant Lake	Lake
Deerfield Lake	Pennington
East Oakwood Lake	Brookings
Little Moreau #1	Dewey
Mina Lake	Brown
Pelican Lake	Codington
Stockade Lake	Custer
Wall Lake	Minnehaha
Waubay Lake	Day

Total mercury was present at all sites ranging from 0.019 mg/kg to 0.440 mg/kg. Selenium was detected at nine of the ten sites and concentrations ranged from 0.320 mg/kg to 1.100 mg/kg. Endrin aldehyde was detected at Waubay Lake (0.0074 mg/kg) and Brant Lake (0.0032 mg/kg). 4-4 DDE was found at Brant Lake at a concentration of 0.0037 mg/kg. Ten sites were also sampled in 1999, but analytical results are not yet available. No fish consumption advisories were issued this reporting cycle (Table 39).

TABLE 37. WATERBODIES AFFECTED BY BATHING AREA CLOSURES (1998)

Name of Waterbody	Waterbody Type	Size Affected	Cause of Pollutant	Conc. of Pollutant[a]	Source of Pollutant	Number of Events[c]
Lake Francis Case (Snake Creek)	Missouri River mainstem reservoir	Beach area	fecal coliform	2,300[b]; 610; 20,000[b]	NPS runoff	3
Lake Francis Case (American Creek)	Missouri River mainstem reservoir	Beach area	fecal coliform	210; 760; 450[b]	NPS runoff	3
Lake Sharpe (Pierre City Beach)	" "	" "	" "	210; 670	" "	2
Lake Sharpe (Pierre Downstream North)	" "	" "	" "	500	" "	1
Lake Sharpe (Ft. Thompson, North Shore)	" "	" "	" "	760	" "	1
Lake Oahe (West Whitlock)	" "	" "	" "	220; 3,000[b]	" "	2
Lake Oahe (West Indian Creek)	" "	" "	" "	500; 1,400[b]	" "	2
Blue Dog Lake, (Waubay, SD)	Lake	" "	" "	600; 650; 220[b]	" "	3
Farley Lake, (Milbank, SD)	" "	" "	" "	280; 260	" "	2
Lake Alvin	" "	" "	" "	580; 230	" "	2
Big Stone Lake (Hartford Beach)	" "	" "	" "	6,800[b]	" "	1

TABLE 37. Cont.

Name of Waterbody	Waterbody Type	Size Affected	Cause of Pollutant	Conc. of Pollutant[a]	Source of Pollutant	Number of Events[c]
Lake Cochrane	Lake	Beach area	fecal coliform	250	NPS runoff	1
Legion Lake (Custer St. Pk., Black Hills)	Lake	Beach area	fecal coliform	2,440[b]	NPS runoff	1
Sylvan Lake (Custer St. Pk., Black Hills)	" "	" "	" "	620	" "	1
Lake Hiddenwood	" "	" "	" "	220	" "	1
Lake Kampeska (Sandy Shore)	" "	" "	" "	200; 2,200; 1,700[b]	" "	3
LaCreek Headquarters (Nat. Wildlife Refuge)	" "	" "	" "	400; 220	" "	2
Lake Lakota (Black Hills)	" "	" "	" "	14,000[b] 5,000[b]	" "	2
Lake Poinsett	" "	" "	" "	4,000[b]	" "	1
Lake Mitchell (Campground Beach)	" "	" "	" "	260	" "	1
Pickerel Lake (West)	" "	" "	" "	670	" "	1
Lake Prior (Woonsocket, SD)	" "	" "	" "	230; 1,600[b]	" "	2
Roubaix Lake (N Black Hills)	" "	" "	" "	230; 980; 380	" "	3

TABLE 37. Cont.

Name of Waterbody	Waterbody Type	Size Affected	Cause of Pollutant	Conc. Of Pollutant[a]	Source of Pollutant	Number of Events[c]
Lake Pelican	Lake	Beach area	fecal coliform	220; 330	NPS runoff	2
Shadehill Reservoir (North Shore)	Lake	Beach area	fecal coliform	320	NPS runoff	1
Wylie Lake (NW Aberdeen, SD)	" "	" "	" "	1,700[b]	" "	1
Lake Hanson (Alexandria, SD)	" "	" "	" "	800	" "	1
Oak Lake (NE Brookings Co.)	" "	" "	" "	470	" "	1
Lake Kampeska (Watertown City Beach)	" "	" "	" "	360	" "	1
Sheridan Lake (North Shore)	" "	" "	" "	430	" "	1
Pactola Reservior (Pactola Point)	" "	" "	" "	305	" "	1

[a] Beach considered potentially unsafe at $\geq$ 200/100 ml (Drinking Water Program Standards)
[b] Beach closure recommended: Beach to remain closed until safe fecal coliform levels (<200/100 ml) are attained
[c] Number of reported incidents of $\geq$ 200/100 ml fecal coliform concentration.

TABLE 38. WATERBODIES AFFECTED BY BATHING AREA CLOSURES (1999)

Name of Waterbody	Waterbody Type	Size Affected	Cause of Pollutant	Conc. Of Pollutant[a]	Source of Pollutant	Number of Events[c]
Lake Oahe (Mobridge Reveheim)	Missouri River mainstem reservoir	beach area	fecal coliform	8,100 [b]	NPS runoff	1
Lake Oahe (West Whitlock)	Missouri River mainstem reservoir	beach area	fecal coliform	440	NPS runoff	1
Lake Sharpe (Pierre Downstream North)	" "	" "	" "	310; 300; 230	" "	3
Lake Francis Case (American Creek)	" "	" "	" "	1,100 [b]	" "	1
Lewis & Clark Lake (Gavins West)	" "	" "	" "	570; 270; 400	" "	3
Lewis & Clark Lake (Midway West)	" "	" "	" "	820; 360 [b]	" "	2
Lake Hanson (Alexandra, SD)	Lake	" "	" "	330; 720 [b]	" "	2
Lake Cochrane	Lake	" "	" "	680	" "	1

TABLE 38. Cont.

Name of Waterbody	Waterbody Type	Size Affected	Cause of Pollutant	Conc. of Pollutant[a]	Source of Pollutant	Number of Events[c]
Lake Eureka (Eureka City Beach)	lake	beach area	fecal coliform	210	NPS runoff	1
Lake Prior (Woonsocket, SD)	lake	beach area	fecal coliform	1,020[b]	NPS runoff	1
Lake Herman	" "	" "	" "	420	" "	1
Big Stone Lake (Hartford Beach)	" "	" "	" "	600	" "	1
Lake Louise	" "	" "	" "	240	" "	1
Lake Alvin	" "	" "	" "	1,600; 500; 16,000; 240[b]	" "	4
Lake Vermillion	" "	" "	" "	900	" "	1
Lake Kampeska (Memorial Beach)	" "	" "	" "	500; 3,900[b]	" "	2
Lake Pelican	" "	" "	" "	260	" "	1

TABLE 38. Cont.

Name of Waterbody	Waterbody Type	Size Affected	Cause of Pollutant	Conc. Of Pollutant[a]	Source of Pollutant	Number of Events[c]
Lake Mitchell (Day Camp Beach)	Lake	Beach area	fecal coliform	360	NPS runoff	1
Lake Kampeska (Watertown City Beach)	" "	" "	" "	20,000[b]; 1,200[b]	" "	2
Roubaix Lake (N Black Hills)	" "	" "	" "	440	" "	1
Legion Lake (Black Hills)	" "	" "	" "	3,300[b]	" "	1
Ravine Lake (Ravine Beach)	" "	" "	" "	300; 570[b]	" "	2

[a] Beach considered potentially unsafe at ≥ 200/100 ml (Drinking Water Program Standards)
[b] Beach declared closed until safe fecal coliform levels (<200) are attained
[c] Number of reported incidents of ≥ 200/100 ml fecal coliform concentration

TABLE 39. WATERBODIES AFFECTED BY FISH AND SHELLFISH[a] CONSUMPTION RESTRICTIONS

Name of Waterbody	Waterbody Type	Size Affected	Type of Fishing Restriction				Cause(s) (Pollutant(s)) of Concern
			Non Consumption		Limited Consumption		
			General Population	Sub-Population	General Population	Sub-Population	
NONE	-	-	-	-	-	-	-

[a] Does not include shellfish harvesting restrictions due to pathogens.

TABLE 40. WATERBODIES AFFECTED BY SURFACE DRINKING WATER RESTRICTIONS

Name of Waterbody	Waterbody Type	Type of Restriction			Cause(s) (Pollutant(s)) of Concern	Source(s) of Pollutant(s)
		Closure[a] (Y/N)	Advisory[b] (Y/N)	Other (explain)		
NONE	-	-	-	-	-	-

[a] Closures restrict all consumption from a drinking water supply.

[b] Advisories require that consumers disinfect water (through boiling or chemical treatment before ingestion).

TABLE 41. SUMMARY OF WATERBODIES FULLY SUPPORTING DRINKING WATER USE

Rivers and Streams	Contaminants Included in the Assessment	Lakes and Reservoirs	Contaminants Included in the Assessment
Missouri River[a]	All MCLs[b]	Byre Lake	All MCLs
Big Sioux River	" "	Lake Isabel	" "
Elm River	" "	Lake Kampeska	" "
James River	" "	Lake Mitchell	" "
Rapid Creek	" "	Lake Murdo	" "
Spearfish Creek	" "	Lake Waggoner	" "
Lake Oahe[c]	" "	White Lake Dam	" "
Lake Francis Case[c]	" "		
Lewis & Clark Lake[c]	" "		

[a]Rural Water System (RWS) Intakes:
Yankton, SD.
Pickstown, SD.
[b]MCL - maximum contaminant level for drinking water standards.
[c]Missour River mainstem reservoirs
Rural Water System (RWS) Intakes:

Lake Oahe:	Lake Francis Case:	Lewis & Clark Lake:
Mobridge, SD	Oacoma, SD	Springfield, SD
WEB RWS	Chamberlain, SD	Bon Homme/Yankton RWS
Gettysburg, SD	Aurora/Burke RWS	
Oahe Plains RWS	Randall II & III RWS	
Tri-County RWS	Lake Andes, SD	
Mid-Dakota RWS		

TABLE 42. SUMMARY OF WATERBODIES NOT FULLY SUPPORTING DRINKING WATER USE

Waterbodies (List)	Source(s) of Data (√)			Characterization[1]	Major Causes
	Ambient	Finished	Use Restrictions		
River and Streams					
None	√	√			
Lakes and Reservoirs					
None	√	√			

[1]Characterization: Fully Supporting but Vulnerable, Partially Supporting, Not Supporting.

TABLE 43. SUMMARY OF CONTAMINANTS USED IN DRINKING WATER ASSESSMENT

River and Streams	Contaminants Included in the Assessment[1]	Lakes and Reservoirs	Contaminants Included in the Assessment[1]
Missouri River	a,b,c,d,e,f,g,h	Byre Lake	a,b,c,d,e,f,g,h
Big Sioux River	a,b,c,d,e,f,g,h	Lake Isabel	a,b,c,d,e,f,g,h
Elm River	a,b,c,d,e,f,g,h	Lake Kampeska	a,b,c,d,e,f,g,h
James River	a,b,c,d,e,f,g,h	Lake Mitchell	a,b,c,d,e,f,g,h
Rapid Creek	a,b,c,d,e,f,g,h	Lake Murdo	a,b,c,d,e,f,g,h
Spearfish Creek	a,b,c,d,e,f,g,h	Lake Waggoner	a,b,c,d,e,f,g,h
Lake Oahe	a,b,c,d,e,f,g,h	White Lake Dam	a,b,c,d,e,f,g,h
Lake Francis Case	a,b,c,d,e,f,g,h		
Lewis & Clark Lake	a,b,c,d,e,f,g,h		

1. Contamination groups. Individually tested contaminants are listed in Appendix E for:
   a = VOCs or Volatile Organic Compounds
   b = SOCs or Synthetic Organic Compounds
   c = Inorganic Compounds
   d = Microbiological Contaminants
   e = Radiological Contaminants
   f = Lead and Copper
   g = Turbidity
   h = Trihalomethanes

TABLE 44. STATE-LEVEL SUMMARY OF DRINKING WATER USE ASSESSMENTS FOR RIVERS AND STREAMS

Total Miles Designated for Drinking Water Use 1,091[a]

Total Miles Assessed for Drinking Water Use 923

Miles Fully Supporting Drinking Water Use	923	% Fully Supporting Drinking Water Use	100%	Major Causes
Miles Fully Supporting but Vulnerable For Drinking Water Use	-	% Fully Supporting but Vulnerable for Drinking Water Use	-	-
Miles Partially Supporting Drinking Water Use	-	% Partially Supporting Drinking Water Use	-	-
Miles Not Supporting Drinking Water Use	-	% Not Supporting Drinking Water Use	-	-
Total Miles Assessed for Drinking Water Use	923		100%	

[a]Includes 482 miles of the Missouri River (mainstem reservoirs and flowing river)

TABLE 45. STATE-LEVEL SUMMARY OF DRINKING WATER USE ASSESSMENT FOR LAKES AND RESERVOIRS

Total Waterbody Area designated for Drinking Water Use 14,006 acres

Total Waterbody Area Assessed for Drinking Water Use 5,975 acres

Acres Fully Supporting Drinking Water Use	5,975	% Fully Supporting Drinking Water Use	100%	Major Causes
Acres Fully Supporting but Vulnerable For Drinking Water Use	-	% Fully Supporting but Vulnerable for Drinking Water Use	-	-
Acres Partially Supporting Drinking Water Use	-	% Partially Supporting Drinking Water Use	-	-
Acres Not Supporting Drinking Water Use	-	% Not Supporting Drinking Water Use	-	-
Total Acres Assessed for Drinking Water Use	5,975		100%	

IV.
GROUND WATER QUALITY ASSESSMENT

A. STATE GROUND WATER QUALITY PROGRAM (GWQP): OVERVIEW AND NEEDS

More than three-quarters of the state's population utilizes ground water for domestic needs. General ground water quality in the state is good with only a few aquifers having naturally occurring contaminant problems. Deeper aquifers generally have poorer water quality than shallow aquifers but are also generally less susceptible to contamination.

In South Dakota the most significant ground water quality problems are man-induced ground water degradation from petroleum, nitrate, and other chemicals through accidental releases and product mishandling, poor management practices, improper locating of pollutant producing facilities, and the contamination of shallow wells because of poor well construction or location adjacent to pollution sources. The DENR Ground Water Quality Program (GWQP) is making strides to reduce these problems by requiring cleanup of contaminated sites and implementing various programs to prevent contamination from occurring. These programs include source water and wellhead protection of public water supplies, underground injection control, ground water discharge permitting regulations, development of management plans for fertilizer and pesticide use, concentrated animal feeding operations permits, underground and aboveground storage tank regulations, and other programs.

The future needs or goals of the GWQP in regard to ground water protection primarily involve better protection of the state's ground water resources by preventing future contamination and more effectively cleaning up the sites already contaminated. Some areas of concern include a need for better understanding of the fate and transport of contaminants through the soils and ground water, a need to monitor agricultural chemicals in ground water, an assessment of aquifer vulnerability, better protection of public water supplies, and the continued development of a comprehensive data base integrated with a Geographical Information System (GIS). The future goals of the GWQP are discussed in the Comprehensive State Ground Water Protection Strategy.

The ability of the GWQP to better evaluate and protect the state's ground water quality would be enhanced if the above needs were met. Projects such as the statewide monitoring of ground water quality and limited mapping of all aquifers for contamination vulnerability are on-going or were completed. Additional work in these areas and the development of a comprehensive data base integrated with GIS are steps that are currently being taken to aid the GWQP in making the decisions necessary to protect the ground water resources of the state. A concerted effort to standardize location and site identification information for facilities in all DENR data bases is currently under way for future use in a GIS format. Such projects require funds and personnel to carry out stated objectives, but a long range commitment to protect our ground water supplies is essential for future growth and development.

B. GROUND WATER QUALITY

General Discussion

The state is heavily dependent on ground water. Almost 50% of the approximately 450 million gallons of water used per day in South Dakota is ground water. The uses of ground water include: domestic, agricultural (livestock watering, irrigation) and industrial. Approximately 78% of the state's public water supplies rely on ground water. Virtually everyone not supplied by public water systems is dependent on ground water for domestic use.

Aquifers within South Dakota can be grouped into two categories, unconsolidated sand and gravel aquifers (glacial outwash and alluvial), and bedrock aquifers. Glacial aquifers consist of sand and gravel outwash deposited by glacial meltwaters. These occur over much of the area east of the Missouri River. Alluvial aquifers include sand and gravel deposits underlying the major streams and rivers within the state. The glacial and alluvial aquifers are the most abundant and easily accessible sources of ground water for much of the state's population. East of the Missouri River, ground water accounts for about seventy (70) percent of all water used. The water quality within these shallow aquifers is highly variable but generally suitable for domestic, industrial, and agricultural use. With many of these aquifers being shallow and consisting of permeable material, they are often susceptible to contamination. The water quality generally deteriorates with depth.

The bedrock aquifers, although less susceptible to contamination when they are overlain by thick clay and shale deposits, are also susceptible to contamination where the bedrock occurs at the land surface such as the Ogallala aquifer and outcrop areas in the Black Hills. Bedrock aquifers are the only source of ground water west of the Missouri River, except for a few small alluvial areas along major streams. Greater mineralization commonly occurs at greater depths as distance from recharge areas in the Black Hills increases. These aquifers are still used extensively as rural-domestic and stock water supplies, as well as for municipal and industrial use. The majority of the bedrock aquifers are unsuitable for irrigation. Ground water accounts for up to thirty (30) percent of water used in the western part of the state.

Ground Water Quality Problems

Other than naturally occurring problems in a small number of aquifers, South Dakota does not suffer widespread ground water contamination. However, numerous incidents of man-induced ground water degradation have occurred. The following list identifies the types of facilities or materials documented or suspected of being sources of ground water contamination in South Dakota: fertilizers and pesticides; wastewater treatment lagoons; landfills; mining operations; septic systems; inadequate well design and construction; feedlots; and petroleum and other chemical spills or leaks. The types of pollution problems have remained consistent through the years, although reported spills or leaks of petroleum and other chemicals have varied considerably year to year. Increases in reported releases are often driven by requirements for facility upgrades and property transfer site assessments, as releases are often found during these activities.

Generally, over the past ten years, reported incidents of potential ground water contamination have increased. Petroleum products, fertilizers, and pesticides were the major contaminants, respectively. The annual totals of reported spills of oil and other hazardous substances have fluctuated during the past 10 years. There were increases of forty-one percent (41%) from 1986 to 1987, 120% from 1987 to 1988, 22% from 1988 to 1989, 92% from 1989 to 1990, and 7% from 1990 to 1991. A decrease of 40% occurred between 1991 and 1992 which was followed by an annual 21% increase and another yearly decrease of 19% between 1993 and 1994. A decrease of 14% occurred between 1994 and 1995. An increase of 5% occurred from 1995 to 1996 and an increase of 11% occurred between 1996 and 1997. In the recent reporting period (1997 to1999), there was again an increasing trend of 15% in the number of spills reported.

The large increases in recorded spills during the 1980s may have been due to a greater awareness of the responsibility to report spills; and to underground storage tank (UST) regulations. The reversal of this trend after 1991 may have been partly due to cost factors (such as changes in the out-of-pocket deductible charged to the party responsible for the release) which caused a slowdown in petroleum facility upgrades during which many of the contamination problems are discovered. Recent increases in the number of reported contamination incidents may have occurred because of the federally-imposed underground storage tank facility upgrade deadline of 1998.

Petroleum products were involved in 80% of reported spills during the present reporting cycle. Leaking USTs (nearly all containing petroleum products) were responsible for 46% of the incidents reported from October 1, 1991, to September 30, 1993, but made up only 28% of the reported releases during the 1993-1995 reporting period. From 1995-1997 this portion was 32%. From 1997-1999 this portion was 45%. In addition, petroleum spills from past years continue to be remediated and monitored. Petroleum components such as benzene, toluene, ethylbenzene, and xylene constitute potential health risks as well as rendering water unpalatable at very low concentrations.

Fertilizers and pesticides also represent a portion of South Dakota's point source contamination. Damaged equipment and improper handling and disposal of containers and rinse water have resulted in agricultural chemicals reaching the ground water. The number of reports concerning spills of agricultural chemicals has remained relatively steady over the past ten years, with roughly 40 to 60 incidents reported each year.

Bulk pesticide containment regulations went into effect January 1, 1988, and bulk fertilizer container regulations went into effect July 1989. To further address potential point sources of pesticides or fertilizers, chemigation equipment regulations are also in effect. The South Dakota Department of Agriculture (SDDA) has required facilities to have fertilizer containment pads for chemical loading and rinsing to be in place by 1992, and all pesticide operational area containment systems were required to be in place by 1995. In addition, all secondary containment structures were to be constructed by 1996. It does appear that the number and/or severity of releases at fixed agricultural chemical facilities is being reduced as a result of these requirements.

The effects of agriculture on South Dakota ground water have not been fully identified. Pesticide and fertilizer use is widespread and includes areas overlying shallow aquifers. Fertilizer and pesticide management plans, designed to reduce potential impacts to ground water from land application of agricultural chemicals, have been cooperatively developed by SDDA and DENR. Nitrate concentrations (NO_3 as N) greater than 10 mg/l have been measured in wells in shallow aquifers in eastern South Dakota and in one bedrock aquifer within south central South Dakota. Pesticides have not been found at significant levels in ground water as a result of normal labeled use. Three studies, described later in this section, were initiated to determine what impacts agricultural chemicals may have on the state's ground water. These projects have been supplanted by the permanent statewide ground water quality monitoring network, which has incorporated some of the wells used in those studies.

Potential sources and substances presently responsible for ground water contamination in South Dakota are listed in Table 46. The table shows ten priority pollution sources most affecting state ground water, but a number of other sources such as land application, material transfer operations, pesticide application, shallow injection wells, road salting and others also have the potential to cause contamination. The substance in ground water most frequently occurring in concentrations above the EPA Maximum Contaminant Level (MCL) is nitrate as nitrogen. There are several potential sources of nitrate including nonpoint sources such as commercial and manure fertilizer use on croplands.

Some of the contaminant sources were selected as a priority problem based on being a high concern in localized areas of the state but not over the majority of the state (factor G in Table 46). This was due to the limited number of these sources and/or their being located in a small area of the state. An example is gold mining (mining and mine drainage and waste tailings) which only occurs in the Black Hills area. Many of the previously mentioned contamination problems are the result of improper well location and the construction of various facilities relative to aquifers. Pollution sources such as leaking wastewater treatment lagoons, and improperly located septic systems, feed-lots, landfills and pesticide or fertilizer handling and storage facilities, may cause localized ground water contamination. Improper location and/or construction of wells may also lead to and com-pound ground water contamination. For these reasons, private wells are prone to bacterial, nitrate, and other water quality problems from surface sources.

Table 46. MAJOR SOURCES OF GROUND WATER CONTAMINATION

Contaminant Source	Ten Highest-Priority Sources (√)	Factors Considered in Selecting a Contaminant Source (1)	Contaminants (2)
Agricultural Activities			
Agricultural chemical facilities	√	F, A, C, G	A, B, E
Animal feedlots	√	D, C, B	E, J
Drainage wells			
Fertilizer applications	√	D, C, F, B, G	E, J
Irrigation practices			
Pesticide applications			
Storage and Treatment Activities			
Land application			
Material stockpiles			
Storage tanks (aboveground)	√	D, F, B	D, E, B, H, C
Storage tanks (underground)	√	D, F, B	D, E, B, H, C
Surface impoundments	√	F	E, G
Waste piles			
Waste tailings			
Disposal Activities			
Deep injection wells			
Landfills	√	G	M_2
Septic systems	√	D, C	E, J
Shallow injection wells			
Other			
Hazardous waste generators			
Hazardous waste sites			
Industrial facilities			
Material transfer operations			
Mining and mine drainage and waste tailings	√	G, E	E, H, M
Pipelines and sewer lines	√	B, C	D, E, J
Salt storage and road salting			
Salt water intrusion			
Spills	Covered in other priorities that include spills		
Urban runoff			
Transportation of Materials			

TABLE 46. CONTINUED

(1) Factors considered in selection of contaminant source:

A. Human health and/or environmental risk (toxicity)
B. Size of the population at risk
C. Location of the sources relative to drinking water sources
D. Number and/or size of contaminant sources
E. Hydrogeologic sensitivity
F. State findings, other findings
G. Other criteria: high to very high priority in localized areas.

(2) Contaminants and classes of contaminants associated with each identified source:

A. Inorganic pesticides
B. Organic pesticides
C. Halogenated solvents
D. Petroleum compounds
E. Nitrate
F. Fluoride
G. Salinity/brine
H. Metals
I. Radionuclides
J. Bacteria
K. Protozoa
L. Viruses
M. Cyanide
M_2. Other (a variety of contaminants)

Table 46 summarizes point source contamination incidents by source, type of contaminant(s) present and status of the cleanup activities. This information is provided for the entire state as a general statewide contamination incident summary. The state summary covers contamination found in ground water that may or may not be considered an aquifer. The spill site data base covers all reported spill cases in South Dakota but at the present time does not describe the specific aquifer or waterbody impacted.   The listed number of reported spills and number of sites that are closed or inactive are specific numbers, but the other data in the table are estimates based on the stage of clean up actions, and the information available about the sites. On the table, the source type labeled "state sites" refers to all reported contamination spills other than leaking petroleum underground storage tanks (LUST) cases and the other described source types. This category includes agricultural chemical spills, above ground storage tank leaks, transportation spills (primarily petroleum and agricultural chemicals) industrial chemicals, and others, because they cannot be addressed under other categories in this table.

Table 47. STATEWIDE GROUND WATER CONTAMINATION SUMMARY

Aquifer Description <u>Includes aquifers and non-aquifers</u> County(ies) <u>Statewide</u>
Aquifer Settings <u>Glacial, alluvial and bedrock</u> Longitude/Latitude <u>-</u>
Data Reporting Period <u>Inception of spill reporting through September 1999</u>

Source Type	Present in reporting area (circle)	Number of sites in area	Number of sites that are listed and/or have confirmed releases (Total)	Number with confirmed ground water contaminants	Contaminants	Number of site investigations	Number of sites that have been stabilized or have had the source removed	Number of sites with corrective action plans	Number of sites with active remediation	Number of sites with cleanup completed (closed & inactive)
NPL	**Yes**/No	1	1	1	solvents, metals, petroleum	1	1	1	1	1
CERCLIS (non-NPL)	**Yes**/No	33	33	13	petroleum, metals, solvents, pesticides, fertilizer	24	11	11	11	7
DOD/DOE	**Yes**/No	47	47	2	petroleum, ordinance, metals, solvents	6	6	3	3	5
LUST	**Yes**/No		2425	1120	Petroleum	2425	254	677	677	1494
RCRA Corrective Action	**Yes**/No		1		Mineral Spirits, Metals	1	1			
Underground Injection	**Yes**/No		Regulated by EPA							
State Sites	**Yes**/No		3314	720	Petroleum products, Agricultural and industrial chemicals	3314	71	557	557	2686
Nonpoint Sources	**Yes**/No	See the information in Appendix D: Table 8-4A concerning the ambient ground water monitoring network and the text concerning nitrate and pesticide sampling studies.								
Other	Yes/**No**									

NPL - National Priority List
CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOE - Department of Energy
DOD - Department of Defense
LUST - Leaking Underground Storage Tanks
RCRA - Resource Conservation and Recovery Act

The number of sites described as having confirmed ground water contamination is an estimate based on available information and experience. It must be noted that this is an estimated value because this information is not readily available in the data base. The numbers have been revised compared to the last report, based on a better estimate of the numbers. The general conclusion that can be drawn is that a larger percentage of the LUST sites have ground water contamination compared to State Sites. The State Sites include many transportation accidents and other surface spills which often do not impact ground water. These differences are also reflected in the number of sites that have been cleaned up completely, which shows that the surface spills and those that are one-time releases are more quickly identified and cleaned up, and do not generally cause as long-term a problem as do LUST sites.

The percentage of closed LUST sites (in relation to total LUST spill cases reported) was approximately 59%, while about 79% of the other spill incidents reported were closed at the end of the 1995 reporting period. By 1997 the percentage of closed sites went up slightly to 62% for LUST sites and 80% for the other sites. To date, 73% of the total number of spills reported to DENR have been adequately cleaned up and closed. Although new spills will continue to occur, and existing difficult cases can remain open for a number of years, progress is being made in reducing the environmental threats to South Dakota's ground water from contaminant releases as evidenced by the large number of spill cases that are closed every year.

For this table, sites that are stabilized or have had the contaminant source removed are ones that have been placed in a monitoring program until DENR determines no further action is necessary. Some of these sites have had the initial source, such as an underground storage tank, removed or most of the contaminated soils excavated or remediated. However, if the release has caused ground water impacts that are still a concern, monitoring of the ground water continues. When the monitoring shows the remedial actions taken have adequately cleaned up the contamination, the site is either closed or placed in inactive status.

If a site is in the initial stages of assessment, remediation is planned, or a remediation system is in place, the site is considered "open" and to be in active remediation. In some cases the contaminant concentrations may be low and no active remediation is needed, or if limited ground water contamination is found, only monitoring will be required. Active remediation may range from excavating very limited amounts of soil contamination from around the source, to large scale soil and ground water remediations. For the LUST and State Sites, any contaminated site that has not reached the stabilized monitoring stage is considered to be in active remediation (with a corrective action plan that will be implemented after it is submitted and approved). Some of the more limited source types (as DOD sites) depict more specific stages of clean-up action. All sites that have confirmed contamination were considered to have had a site investigation.

CERCLIS sites listed include only those sites that are presently active or have potential action pending. Some of these sites may go to a further action category after additional review. Included with the US Department of Defense (DOD) sites are formerly used defense sites.

Tabular information for 4 shallow vulnerable aquifers in eastern South Dakota is shown in Appendix C. These listed aquifers: the Vermillion East Fork, Vermillion West Fork, Parker-Centerville, and Missouri (Elk Point management unit), are shown on Figure 5. These aquifers are composed mainly of sand and gravel from glacial outwash deposits. The Missouri aquifer is primarily an outwash aquifer with some recent alluvial deposits at land surface. The major water bearing portion of the aquifer consists of the outwash. These four aquifers are also part of the state wide ground water quality monitoring network which examines 24 shallow, vulnerable aquifers across the state. Ground water quality information from the monitoring network in those aquifers is shown in Appendix C, Table 8.4A.

There are 15 small towns located over these shallow aquifers and 5 of these towns have shallow public water supply wells in these aquifers. Since contaminant releases began to be recorded in a DENR database in the 1980s there have been 121 spill cases documented over these aquifers. The majority of these spills involved petroleum. To date none of the contamination events have impacted any of the vulnerable public water supply wells for these communities.

The Ground Water Contamination Summary for the Vermillion East Fork, Vermillion West Fork, Parker-Centerville, and Missouri (Elk Point management unit) aquifers is found in Table 8.2A of Appendix C. A summary of this data is shown in the table below. In a majority of instances, "other" spills include releases of petroleum and agricultural chemicals from transportation incidents. Although there are fewer LUST spills than other spills, a greater percentage of "other" spills have been closed. Sixty-five percent of all spills in these aquifers have been closed. In general, LUST cases involve a greater percentage of ground water contamination than other spills.

Summary of Table 8.2A in Appendix C					
Aquifer	**Number of Sites**	**Number of LUST spills**	**Number of LUST spills *closed***	**Number of Other spills**	**Number of Other spills *closed***
Vermillion East Fork	16	6	4	9	5
Vermillion West Fork	19	4	3	15	12
Parker-Centerville	22	10	8	11	5
Missouri (Elk management unit)	67	20	7	45	37
Total:	124	40	22	80	59

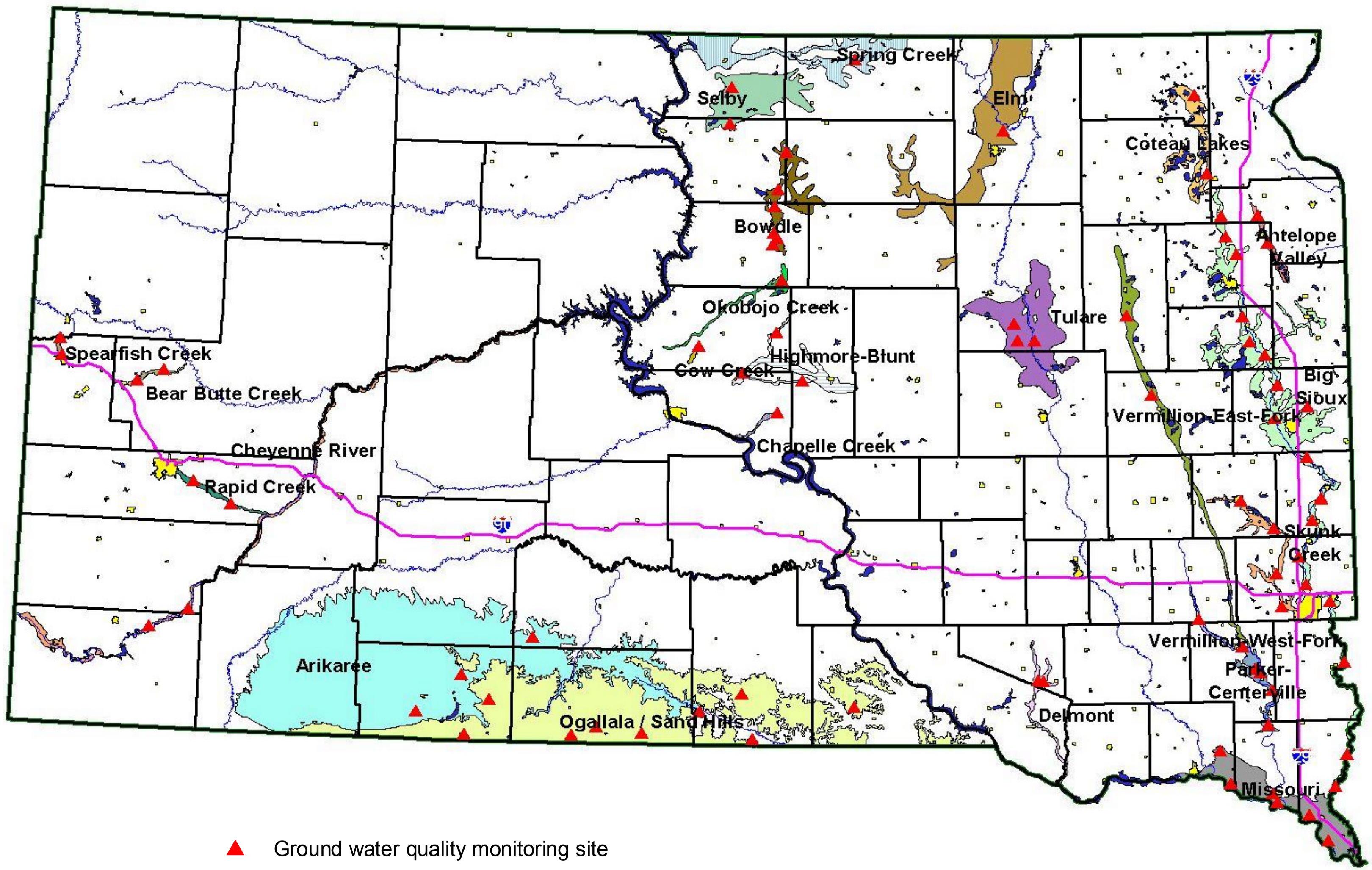


Figure 5. Aquifers monitored in the Statewide Ground Water Quality Monitoring Network

Table 8.4A in Appendix C describes the results of the ambient ground water quality monitoring for the four shallow aquifers mentioned above. These results are based on sampling the ground water in areas not associated with any known point sources of contamination. This monitoring network has been established in the last few years, therefore these wells have not been sampled extensively at this time. All of the monitoring wells for the four aquifers mentioned above are located in vulnerable areas.

With the exception of nitrate, analysis of the samples from the majority of wells did not detect parameters above the method detection limit or background levels. The VOC parameter is not sampled every sampling event; therefore, this parameter is considered not applicable to the information presented in Table 8.4A. Table 8.4A indicates 22 of the 24 sampled wells had detectable concentrations of nitrate for at least one sampling event. The Vermillion East Fork, Vermillion West Fork, Parker-Centerville, and Missouri (Elk management unit) aquifers each had one monitoring well exceed the MCL for nitrate. The Missouri (Elk Point management unit) aquifer also had one monitoring well exceed the MCL for arsenic.

Ground Water Indicators

Indicators presently used by the state to track progress and trends in ground water protection efforts are listed for the three categories below:

a. Public ground water supplies.

A number of local communities have developed wellhead protection ordinances to protect their public water supplies (PWS) from contaminant sources. Other communities are also moving forward with various aspects of wellhead protection. Under new source water assessment requirements, all public water supply systems will have recommended protection areas defined around their drinking water source, along with an inventory of the significant contaminant sources within that area. The public water supply systems will be encouraged to develop source water protection measures based on these assessments. As of September 30, 1999, the contaminants for which MCLs have been exceeded at PWS wells include fluoride, thallium, nitrate, and radium 226 and 228. One PWS exceeded fluoride, one PWS exceeded nitrate, four PWS exceeded radium 226 and 228, and one PWS exceeded thallium.

b. Point sources of contamination.

There is one Resource Conservation and Recovery Act (RCRA) facility in the state as defined under Subtitle C. This facility is in Sioux Falls which has a population of approximately 110,000. No assessment of the population at risk was undertaken.

One CERCLA site, Ellsworth Air Force Base, remains in the National Priority List. There are approximately 6,000 people within one to three miles of the facility.

c. Nonpoint sources of contamination.

Three studies have evaluated the presence of nonpoint sources of nitrate and pesticides in shallow ground water aquifers. Data indicate that both types of chemicals are present, but only nitrate has consistently been found above the MCL. Several studies have shown that up to 25% of shallow domestic wells tested have nitrate levels above 10 mg/l.

Table 8.4A in Appendix C presents results of the ambient monitoring conducted through September 1998 for the statewide monitoring network in the aquifers discussed in this report. Sampling for this network began in 1994, but not all the aquifers included in this report have been sampled that long.

There is very limited PWS data available at the present time and it is mostly presented as a statewide summary (Appendix Table 8.4A). The state does not at present routinely monitor VOCs and SOCs for unregulated private wells. Nitrates (NO_3) are monitored but currently are not listed for private wells on an aquifer basis.

The ground water indicators tabulated above are a limited set of selected data that, taken together, can give a relative indication of the condition of the state's ground water resource. When collected over time these data can be used to help determine trends and chart progress made in the improvement and protection of this vital resource.

C. PESTICIDES AND FERTILIZERS IN GROUND WATER

Ambient Ground Water Quality Monitoring

Over the years, several projects have produced ambient ground water quality data of various types but there was no coordinated effort to systematically assess the ground water quality on a statewide basis. The Department of Environment and Natural Resources began planning a statewide approach for the monitoring of many of the state's shallow aquifers around 1990. The planning resulted in the implementation of the Statewide Ground Water Quality Monitoring Network in 1994. Three studies which preceded the statewide monitoring effort are the *Oakwood Lakes-Poinsett Rural Clean Water Program (RCWP), Pesticide and Fertilizer Sampling Program* and the *Water Quality Monitoring and Evaluation of Nonpoint Source Contamination in the Big Sioux Aquifer*. These three projects will be briefly discussed below to provide some background on the type of information that has been gathered in South Dakota. Then, a brief explanation of the Statewide Ground Water Quality Monitoring Network will be provided.

RCWP Project

The presence of agricultural chemicals in the ground water has been assessed in several areas of the state through three studies. The 10-year Oakwood Lakes-Poinsett Rural Clean Water Program (RCWP) was one of the first long term ground water monitoring projects in the nation looking at agricultural chemical practices and the impacts to ground water.

In a 106,000-acre area in portions of Brookings, Kingsbury, and Hamlin Counties, seven sites of 10-80 acres in size were instrumented with 114 monitoring wells. Nitrate concentration ranged from less than 0.1 mg/l to over 70 mg/l with 15% of the 3,092 samples exceeding the MCL of 10 mg/l. Nitrate concentrations above the MCL were found in at least one well at all of the seven sites. The highest nitrate concentrations (> 5 mg/l) were found in the top 20 feet of saturated materials. Nitrate concentrations were significantly higher at the farmed sites than the unfarmed sites.

Pesticides were detected in 11% of the 1,628 ground water samples collected. Most detections were very low concentrations with less than 1% of the detections in excess of the MCL or health advisory. Most pesticide detections were not recurring, i.e. a pesticide was detected one month but not in subsequent sampling events. Lasso (alachlor), 2,4-D, and Banvel (dicamba) were most frequently detected, and where these chemicals were used, they were detected in the ground water.

Pesticide and Nitrogen Sampling Program

In 1988, the South Dakota Legislature directed DENR to address the potential effect of pesticide and fertilizer use on ground water. A Pesticide and Nitrogen Sampling Program was developed to provide data on the presence and extent of pesticides and nitrate from fertilizers in ground water. The initial year of study was intended to assess future needs for the investigation of ground water quality. The pilot program was designed to detect the presence of pesticides and fertilizer under conditions considered most conducive to movement of chemicals into ground water. DENR chose a portion of a shallow, susceptible aquifer, where irrigation and chemical use were occurring. Monitoring sites were selected to eliminate sources other than field applications of fertilizer or pesticides.

The study was initiated in Turner County in the Parker-Centerville aquifer (Figure 5) during 1988. A total of 24 nested observation wells at 10 sites enabled the sampling of various intervals of the aquifer. Wells were sampled monthly, generally from May through September or October for nitrate, and for common pesticides known to be used in the area.

The following year, monitoring was expanded to include a second shallow sand and gravel aquifer, the Bowdle aquifer. The new sites were chosen to monitor non-irrigated conditions. A year later, two monitoring sites were added to each aquifer.

In 1991, the project was continued in the above two aquifers. During the fall of 1991 an additional 10 wells were drilled at seven sites in the Delmont aquifer located primarily in Douglas County, but no samples were collected from the aquifer in 1991. This aquifer is also a shallow sand and gravel aquifer which is overlain by both irrigated and non-irrigated land.

Most monitoring wells were nested, with the shallowest well screened across the water table and the deeper wells screened through various intervals of the saturated material. The monitoring wells were constructed specifically for securing samples for pesticide analysis, i.e., carefully constructed to prevent the introduction of any contaminants to the well or surrounding aquifer materials.

All three aquifers were sampled from 1992 through 1994 and consisted of approximately 45 wells at 25 sites. During the seven-year monitoring program, more than 1,600 nitrate (as N) samples and nearly 1,200 pesticide samples were collected. Approximately 19% of the nitrate samples had concentrations over 10 mg/l, the South Dakota Ground Water Quality Standard. About half of the sites had at least one well frequently above the Maximum Contaminant Level (MCL) for nitrate. Pesticides were detected in about 16% of the samples but none were found over the MCL or Life Time Health Advisory (LTHA), indicating limited impact to ground water from labeled use.

At sites with multiple wells, samples from deeper portions of the aquifer had lower nitrate concentrations than those from shallower portions of the aquifer at the same site. There was not a discernable trend in nitrate concentrations over the seven-year period from 1988 through 1994. Nitrate levels were somewhat higher in the later years of the study, but the short time of the study and other variables made it difficult to define a specific trend.

Pesticide sampling indicated approximately 16% of the samples collected showed detections of various pesticides, but none of the detections were above the MCL or life time health advisory limit for that pesticide. Different pesticides were detected most frequently in different years. Pesticides were seldom detected in the same well in successive sampling periods indicating possible natural degradation or dilution of the pesticides in the aquifer system. The most commonly detected pesticides were alachlor (Lasso), atrazine (Atrazine), terbufos (Counter), metolachlor (Dual), 2,4-D, phorate (Thimet), and dicamba (Banvel).

Water Quality Monitoring and Evaluation of Nonpoint Source Contamination in the Big Sioux Aquifer

The Big Sioux aquifer provides approximately one-third of South Dakota's population with water for municipal, rural water, irrigation, and other uses. Because of the surficial and unconfined nature of the Big Sioux aquifer, it is potentially vulnerable to both point source and nonpoint source contamination. Recent ground water investigations in the Big Sioux aquifer have found that several areas in the Big Sioux drainage basin contain elevated concentrations of nitrate. Due to the aquifer's vulnerability and growing public concerns about the quality and long-term suitability of water for drinking-water supplies, a permanent monitoring network was established in 1989 to periodically monitor the water quality in the Big Sioux aquifer. General water quality was studied with an emphasis on nitrate and pesticides. Under the auspices of this study, wells in the network were monitored from 1989 through 1993. Results presented below reflect work conducted in this time period.

The permanent monitoring network, consisting of 28 monitoring wells as of 1993, was installed at 11 locations within the Big Sioux drainage basin (Figure 5). The network wells were not located downgradient from any identifiable point source pollution areas and provided for monitoring over much of the aquifer's extent. Network monitoring wells were nested at each site to monitor the water quality vertically within the aquifer.

The entire permanent monitoring network was sampled 17 times for inorganic analysis. Seven monitoring wells were sampled 32 times for nitrate plus nitrite nitrogen analysis. Since the beginning of 1989, a total of 582 water samples were collected and analyzed for inorganic parameters.

The entire permanent monitoring network was sampled nine times for pesticide analysis except for two wells at one location which were inaccessible on three occasions and two wells at another location which were inaccessible on one occasion. A total of 232 samples were analyzed for 21 pesticides using the gas chromatography/mass spectrometry method and 233 samples were analyzed for 3 pesticides using the immunoassay method.

Nitrate concentrations greater than 5 milligrams per liter (mg/l) were detected in nine of the 28 Big Sioux aquifer permanent monitoring network wells. Of these nine monitoring wells, the highest concentrations of nitrate were found in shallow monitoring wells screened at or through the water table indicating a vertical stratification of nitrate in the ground water. Two of the nine monitoring wells consistently had nitrate concentrations above the primary drinking water standard of 10 mg/l for public water systems.

Pesticide analyses using the gas chromatography/mass spectrometry method detected atrazine, 2,4-D, trifluralin, cyanazine, bentazon, EPTC, picloram, dicamba, metolachlor, and alachlor in some of the monitoring wells at one time or another. However, no specific trends could be determined from these data. In addition, two metabolites of atrazine were detected: desethyl atrazine and desisopropyl atrazine. The immunoassay method of analysis was also used in this investigation and detected atrazine, alachlor, and 2,4-D. These three pesticides were the only pesticides analyzed with the immunoassay method.

Using the gas chromatography/mass spectrometry method of analysis, one ground water sample out of 232 analyzed was found to have an atrazine concentration above the Maximum Contaminant Level (MCL) established by the US EPA. Four ground water samples had a cyanazine concentration above the Lifetime Health Advisory (LTHA) established by US EPA. All other pesticides had concentrations below their respective MCL or LTHA.

Using the immunoassay method of analysis, four ground water samples out of 233 analyzed had atrazine above the MCL. Two ground water samples had alachlor at or above the MCL.

Beginning in 1994, monitoring of the Big Sioux aquifer was expanded and incorporated into a larger effort which examines the water quality in sensitive aquifers across the state. Additional wells have been installed in the Big Sioux aquifer and regular monitoring now occurs in 36 wells at 19 locations. These wells are part of the Statewide Ground Water Quality Monitoring Network.

Statewide Ground Water Quality Monitoring Network

A permanent ground water quality monitoring network has been established in a number of shallow aquifers in South Dakota. The aquifers in which permanent monitoring has been established are shown in Figure 5. The purpose of this network is to examine the water quality in sensitive surficial aquifers across South Dakota. The goals of the monitoring effort are to maintain, and modify as necessary, ground water quality monitoring activities that regularly and systematically assess (a) the present ground water quality, (b) the impact of agricultural chemicals on ground water, and (c) long-term trends in water quality in sensitive aquifers. The initial well installation phase of this project was completed in 1998. Thus far, 80 monitoring sites have been established consisting of a total of 145 water quality monitoring wells. These monitoring sites are distributed across 24 aquifers. Water quality parameters being examined include major ions, trace elements, radionuclides, volatile organic compounds, and pesticides. In 1999, 145 wells at 80 sites were sampled.

This network of wells was designed and installed specifically to monitor the background quality of shallow ground water for nonpoint source pollutants. To accurately assess the background quality of shallow ground water in these aquifers, municipal, industrial, irrigation, and private wells were avoided. Municipal, industrial, and irrigation wells are usually not suited for examining shallow ground water because they are often completed deep into an aquifer to allow for the maximum yield. Private wells are often unsuitable for background ground water quality monitoring for the same reason as municipal and industrial wells, and also because of their location near local sources of pollution such as animal-holding areas and septic systems. However, shallow ground water is most often the first to be impacted by pollutants and is, therefore, where monitoring efforts of this type should be concentrated. Information from this type of monitoring is very much in demand as agricultural development and drinking water demands continue to put pressure on shallow ground water resources. A comprehensive report of data gathered from 1994-1997 is scheduled for completion in 2000.

D. QUALITY OF PUBLIC DRINKING WATER SYSTEMS

Public Drinking Water Systems

South Dakota has approximately 729 public water systems (PWS). A PWS is defined as a system that has 15 or more service connections or that regularly serves at least 25 people a day for at least 60 days each year. A community water system is a public water system that has at least 15 service connections for year-round residents or that serves at least 25 year-round residents. Community PWS make up 474 of the total PWS and serve residential populations. A breakdown of the PWS by type is shown by Figure 6.   Most South Dakota water systems (85%) rely totally on ground water.

South Dakota now regulates PWS through South Dakota State Drinking Water Regulations. Previous to 1983, the program was administered by the Environmental Protection Agency. The SD State Drinking Water Regulations dictate the quality of water provided by systems. They address the type and frequency of testing and set Maximum Contaminant Levels (MCLs). MCLs are the highest level at which a chemical or a bacteriological parameter can be consumed without ill effects. Systems exceeding MCLs must notify their customers and investigate realistic alternatives for their water supply such as treatment of the present source, connection to a regional water system, or development of a new source.

Community PWS regularly monitors chemical quality of their water. The 13 inorganic chemicals that are regulated by the SD State Drinking Water Regulations are analyzed every three years by groundwater systems while surface water systems are analyzed annually. After base requirements are met, sampling frequency may be reduced to once every nine years if a waiver is obtained. Radiological chemicals are analyzed at least every four years by all community systems. Volatile Organic Compounds (VOCs) are analyzed every three months for the initial monitoring. After base requirements are met, sampling frequency may be reduced to once every year. Sampling may be further reduced if a waiver is obtained. Sampling for Synthetic Organic Compounds (SOCs) began in 1993. SOCs must be analyzed every three months for the initial monitoring. After base requirements are met, sampling frequency can be reduced to once or twice during each succeeding compliance period, depending on population served. Sampling can be further reduced if a waiver is obtained. Appendix E contains a listing of all tested contaminants as well as the regulations, definition and some procedures pertaining to their assessment.

There are approximately 504 public water systems required to test for compliance with the Lead and Copper Rule. All systems have reported through January 1999.

Additional monitoring or treatment technique requirements are triggered when the samples exceed a lead action level of 15.0 ppb or a copper action level of 1.3 ppm, measured in the 90th percentile at the customer's tap. In other words, each system is allowed to exceed the action level with 10 percent of their samples with the 90th percentile concentration determining whether or not the system actually exceeds an action level. Of the 504 systems that have monitored to date, 8 percent have exceeded the lead action level and 9 percent have exceeded the copper action level.

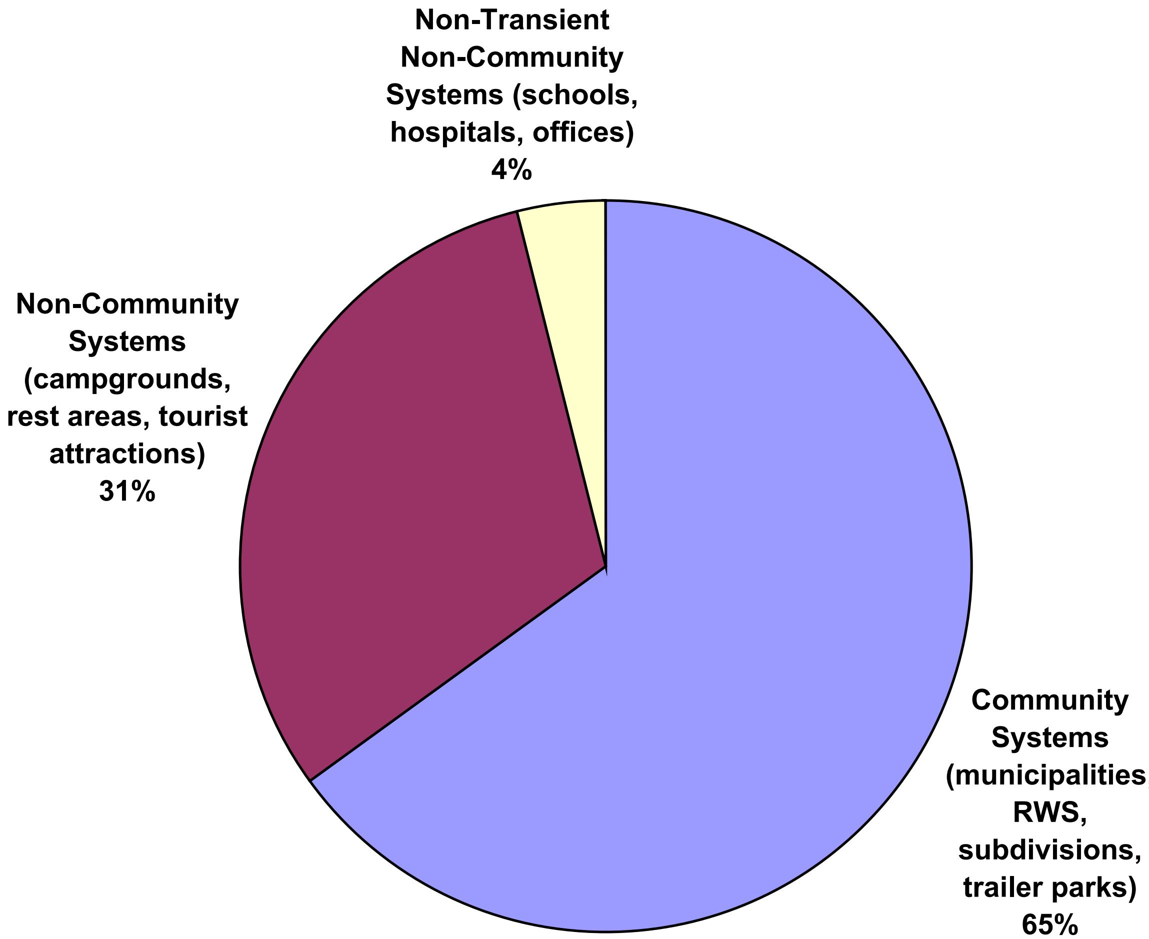


Figure 6. Public water systems in South Dakota.

A sample is to be analyzed for nitrate by all systems at least once a year. If the sample exceeds the MCL or half the MCL, sampling frequency increases. A nitrite sample must be analyzed by all systems once every three years.

In terms of the secondary drinking water standards, much of the water quality of public drinking water supplies within South Dakota is poor. Many PWS have very hard water. Numerous PWS exceed the recommended standards for total dissolved solids, iron, manganese, chlorides, and sulfates. Some systems also violate the primary water standards of nitrate (1 PWS) and radium (10 PWS). Figure 7 shows the number of PWS exceeding secondary standards. Organic chemicals are regularly sampled by all systems with no MCLs being violated.

PWS regularly analyze for an indicator of bacteriological water quality the total coliform bacteria. Sampling frequency is dependent on the population served by the system. Coliform bacteria, while usually not pathogenic, are indicators of possible fecal contamination. The bacteriological quality of community water supplies varies from month to month, but generally about 80% of the systems are considered safe at any one time. From January 1997 through September 1999, a total of 30,113 routine samples were submitted for testing by state public water systems. Of these, 918 or 3.1% were declared unsafe due to the presence of coliform bacteria. This compares with 4.5% of samples found to be unsafe during the last reporting cycle (State Health Laboratory).

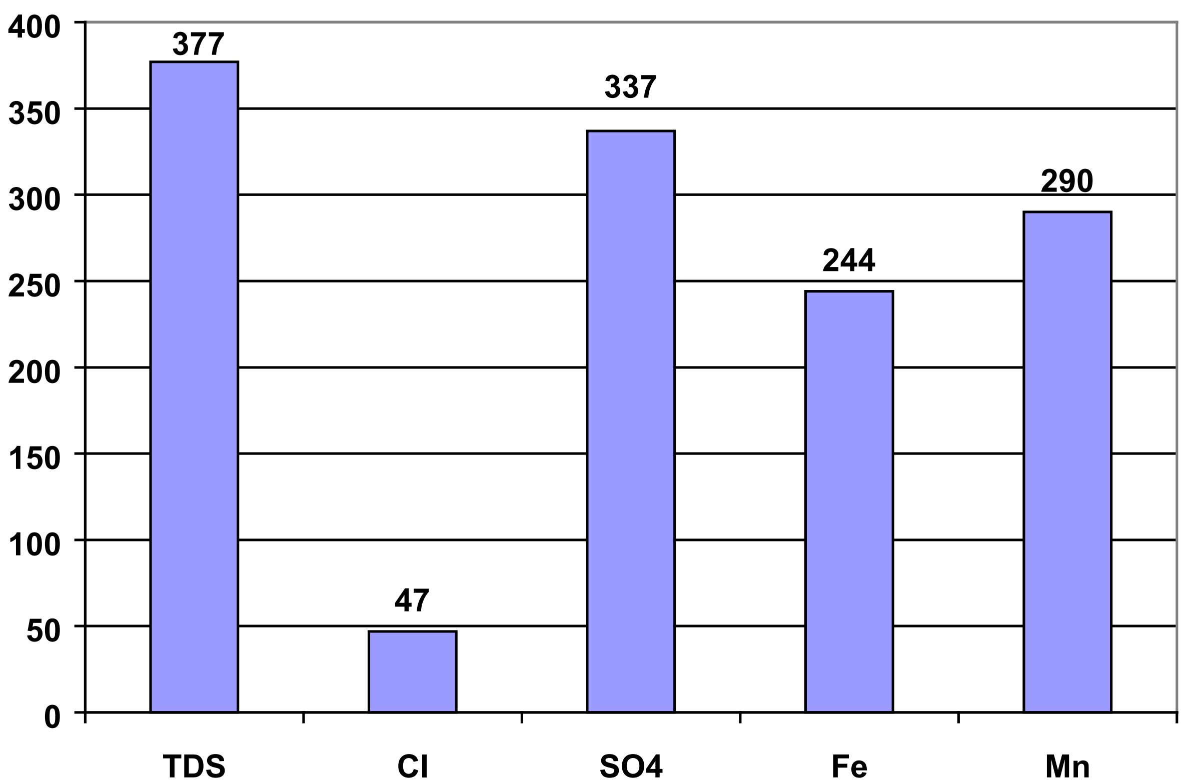


Figure 7. Public water systems exceeding secondary standards

E. QUALITY OF PRIVATE DRINKING WATER SYSTEMS

Specific problems found in unregulated private wells throughout the state are primarily high nitrate levels and coliform bacteria. During the present reporting period 13% of 1,915 tested domestic wells exceeded the Federal Drinking Water Standard of 10 mg/l nitrate-nitrogen. By contrast, only one PWS out of 756 tested was found to exceed the nitrate standard. Exceedances of the drinking water standard for total coliform bacteria (i.e. the mere presence of coliforms) were found in 27% of 2,705 private wells. This is approximately six times the frequency reported in regulated state public water systems (4.1%) over a comparable period of time.

The frequency of exceedance (private systems) for nitrate and total coliform bacteria stayed the same between the last two reporting periods at 13% and 27%, respectively. By comparison, frequency of bacteria exceedance for PWS was considerably lower. There were 108 coliform MCL violations in 77 systems in 1997. These 108 violations were out of a possible 7761 compliance periods - 1.4% exceedance rate. The exceedances for nitrate over the same time span ranged well below 1%, represented by one violation for 754 PWS tested during 1997.

The yearly variability in reported exceedances, particularly in private wells, can be traced partly to the considerable variation in annual weather patterns since 1991. For example, rainfall amounts have been appreciably greater over much of the state in the odd-numbered years of this decade.

Information supplied by domestic well owners during sampling of their wells indicates that feedlots, corrals, and septic tanks are the major sources of nitrate contamination that is exacerbated by runoff from flooding and heavy rains. This survey revealed the following practices to be particularly prevalent: 1) placement of a well within a feedlot or downgradient of a feedlot; 2) placement of a well downgradient from a septic tank or drainfield; and most importantly 3) poor well construction allowing for entrance of contaminants into the well.

The majority of wells within the state are shallow, ranging in depth between 10 and 90 feet. Many wells are bored and cased with porous concrete. Gravel pack is sometimes used to pack the well screens. The most serious well construction problem with the shallow wells is poor well placement. Of the older well records (dated prior to 1985) reviewed, 90% were not placed properly to prevent surface contamination from entering the well bore. South Dakota Well Construction Standards were revised in 1985 and this defect was likely more prevalent in older wells.

Best Management Practices for well construction have been recommended for each basin. Proper well construction would include the following practices: 1) proper location and placement of the well; 2) following the South Dakota Well Construction Standards and using a Licensed Water Well Driller; 3) the use of PVC or steel casing and screen; 4) construction of the well into the base of the aquifer; 5) the use of grout to prevent surface runoff from entering the well; 6) the addition of gravel pack, if necessary, and 7) the proper development and disinfection of the well. Proper well maintenance should include periodic analysis of the water and additional rehabilitation treatment, as necessary.

V.
POLLUTION CONTROL PROGRAMS

A. POINT SOURCE POLLUTION CONTROL PROGRAM

The state received delegation of the federal National Pollutant Discharge Elimination System (NPDES) program from the United States Environmental Protection Agency (EPA) on December 30, 1993. The NPDES permits issued by the state are referred to as Surface Water Discharge (SWD) permits. EPA continues to issue NPDES permits in South Dakota for facilities over which they retained jurisdiction. As of April 1, 2000, a total of 410 SWD and NPDES permits have been issued in South Dakota.

Technology-based controls are placed in most SWD and NPDES permits. However, technology-based controls alone do not necessarily protect waters of the state from toxic pollutants. Therefore, water quality-based limits and toxicity testing requirements are also placed in many of the permits.

Water quality-based limits are developed when technology-based limits alone are not adequate to protect the beneficial uses of the receiving stream. In these cases, the state develops a total maximum daily load (TMDL). The TMDL is implemented through the use of water quality-based effluent limits in the SWD permits. TMDLs are generally developed for water bodies that are not fully supporting their beneficial uses or that would not support their uses with technology-based controls alone.

The state continues to require whole effluent toxicity testing for all major SWD and NPDES permittees. The goal of the whole effluent toxicity approach is to ensure that point source discharges do not contain toxics in toxic amounts. If toxicity is found, the discharger is required to conduct an evaluation of the discharge to determine the source of the toxicity and identify ways to eliminate the toxicity.

Since 1979, 166 wastewater treatment facilities were completed with assistance from the Construction Grants program (Table 48A). The EPA Construction Grants program provided over $208 million to the state for wastewater improvements.

The 1987 Clean Water Act amendments created the Clean Water State Revolving Fund program. This is a low-interest loan program to finance the construction of wastewater conveyance and treatment systems, storm sewers and nonpoint source pollution control projects. Funds have been provided annually to the state in the form of capitalization grants since 1989. These grants are matched by the state at a 5:1 ratio. Interest rates on the loans must be at or below the market rate and are set annually by the Board of Water and Natural Resources. Rates are currently 4.5 percent for a 10-year term, 4.75 percent for 15-year term, and 5.0 percent for a 20-year term.

As of September 30, 1999 (the end of federal fiscal year 1999), the Board of Water and Natural Resources had awarded 106 loans totaling $93.45 million. Loans have been made to 56 entities, which include municipalities, sanitary districts, and waste management districts (Table 48B).

In the 1996 EPA Clean Water Needs Survey, the state documented $106 million of Clean Water State Revolving Loan Fund (SRF) needs for eligible wastewater treatment facilities through the year 2016. The largest areas of need are for secondary treatment ($36 million) and major sewer rehabilitation ($26 million).

TABLE 48A. SOUTH DAKOTA COMMUNITIES THAT HAVE COMPLETED EPA CONSTRUCTION GRANTS FUNDED WASTEWATER FACILITIES

1. - Aberdeen
2. - Alcester
3. - Alexandria
4. - Alpena
5. - Arlington
6. - Armour
7. - Artesian
8. - Ashton
9. - Avon
10. - Baltic
11. - Belle Fourche
12. - Blunt
13. - Box Elder
14. - Brandon
15. - Brandt
16. - Bridgewater
17. - Bristol
18. - Brookings
19. - Bruce
20. -Camp Crook
21. - Canistota
22. - Canton
23. - Carthage
24. - Cavour
25. - Centerville
26. - Chamberlain
27. - Chancellor
28. - Clark
29. - Clear Lake
30. - Colton
31. - Crooks
32. - Custer
33. - Dell Rapids
34. - DeSmet
35. - Doland
36. - Dupree
37. - Eden
38. - Elk Point
39. - Erwin
40. - Estelline
41. - Ethan
42. - Eureka
43. - Faith
44. - Faulkton
45. - Flandreau
46. - Frederick
47. - Freeman
48. - Ft. Pierre
49. - Garretson
50. - Gary
51. - Geddes
52. - Goodwin
53. - Gregory
54. - Groton
55. - Harrisburg
56. - Hartford
57. - Hazel
58. - Hayti
59. - Henry
60. - Herreid
61. - Highmore
62. - Hot Springs
63. - Hoven
64. - Hughes County
65. - Humboldt
66. - Hurley
67. - Huron
68. - Ipswich
69. - Irene
70. - Iroquois
71. - Isabel
72. - Java
73. - Kadoka
74. - Keystone-Mt Rushmore SD*
75. - Kimball
76. - Kranzburg
77. - LaBolt
78. - Lake Andes
79. - Lake Cochrane SD*
80. - Lake Madison SD*
81. - Lake Norden
82. - Lake Poinsett SD*
83. - Lake Preston
84. - Langford
85. - Lead-Deadwood SD*
86. - Lemmon
87. - Lennox
88. - Letcher
89. - Madison
90. - Marion
91. - Martin
92. - McCook Lake SD*
93. - McIntosh
94. - Mellette
95. - Marion
96. - Menno
97. - Milbank
98. - Miller
99. - Mina Lake SD*
100. - Mission
101. - Mitchell
102. - Mobridge
103. - Monroe
104. - Murdo
105. - Oacoma
106. - Onida
107. - Parker
108. - Parkston
109. - Philip
110. - Peever
111. - Pierre
112. - Plankinton
113. - Platte
114. - Pollock
115. - Prairiewood SD*
116. - Presho
117. - Ramona
118. - Rapid City
119. - Ravinia
120. - Redfield
121. - Reliance
122. - Renner
123. - Revillo
124. - Rosholt
125. - Roslyn
126. - Salem
127. - Scotland
128. - Sinai
129. - Sioux Falls
130. - Sisseton
131. - Spearfish
132. - Spencer
133. - Stickney
134. - Stockholm
135. - Sturgis
136. - Tabor
137. - Tea
138. - Timber Lake
139. - Tripp
140. - Turton
141. - U/B SD*
142. - Veblen
143. - Vermillion
144. - Viborg
145. - Vivian
146. - Volga
147. - Wagner
148. - Wall
149. - Wall Lake SD*
150. - Wakonda
151. - Warner
152. - Wasta
153. - Watertown
154. - Waubay
155. - Wagner
156. - Wessington
157. - Wessington Springs
158. - Westport
159. - Whitewood
160. - White River
161. - Wilmot
162. - Willow Lake
163. - Winner
164. - Wolsey
165. - Woonsocket
166. - Yankton

*SD = Sanitary District

Table 48B
South Dakota Clean Water SRF Funding Categories
September 30, 1999

LOAN RECIPIENT	DATE OF AWARD	I & II	IIIA & IIIB	IVA & IVB	V & VI	NPS	TOTAL
Belle Fourche (01)	08/22/90			$253,000			$253,000
Belle Fourche (02)	06/22/95		$264,422				$264,422
Box Elder	04/11/90	$648,600					$648,600
Brandon (01)	09/14/91				$105,000		$105,000
Brandon (02)	03/31/93			$526,018			$526,018
Bridgewater	09/25/97				$90,328		$90,328
Britton (01)	05/13/99	$509,935					$509,935
Brookings	03/14/91			$188,065			$188,065
Canton	05/19/92		$185,657		$330,058		$515,715
Chamberlain (01)	07/08/92		$175,250		$175,250		$350,500
Chamberlain (02)	01/26/93		$132,500		$132,500		$265,000
Chamberlain (03)	06/27/96	$2,700,000					$2,700,000
Chamberlain (04)	03/26/98			$450,000			$450,000
Clear Lake	06/13/91	$79,537					$79,537
Custer (01)	04/11/90	$430,000					$430,000
Custer (02)	07/11/90			$182,000			$182,000
Custer (03)	08/23/93	$276,000					$276,000
Custer-Fall River WMD	06/22/95					$106,939	$106,939
Deadwood	04/25/94		$447,838				$447,838
Dell Rapids	12/09/93		$156,000		$144,000		$300,000
Elk Point	05/27/93		$384,720	$73,280			$458,000
Fort Pierre	05/11/94			$75,968	$254,326		$330,294
Garretson	05/11/94	$300,000					$300,000
Groton (01)	01/13/94			$189,524			$189,524
Groton (02)	05/11/94			$74,630			$74,630
Groton (03)	07/23/97	$635,000					$635,000
Harrisburg (01)	06/23/99	$520,000					$520,000
Hot Springs (01)	03/12/92			$196,930			$196,930
Hot Springs (NPS/01)	01/13/94					$930,000	$930,000
Huron (01)	11/09/89	$1,656,000					$1,656,000
Huron (02)	06/13/91				$701,997		$701,997
Huron (03)	09/19/95	$1,856,828					$1,856,828
Lake Cochrane	04/11/90	$80,000					$80,000
Lake Madison	03/14/91	$46,200		$283,800			$330,000
Lead (01)	07/11/90		$186,409				$186,409
Lead (02)	07/11/91		$500,770				$500,770
Lead (03)	05/19/92		$375,298				$375,298
Lead-Deadwood San. Dist.	06/07/90	$106,855					$106,855
Lemmon	04/11/90		$427,100				$427,100
Lennox (01)	06/27/96	$49,000		$301,000			$350,000
Lennox (02)	07/23/97	$600,000					$600,000
Madison	03/14/91			$119,416			$119,416
McCook Lake San. Dist.	08/29/91	$417,258	$199,000	$25,677			$641,935
Mitchell	04/15/97				$1,543,405		$1,543,405
Mobridge (01)	07/11/90	$1,500,000					$1,500,000
Mobridge (02)	12/11/91	$158,000					$158,000
North Sioux City (01)	07/08/92				$239,650		$239,650
North Sioux City (02)	06/22/95				$646,000		$646,000

Table 48B
South Dakota Clean Water SRF Funding Categories
September 30, 1999

LOAN RECIPIENT	DATE OF AWARD	I & II	IIIA & IIIB	IVA & IVB	V & VI	NPS	TOTAL
Northdale Sanitary District	04/25/94			$256,380			$256,380
Philip (01)	06/22/95		$68,083		$385,802		$453,885
Philip (02)	06/26/97		$128,451		$192,676		$321,127
Pickerel Lake San. Dist. (1)	05/09/96	$850,000					$850,000
Pickerel Lake San. Dist. (2)	09/25/97	$670,000					$670,000
Pierre (01)	11/08/90	$347,181		$86,795			$433,976
Pierre (02)	03/26/98	$4,417,000					$4,417,000
Pierre (03)	03/25/99	$5,391,260					$5,391,260
Platte (01)	03/25/99		$1,000,000				$1,000,000
Pollock	09/23/93	$151,619					$151,619
Rapid City (01)	12/12/90	$1,066,359	$619,976	$793,570			$2,479,905
Rapid City (02)	07/08/92	$325,606	$661,079				$986,685
Rapid City (03)	06/23/93		$377,763	$296,814			$674,577
Rapid City (04)	08/10/94			$607,431	$607,431		$1,214,861
Rapid Valley San. Dist. (1)	01/11/90		$251,740	$362,260			$614,000
Rapid Valley San. Dist. (2)	11/10/94		$364,583				$364,583
Rapid Valley San. Dist. (3)	07/29/96		$630,000				$630,000
Richmond Lake San. Dist.(1)	06/27/96	$414,000					$414,000
Richmond Lake San. Dist.(2)	06/25/98			$226,500			$226,500
Roscoe	07/29/96	$236,549	$107,522	$14,336			$358,408
Sioux Falls (01)	04/11/90		$1,049,676	$1,787,286			$2,836,963
Sioux Falls (02)	07/11/90	$236,080	$217,920				$453,999
Sioux Falls (03)	12/12/90		$845,000				$845,000
Sioux Falls (04)	12/12/90				$1,200,000		$1,200,000
Sioux Falls (05)	03/12/92		$801,550	$1,153,450			$1,955,000
Sioux Falls (06)	03/12/92				$700,000		$700,000
Sioux Falls (07)	01/26/93	$3,240,000	$990,000	$270,000			$4,500,000
Sioux Falls (08)	01/13/94	$552,212	$146,791				$699,003
Sioux Falls (09)	08/10/94				$1,250,000		$1,250,000
Sioux Falls (10)	08/10/94	$1,432,941					$1,432,941
Sioux Falls (11)	06/22/95		$418,371	$776,975			$1,195,346
Sioux Falls (12)	03/27/96		$1,300,000				$1,300,000
Sioux Falls (13)	01/09/97			$2,500,000			$2,500,000
S. Missouri WMD	10/06/94					$700,000	$700,000
Spearfish	03/12/92	$1,956,000					$1,956,000
Sturgis (01)	08/23/93			$502,000			$502,000
Sturgis (02)	06/23/94	$936,250					$936,250
Sturgis (03)	06/27/97	$450,000					$450,000
Tea (01)	03/31/93				$600,000		$600,000
Tea (02)	05/11/94				$600,000		$600,000
Tea (03)	06/27/97			$208,813			$208,813
Tea (04)	05/14/98	$375,000					$375,000
Valley Springs	05/14/98	$430,000					$430,000
Vermillion (01)	06/07/90		$125,000				$125,000
Vermillion (02)	12/09/93				$370,471		$370,471
Vermillion (NPS/01)	08/10/95					$356,531	$356,531
Wall	07/22/99	$573,000		$573,000			$1,146,000
Warner	03/23/95				$101,152		$101,152

Table 48B
South Dakota Clean Water SRF Funding Categories
September 30, 1999

LOAN RECIPIENT	DATE OF AWARD	I & II	IIIA & IIIB	IVA & IVB	V & VI	NPS	TOTAL
Watertown (01)	10/09/91	$2,000,000					$2,000,000
Watertown (02)	08/12/92	$4,000,000					$4,000,000
Watertown (03)	06/22/95		$2,583,734				$2,583,734
Watertown (04)	11/09/95	$932,830					$932,830
Waubay	02/18/92			$81,454			$81,454
Webster	03/27/96		$345,394				$345,394
Whitewood	02/18/92	$180,801					$180,801
Worthing	06/27/96	$227,645					$227,645
Yankton (01)	12/11/97	$2,625,000					$2,625,000
Yankton (02)	12/11/97	$4,500,000					$4,500,000
TOTAL 106 Loans, 56 Entities		$51,086,546	$16,467,597	$13,436,372	$10,370,046	$2,093,470	$93,454,031

Description of Categories:

Category I - Secondary Treatment

Category II - Advanced Treatment

Category IIIA - Infiltration/Inflow Correction

Category IIIB - Major Sewer System Rehabilitation

Category IVA - New Collectors

Category IVB - New Interceptors

Category V - Correction of Combined Sewer Overflows

Category VI - Storm Sewers

NPS - Non-Point Source

B. COST/BENEFIT ASSESSMENT

The Department's EPA project priority list gives higher priority to those wastewater treatment facilities which discharge to fishable and/or swimmable waters. In addition, DENR has placed a high priority on getting all state WWTFs into compliance as soon as possible.

The small communities served by these "minor" WWTFs are for the most part agriculturally oriented and financially strapped. Financial assistance in the form of grants is usually necessary to make the required upgrading economically feasible. These communities may not have the financial capability to secure an SRF loan. The Department makes every effort to reduce local costs where possible to a manageable level through the state's Consolidated Water Facility Construction (Consolidated) Program. The state has secured a dedicated source for Consolidated funds and receives $2.5 million to $4.0 million per year for this fund. Small communities will often package Consolidated Grant Funds with SRF loans to make rates affordable for their residents.

EPA regulations require that a community establish acceptable sewer use and user charge ordinances prior to receiving an EPA grant. The user charge ordinance is intended to establish equitable charges for the annual operation and maintenance costs associated with operation of the WWTF. However, most communities also include the debt retirement costs in the user charge ordinance so they can collect all necessary charges once per month.

C. NONPOINT SOURCE POLLUTION CONTROL PROGRAM

Prior to 1988 efforts to protect South Dakota's ground and surface waters from pollution were directed primarily toward municipal and industrial wastewater treatment. With the elimination or reduction of pollution from these point sources, the state has focused on nonpoint sources. Efforts to control nonpoint source (NPS) pollution in South Dakota are implemented through the nonregulatory Nonpoint Source Control Program located within DENR's Water Resources Assistance Program.

The primary focus of the NPS Program is the control of NPS pollution through the voluntary implementation of best management practices (BMPs) and holistic land management plans. The major sources of NPS pollution in South Dakota are associated with land use practices. These practices along with specific activities associated with each practice are summarized in Table 49.

The South Dakota NPS Program coordinates its efforts with several state and federal agencies. These agencies supply practices and funds to control NPS pollution. The remainder of this section of the 305(b) Report summarizes how the program is organized and managed. NPS control projects that have been implemented are also listed. Additional information concerning the program and the projects may be found by consulting the South Dakota Nonpoint Source Program Plan and NPS Annual Reports, respectively.

Nonpoint Source Program Organization

The enactment of Section 319 of the Water Quality Act of 1987 focused attention on the importance of controlling nonpoint source (NPS) pollution. The Act provided direction and significant federal financial assistance for the implementation of state nonpoint source programs.

The South Dakota Nonpoint Source Program has utilized Section 319 of the federal Clean Water Act in addition to other state and federal programs to control nonpoint source pollution. The South Dakota Department of Environment and Natural Resources (DENR) is the designated lead agency. It created a Nonpoint Source Control Program in response to the water quality impairments present in the state. The program is guided by a multi-organization task force. The task force has an open membership and consists of state, federal and local agencies, tribes and organizations having an interest in NPS pollution. Task force membership by agency is shown in Table 50. The task force normally meets five times each year. Agencies, organizations and concerned citizens have the opportunity to provide input and guidance to the program at the meetings and through special issue specific committees. This approach has enabled South Dakota to be recognized as having one of the best NPS programs in the nation. Financial assistance for NPS projects is approved by the South Dakota Board of Water and Natural Resources.

Table 49. South Dakota Categories and Subcategories of NPS Pollution Sources.

Agriculture

Non-irrigated crop production
Irrigated crop production
Pasture grazing - riparian and upland
Pasture grazing - riparian
Pasture grazing - upland
Concentrated animal feeding operations
Confined animal feeding operations
Aquaculture
Rangeland - riparian and upland
Rangeland - riparian
Rangeland – upland

Silviculture

Harvesting, restoration, residue management
Forest management
Logging road construction/maintenance

Construction Runoff

Highway/road/bridge construction
Land development

Other

Golf Courses
Erosion from derelict land
Atmospheric deposition
Waste storage/storage tank leaks
Highway maintenance and runoff
Spills
Natural sources
Internal nutrient cycling
Sediment resuspension
Sources outside jurisdiction or borders
Erosion and sedimentation

Resource Extraction/Exploration/Development

Surface mining
Subsurface mining
Petroleum activities
Abandoned mining

Land Disposal (runoff/leachate from areas)

Sludge
Wastewater
Landfills
Industrial land treatment
On-site wastewater systems (septic tanks, etc.)

Habitat Modification

Removal of riparian vegetation
Bank or shoreline modification/destabilization
Drainage/filling of wetlands

Hydromodification

Channelization
Dredging
Dam construction
Upstream impoundment
Flow regulation/modification

Urban Runoff/Storm Sewers

Nonindustrial
Industrial
Surface runoff
Other urban runoff
Highway/road/bridge runoff

Table 50. South Dakota NPS Task Force Membership by Agency

U.S. Environmental Protection Agency
U.S. Forest Service
U.S. Geological Survey
USDA Natural Resources Conservation Service
U.S. Bureau of Reclamation
USDA Consolidated Farm Services Agency
S.D. Department of Environment and Natural Resources
S.D. Department of Agriculture
S.D. Department of Game, Fish and Parks
S.D. Board of Water and Natural Resources
S.D. Conservation Commission
S.D. Association of Conservation Districts
S.D. Cooperative Extension Service
S.D. State University
S.D. School of Mines and Technology
Water Development Districts
Cheyenne River Sioux Tribe
Oglala Sioux Tribe
Standing Rock Sioux Tribe
Flandreau Santee Sioux Tribe
Sisseton-Wahpeton Sioux Tribe
Lower Brule Sioux Tribe
Crow Creek Sioux Tribe
Yankton Sioux Tribe
Rosebud Sioux Tribe
South Dakota Resources Coalition
Resource Conservation and Development Districts
Planning Districts
S.D. Farm Bureau
S.D. Pork Producers
S.D. Cattlemans Association
S.D. Farm Bureau
S.D. Corn Growers
S.D. Wheat, Inc.
S.D. Water Congress
Izaak Walton League
Black Hills Forest Resources Coalition
S.D. Lakes and Streams Association

Nonpoint Source Program Assessment

The provisions of Section 319 require that states complete a nonpoint source assessment prior to requesting financial assistance. DENR completed the assessment for South Dakota during 1988. Copies can be obtained from DENR. An update is contained in this report. Information about specific waterbodies can be found in the Surface Water Assessment Section. Nearly all of the waterbodies in the state that have impaired beneficial uses are impacted by NPS pollution. Sediment, pathogens, and nutrients are the major causes of impairment. Agricultural activities are the major source of the pollutants. Other sources include silviculture, construction, urban runoff, resource extraction, land disposal, hydrological modification, and natural processes.

The USDA Natural Resources Conservation Service (NRCS) "Hydrologic Unit (HU) Planning Process" is used as a tool to aid in the assessment of water quality problems and the development of NPS pollution control projects. The process uses public meetings to obtain input on the perceived problems and needs in an HU. By using this input in conjunction with information obtained from water quality assessment studies the South Dakota NPS Program has been able to plan restoration projects that have strong local support and hence a high probability of success.

Nonpoint Source Management Program Plan

The South Dakota Nonpoint Source Management Program Plan reflects a multi-agency effort to control NPS pollution in the state. The plan contains nine key elements required by USEPA :

1. The state program contains explicit short and long term goals, objectives and strategies to protect surface and ground water.

2. The state strengthens its working partnerships and linkages to appropriate state, interstate, tribal, regional, and local entities (including conservation districts), private sector groups, citizen groups, and federal agencies.

3. The state uses a balanced approach that emphasizes both state-wide nonpoint source programs and on-the-ground management of individual watersheds where waters are impaired or threatened.

4. The state program (a) abates known water quality impairments from nonpoint source pollution and (b) prevents significant threats to water quality from present and future nonpoint source activities.

5. The state program identifies waters and their watersheds impaired by nonpoint source pollution and identifies important unimpaired waters that are threatened or otherwise at risk. Further, the state establishes a process to progressively address these identified waters by conducting more detailed watershed assessments and developing watershed implementation plans, and then by implementing the plans.

6. The state reviews, upgrades, and implements all program components required by Section 319(b) of the Clean Water Act, and establishes flexible, targeted and iterative approaches to

achieve and maintain beneficial uses of water as expeditiously as practicable. The state programs include:

> A mix of water quality based and/or technology based programs designed to achieve and maintain beneficial uses of water; and
> A mix of regulatory, non-regulatory, financial and technical assistance as needed to achieve and maintain beneficial uses of water as expeditiously as practicable.

7. The state identifies federal lands and activities that are not managed consistently with state nonpoint source program objectives. Where appropriate, the state seeks EPA assistance to help resolve issues.

8. The state manages and implements its nonpoint source program efficiently and effectively, including necessary financial management.

9. The state periodically reviews and evaluates its nonpoint source management program using environmental and functional measures of success, and revises its nonpoint source assessment and its management program at least every five years.

The Plan was first completed during 1989 and has been approved by EPA. It has been amended periodically. It underwent major revision in 1999 and was approved by EPA in March 2000.

Program review is provided by the SD NPS Task Force. The Task Force utilizes program neutral planning to direct its efforts. Program neutral planning is a process of planning based on need rather than a particular source of funds. Once a project is planned, funding is sought from several potential sources. The approach encourages effective use of other programs in addition to the 319 Program.

The Task Force recognizes the importance of using a statewide - but watershed specific approach. The program includes preventative strategies. Prevention is encouraged primarily through an information and education (I&E) program.

Watershed specific projects are selected through a competitive process based on impairment of beneficial uses, presence of public recreational facilities, public health risk, offsite effects, and special considerations. The Task Force selects the highest priority water bodies for consideration to receive financial assistance. Following a technical review by DENR, the recommendations of the Task Force are submitted to the South Dakota Board of Water and Natural Resources for final review and approval.

Process for Best Management Practices Selection

Many of the NPS control programs utilize existing BMP (Best Management Practice) manuals pertaining to agriculture, silviculture, and mining. To further refine these manuals and to identify additional BMPs for each NPS category the Task Force actively supports BMP selection. BMPs chosen for specific projects are initially identified by the appropriate agency (e.g. NRCS for Ag BMPs) and reviewed by the NPS Task Force.

Agricultural BMPs consist of most of the conservation practices listed in the NRCS Field Office Technical Guide. The usual planning process with an individual landowner involves choosing a combination of practices that will achieve a desired water quality goal. This planning process is called a Resource Management System (RMS). A RMS is a combination of conservation practices and management techniques identified by the primary use of the land or water. Under a RMS, the resource base is protected by meeting acceptable soil losses, maintaining acceptable water quality, and maintaining acceptable ecological and management levels for the selected area. The landowner has a choice of mixing various structural, vegetative, tillage, cropping rotations, land use and management practices that best suit his operation. Often, there are several combinations of practices that will achieve a desired level of erosion or water quality pollution control. Therefore, for NPS control it is more practical to specify the desired goal rather than to try to dictate which practices are mandatory.

Nonpoint Source Development Projects

The NPS Program has assisted a number of organizations with planning and diagnostic activities. Using NPS Development funds [604(b)] the following activities listed in Table 51 have been undertaken:

Table 51. Section 604(b) Nonpoint Source Development Projects

Blue Dog Lake/Enemy Swim Septic Leachate Survey
Lake Cochrane/Oliver Watershed Assessment
Lakes Herman, Madison, Brandt Project Planning
Lake Alvin/Nine Mile Creek Assessment
Grand River Watershed Assessment
Moccasin Creek Watershed Assessment
Big Sioux River Bank Stabilization Demonstration Project
White River Watershed Data Collection Project
Whitewood Creek Watershed Project Planning
Upper Big Sioux Watershed AGNPS
Lake Poinsett Project Planning and Design
Big Sioux River (Moody/Minnehaha Counties) Riparian Assessment
Rapid Creek NPS Assessment Project
Rapid Creek Stormwater Impact Prioritization
Whitewood Creek Streambank Assessment Project
Lake Hendricks Restoration Assessment
Pelican Lake Control Structure Feasibility

Turtle Creek/Lake Redfield Landowner Survey
White River Preservation Project
Lake Faulkton Assessment Project
Firesteel Creek/Lake Mitchell Water Quality Needs Assessment - Landowner Survey
Rapid City Stormwater Impact Prioritization
Vermillion River Basin Watershed Planning
West Yankton Sanitary Sewer Survey
Riparian Area Forestry Project
East River Riparian Demonstration Project
Lake Traverse and Little Minnesota River Land Inventory Project
Demonstrating the Use of Slash Piles to Control Erosion on Fragile Soils
Detention Cell Demonstration Project
Livestock Waste Management Handbook
Project to Develop NPS BMPs for the Western Pennington County
Drainage District
Lake Louise Water Quality Monitoring
Lake Andes Watershed Treatment Project
Forestry BMP Pamphlet
Groundwater Protection Project
Local Water Quality Planning through the Hydrologic Unit Planning Concept
Wetland Assessment for the Nonpoint Source Program
Pesticide and Nitrogen Program
Randall RC&D Implementation Planning
North Central RC&D HU Implementation
Mina Lake Water Quality Project
Stockgrowers Speaker
Streambank Erosion Assessment Project - Upper Whitewood Creek
Broadland Creek Watershed Study
Chemical Containment
Platte Lake Planning
Nonpoint Source Impacts of Riparian Areas
Ravine Lake Diagnostic/Feasibility Study
Fish Lake Water Level and Quality Study
Water Quality Study of South Dakota Glacial Lakes and Wetlands
Big Sioux Aquifer Protection Project
Burke Lake Diagnostic/Feasibilty Study
Bad River Phase IA
Minnehaha County NPS Planning Project
Galena Fire Project
Rapid Creek and Aquifer Assessment Project
Bad River Phase IB
Big Sioux Aquifer Study
Pesticide and Fertilizer Groundwater Study

Many of the assessment projects have led to the development of additional 319 NPS Implementation Projects. Also, based on the information gathered, additional projects have been funded through other programs such as the state Soil and Water Fund administered by the SD Conservation Commission.

Nonpoint Source Projects

South Dakota has been actively implementing projects to control nonpoint source pollution. South Dakota uses maximum allowed by EPA for assessments to establish TMDLs. TMDLs are used as the basis for planning implementation projects. A list of the 319 Implementation Projects completed or in progress is shown below in Table 52. These projects have received Section 319 funding in addition to financial and technical assistance from other federal agencies, the state of South Dakota, and local units of government. Specific information about each project may be obtained by consulting the South Dakota Department of Environment and Natural Resources.

Table 52. Section 319 Nonpoint Source Implementation and Assessment Projects

Grand River Assessment
Central Big Sioux TMDL
Cochrane & Oliver TMDL
Cottonwood & Louise TMDL
Bad River Phase III
Lower Rapid Creek TMDL
Moccasin Creek Assessment
Rapid City Stormwater
Firesteel Creek
Lake Poinsett Restoration
Bigstone Lake Restoration
Animal Waste Team III
Statewide Lake Assessment
Lake Mitchell Watershed
Lake Hendricks Watershed
Lake Poinsett Watershed
Bachelor Creek Assessment
Shadehill Lake Protection
Animal Waste Team (Buffer salesmen)
Upper Big Sioux River Watershed
Lake Redfield Restoration
Bootstraps
Upper Bad River Demonstration
Bad River Phase III
Ground Water Monitoring Network
Blue Dog Lake Assessment
Bad River National Watershed Monitoring
Bigstone Lake/Little Minnesota

Mina Lake Water Quality
Nonpoint Source Information / Education 1996
Nonpoint Source Information / Education 1994
Lake Campbell Watershed Restoration
South Dakota Lake Protection
Bigstone Lake Restoration II
Foster Creek Riparian Demonstration - Beadle County
Coordinated Resource Management II
Swan Lake Restoration
East River Area Riparian Demonstration
Piedmont Valley Assessment
Clear Lake Assessment - Marshall County
Lake Byron Watershed
Animal Waste Management II
Lake Kampeska Watershed
Ravine Lake Watershed
Nonpoint Source Information / Education 1989
Foster Creek Riparian Demonstration - Stanley County
East River Riparian Demonstration II
Wall Lake
Bigstone Lake
South Dakota Association of Conservation Districts
Coordinated Resource Management I
Big Sioux Well Head Protection
Burke Lake
Richmond Lake
Animal Waste Management I
Bad River Phase II
Riparian Grazing Workshop
Lake Cochrane Protection
Abandoned Well Sealing
East River Riparian Grazing I
Nitrogen & Pesticides in Ground Water
Nonpoint Source Information & Education
Rainfall Simulator
Pickerel Lake Protection.

Future Nonpoint Source Program Directions

NPS pollution originates from diverse sources. Nonpoint pollution controls must reflect this by using all of the resources available from the various state, federal, and local organizations and in addition have landowner support and participation. The technical and financial assistance currently available is not sufficient to solve all of the NPS pollution problems in the state. Additional solutions must be tried. Landowners have the capability to accomplish much if they understand the problems and the ways to solve them. Educating the public about NPS pollution issues may prompt landowners to voluntarily implement activities to control NPS pollution. New federal programs must also be developed to supplement existing programs. Enforcement may be needed to increase compliance with state and federal requirements. The continuation of existing activities coupled with the addition of innovative new programs will ensure that South Dakota remains a leader in nonpoint source pollution control.

D. GROUND WATER PROTECTION PROGRAM

The South Dakota Department of Environment and Natural Resources (DENR) is responsible for all functions pertaining to research, development, planning, allocation, protection and remediation of ground water resources. In 1986, the Department developed a Ground Water Protection Strategy which has been updated on a regular basis. The strategy outlines existing and future efforts for ground water quality management. The major sources of ground water pollution were identified in the strategy. These sources are now addressed by preventative measures, including ground water classification for beneficial uses, ground water quality standards, ground water discharge permits, wellhead and source water protection efforts, concentrated animal feeding operations permits, aboveground storage tank and underground storage tank regulations.

DENR ground water quality projects and activities include: a completed pesticide and fertilizer sampling program; primary enforcement authority for Underground Injection Control (UIC); the enforcement of the Underground Storage Tank (UST) program under RCRA Subtitle I; the enforcement of a state Aboveground Storage Tank (AST) program; enforcement of concentrated animal feeding operations permits; ground water quality standards; SARA Title III, state Superfund/Federal Facilities program (state CERCLA program); increased involvement in assessment, enforcement, and cleanup activities resulting from accidental releases of potential pollutants; wellhead protection program activities; a source water assessment program, a ground water discharge permit program; an agricultural chemicals (pesticides and fertilizers) in ground water management program, and a statewide ground water quality monitoring network.

The 1989 State Legislature enacted the Centennial Environmental Protection Act (CEPA) which included statutory authority for additional ground water protection activities. These included: a voluntary wellhead protection program; water quality analysis for new domestic wells; certification of small on-site wastewater disposal system installers; and pesticide and agricultural chemical management plans to protect water quality.

DENR also reviews the construction and operation plans and specifications of municipal wastewater facilities, septic systems and feedlot facilities. Approval of other plans and specifications are given only to those facilities with required protection of ground water resources.

Many reports on ground water resources of the state have been completed in the past several years including those dealing with: average water use in eastern South Dakota; recharge in eastern South Dakota; water quality suitability for both the eastern and western parts of the state; and special studies. Geologic and water resources studies of individual counties are ongoing, as is the state ambient ground water quality monitoring network. In addition, a geologic and water resource bibliography of references was completed. Current state ground water protection programs and their implementation status are summarized in Table 53.

Table 53. SUMMARY OF STATE GROUND WATER PROTECTION PROGRAMS

Programs or Activities	Check (√)	Implementation Status	Responsible State Agency
Active SARA Title III Program	√	Fully Established	DENR
Ambient ground water monitoring system	√	Established, but continually evaluated	DENR
Aquifer vulnerability assessment	√	Continuing Effort	DENR
Aquifer mapping	√	Continuing Effort	DENR
Aquifer characterization	√	Continuing Effort	DENR
Comprehensive data management system	√	Under Development	DENR
EPA-endorsed Core Comprehensive State Ground Water Protection Program (CSGWPP)	√	Under Development	DENR
Ground water discharge permits	√	Fully Established	DENR
Ground water Best Management Practices	√	Continuing Effort	NRCS*
Ground water legislation	√	Fully Established	DENR
Ground water classification	√	Fully Established	DENR
Ground water quality standards	√	Fully Established	DENR
Interagency coordination for ground water protection initiatives	√	Continuing Effort	DENR*
Nonpoint source controls	NA - not a regulatory program		
Pesticide State Management Plan	√	Under Revision	SDDA*
Pollution Prevention Program	√	Continuing Effort	DENR*
Resource Conservation and Recovery Act (RCRA) Primacy	√	Fully Established	DENR
State Superfund	√	Fully Established	DENR
State RCRA Program incorporating more stringent requirements than RCRA Primacy	NA - Regulations adopted by reference		DENR
State septic system regulations	√	Fully Established	DENR
Underground storage tank installation requirements	√	Fully Established	DENR
Underground Storage Tank Remediation Fund	√	Fully Established	PRCF
Underground Storage Tank Permit Program	√	Fully Established	DENR**
Underground Injection Control Program: Section 1425	√	Fully Established	DENR
Underground Injection Control Program: Section 1422	√	Developed, Waiting EPA Approval	DENR
Vulnerability assessment for drinking water/wellhead protection	√	Continuing Effort	DENR
Well abandonment regulations	√	Fully Established	DENR
Wellhead Protection Program (EPA-approved)	√	Fully Established	DENR
Concentrated Animal Feeding Operations Permits	√	Fully Established	DENR
Source Water Assessment and Protection Program	√	Program Approved by EPA, Implementation in Progress	DENR
Well installation regulations	√	Fully Established	DENR

*Lead agency with other agencies involved.
**Not a permit program

Underground Injection Control (UIC)

The intent of the UIC program is to maintain ground water quality in useable aquifers. The State UIC program regulates underground injection of oil and gas wastes and the material used for enhanced oil and gas recovery. South Dakota was granted primacy of the Class II (1425) program in 1984. The state has applied for primacy regulating underground injection for in situ mining, shallow injection wells (Classes III & V-1422) such as drainage wells and septic systems, and uses such as geothermal heating systems. Injection of hazardous wastes is prohibited.

Underground Storage Tanks (UST)

The state UST program regulates underground storage tanks. The UST program is designed to prevent ground water pollution from underground storage tank sources and clean up activities from such incidents. South Dakota's UST regulations require tank notification, performance standards, upgrading existing systems, spill and overfill control, installation, corrosion protection, release detection, record keeping, tank maintenance, reporting of releases or spills of petroleum and hazardous substances, initial abatement, investigation and cleanup of spills, requirements for new UST systems, financial responsibility, and closure. South Dakota was granted primacy of the federal UST program within the state in March 1995.

Aboveground Storage Tanks (AST)

The AST program is also designed to prevent ground water pollution and provide for assessment, enforcement, and clean-up from these point sources. The AST regulations require tank notification, performance standards, the upgrading of existing systems, installation, secondary containment, spill and overflow control, corrosion protection, record keeping, tank maintenance, release detection, reporting of releases and spills, initial abatement and corrective action, free product removal and cleanup, and closure.

LUST Trust Fund

DENR administers the Federal Leaking Underground Storage Tank (LUST) Trust Fund through a cooperative agreement with EPA. LUST Trust Funds are used to identify parties responsible for petroleum contamination incidents from underground storage tanks. Based on federal requirements, DENR will be able to use the funds to clean up contamination where a responsible party cannot be identified or is unable to clean up the contamination. DENR can also use LUST Trust Fund money to respond to emergency situations resulting from releases from underground storage tanks.

Superfund/Federal Facilities Program

The Superfund/Federal Facilities Program provides regulatory oversight at all Superfund or National Priorities List (NPL) sites and Formerly Used Defense Sites (FUDS) in South Dakota. DENR personnel assist federal cleanup programs by ensuring compliance with South Dakota’s environmental regulations.

Regulated Substance Response Fund

A Regulated Substance Response Fund was established by the 1988 Legislature. This fund was generated from the petroleum and agricultural chemical industries. The fund can be used in emergency remedial efforts, in pollution incident investigations to determine the responsible party, and for corrective actions when a responsible party cannot be identified or refuses to undertake corrective actions. In all cases, DENR attempts to recover all costs from responsible parties.

Petroleum Release Compensation Fund

The 1988 Legislature established a $5 million Petroleum Release Compensation Fund (PRCF). This fund is used for reimbursement to petroleum tank owners for cleanup costs greater than $10,000 and less than $1,000,000. The PRCF balance has varied since its inception and changes in its funding have occurred. The PRCF balance as of August 31, 1999, was approximately $11,000,000. Since its inception, the PRCF has provided over $60,000,000 in reimbursement for costs associated with the assessment and clean up of petroleum releases in South Dakota.

Ground Water Discharge Permits

The ground water discharge permit program is designed to further control point sources that may adversely affect ground water. Ground water has been classified for beneficial uses, and ground water quality standards have been set by the Board of Water Management. Ground water with total dissolved solids (TDS) concentrations of 10,000 mg/l or less is classified for drinking water purposes and protected for this beneficial use through numerical ground water quality standards and ground water discharge permits. Ground water with TDS concentrations greater than 10,000 mg/l is not classified for beneficial uses but further degradation is not allowed without the necessary permits.

The ground water discharge permit program involves three permits for a complete plan. These are: a construction permit, a water quality variance, and a discharge permit. The water quality variance limits discharges that degrade ground water. This involves limiting the area and quality of discharge and degradation. Ground water monitoring plans are also a part of the permit. Ground water discharge permits are necessary for discharges above ground water quality standards. These standards must be met at specific compliance points on the site.

Wellhead Protection Program

Wellhead Protection (WHP) activities have been proceeding in South Dakota since 1985 when preliminary work was done to identify areas of influence and potential pollution sources for vulnerable public water supply wells. In 1987, state legislation gave DENR authority to administer a WHP Program. In 1989, the Centennial Environmental Protection Act (CEPA) required the development of a voluntary WHP program. The state WHP plan was approved by EPA in October 1992. State guidelines for local use in WHP were completed in April 1995.

These state WHP guidelines include facility siting and construction criteria, governmental subdivision duties, wellhead protection area delineation, determination of pollution source locations, new well siting, and contingency planning. CEPA also provided for political subdivision agreements to enforce WHP programs.

Voluntary local WHP programs have been initiated on a city and county level. Efforts to date involve primarily the Big Sioux aquifer. Brookings County in east-central South Dakota has enacted an ordinance to protect all PWS wells in the County with WHP area delineation based on a 10-year time of travel. Minnehaha County and the city of Sioux Falls have adopted ordinances and completed delineation of WHP areas. Building on these projects, the East Dakota Water Development District and the First District Association of Local Governments have developed uniform ordinances for an eleven (11) county area. Ten counties have adopted the ordinances. Presentations about WHP and the ordinances will improve public awareness, aid in ground water quality management and protect the water quality of the Big Sioux aquifer. Some areas outside the Big Sioux aquifer that have recently moved forward with wellhead protection activities include the Black Hills area (primarily in Lawrence County), Tripp Rural Water System and Clay Rural Water System.

Table 54 shows the number of communities that have wellhead protection ordinances in place and/or have a specific designated wellhead protection zone. A number of other communities have undertaken initial wellhead protection activities through the DENR PWS Waiver Program. DENR anticipates there will be more activity in this area in the near future, primarily because of the new Source Water Assessment requirements noted below.

Table 54. STATE PWS WELLHEAD PROTECTION PROGRAM (1999)

Number of Ground Water-based or Partial Ground Water-supplied Community PWSs	Population Served	Number of Ground Water-based or Partial Ground Water-supplied Community PWSs with Local WHPP in Place	Population Served
294	446,978	41	340,810

A DENR program was enacted in October 1994 that allows waivers of certain public water supply (PWS) sampling requirements provided the systems (PWS) could demonstrate they were not vulnerable to the contaminants in question. This program increased public awareness and involvement in wellhead protection

Source Water Assessment and Protection Program

Federal Safe Drinking Water Act amendments passed in 1996 require states to conduct source water assessments for all public water supplies in the state. In South Dakota, this is approximately 730 systems at this time. The Act requires the state to delineate a water supply protection zone (both surface and ground water), identify potential contaminant sources in that zone, and determine the susceptibility of the water supply to the potential contaminant sources. Additionally, public involvement was required in the assessment planning process, and the results of the assessments must be made available to the individual public water supply systems and to the public. EPA approved South Dakota's Source Water Assessment and Protection Program plan, which describes the procedures the state will employ to conduct the assessments and provide the information to the public.

Pesticides in Ground Water

The South Dakota Department of Agriculture and DENR have developed a generic State Management Plan (SMP) for pesticides in ground water. The management plan is a CEPA requirement as well as an EPA requirement. The SMP was reviewed by the state's Nonpoint Source Task Force, which consists of numerous agencies and organizations. The SMP was also presented at public meetings. On March 8, 2000, EPA formally concurred with South Dakota's generic SMP.

Ellsworth Air Force Base Superfund Site

As a result of past waste and resource management practices at Ellsworth Air Force Base, some areas were contaminated by various toxic and/or hazardous compounds. In response, a number of environmental restoration programs have been initiated at the Base. In addition, ongoing efforts to comply with applicable laws and regulations ensure that present waste and resource management practices are carried out in a manner that protects human health and the environment.

Ellsworth AFB was activated in 1942. It is in western South Dakota, about 5 miles east of Rapid City and 1 mile north of Interstate 90. The mission of Ellsworth AFB has been to maintain a combat-ready force capable of long-range bombardment operations. To support this mission, quantities of petroleum, oils, and lubricants, solvents, and protective coatings have been used, with resultant wastes generated.

On August 30, 1990, Ellsworth AFB was placed on the National Priorities List (NPL), which brought it under the federal facility provisions of Section 120 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This action required the USAF to enter into a Federal Facilities Agreement (FFA) with the US Environmental Protection Agency (EPA) and the State of South Dakota to conduct base environmental restoration efforts. The FFA became effective April 1, 1992. The FFA requires compliance with the National Oil and Hazardous Substances Pollution Contingency Plan, CERCLA guidance and policy, RCRA guidance and policy, and applicable state law. The DENR Ground Water Quality Program has dedicated staff to oversee the Ellsworth AFB cleanup.

Contaminated areas have been subdivided based on the average concentration of hazardous substance, pollutants, or contaminants present. Several areas contain confirmed concentrations of released substances, primarily chlorinated solvents and jet fuel, above risk-based or standard-based action levels. To date, remedial investigations, risk assessments, feasibility studies, and remedial actions are complete at 12 Superfund Operable Units (OUs). Additional work is required east of the Base where chlorinated solvent releases have impacted private drinking water wells. The Air Force has provided an alternative source of drinking water to affected residents.

Long term monitoring is being conducted at nine Superfund OUs and three state lead sites to determine the effectiveness of the remedial actions. The remedial action at five sites consists of a pump and treat system. The remaining OUs are either inactive landfills or burn areas in which the remedial action was design and construction of a cover. In addition, small quantities of low-level radioactive waste were located and removed at two OUs. Chemical warfare agent test kits were also discovered in a radioactive waste burial pit and removed from the Base.

E. OPEN PIT MINING AND HEAP LEACH PROCESSING

The first production scale precious metal open pit mine/heap leach operation began in 1983. This mine is operated by Wharf Resources and is located approximately four miles west of Lead, South Dakota, in the northern Black Hills. This operation was followed in 1988 by Brohm Mining Corporation's Gilt Edge Mine (permitted in 1986) which is located approximately four miles southeast of Lead. In the same year, the Richmond Hill Mine (permitted in 1988) opened. The mine, now owned by LAC Minerals, Inc., is located approximately six miles northwest of Lead. In late 1989, the Golden Reward Mining Company, L.P. started heap leach operations at its Golden Reward Mine (permitted in June 1988). This mine is located approximately two miles southwest of Lead and is now owned by Wharf Resources.

These operations typically consist of open pit mines from which ore and waste rock are excavated; many haul and access roads; low grade ore, and topsoil stockpiles; spent ore and waste rock disposal areas; office/shop buildings; crushers to reduce ore to leachable size; and ore processing areas which consist of a processing plant, leach pads, and process ponds.

All leach pads and the bulk of process ponds used in heap leach operations have been designed or retrofitted to double liner systems (sometimes tertiary liners). A double lined system typically consists of a primary liner of high density polyethylene (HDPE) or asphalt (leach pad only), a leak detection, collection, and recovery system (drainage layer), a composite secondary liner of HDPE, polyvinyl chloride (PVC), or asphalt (leach pad only), and clay or low permeability soil. In 1996, operators began using geosynthetic clay liners to replace traditional soil liners. Since 1988, the State of South Dakota has mandated through permit conditions that the primary liners of pads and ponds meet site specific performance standards or action leakage rate (ALR) schedules. The ALR schedule is a system of actions that must be performed in response to different leakage rates through a primary liner. Typically, leakage rates and corresponding actions range from 0 to 20 gallons per acre per day (gpad) and no response, to over 500 gpad and shutdown of a pad or pond. The operators are also required to submit a detailed leakage response action plan. This plan describes corrective measures and monitoring in response to leakage through a primary liner. Monitoring of the leak detection, collection, and recovery system occurs at a minimum of once per week or more depending on leakage rates.

At Wharf Resources, the processing area consists of four leach pads with double geomembrane liners placed over a clay liner for ore processing; a clay, hypalon, and double HDPE lined pregnant pond; clay, hypalon, and HDPE lined barren and overflow ponds; a clay, PVC, hypalon, and HDPE-lined neutralization pond, and a HDPE and clay-lined contingency pond. Wharf has retrofitted two of the older leach pads to include the double liner technology. They have switched from permanent, one time use leach pads to on-off load leach pads. On-off loading entails leaching the ore, neutralizing the ore until required standards are met, and then off loading the neutralized spent ore into a managed depository. The pregnant, neutralization, barren, and overflow ponds were also retrofitted with additional HDPE liners to improve the integrity of these ponds. In 1997, Wharf installed a new 80-mil HDPE primary liner on its Overflow Pond. In 1995, Wharf lined its contingency pond with a single HDPE liner, and in 1997 added a second (new primary) liner to this pond making it a double lined pond. In the next few years, Wharf plans to put new primary liners on its Neutralization Pond and Barren Pond. Wharf's present operation encompasses approximately 972 acres, including the 279-acre expansion area permitted in 1998.

The processing area for Brohm Mining consists of a single on-off load leach pad with a very low density polyethylene (VLDPE) primary liner, an asphalt secondary liner and a HDPE/soil composite tertiary liner for ore processing; and surge, neutralization, and diatomaceous earth ponds lined with HDPE primary and HDPE/soil composite secondary liners. In 1996, Brohm was granted a new permit to expand its operation. The leach pad was expanded by 8 acres and a stormwater pond was constructed. The pad expansion and pond has a HDPE primary and HDPE/geosynthetic clay composite secondary liner. In 1997, Brohm again expanded this leach pad by an additional 6 acres, using a liner design similar to the 1996 expansion. Brohm is permitted to affect approximately 564 acres at the operation.

The processing area for LAC Minerals, Inc.'s Richmond Hill Mine consists of three permanent single-use leach pads with an HDPE primary and an asphalt emulsion/clay secondary liner for ore processing; barren, pregnant and chlorine ponds with HDPE primary and HDPE/clay secondary liners; and a stormwater pond with an HDPE primary and clay secondary liners. In 1996, LAC Minerals began closure of its pads, completing the project in 1997. The pads were capped with a soil liner to minimize infiltration. LAC Minerals is permitted to affect approximately 439 acres.

The processing area for Golden Reward consists of a single on-off load leach pad with an asphalt primary and PVC/clay composite secondary liner for ore processing; and surge, detoxification, and PMP ponds with HDPE primary and HDPE/clay composite secondary liners. Golden Reward uses a stacker conveyor system for loading the leach pad instead of haul trucks that are used at other operations. However, haul trucks have replaced a mechanical reclaimer in unloading spent ore from the leach pad. Beginning in late 1996, Golden Reward placed the mine under temporary cessation. The period of temporary cessation will last until 2001 unless Golden Reward resumes production, asks for a five-year extension, or reclaims the mine site. The process area will be maintained on a standby basis. Golden Reward is permitted to affect approximately 493 acres at this operation.

One primary concern related to heap leach operations is the potential that exists for surface and groundwater contamination. Potential contaminants include cyanide, metals, and other chemical constituents related to the processing cycle, acid mine drainage and metals related to pyrite oxidation in waste rock and pit highwalls, and sediment loads from land disturbing activities. Water quality at the various operations is monitored by several different systems. Surface water quality is monitored quarterly at a series of monitoring stations located on streams and springs surrounding the mine operations. Ground water monitoring wells measuring shallow and deep aquifers are positioned around the processing facility. These wells are sampled monthly or quarterly for cyanide, heavy metals, and other conventional water quality parameters.

There was one instance in 1991 when cyanide leaked from a mining facility. In June 1991, a leach pad at Brohm Mining's heap leach facility leaked when solution rose above a point where process pipes penetrated a lined berm surrounding the pad. This pad was designed to hold excess stormwater and process solution. Upon detection, excess solution was removed from the pad and a monitoring program was initiated. Also, contaminated soils and water were detoxified to ambient conditions and the pipe penetration was eliminated. Additional methods of treating and safely disposing of excess solution were also put in place at the mine. Two Notices of Violation and a penalty of $99,800 were issued to Brohm Mining for the leak incident.

In 1995, Wharf Resources discharged inadequately treated cyanide solution into a tributary of Annie Creek. This discharge resulted in a fish kill in Annie Creek. The discharge ended upon discovery of the problem and Wharf subsequently changed its treatment process to avoid out-of-compliance discharge. Two Notices of Violation were issued, and Wharf agreed to a settlement of $150,000.

Acid mine drainage became a major concern at LAC Minerals' Richmond Hill mine and Brohm's Gilt Edge mine in the early 1990's. Acid drainage was detected draining from waste rock dumps and pit areas at both mines. The acid drainage was the result of sulfide mineral (pyrite) oxidation contained in the waste rock and mine pits. Both companies were required to submit mitigation plans as mine permit amendment applications. LAC Minerals' amendment was approved in February 1994, and Brohm's was approved in March 1995. LAC Minerals hauled acid producing waste rock from the waste rock dump to backfill the pit and capped the backfilled pit. This backfilling and capping project was completed in 1995 and has performed exceptionally well, resulting in the project becoming an internationally known case history of successful reclamation of an acid mine drainage problem. Reclamation and capping of the leach pads at LAC was completed in 1997. As a result of the acid drainage problem, LAC's reclamation bond was increased from $1.1 million to $10.7 million. Brohm's bond was increased from $1.2 million to $13 million. However, neither Brohm or its parent company had the assets to post the full bond amount. The best the state could get out of Brohm was an additional $5 million in cash and a promissory note for the remainder.

Several other concerns related to open pit heap leach operations include potential impacts to wildlife, nearby residential and recreational areas, and the local economy and government. Additionally, the cumulative impact of several such operations may be greater than the impact from a single operation. In response to these concerns, the State of South Dakota adopted new mining regulations in 1988. These regulations address the filing and review of mine permit applications and amendments, permit transfers, reclamation of mill sites, procedures for determining reclamation types, minimum reclamation standards, concurrent reclamation, and temporary cessation.

In 1989, legislation was passed that addresses cumulative impacts of mining and unique and scenic lands designation. Cumulative impacts from open pit heap leach gold mines in the Black Hills were studied in a Cumulative Environmental Evaluation (CEE). This study was funded by large-scale gold producers and was completed in December 1990.

Following completion of the CEE, a governor-appointed task force developed recommendations for additional requirements to address concerns related to heap leach mining. The task force's work resulted in several new laws as follows:

- Heap leach gold mines in the Black Hills were limited to 6,000 acres of total land disturbance,

- 500 acres of surface mining disturbed land were to be reclaimed by September 1, 1997,

- No new permits or amendments to existing permits for large-scale gold mines would have been issued after this date until 500 acres have been reclaimed,

- Post closure plans and bonds would be required for mining operations, and

- New annual reporting requirements were established for large-scale gold mining and mineral exploration.

In July 1997, the Board of Minerals and Environment conducted a review of the state reclamation standards for large-scale surface gold mines and inspected reclamation efforts at the five major surface gold mines. The board found that the existing South Dakota reclamation standards are effective.

An initiative approved by voters in November 1992 placed additional acreage limitations on large-scale heap leach gold mines. Expansions of existing large-scale gold and silver operations are now limited to 200 acres of surface mined disturbed land per each individual mine permit. New operations are allowed to affect up to 320 acres of surface-mined disturbed land. Operators can expand beyond these limits if they reclaim an acre of land for every acre of expansion; agree not to disturb an equal amount of permitted affected land; or agree to reclaim previously disturbed land inside or outside a permit boundary area. Reclamation acreage credit can be reassigned from one large-scale gold or silver operator to another.

Wharf Resources submitted a permit application in late 1996 for an expansion area located immediately to the east of its current operations. It is estimated approximately 279 acres will be affected by this new operation. The application was approved by the Board of Minerals and Environment in May 1998. There are currently no mine permit applications pending for large-scale gold mines, and none are expected in the foreseeable future. One reason for this is the current low gold prices.

Whitewood Development Corporation, a fully owned subsidiary of Homestake Mining Co., was working on a large-scale permit application to mine and reprocess approximately 10 million tons of old mill tailings deposited along Whitewood Creek. The deposits are located north of Whitewood, South Dakota, and downstream along Whitewood Creek to the Belle Fourche River confluence. Plans were to place tailings on a heap leach pad in a manner similar to a conventional heap leach operation.

Goldstake Mining, a partner in the Whitewood Creek project, sued Whitewood Development (Homestake) regarding Whitewood Development's failure to develop the project as specified in its contractual agreement. Goldstake was successful in its suit. The arbitrator in the case ruled in early 1995 that Whitewood Development must proceed with acquiring a mining permit for the project. However, in September 1997, Homestake announced it was suspending permitting activities for the project. Homestake, through its subsidiary, Whitewood Development, planned to take Goldstake to arbitration over the project, claiming that Goldstake is not fulfilling its obligations to the partnership. There is no current activity related to this project.

Brohm Mining Co. submitted an application in May 1995, to mine its Anchor Hill Project, near their present mine. The mine was to provide the cash flow and low sulfide waste rock needed to reclaim the Gilt Edge mine. Since part of this proposed mine area is on US Forest Service administered lands, an environmental impact statement was required. In January 1996, the state granted a permit to mine on private lands with conditions to increase the cash reclamation bond. Due to delays in obtaining US Forest Service approval to allow expansion onto public lands, Brohm temporarily suspended mining operations beginning August 27, 1997.

The US Forest Service Record of Decision approving the Anchor Hill Project was signed in early November 1997. Several parties, including citizens, environmental groups, and Indian tribes, appealed the Record of Decision. On February 18, 1998 the US Forest Service rescinded its approval to correct parts of the environmental impact statement. In July 1998, the Forest Service issued a new Record of Decision approving the expansion onto public lands. In September, *Earthlaw,* a nonprofit legal organization, appealed the decision on behalf of several parties. On October 29, 1998, the Forest Service denied the *Earthlaw* appeal. However, at about this same time, *Earthlaw* filed a lawsuit against Brohm alleging violations of the Federal Clean Water Act. This lawsuit was settled in spring 1999. However, due to continued delays, low gold prices, and severe financial difficulties, Dakota Mining (Brohm's parent company) declared bankruptcy in July 1999. After the bankruptcy, Governor Janklow authorized the Department of Environment and Natural Resources to begin paying for site maintenance and water treatment to avert a potential discharge of acid water stored in the mine pits. Funding is being provided at a rate of approximately $100,000 per month from the Regulated Substance Response Fund. Final reclamation, including capping of the waste rock disposal facility, is slated to begin during 2000.

The Naneco Minerals, Inc. (formerly Minerva Explorations) proposed Ragged Top Project may involve up to 120 acres of affected land. An existing large-scale mining permit for this area was transferred from Homestake Mining Company to the then Minerva Explorations, Inc. in September 1991. No mining has been conducted at the site to date. The permit does not allow on-site processing, obligating Naneco to ship ore to another facility for processing. In September 1993, the Lawrence County Commission revoked Naneco's Conditional Use Permit (CUP) that was originally issued in 1984. The Commission decided the CUP was invalid, as Naneco did not initiate mining at the site in a timely fashion. Before Naneco can begin operations at the site, it will need to obtain a new county CUP.

Golden Reward placed its mine under temporary cessation in 1995. The period of temporary cessation will last until 2001 unless Golden Reward resumes production, asks for a five-year extension, or reclaims the mine site. During the period of temporary cessation, Golden Reward continues maintenance and reclamation activities at the mine site.

F. ON-SITE WASTEWATER DISPOSAL SYSTEMS

Individual and Small On-site Waste-water Treatment Systems

South Dakota has 292,436 housing units throughout the state, according to the 1990 Bureau of the Census report. At least 25% of these households utilize on-site wastewater treatment systems for their sewage disposal needs. For the majority of these households, there is no alternative to an on-site system for treating their wastewater. This can be credited to the rural setting that exists throughout the state.

An on-site wastewater treatment system typically consists of a septic tank for removing solids, and a series of absorption trenches for treatment of septic tank effluent. If these systems are properly constructed and if they are constructed in a proper location, they are a reliable and sanitary method of treating wastewater.

In February 1975, regulations entitled, ARSD 34:04:01 "Private Sewage Disposal Systems" were put into effect to ensure that the on-site systems were installed properly. These regulations remained unchanged until July 18, 1985, when the majority of the requirements were revised. The revisions include design improvements for every component of an on-site wastewater treatment system. The new regulations are entitled, ARSD 74:53:01 "Individual and Small On-site Wastewater Systems".

New on-site wastewater treatment systems constructed anywhere in South Dakota must comply with all of the requirements listed in the regulations. These are minimum standards, although counties may develop more stringent requirements. The Department of Environment and Natural Resources (DENR) is the agency responsible for reviewing on-site systems for compliance with the regulations. DENR must receive detailed plans and specifications of unconventional systems (as defined in the regulations) to review and approve prior to construction. Mound systems or evapotranspiration systems must also have plans reviewed and approved by DENR prior to construction. Conventional systems may be constructed without having plans approved by DENR, however, some counties require their approval for conventional systems. From October 1997 to October 1999 there were 98 on-site treatment systems approved by DENR. There were also numerous systems that were reviewed, but not approved by DENR.

If an existing system or a new system is improperly constructed and it causes sewage to surface or pollute waters of the state, the regulations contain criteria that are easily interpreted for enforcement purposes. The enforcement of the regulatory requirements is currently managed on a complaint basis. Once a complaint is received, an inspection is conducted. If it is determined that the system is a problem, DENR personnel try first to work with the homeowner. If the problem cannot be resolved, enforcement actions can be undertaken in cooperation with the Attorney General's Office. Approximately fifty complaints were received and investigated by DENR during the present reporting period.

One other activity associated with on-site wastewater systems, is the performance of technical assistance for any interested party. The majority of the technical assistance activities are simply carried out as phone conversations, but occasionally involve discussions with large groups. Technical assistance normally involves interpreting the regulatory requirements for a variety of people, including engineers, contractors, private citizens, government employees, and others.

Improperly constructed on-site wastewater systems can present a very serious health and pollution hazard. The comprehensive regulations that the state has adopted allows DENR to eliminate and prevent the unhealthy conditions resulting from the inadequate systems that occasionally are constructed.

DENR has found that installers were not always aware of the construction requirements. A certification program for installers was established in 1990 to improve the quality of system construction.

To become certified the installer must successfully pass an examination which tests his/her knowledge of the construction requirements. The exam consists of an open book test which encourages the use of the construction regulations to answer test questions, in much the same way the installer should use the regulations when designing and constructing an on-site system. As of October 1999, 608 installers are certified and 229 of those became certified during this reporting period.

G. FEEDLOT PROGRAM

In accordance with the Federal Clean Water Act, the United States Environmental Protection Agency adopted regulations that created the National Pollutant Discharge Elimination System (NPDES) Program to control pollution from point sources. Feedlot operations are defined as point sources of pollution by these regulations. The specific requirements for feedlots are located in the *Code of Federal Regulations* at 40 CFR 122.23 and Appendix B to Part 122. The state has adopted identical regulations which are found in the Administrative Rules of South Dakota, Chapter 74:52:02 - Application requirements. The authority to administer the NPDES Program was delegated to the state on December 30, 1993.

In 1996, several large pork producers were looking at locating swine feeding operations in South Dakota. To ensure appropriate environmental controls were in place to address new and expanding swine units, the department worked with the people of South Dakota to develop a general permit containing all the requirements necessary to protect the state's ground water and surface water resources. This permit became effective February 1, 1997.

Shortly after the first permit was implemented, the South Dakota Department of Agriculture asked DENR to develop a second general permit that would apply to all other types of livestock feeding operations. This permit became effective February 10, 1998. These two permits establish the environmental standards that a producer must meet in order to design, construct and operate a livestock confinement operation in South Dakota.

Producers need a permit if:

- They have a new or expanding livestock confinement operation with 1,000 animal units or more;
- Their operation, regardless of size, is required to obtain approval by a local government entity – such as a county commission; or
- Their operation, regardless of size, when DENR determines permit coverage is necessary to ensure protection of the state's water resources.

Equivalent - 1,000 Animal Units
- 1,000 slaughter or feeder cattle;
- 700 mature dairy cattle;
- 2,500 finisher swine;
- 10,000 nursery swine;
- 2,130 production sows;
- 270-sow farrow to finish unit;
- 500 horses;
- 10,000 sheep or lambs;
- 30,000 chickens;
- 55,000 turkeys;
- 5,000 ducks;
- 5,000 geese; or

a combination of animals totaling 1,000 animal units

The permit process begins when a producer submits an application to DENR for general permit coverage. The permit application must include a Certification of Applicant form, plans and specifications signed and stamped by a South Dakota licensed engineer, a signed operation and maintenance guideline, and a nutrient management plan. Following DENR's review and approval of the permit application, construction of the manure management system can begin. The department must be notified when construction begins to allow for construction inspections required by the state rules. The project engineer must submit a Notice of Completion to DENR when construction of the manure management system is completed. A Certificate of Compliance and permit coverage is then issued by DENR, allowing the facility to begin operation.

These permits were supplemented by legislative actions.

- In 1997, legislation was passed that covered four area

  - First, one new law requires additional permitting requirements for any new livestock confinement operations constructed over shallow aquifers.

  - A second law required regulated livestock confinement operations to pay an annual fee to be used for defraying the cost of the regulated concentrated animal feeding operations program.

  - A third law required DENR to develop new rules that established an inspection and enforcement program.

  - Finally, the fourth law strengthened the state's regulatory program regarding livestock confinement operations in South Dakota.

- In 1998, legislation was passed that covered two areas.

  - First, one law gives the state the ability to hold owners of livestock liable for environmental pollution in cases where the owners negligently entrust their livestock.

  - The second law established an environmental cleanup fund for spill and releases from animal feeding operations.

With these regulatory tools in place, DENR is able to address the new, larger types of livestock feeding operations being built today to prevent any serious environmental problems that may result from them.

VI.
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REFERENCES CITED

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VII.

KEY TO ABBREVIATIONS

KEY TO ABBREVIATIONS

ACP - Agricultural Conservation Program
AGNPS - agricultural nonpoint source computer model
ALR - action leakage rate
ARSD - Administrative Rules of South Dakota
ASCS - Agricultural Stabilization and Conservation Service
AST - aboveground storage tank
AWMS - animal waste management systems
BMP - best management practice
CDBG - Community Development Block Grant
CEE - cumulative environmental evaluation
CEPA - Centennial Environmental Protection Act
CERCLA - Comprehensive Environmental Response Compensation and Liability Act
CERCLIS - Comprehensive Environmental Response Compensation and Liability Info. System
CES - Cooperative Extension Service
CFR - Code of Federal Regulations
CM&E (CME) - comprehensive monitoring and evaluation
COE - United States Army Corps of Engineers
CRG - Conservation Review Group
CRP - Conservation Reserve Program
CUP - conditional use permit
CWA - Clean Water Act
CWFCP - Consolidated Water Facility Construction Program Funds
DENR - Department of Environment and Natural Resources
DO - dissolved oxygen
EIS - environmental impact statement
EPA - Environmental Protection Agency
FERC - Federal Energy Regulatory Commission
FIFRA - Federal Insecticide, Fungicide, Rodenticide Act
FmHA - Farm Home Loan Administration
FOTG - field office technical guide
gpad - gallons per acre per day
GIS - Geolographical Information System
GPCP - Great Plains Conservation Program
GWQP - Ground Water Quality Program
HDPE - high density polyethylene
HU - hydrologic unit
IWG - Interagency Wetlands Group
LTHA - Life Time Health Advisory
LUST - leaking underground storage tank
MCL - maximum contaminant level
MOU - memorandum of understanding
NMP - National Municipal Policy
NPDES - National Pollutant Discharge Elimination System
NPS - nonpoint source
NRCS - Natural Resources Conservation Service (formerly SCS)
PL - public law

PMP - probable maximum precipitation pond
PVC - polyvinyl chloride
PWS - public drinking water system(s)
QA - quality assurance
QC - quality control
RC&D - Resource Conservation and Development Program
RCRA - Resource Conservation and Recovery Act
RCWP - Rural Clean Water Program
RMS - Resource Management System
SARA - Superfund Amendments and Reauthorization Act of 1986
SCEPA - Second Century Environmental Protection Act
SCS - Soil Conservation Service
SDACD - South Dakota Association of Conservation Districts
SDCL - South Dakota Codified Law
SDCLG - South Dakota Council of Local Governments
SDDA - South Dakota Department of Agriculture
SDEPA - South Dakota Environmental Protection Act
SDGF&P - South Dakota Department of Game, Fish and Parks
SDGS - South Dakota Geological Survey
SDWAG - South Dakota Wetlands Advisory Group
SDWPCA - South Dakota Water Pollution Control Act
SEA - State/EPA Agreement
SMP - State Management Plan
SOC - semivolatile organic compound
SRF - State Revolving Fund
STORET - EPA computer data storage and retrieval system
SWD - Surface Water Discharge program
TDS - total dissolved solids
TMDL - Total Maximum Daily Load
TRE - toxicity reduction evaluation
TSI - Carlson's (1977) Trophic State Indices
TSS - total suspended solids
UIC - underground injection control
USDA - United States Department of Agriculture
USEPA - United States Environmental Protection Agency
USFS - United States Forest Service
USFWS - United States Fish and Wildlife Service
USGS - United States Geological Survey
UST - underground storage tank
VLDPE - very low density polyethylene
VOC - volatile organic compound
WHP - wellhead protection
WQIP - water quality initiative projects
WQM - ambient water quality monitoring
WQS - water quality standards
WQSP - water quality special project
WWTF - wastewater treatment facility

APPENDICES

APPENDIX A

Surface Water Quality Monitoring Schedule and Sampling Site Description

APPENDIX A

WATER QUALITY MONITORING SCHEDULE

FIELD ANALYSES:

1. Water temperature
2. Air temperature
3. Dissolved oxygen
4. pH
5. Visual observations
6. Water width and depth (where possible)
7. Flow

FREQUENCY SYMBOLS USED FOR WQMS:

Q = Quarterly samples.
M = Monthly samples.
S = Seasonal samples.
B = Semi-annual samples in April and October.

ANALYSES GROUP PARAMETERS:

1. Ammonia, Conductivity, Hardness, Alkalinity, Total Phosphorous, Dissolved Phosphorous, Total Suspended Solids, Total Solids, Nitrate-Nitrite, Total Kjeldahl Nitrogen, Sodium, Sulfates, Chlorine, (Calcium, Magnesium, May-August) (Fecal Coliforms, May-September)

2. Ammonia, Conductivity, Hardness, Alkalinity, Total Phosphorous, Dissolved Phosphorous, Total Suspended Solids, Total Solids, Nitrate-Nitrite, Total Kjeldahl Nitrogen, (Sodium, Calcium, Magnesium, May-August) (Fecal Coliforms, May-September)

3. Ammonia, Conductivity, Hardness, Alkalinity, Total Phosphorous, Dissolved Phosphorous, Total Suspended Solids, Total Solids, Nitrate-Nitrite, Total Kjeldahl Nitrogen, (Fecal Coliforms, May-September)

4. Ammonia, Conductivity, Hardness, Alkalinity, Total Phosphorous, Dissolved Phosphorous, Total Suspended Solids, Total Solids, Nitrate-Nitrite, BOD_5, Total Kjeldahl Nitrogen, (Sodium, Calcium, Magnesium, May-August) (Fecal Coliforms, May-September)

5. Ammonia, Conductivity, Alkalinity, Total Phosphorous, Dissolved Phosphorous, TotaSuspended Solids, Total Solids, Nitrate-Nitrite, Total Kjeldahl Nitrogen, Hardness, Total Cadmium, Dissolved Cadmium, Total Copper, Dissolved Copper, Total Zinc, Dissolved Zinc, Total Chromium, Dissolved Chromium, Total Lead, Dissolved Lead, Total Mercury, Dissolved Mercury, Total Nickel, Dissolved Nickel, Total Silver, Dissolved Silver, Total Arsenic, Dissolved Arsenic, Total Cyanide, WAD Cyanide, (Fecal Coliforms, May-September)

South Dakota Water Quality Monitoring Sites
Revised through September 30, 1999

STATION	STORET ID	WATERBODY	LOCATION	COUNTY	BASIN	FREQUENCY	ANALYSIS GROUP

Black Hills Region Sites

STATION	STORET ID	WATERBODY	LOCATION	COUNTY	BASIN	FREQUENCY	ANALYSIS GROUP
MN 31	46MN31	Annie Creek	Elmore	Lawrence	Belle Fourche	Quarterly	5
WQM 103	460103	Battle Creek	Keystone	Pennington	Cheyenne	Quarterly	3
WQM 17	460905	Battle Creek	Hayward	Pennington	Cheyenne	Monthly	3
WQM 125	460125	Bear Butte Creek	Galena	Lawrence	Belle Fourche	Monthly	5
WQM 126	460126	Bear Butte Creek	Galena	Lawrence	Belle Fourche	Monthly	5
WQM 128	460128	Beaver Creek	north-south gravel road bridge near Burdock, 2 miles above confluence with Cheyenne River	Fall River	Cheyenne	Quarterly	3
WQM 129	460129	Belle Fourche River	north-south County Hwy MC-31 (Elm Springs Rd) north of Elm Springs)	Meade	Belle Fourche	Monthly	2
WQM 130	460130	Belle Fourche River	north-south US Hwy 85 bridge in Belle Fourche	Butte	Belle Fourche	Quarterly	2
WQM 21	460880	Belle Fourche River	Sturgis	Meade	Belle Fourche	Quarterly	2
WQM 81	460681	Belle Fourche River	Vale	Butte	Belle Fourche	Quarterly	5
WQM 83	460683	Belle Fourche River	Vale	Butte	Belle Fourche	Quarterly	5
WQM 30	460925	Box Elder Creek	Nemo	Pennington	Cheyenne	Monthly	3
WQM 79	460679	Box Elder Creek	New Underwood	Pennington	Cheyenne	Quarterly	2
WQM 46	460646	Castle Creek	Mystic	Pennington	Cheyenne	Monthly	3
WQM 132	460132	Cheyenne River	north-south SD Hwy 40 bridge east of Red Shirt	Custer	Cheyenne	Monthly	2
WQM 14	460875	Cheyenne River	Edgemont	Fall River	Cheyenne	Quarterly	2
WQM 15	460865	Cheyenne River	Wasta	Pennington	Cheyenne	Monthly	2
WQM 127	460127	Deadwood Creek	Blacktail	Lawrence	Belle Fourche	Monthly	5
WQM 57	460657	Fall River	north-south gravel road bridge just north of US Hwy 18. 5 miles SE of Hot Springs	Fall River	Cheyenne	Quarterly	1
MN 38	46MN38	False Bottom Creek	Maitland	Lawrence	Belle Fourche	Quarterly	5
WQM 119	460119	Fantail Creek	Lead	Lawrence	Belle Fourche	Quarterly	5
WQM 111	460111	Flynn Creek	Bluebell Lodge	Custer	Cheyenne	Quarterly	3
WQM 102	460102	French Creek	Custer	Custer	Cheyenne	Monthly	2
WQM 51	460651	French Creek	Custer	Custer	Cheyenne	Quarterly	3
WQM 53	460653	French Creek	Custer	Custer	Cheyenne	Quarterly	3
WQM 59	460659	Gold Run Creek	Pluma	Lawrence	Belle Fourche	Monthly	5
WQM 50	460650	Grace Coolidge Creek	Custer	Custer	Cheyenne	Quarterly	3
WQM 110	460110	Rapid Creek	Above Rapid City	Pennington	Cheyenne	Monthly	3
WQM 19	460910	Rapid Creek	Farmingdale	Pennington	Cheyenne	Monthly	2
WQM 47	460647	Rapid Creek	Rochford	Pennington	Cheyenne	Monthly	1
WQM 69	460669	Rapid Creek	W Rapid City	Pennington	Cheyenne	Monthly	1
WQM 92	460692	Rapid Creek	Below Rapid City	Pennington	Cheyenne	Monthly	2
WQM 23	460895	Redwater River	Belle Fourche	Butte	Belle Fourche	Monthly	2
MN 32	46MN32	Spearfish Creek	Elmore	Lawrence	Belle Fourche	Quarterly	5

South Dakota Water Quality Monitoring Sites
Revised through September 30, 1999

STATION	STORET ID	WATERBODY	LOCATION	COUNTY	BASIN	FREQUENCY	ANALYSIS GROUP
MN 33	46MN33	Spearfish Creek	Elmore	Lawrence	Belle Fourche	Quarterly	5
MN 34	46MN34	Spearfish Creek	Elmore	Lawrence	Belle Fourche	Quarterly	5
MN 35	46MN35	Spearfish Creek	Maurice	Lawrence	Belle Fourche	Quarterly	5
WQM 22	460900	Spearfish Creek	Spearfish	Lawrence	Belle Fourche	Monthly	3
WQM 89	460689	Spearfish Creek	Belle Fourche	Lawrence	Belle Fourche	Monthly	3
WQM 49	460649	Spring Creek	Rapid City	Pennington	Cheyenne	Quarterly	3
WQM 54	460654	Spring Creek	Sheridan L	Pennington	Cheyenne	Monthly	3
MN 39	46MN39	Squaw Creek	Maurice	Lawrence	Belle Fourche	Quarterly	5
WQM 124	460124	Stewart Gulch	Lead	Lawrence	Belle Fourche	Quarterly	5
WQM 116	460116	Strawberry Creek	Lead	Lawrence	Belle Fourche	Monthly	5
WQM 75	460675	W Strawberry Creek	Pluma	Lawrence	Belle Fourche	Quarterly	3
WQM 42	460842	White River	Oglala	Shannon	White	Quarterly	2
WQM 118	460118	Whitetail Creek	Lead	Lawrence	Belle Fourche	Monthly	5
WQM 122	460122	Whitewood Creek	Deadwood	Lawrence	Belle Fourche	Monthly	5
WQM 123	460123	Whitewood Creek	Deadwood	Lawrence	Belle Fourche	Monthly	5
WQM 52	460652	Whitewood Creek	Whitewood	Lawrence	Belle Fourche	Monthly	3
WQM 82	460682	Whitewood Creek	Above Belle Fourche	Butte	Belle Fourche	Monthly	5
WQM 84	460684	Whitewood Creek	Crook City	Lawrence	Belle Fourche	Monthly	5
WQM 85	460685	Whitewood Creek	Deadwood	Lawrence	Belle Fourche	Quarterly	5
WQM 86	460686	Whitewood Creek	Pluma	Lawrence	Belle Fourche	Quarterly	5

Total Number of Black Hills Region Sites: 54

South Dakota Water Quality Monitoring Sites
Revised through September 30, 1999

STATION	STORET ID	WATERBODY	LOCATION	COUNTY	BASIN	FREQUENCY	ANALYSIS GROUP

Central Region Sites

STATION	STORET ID	WATERBODY	LOCATION	COUNTY	BASIN	FREQUENCY	ANALYSIS GROUP
WQM 29	460850	Bad River	Ft Pierre	Stanley	Bad	Quarterly	4
WQM 131	460131	Cherry Creek	north-south SD Hwy 73 bridge approximately 19 miles south of Faith	Meade	Cheyenne	Quarterly	2
WQM 133	460133	Cheyenne River	north-south SD Hwy 63 bridge NE of Cherry Creek	Haakon	Missouri	Monthly	2
WQM 16	468860	Cheyenne River	Plainview	Haakon	Cheyenne	Monthly	2
WQM 153	460153	Cottonwood Creek	2 miles west and 3 miles north of White River	Mellette	White	Monthly	2
WQM 135	460135	Crow Creek	5 miles west and 1 mile north of Shelby, above Bedashosho Lake	Buffalo	Missouri	Quarterly	2
WQM 138	460138	Grand River	east-west SD Hwy 65 east of Thunder Butte	Corson	Grand	Quarterly	2
WQM 25	460945	Grand River	Little Eagle	Corson	Grand	Monthly	2
WQM 40	460640	Grand River	Shadehill	Perkins	Grand	Quarterly	2
WQM 77	460677	Grand River, N Fork	Shadehill	Perkins	Grand	Quarterly	2
WQM 139	460139	Grand River, S Fork	north-south US Hwy 85 south of Buffalo	Harding	Grand	Quarterly	2
WQM 78	460678	Grand River, S Fork	Bison	Perkins	Grand	Quarterly	2
WQM 10	460815	Keya Paha River	Wewela	Tripp	Niobrara	Quarterly	1
WQM 26	460955	Little Missouri River	east-west SD Hwy 20 bridge, on east edge of Camp Creek	Harding	Little Missouri	Quarterly	2
WQM 13	460840	Little White River	White River	Mellette	White	Monthly	2
WQM 141	460141	Medicine Creek	north-south SD Hwy 273 bridge in Kennebec	Lyman	Missouri	Monthly	2
WQM 142	460142	Medicine Knoll Creek	north south bridge at Canning	Hughes	Missouri	Quarterly	2
WQM 71	460671	Missouri River	Oahe powerhouse	Hughes	Missouri	Quarterly	2
WQM 72	460672	Missouri River	Big Bend powerhouse	Buffalo	Missouri	Quarterly	2
WQM 143	460143	Moreau River	SD Hwy 65 bridge NE of Dupree	Ziebach	Moreau	Quarterly	2
WQM 24	460935	Moreau River	Whitehorse	Dewey	Moreau	Monthly	2
WQM 39	460039	Moreau River	Usta	Perkins	Moreau	Quarterly	2
WQM 144	460144	Moreau River, S Fork	east-west Zeona Rd bridge approximately 8 miles south of Zeona	Perkins	Moreau	Quarterly	2
WQM 155	460155	Spring Creek	east-west 106th Street bridge 3 miles south and 3 miles east of Pollock	Campbell	Missouri	Monthly	2
WQM 147	460147	Thunder Butte Creek	north-south SD Hwy 73 bridge 14 miles east and 10 miles south of Bison	Perkins	Moreau	Quarterly	2
WQM 11	460835	White River	Kadoka	Jackson	White	Monthly	2
WQM 12	460825	White River	Oacoma	Lyman	White	Monthly	2
WQM 152	460152	White River	north-south US Hwy 83 bridge 23 miles south of Murdo	Mellette	White	Monthly	2

Total Number of Central Region Sites: 28

South Dakota Water Quality Monitoring Sites
Revised through September 30, 1999

Northeast Lakes Region Sites

STATION	STORET ID	WATERBODY	LOCATION	COUNTY	BASIN	FREQUENCY	ANALYSIS GROUP
BS08	46BS08	Big Sioux River	east-west SD Hwy 28 bridge 1 mile west of Estelline	Hamlin	Big Sioux	Monthly	1
BSA1	46BSA1	Big Sioux River	north-south gravel road bridge 7 miles south and 2 miles east of Ortley (452 Ave.)	Grant	Big Sioux	Monthly	1
WQM 1	460740	Big Sioux River	Watertown	Codington	Big Sioux	Monthly	1
WQM 55	460655	Big Sioux River	Above Watertown	Codington	Big Sioux	Monthly	2
WQM 136	460136	Elm River	north-south US Hwy 281 bridge NE of Westport	Brown	James	Monthly	2
WQM 112	460112	James River	Above Columbia	Brown	James	Monthly	2
WQM 113	460113	James River	Above Columbia	Brown	James	Monthly	2
WQM 140	460140	James River	east west US Hwy 212 bridge 1 mile west of Frankfort	Spink	James	Monthly	2
WQM 33	460733	James River	Columbia	Brown	James	Monthly	2
WQM 34	460734	James River	Stratford	Brown	James	Quarterly	2
WQM 6	460805	James River	Hecla	Brown	James	Monthly	2
WQM 45	460645	Lac Qui Parle River, W Br	Gary	Deuel	Minnesota	Seasonal	3
WQM 27	460710	Little Minnesota River	Peever	Roberts	Minnesota	Quarterly	3
WQM 95	460695	Mocassin Creek	Aberdeen	Brown	James	Monthly	3
WQM 94	460694	Moccasin Creek	Aberdeen	Brown	James	Monthly	3
WQM 145	460145	Mud Creek	east-west County Hwy 2 bridge 5 miles south of Stratford	Spink	James	Quarterly	2
WQM 146	460146	Snake Creek	north-south US Hwy 281 bridge 5 miles north of Redfield	Spink	James	Quarterly	2
WQM 148	460148	Turtle Creek	east-west SD Hwy 26 bridge 3 miles south and 4 miles west of Redfield	Spink	James	Quarterly	2
WQM 28	460700	Whetstone River	Big Stone City	Grant	Minnesota	Quarterly	3
WQM 90	460690	Whetstone River, S Fork	Above Milbank	Grant	Minnesota	Quarterly	3
WQM 91	460691	Whetstone River, S Fork	Below Milbank	Grant	Minnesota	Quarterly	3
WQM 151	460151	Wolf Creek	north-south bridge on Hand-Spink County line (374 Ave.)	Hand	James	Quarterly	2
WQM 88	460688	Yellow Bank River, N Fork	Big Stone City	Grant	Minnesota	Seasonal	3
WQM 87	460687	Yellow Bank River, S Fork	Albee	Grant	Minnesota	Seasonal	3

Total Number of Northeast Lakes Region Sites: 24

South Dakota Water Quality Monitoring Sites
Revised through September 30, 1999

Sioux Falls Region Sites

STATION	STORET ID	WATERBODY	LOCATION	COUNTY	BASIN	FREQUENCY	ANALYSIS GROUP
BS 23	46BS23	Big Sioux River	Above SF	Minnehaha	Big Sioux	Monthly	4
BS 29	46BS29	Big Sioux River	Above SF	Minnehaha	Big Sioux	Monthly	4
BS18	46BS18	Big Sioux River	north-south SD Hwy 13 bridge 1.5 miles north of Flandreau	Moody	Big Sioux	Monthly	1
WQM 117	460117	Big Sioux River	Below SF	Minnehaha	Big Sioux	Monthly	4
WQM 2	460702	Big Sioux River	Below Brookings	Brookings	Big Sioux	Monthly	1
WQM 3	460703	Big Sioux River	Dell Rapids	Minnehaha	Big Sioux	Monthly	1
WQM 31	460831	Big Sioux River	Brandon	Minnehaha	Big Sioux	Monthly	2
WQM 32	460832	Big Sioux River	Richland	Union	Big Sioux	Monthly	3
WQM 62	460662	Big Sioux River	Above Brookings	Brookings	Big Sioux	Monthly	1
WQM 64	460664	Big Sioux River	In SF	Minnehaha	Big Sioux	Monthly	4
WQM 65	460665	Big Sioux River	Canton	Lincoln	Big Sioux	Monthly	2
WQM 66	460666	Big Sioux River	Hudson	Lincoln	Big Sioux	Monthly	2
WQM 67	460667	Big Sioux River	Alcester	Union	Big Sioux	Monthly	2
WQM 134	460134	Choteau Creek	east-west road bridge located 7 miles west of Perkins	Bon Homme	Missouri	Quarterly	2
WQM 137	460137	Firesteel Creek	north-south bridge 4 miles north of Mt. Vernon (397 Ave.)	Davison	James	Quarterly	2
WQM 35	460735	James River	Above Huron	Beadle	James	Quarterly	2
WQM 36	460736	James River	Below Huron	Beadle	James	Quarterly	2
WQM 37	460737	James River	Above Mitchell	Davison	James	Quarterly	2
WQM 7	460707	James River	Mitchell	Hanson	James	Quarterly	2
WQM 8	460761	James River	N Yankton	Yankton	James	Monthly	2
WQM 73	460673	Missouri River	Fort Randall powerhouse	Charles Mix	Missouri	Quarterly	2
WQM 74	460674	Missouri River	Gavins Point powerhouse	Yankton	Missouri	Quarterly	2
WQM 121	460121	Skunk Creek	Sioux Falls	Minnehaha	Big Sioux	Quarterly	4
WQM 149	460149	Vermillion River	east-west SD Hwy 44 bridge 3 miles west of Chancellor	Turner	Vermillion	Monthly	2
WQM 4	460755	Vermillion River	Wakonda	Clay	Vermillion	Monthly	2
WQM 5	460745	Vermillion River	Vermillion	Clay	Vermillion	Monthly	2
WQM 150	460150	Vermillion River, E Fork	east-west bridge 10 miles north of Montrose	McCook	Vermillion	Quarterly	2
WQM 154	460154	Vermillion River, E Fork	east-west bridge 3 miles south and 1 mile east of Montrose	McCook	Vermillion	Quarterly	2

Total Number of Sioux Falls Region Sites: 28

Descriptions of Individual River/Stream
WQM Sites available from
DENR, Surface Water Quality Program
on request.
Phone: (605) 773-3351
or
Internet Address:
Http://www.state.sd.us/denr

SDDENR Water Quality Monitoring Sites

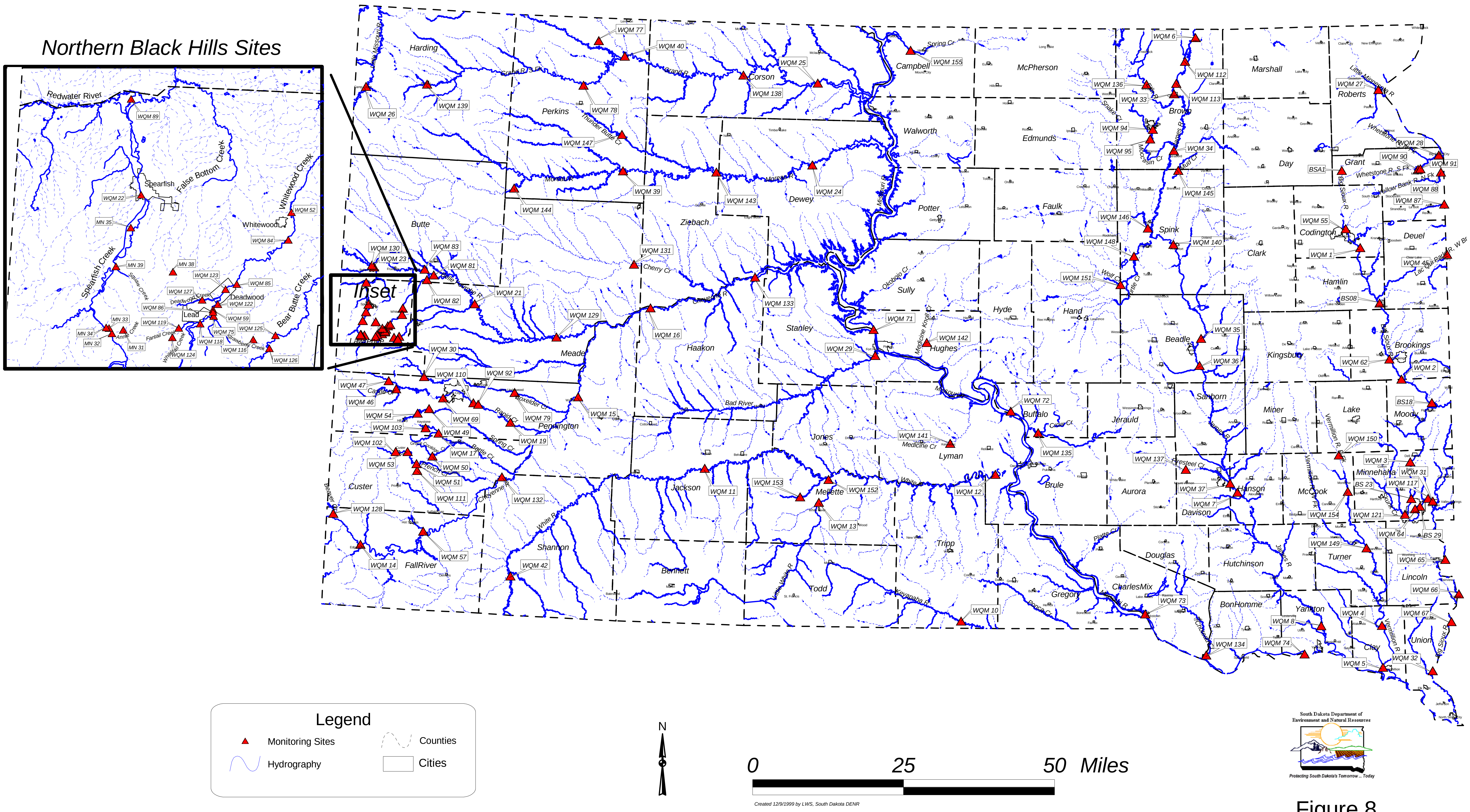

Figure 8

BACK OF FOLDOUT MAP

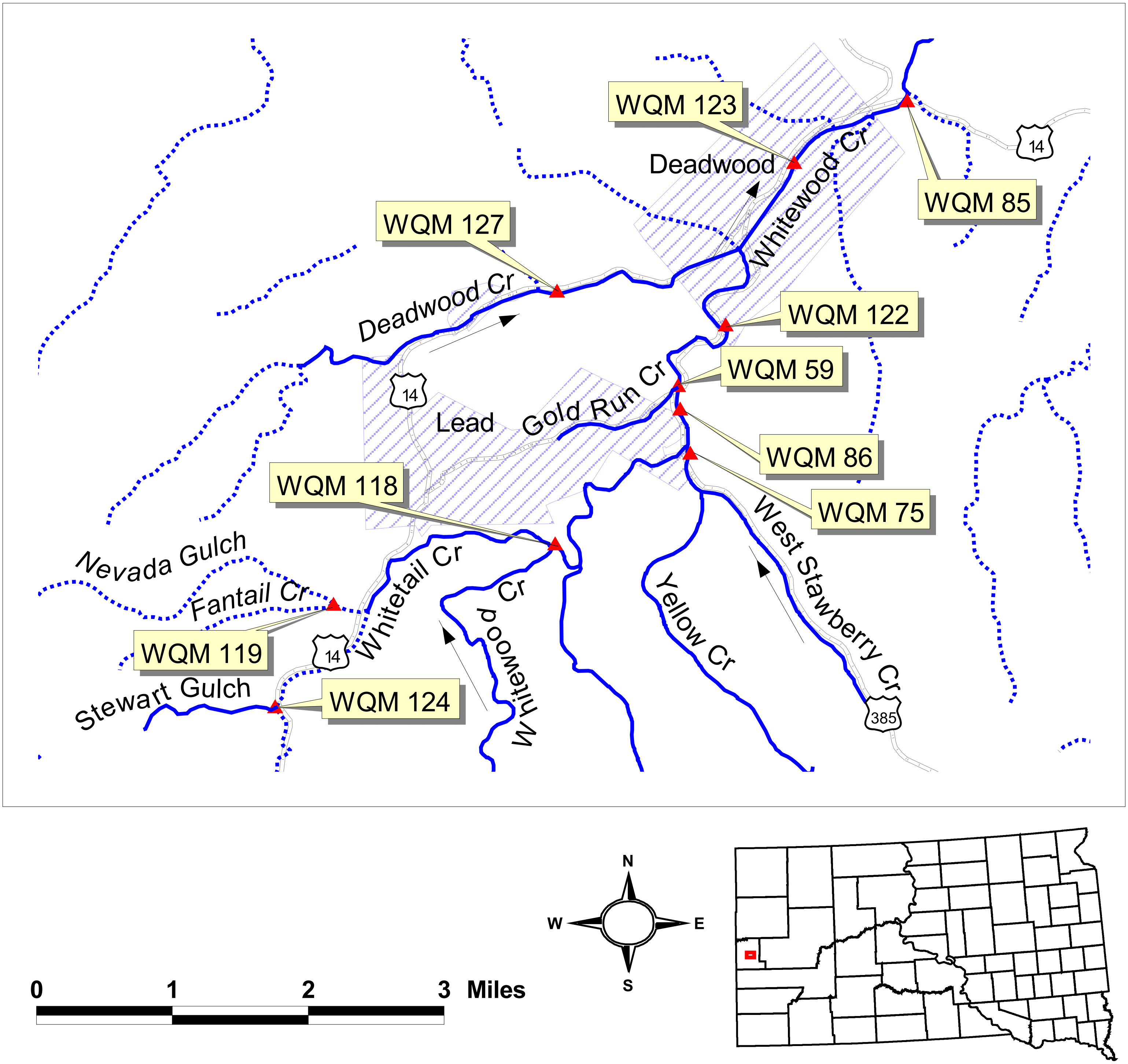

Figure 9. WQM stations located on Whitewood Creek and tributaries in the Lead-Deadwood area

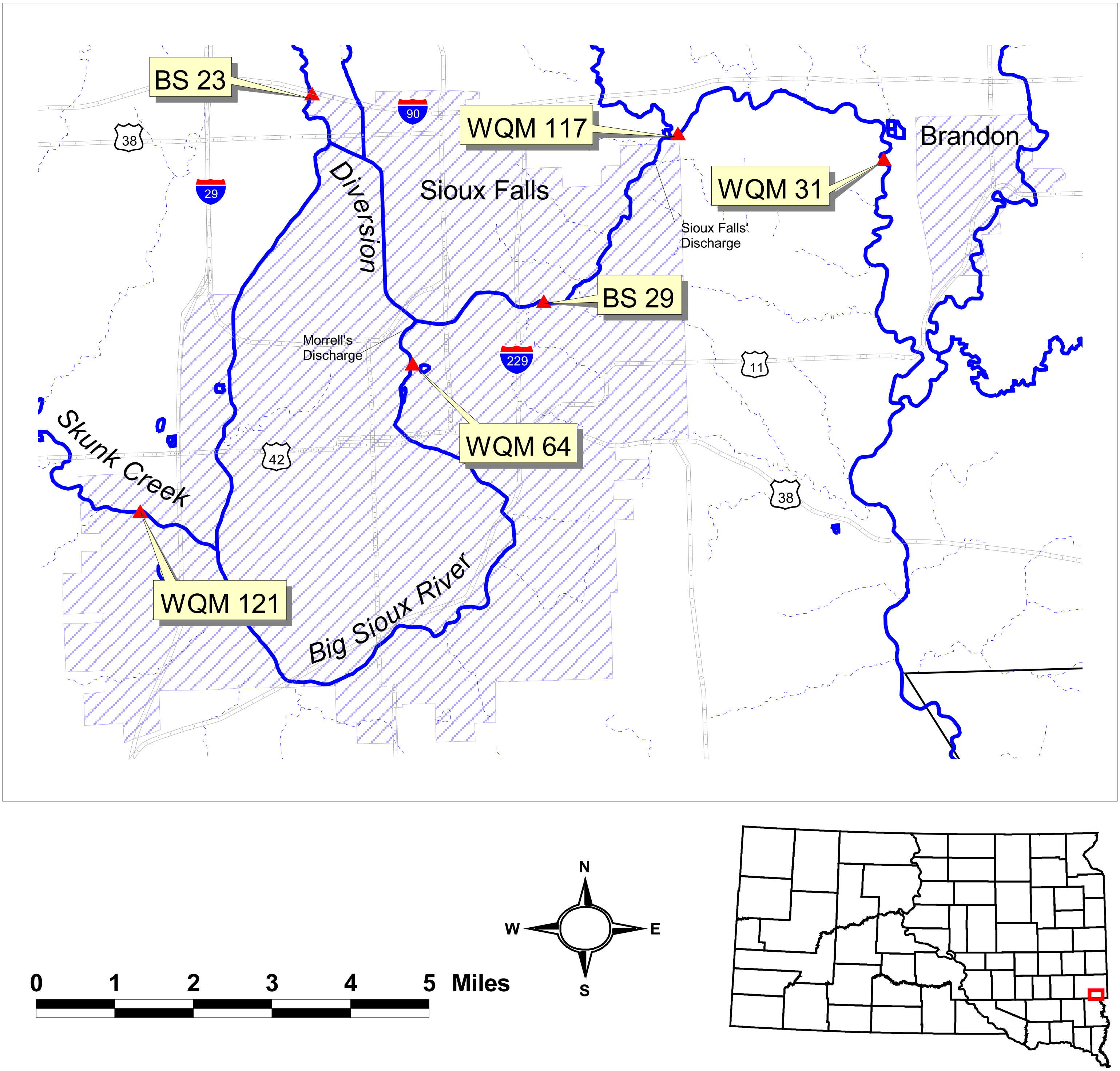

Figure 10. WQM stations located on the Big Sioux River in the Sioux Falls area

APPENDIX B

State Ground Water Program Summary Update

STATE: SOUTH DAKOTA

3 STATE GROUND WATER MANAGEMENT STRUCTURE

3.1 State Statutes Pertaining to Ground Water Quality and Pollution Control

Subject Monitored by Statute	**Statute Name/No.**	**Description of Authority Pertaining to Ground Water Protection**
General water pollution control	SDCL 34A-2 General Water Pollution	Statutes give state authority to regulate pollution monitoring and cleanup of state waters. This includes ground water quality standards, ground water discharge permits and chemigation.
Ground water quality (including public health standards)	SDCL 34A-2 General Water Pollution Control Statutes	Covered under general water pollution control.
Solid waste	SDCL 34-16B	Regulates disposal of solid wastes, outlines monitoring requirements.
Hazardous waste	SDCL 34A-2 SDCL 34A-11	Prohibits toxic and dangerous discharges. Outlines hazardous waste disposal, monitoring and handling.
Mining	SDCL 45-6D SDCL 45-6C SDCL 45-6B SDCL 45-6	Regulates mining activities, including water pollution.
Oil and gas	SDCL 45-9	State authority to permit oil and gas development according to environmentally sound practices.
Other (specify) Underground Storage Tanks Above Ground Storage Tanks	 SDCL 34A-2 SDCL 34A-2	Statutes give state authority to develop regulations for monitoring, corrective action and financial responsibility for underground storage tanks. Above ground storage tank regulations are also in effect for registration, monitoring and corrective action.
Pesticides	SDCL 38-21	Prohibits pesticide handling practices which cause pollution.
Fertilizers	SDCL 38-19	Authority for facility construction and siting. Regulations include preventative measures, leak detection and spill reporting and clean up.

Notes: SDCL refers to South Dakota Codified Law.

3.2. State Ground-Water Policy

3.2.1 Status

	Check
Ground water covered under general state statutes	X
Specific state statutes for ground water	X
Policy in existence for protecting ground water quality	X

STATE: SOUTH DAKOTA

3.2.2. Development of Ground Water Policy
3.2.1.1. Is there a ground water policy or strategy development process? Yes X No _
3.2.2.2. Lead agency: Department of Environment and Natural Resources
3.2.2.3. Describe development process (inter-agency agreements, progress to date, target completion date, etc.):

A state ground water protection strategy was completed in 1987 and is updated as needed. The state has adopted ground water quality classification and standards and ground water discharge permit regulations.

Policies involving specific contamination categories have also been and continue to be implemented. Underground and above ground storage tank regulations include construction, monitoring, and corrective action requirements. The mining and oil and gas regulations also encompass ground water protection.

A comprehensive environmental protection act was enacted in 1989 which included statutory authority for additional ground water protection activities. Activities authorized in CEPA include a wellhead protection program; new domestic well water quality analyses; certification of small on-site wastewater disposal system installers; and agricultural chemical management plan development for ground water quality protection.

The state is developing the Comprehensive State Ground Water Protection Program document describing comprehensive protection efforts in the state. The state Source Water Assessment and Protection program was recently approved by EPA in October of 1999. The South Dakota Source Water Assessment and Protection Program combines elements of the previously approved wellhead protection program with new federal requirements for protecting surface water public drinking water supplies, as well as the additional requirements for potential contaminant source identification and susceptibility analysis. The preparation of Source Water Assessments is currently in progress in South Dakota.

3.2.3. Characteristics of Policy Developed

Type of Protection	Check
General language	
Non-degradation	X
Limited degradation	X
Differential protection	

Notes:

3.2.4. Policy Classification

3.2.4.1. Does state have a ground water classification system or other system for distinguishing among types of ground water (e.g. use, quality, or other contamination potential)? Yes _X_ No

3.2.4.2. If yes, give brief description of classes: The ground water classification system consists of two classes: water that is less than or equal to 10,000 mg/L TDS and water that is greater than 10,000 mg/L TDS. All ground water that has an ambient concentration of 10,000 mg/L or less TDS is to be maintained for the beneficial use of drinking water supplies at the numerical standards or existing water quality whichever is better.

3.2.5. Quality Standards

3.2.5.1. Has the state adopted ground water quality standards? Yes_X_ No _

3.2.5.2. How are the standards used? The standards are used to control ground water degradation through ground water discharge permits for limited areas and to enforce cleanup standards for spills.

3.2.5.3. Describe briefly the range of contaminants covered. Ground water quality standards apply to all ground water with TDS equal to or less than 10,000 mg/L. Standards include numerical Maximum Contaminant Levels (MCL). Narrative standards apply to potentially toxic pollutants which include many organic chemicals.

STATE: SOUTH DAKOTA

3.4. Inter-Agency Agreements

Topics	Check if Applicable	Description of Agreements and Agencies
Protection of specific aquifers		
Policy and strategy development		
Ground water discharges		
Underground injection control		
Ground water contamination incidents	X	Cooperation with the Division of Emergency and Disaster Services, the State Fire Marshal, and a Memorandum of Understanding with the Department of Agriculture.
Geological survey		South Dakota Geological Survey is a Program within the Department of Environment and Natural Resources.
Other (specify)		

3.5. Status of Ground-Water Resource Assessment Activities

Activity	Check if Applicable	Description of Activities
Ground-water resources assessment (aquifer)	X	County-wide resource assessments have been completed and published for 27 counties in the eastern part of the State. Field work is complete for an additional 11 counties and field work is in progress for three counties in the State. Additionally, the state has conducted a detailed water quality study of the Big Sioux aquifer, and is currently involved in a comprehensive hydrology study of the Black Hills.
Ambient ground-water quality	X	Pesticide and Fertilizer Sampling Programs have been completed. A statewide ground water quality monitoring network is currently operating with additional aquifers and monitoring wells being added to the program.
Other (specify)		

STATE: SOUTH DAKOTA

3.6. State Ground-Water Monitoring Program

Types of Monitoring	Check	Brief Description of Monitoring Program	Monitoring Data Computerized (Check)	Name of Database (Specify)
Non-hazardous waste sites	X	Site monitoring.		
Hazardous waste sites	X	RCRA and Superfund related.		
Salt water				
Pesticides	X	Pesticide and Fertilizer Sampling Programs completed. Site specific sampling and statewide ground water quality monitoring network.	X	DENR-GWQ DENR-GS
Ambient monitoring	X	Statewide network monitoring of ground water quality and site-specific sampling near pollution sources. Monitoring public water supply systems for Safe Drinking Water Act compliance.	X	DENR-DW DENR-GS
Regional, County & Local private and site specific observation		Ground water quality monitoring using public wells, by SDGS and USGS to define background water quality. Often sampling is on a one time basis.		DENR-GS
Quantity monitoring	X	Quantity monitoring is networked and is used to monitor water levels in major use aquifers. Monitoring is periodic throughout the year.	X	DENR-Water Rights

3.7. State Programs for Public Participation

Context Approaches	General Ground Water Issues	Permit Issuance	Regulation Adoption, Changes	Specific Ground Water Strategy	Source Water and Wellhead Protection	UST & Above Ground Tanks
Public hearings, meetings, workshops	X	X	X	X	X	X
Meetings with local officials	X	X	X		X	X
Citizens' advisory groups (Board of Water Management) (Board of Water and Natural Resources)	X	X	X	X	X	X
Public notices	X	X	X	X	X	
Handbook, other written Materials	X	X			X	X
Other (specify):						

STATE: SOUTH DAKOTA

5. STATE-ORIGINATED GROUND WATER PROTECTION PROGRAMS

5.1. Ground Water Strategy
(including ground water quality standards and classification)

Description: See FY 1993-94 SEA.

Funding Source: 106

5.2. Ground Water Monitoring

Description: There is an operating network for ambient ground water quality monitoring, which includes current water quality monitoring of 145 wells at 80 sites in 24 sensitive aquifers. This network is being expanded to include 4 other sensitive aquifers, with 2 additional sites to be also installed in aquifers presently being monitored. Monitoring is also conducted at specific sites near pollution sources. Monitoring in four shallow aquifers for pesticide and fertilizer has been completed. Quantity monitoring is networked and is used to monitor water levels in major use aquifers. Monitoring is periodic throughout the year. Monitoring for nonpoint source contamination began in 1988 through specific projects now completed, and is continuing via the state ambient ground water quality monitoring network.

Funding Source: state funds, 319

5.3. Ground Water Resource Assessment/Aquifer Study/Mapping

Description: The field-work portions of county-wide resource assessments have been completed for 38 counties in eastern South Dakota. A study for Roberts County is now in progress with one more season of field work remaining. The studies include mapping of ground water resources and geology. A two-county study (Todd-Mellette Counties) is underway in western South Dakota. The drilling portion of this study has been completed. Aquifers in the majority of the state have been mapped at least at a reconnaissance level. Approximately 32,700 well logs are kept in the DENR lithologic logs data base. A detailed water quality study of the Big Sioux aquifer has also been conducted. A water quality study of the Fox Hills aquifer in southern Harding County has been completed. A hydrology study in the Black Hills is currently underway.

Funding Source: local, USGS, state funds

5.4. Agricultural Contamination Control

Description: Agricultural Chemicals in Ground Water State Management Plans

Funding Source: 106, FIFRA

5.5. Permits/Control of Discharges to Ground Water

Description: Ground water discharge permit regulations were developed and adopted in 1987. The program is operational.

Funding Source: 106

5.6. Septic Management Program

Description: On-site wastewater disposal is regulated by the State. On-site system installers must be certified by the State.

Funding Source: 106

5.7. Underground Storage Tank (UST) Programs

Description: South Dakota regulates underground storage tanks and in March 1995, received delegation of the program pursuant to Section 9002(b)(2) of RCRA reauthorization of 1984.

Funding Source: RCRA Section 9002(b)(2)

5.8. Contamination Response Program
(other than RCRA/Superfund)

Description: DENR tracks spills of regulated substances from "cradle to grave" and ensures clean-up is completed to protect public health and the environment for its intended beneficial use.

Funding Source: 106

5.9. Other: Above-ground Storage Tank Program

Description: South Dakota regulates above-ground storage tanks; the program is similar to the UST program.

Funding Source: 106

APPENDIX C

Aquifer Monitoring and Ground Water Contamination Management Data

Table 8-2A. GROUND WATER CONTAMINATION SUMMARY

Aquifer Name: Vermillion East Fork **County(ies):** Clark, Kingsbury, Miner, Lake, McCook, Turner

Hydrogeologic Setting: The Vermillion East Fork Aquifer was formed from glacial outwash. The outwash consists of sand and gravel occurring at or near the ground surface.

Spatial Description (optional):

Map Available (optional): see Figure 5

Data Reporting Period: from the initiation of data collection to present

Source Type	Number of sites in area	Number of sites that are listed and/or have confirmed releases	Number with confirmed ground water contaminants	Contaminants	Number of site investigations	Number of sites that have been stabilized or have had the source removed (In post -clean up monitoring only)	Number of sites with corrective action plans	Number of sites with active remediation	Number of sites with cleanup completed (closed & inactive)
NPL	0								
CERCLIS (non-NPL)									2
DOD/DOE	1	1	0	PAH Coal Tar	1		1	1	
LUST	6	2	2	Petroleum	2	1	1	1	4
RCRA Corrective Action									
Underground Injection									
State Sites									
Nonpoint Sources									
Other	9	4	1	Petroleum, Agricultural Chemicals, Mercury	1	1	0	0	5

VOCs - Volatile Organic Compounds
NPL - National Priority List
CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOE - Department of Energy
RCRA - Resource Conservation and Recovery Act
LUST - Leaking Underground Storage Tanks
DOD - Department of Defense
PAH - Polynuclear Aromatic Hydrocarbons

Table 8-2A. GROUND WATER CONTAMINATION SUMMARY

Aquifer Name: Vermillion West Fork **County(ies):** McCook, Turner

Hydrogeologic Setting: The Vermillion West Fork Aquifer consists of valley train outwash deposits. These deposits consist of coarse sand and gravel up to 48 feet thick.

Spatial Description (optional):

Map Available (optional): see Figure 5

Data Reporting Period: from the initiation of data collection to present

Source Type	Number of sites in area	Number of sites that are listed and/or have confirmed releases	Number with confirmed ground water contaminants	Contaminant s	Number of site investigations	Number of sites that have been stabilized or have had the source removed (In post -clean up monitoring only)	Number of sites with corrective action plans	Number of sites with active remediation	Number of sites with cleanup completed (closed & inactive)
NPL									
CERCLIS (non-NPL)									
DOD/DOE									
LUST	4	4	1	Petroleum	4	1	0	0	3
RCRA Corrective Action									
Underground Injection									
State Sites									
Nonpoint Sources									
Other	15	15	0	Agricultural Chemicals, Petroleum	15	0	0	0	12

VOCs - Volatile Organic Compounds
NPL - National Priority List
CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOE - Department of Energy
DOD - Department of Defense
LUST - Leaking Underground Storage Tanks
RCRA - Resource Conservation and Recovery Act

Table 8-2A. GROUND WATER CONTAMINATION SUMMARY

Aquifer Name: Parker-Centerville **County(ies):** Turner, Clay, Lincoln
Hydrogeologic Setting: The Parker-Centerville Aquifer is formed from glacial outwash and alluvium. It consists of fine sand to coarse gravel occurring at or near the land surface.
Spatial Description (optional):
Map Available (optional): see Figure 5
Data Reporting Period: from the initiation of data collection to present

Source Type	Number of sites in area	Number of sites that are listed and/or have confirmed releases	Number with confirmed ground water contaminants	Contaminants	Number of site investigations	Number of sites that have been stabilized or have had the source removed (In post -clean up monitoring only)	Number of sites with corrective action plans	Number of sites with active remediation	Number of sites with cleanup completed (closed & inactive)
NPL									
CERCLIS (non-NPL)									
DOD/DOE									
LUST	10	9	2	Petroleum	10	2	0	0	8
RCRA Corrective Action									
Underground Injection									
State Sites									
Nonpoint Sources									
Other	11	11	2	Petroleum, Agricultural Chemicals	11	5	0	0	5

VOCs - Volatile Organic Compounds
NPL - National Priority List
CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOE - Department of Energy
DOD - Department of Defense
LUST - Leaking Underground Storage Tanks
RCRA - Resource Conservation and Recovery Act

Table 8-2A. GROUND WATER CONTAMINATION SUMMARY

Aquifer Name: Missouri (Elk Point Management Unit) **County(ies):** Yankton, Clay, Union

Hydrogeologic Setting: The Missouri Aquifer consists of outwash and alluvium. The average depth to the top of the aquifer is approximately 20 feet.

Spatial Description (optional):

Map Available (optional): see Figure 5

Data Reporting Period: from the initiation of data collection to present

Source Type	Number of sites in area	Number of sites that are listed and/or have confirmed releases	Number with confirmed ground water contaminants	Contaminants	Number of site investigations	Number of sites that have been stabilized or have had the source removed (In post -clean up monitoring only)	Number of sites with corrective action plans	Number of sites with active remediation	Number of sites with cleanup completed (closed & inactive)
NPL									
CERCLIS (non-NPL)	1	1	0	Coal Gas Waste	1	0	1	0	0
DOD/DOE	1	1	0	Petroleum Fuel Oil	1	1	0	0	0
LUST	20	18	14	Petroleum Fuel Oil	17	5	8	8	7
RCRA Corrective Action									
Underground Injection									
State Sites									
Nonpoint Sources									
Other	45	45	7	Petroleum	44	10	1	1	37

VOCs - Volatile Organic Compounds
NPL - National Priority List
CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOE - Department of Energy
DOD - Department of Defense
LUST - Leaking Underground Storage Tanks
RCRA - Resource Conservation and Recovery Act

Table 8-4 A. Statewide Aquifer Monitoring Data

Aquifer Description Statewide **Counties** All

Aquifer Setting -- **Data Reporting Period** October 1, 1997 – September 30, 1999

Monitoring Data Type	Total No. of Entry Points Used in the Assessment	Parameter Groups	Number of Entry Points: No detections of parameters above MDLs[1] or background levels — ND[2]	No detections … — In sensitive or vulnerable areas	Background or MDL < $[NO_3]^3 \leq 5$mg/l[4] and $[OP]^5 <$ background levels or MDLs — MDL < $NO_3 \leq 5$ mg/l	Background or … — In sensitive or vulnerable areas	5mg/l < $[NO_3] \leq 10$ mg/l and MDL < [OP] ≤ MCL[6]	Parameters are detected at concentrations exceeding the MCLs	Removed from service	Special Treatment	Background parameters exceed MCLs
Raw Water Quality Data from Public Water Supply Wells		VOC[7]	Drinking water is tested at the tap. Therefore there is no differentiation between raw and finished water.								
		SOC[8]									
		NO_3[9]									
		Other									
Finished Water Quality Data from Public Water Supply Entry Points	307	VOC_{21}	175	-	172	-	38	0	-	-	-
		SOC	164		155	-	0	0	-	-	-
		NO_3	2	-	Not applicable	-	Not applicable	4	-	-	-
		Other	-	-	-	-	-	7[10]	-	-	-
Raw Water Quality Data from Private or Unregulated Wells		VOC	Not routinely monitored								
		SOC	Not routinely monitored								
		NO_3	Monitored but not listed by aquifer								
		Other	Not routinely monitored								

1 MDL denotes analytical Method Detection Limit
2 Not Detected at concentrations above the Method Detection Limits
3 $[NO_3]$ denotes Nitrate concentration(s)
4 mg/l denotes concentration units of milligrams per liter
5 [OP] denotes concentrations of parameters other than nitrate
6 MCL denotes Maximum Contaminant Level
7 VOC denotes Volatile Organic Compound
8 SOC denotes Semi-volatile Organic Compound
9 NO_3 denotes Nitrates
10 Includes radium, antimony, thallium, and/or fluoride.

Table 8-4 A. Statewide Aquifer Monitoring Data

Description Vermillion – East Fork **Counties** Multiple
Aquifer Setting -- **Data Reporting Period** Oct. 1995-Sept. 1998 (see note)

Monitoring Data Type	Total Number of Wells Used in the Assessment	Parameter Groups	Number of Wells: No detections of parameters above MDLs[1] or background levels – ND[2]	No detections … – In sensitive or vulnerable areas	Background or MDL < $[NO_3]$[3] ≤ 5mg/l[4] And [OP][5] < background levels or MDLs – MDL < NO_3 ≤ 5 mg/l	Background or … – In sensitive or vulnerable areas	5mg/l < $[NO_3]$ ≤ 10 mg/l and MDL < [OP] ≤ MCL[6]	Parameters are detected at concentrations exceeding the MCLs	Removed from service	Special Treatment	Background parameters exceed MCLs
Ambient Monitoring Network - 1994	4	VOC[7]	NA[10]	NA	NA	NA	NA	NA	--[11]	--	--
		SOC[8]	4	4	3	4	0	0	--	--	0
		NO_3[9]	0	4	3	4	0	1	--	--	0
		Other	0	4	0	4	0	0	--	--	--
Raw Water Quality Data from Public Water Supply Wells	--	VOC	Drinking water is tested at the tap. Therefore there is no differentiation between raw and finished water.								
		SOC									
		NO_3									
		Other									
Finished Water Quality Data from Public Water Supply Entry Points	11	VOC	11	--	11	--	0	0	--	--	0
	11	SOC	11	--	11	--	0	0	--	--	0
	11	NO_3	11	--	11	--	0	0	--	--	0
	NA	Other	NA	NA	NA	NA	NA	NA	NA	NA	NA

1 MDL denotes analytical Method Detection Limit
2 ND denotes Not Detected at concentrations above the Method Detection Limits
3 $[NO_3]$ denotes Nitrate concentration(s)
4 mg/l denotes concentration units of milligrams per liter
5 [OP] denotes concentrations of parameters other than nitrate
6 MCL denotes Maximum Contaminant Level
7 VOC denotes Volatile Organic Compound
8 SOC denotes Semi-volatile Organic Compound
9 NO_3 denotes Nitrates
10 NA denotes data is not available
11 -- denotes information is not applicable

NOTE: Ambient Monitoring Network Data from September 1998-1999 have been collected but compilation is still in progress. As a result, data reporting period ends September 1998.

Table 8-4 A. Statewide Aquifer Monitoring Data

Description	**Vermillion – West Fork**	**Counties**	**Multiple**
Aquifer Setting	**--**	**Data Reporting Period**	**Oct. 1995-Sept. 1998 (see note)**

Monitoring Data Type	Total Number of Wells Used in the Assessment	Parameter Groups	Number of Wells: No detections of parameters above MDLs[1] or background levels		Background or MDL < $[NO_3]^3 \leq 5mg/l^4$ and $[OP]^5 <$ background levels or MDLs		5mg/l < $[NO_3] \leq 10$ mg/l and MDL < [OP] ≤ MCL[6]	Parameters are detected at concentrations exceeding the MCLs	Removed from service	Special Treatment	Background parameters exceed MCLs
			ND[2]	In sensitive or vulnerable areas	MDL < $NO_3 \leq 5$ mg/l	In sensitive or vulnerable areas					
Ambient Monitoring Network - 1994	2	VOC[7]	NA[10]	NA	NA	NA	NA	NA	--[11]	--	--
		SOC[8]	1	2	0	2	0	0	--	--	0
		NO_3[9]	0	2	0	2	0	1	--	--	0
		Other	0	0	0	0	0	0	--	--	--
Raw Water Quality Data from Public Water Supply Wells	--	VOC	Drinking water is tested at the tap. Therefore there is no differentiation between raw and finished water.								
		SOC									
		NO_3									
		Other									
Finished Water Quality Data from Public Water Supply Entry Points	0	VOC	0	--	0	--	0	0	--	--	0
	0	SOC	0	--	0	--	0	0	--	--	0
	0	NO_3	0	--	0	--	0	0	--	--	0
	NA	Other	NA	NA	NA	NA	NA	NA	NA	NA	NA

1 MDL denotes analytical Method Detection Limit
2 ND denotes Not Detected at concentrations above the Method Detection Limits
3 $[NO_3]$ denotes Nitrate concentration(s)
4 mg/l denotes concentration units of milligrams per liter
5 [OP] denotes concentrations of parameters other than nitrate
6 MCL denotes Maximum Contaminant Level
7 VOC denotes Volatile Organic Compound
8 SOC denotes Semi-volatile Organic Compound
9 NO_3 denotes Nitrates
10 NA denotes data is not available
11 -- denotes information is not applicable

NOTE: Ambient Monitoring Network Data from September 1998-1999 have been collected but compilation is still in progress. As a result, data reporting period ends September 1998.

Table 8-4 A. Statewide Aquifer Monitoring Data

Description Missouri (Elk Point Management Unit) **Counties** Multiple
Aquifer Setting -- **Data Reporting Period** Oct. 1995-Sept. 1998 (see note)

Monitoring Data Type	Total Number of Wells Used in the Assessment	Parameter Groups	Number of Wells: No detections of parameters above MDLs[1] or background levels		Background or MDL < $[NO_3]$[3] ≤ 5mg/l[4] and [OP][5] < background levels or MDLs		5mg/l < $[NO_3]$ ≤ 10 mg/l and MDL < [OP] ≤ MCL[6]	Parameters are detected at concentrations exceeding the MCLs	Removed from service	Special Treatment	Background parameters exceed MCLs
			ND[2]	In sensitive or vulnerable areas	MDL < NO_3 ≤ 5 mg/l	In sensitive or vulnerable areas					
Ambient Monitoring Network - 1994	10	VOC[7]	NA[10]	NA	NA	NA	NA	NA	--[11]	--	--
		SOC[8]	10	10	9	10	0	0	--	--	0
		NO_3[9]	0	10	9	10	0	1	--	--	0
		Other	0	10	0	10	0	1 (arsenic)	--	--	--
Raw Water Quality Data from Public Water Supply Wells	--	VOC	Drinking water is tested at the tap. Therefore there is no differentiation between raw and finished water.								
		SOC									
		NO_3									
		Other									
Finished Water Quality Data from Public Water Supply Entry Points	15	VOC	15	--	15	--	0	0	--	--	0
	13	SOC	13	--	13	--	0	0	--	--	0
	15	NO_3	15	--	15	--	0	0	--	--	0
	NA	Other	NA	NA	NA	NA	NA	NA	NA	NA	NA

1 MDL denotes analytical Method Detection Limit
2 ND denotes Not Detected at concentrations above the Method Detection Limits
3 $[NO_3]$ denotes Nitrate concentration(s)
4 mg/l denotes concentration units of milligrams per liter
5 [OP] denotes concentrations of parameters other than nitrate
6 MCL denotes Maximum Contaminant Level
7 VOC denotes Volatile Organic Compound
8 SOC denotes Semi-volatile Organic Compound
9 NO_3 denotes Nitrates
10 NA denotes data is not available
11 -- denotes information is not applicable

NOTE: Ambient Monitoring Network Data from September 1998-1999 have been collected but compilation is still in progress. As a result, data reporting period ends September 1998.

Table 8-4 A. Statewide Aquifer Monitoring Data

Description Parker-Centerville **Counties** Multiple
Aquifer Setting -- **Data Reporting Period** Oct. 1995-Sept. 1998 (see note)

Monitoring Data Type	Total Number of Wells Used in the Assessment	Parameter Groups	Number of Wells: No detections of parameters above MDLs[1] or background levels		Background or MDL < $[NO_3]^3 \leq$ 5mg/l[4] and $[OP]^5$ < background levels or MDLs		5mg/l < $[NO_3] \leq$ 10 mg/l and MDL < [OP] ≤ MCL[6]	Parameters are detected at concentrations exceeding the MCLs	Removed from service	Special Treatment	Background parameters exceed MCLs
			ND[2]	In sensitive or vulnerable areas	MDL < $NO_3 \leq$ 5 mg/l	In sensitive or vulnerable areas					
Ambient Monitoring Network - 1994	8	VOC[7]	NA[10]	NA	NA	NA	NA	NA	--[11]	--	--
		SOC[8]	5	8	4	8	0	0	--	--	0
		NO_3[9]	0	8	6	8	0	1	--	--	0
		Other	0	8	0	8	0	0	--	--	--
Raw Water Quality Data from Public Water Supply Wells	--	VOC	Drinking water is tested at the tap. Therefore there is no differentiation between raw and finished water.								
		SOC									
		NO_3									
		Other									
Finished Water Quality Data from Public Water Supply Entry Points	6	VOC	6	--	6	--	0	0	--	--	0
	6	SOC	6	--	6	--	0	0	--	--	0
	6	NO_3	6	--	6	--	0	0	--	--	0
	NA	Other	NA	NA	NA	NA	NA	NA	NA	NA	NA

1 MDL denotes analytical Method Detection Limit
2 ND denotes Not Detected at concentrations above the Method Detection Limits
3 $[NO_3]$ denotes Nitrate concentration(s)
4 mg/l denotes concentration units of milligrams per liter
5 [OP] denotes concentrations of parameters other than nitrate
6 MCL denotes Maximum Contaminant Level
7 VOC denotes Volatile Organic Compound
8 SOC denotes Semi-volatile Organic Compound
9 NO_3 denotes Nitrates
10 NA denotes data is not available
11 -- denotes information is not applicable

NOTE: Ambient Monitoring Network Data from September 1998-1999 have been collected but compilation is still in progress. As a result, data reporting period ends September 1998.

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