North Dakota
Water Quality Assessment

1998-1999

The 2000 Section 305(b) Report to the Congress of the United States

North Dakota Water Quality Assessment 1998-1999

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PART I. EXECUTIVE SUMMARY/OVERVIEW

The primary purpose of this *State Water Quality Assessment Report*, otherwise known as the Section 305(b) Report, is to assess and report on the extent to which beneficial uses of the state's rivers, streams, lakes, reservoirs, and wetlands are met. The report also summarizes or reports on the quality and condition of the state's ground water and describes management programs used to protect and improve surface and ground water quality. Section 305(b) of the Clean Water Act requires states to submit this assessment report every two years; therefore, the information presented in this report is for the reporting period of 1998-1999. This report is not a trends report, nor should the data or information in this report be used to assess water quality trends. Factors which complicate and prohibit comparisons between reporting years include changes in the number of sites and the quality of data upon which assessment information is based, and changes to the estimated river and stream miles.

The North Dakota Department of Health (hereafter referred to as the Health Department) currently recognizes 223 lakes and reservoirs for water quality assessment purposes. Of this total, there are 134 manmade reservoirs and 89 natural lakes with a combined surface acreage of 714,910 acres. Based on EPA's River Reach File Version 3 (RF3), there are 54,427 miles of rivers and streams in the state.

Historically, water quality monitoring conducted by the Health Department consisted of a statewide network of chemical monitoring stations. Many of these stations were located immediately below point source discharges or near the confluences of major streams. The primary purpose of this historic monitoring program was to assess the general chemical character of the state's rivers and streams and, to the extent practical, assess point source discharge compliance with *State Water Quality Standards*. While effective in its original purpose, this historic strategy was largely ineffective in assessing trends in water quality across the state, nor did it provide enough spatial resolution necessary to conduct beneficial use assessments for any significant number of stream miles in the state. Where data was available, it was still difficult to make beneficial use assessments, since much of it was only indirectly related to beneficial use impairment.

In response to the growing need for better water quality assessment information, the Health Department initiated a biological monitoring program in 1993 to run through 1994. This program, a cooperative effort with the Minnesota Pollution Control Agency and the U. S. Geological Survey's (USGS) Red River National Water Quality Assessment Program, involved approximately 100 sites in the Red River Basin. The result of this initial program was development of an Index of Biotic Integrity (IBI) for fish in the Red River Basin. This program continued in 1995 and 1996 in the Upper Red River Basin, including the Sheyenne River and its tributaries, and in the Souris River Basin in 1997, in the James River Basin in 1998, and in the Lake Sakakawea subbasin of the Missouri River Basin in 1999. Beginning in 1995, biological monitoring was expanded to include macroinvertebrate sampling. This "basin approach" to biological monitoring allows for more intensive water quality monitoring and assessment. The result has been better resolution in the Health Department's monitoring program, an increase in the percentage of rivers and streams assessed, and a direct assessment of aquatic life use support for the state's rivers and streams, rather than reliance upon surrogate measures such as chemical concentration data.

At the same time the Health Department was increasing its commitment to biological monitoring, it reduced the number of ambient chemical monitoring sites. Since 1994, the department has operated a network of 26 to 27 ambient monitoring sites. Where practical, sites were co-located with USGS flow gauging stations, thereby facilitating the analysis of chemical data with stream hydrologic data. All of these sites were established as basin or subbasin integrator sites, where the chemical character measured at each site reflects water quality effects in the entire watershed. It is the department's intention to maintain these as long-term monitoring sites for the purpose of assessing water quality trends and to describe the general chemical character of the state's major river basins.

With a grant from the EPA Clean Lakes Program, the Health Department initiated what is termed the Lake Water Quality Assessment (LWQA) Project in 1991. The objective of the assessment project is to describe the general physical and chemical condition of the state's lakes and reservoirs. Through 1997, the LWQA Project has completed sampling and analyses for 111 lakes and reservoirs in the state.

Beginning in 1997, LWQA Project activities were integrated into the department's rotating basin monitoring strategy. Lake Darling and the Upper Des Lacs Reservoir were sampled as the department focused its monitoring activities in the Souris River Basin in 1997, while Pipestem Dam and Jamestown Reservoir were sampled in 1998. Lake Sakakawea was the focus of LWQA activities in 1999.

In addition to its inclusion in the annual LWQA Project, Devils Lake has received special attention. Devils Lake has increased in elevation 20 feet since 1993. In response to questions regarding water quality changes resulting from these water level increases, the department initiated a comprehensive water quality monitoring program in 1993 for Devils Lake. Devils Lake is sampled approximately five times per year, including once during the winter.

Sixty-nine percent (9923 miles) of rivers and streams assessed for this report fully support the beneficial use designated as aquatic life. Of the streams assessed as fully supporting aquatic life use, 85 percent (8392 miles) are considered threatened. In other words, if water quality trends continue, these streams may not fully support their use for aquatic life in the future. The remaining 31 percent of rivers and streams assessed for this report were either partially supporting or did not support aquatic life use.

Nonpoint Source (NPS) pollution (e.g., nutrient loading, siltation of the streambed, and stream habitat loss or degradation) was the primary cause of aquatic life use impairment. Other forms of pollution causing impairment are trace element contamination, flow alteration, and organic enrichment. Organic enrichment creates conditions in the stream which cause dissolved oxygen

(DO) to be depleted. The primary sources of these pollutants are cropland erosion and runoff, concentrated animal feeding operations, wetland drainage, and poor grazing management. Poor grazing management includes riparian grazing and season-long grazing. Other pollutant sources linked to aquatic life use impairment are point source discharges, urban runoff, and stream channel/flow alteration (e.g., upstream impoundments, lowhead dams, channelization, flow regulation and diversion, riparian vegetation removal, wetland drainage).

Recreation use was assessed on 9707 miles of rivers and streams in the state. Recreation use was fully supporting, fully supporting but threatened, partially supporting, and not supporting on 3484 miles, 1938 miles, 3537 miles, and 747 miles, respectively. Pathogens, as represented by fecal coliform bacteria data collected from monitoring stations across the state, were the primary cause of recreation use impairment. The primary sources of fecal coliform bacteria contamination in the state are concentrated animal feeding operations and riparian area grazing.

Drinking water supply use is classified for 5483 miles of rivers and streams in the state. Of the 474 miles assessed for this report, only 259 miles (55 percent) were assessed as threatened for drinking water supply use. The primary threats to drinking water use impairment are taste and odor problems.

A total of 5548 miles of rivers and streams were identified as capable of supporting a sport fishery from which fish could be used for consumption. One-hundred-forty-seven miles of rivers and streams have been monitored for methyl-mercury in fish, resulting in consumption advisories. These advisories form the basis for fish consumption use impairment in the state. While there are many potential sources of methyl-mercury, both anthropogenic and natural, to date there have been no specific sources identified for the mercury present in North Dakota fish.

A total of 121 lakes and reservoirs (44 natural lakes and 77 reservoirs), representing 702,315 surface acres, were assessed for this report. Sixty-six lakes and reservoirs, representing 683,572 acres, were assessed as fully supporting aquatic life use. Of this total, 55 lakes and reservoirs, representing 32,249 acres, are considered threatened. Forty-five lakes and reservoirs, totaling 18,742 surface acres, were assessed as partially supporting aquatic life use. One of the primary causes of aquatic life impairment to the state’s lakes and reservoirs is low DO in the water column. Low DO in lakes can occur in summer (referred to as summer kills), but usually occurs in the winter under ice cover conditions when senescent plants and algae decompose, consuming available oxygen. Pollutants which stimulate the production of organic matter, such as plants and algae, can also cause aquatic life impairment. Two such secondary pollutant causes are excessive nutrient loading and siltation.

Major sources of nutrient loading to the state’s lakes and reservoirs are erosion and runoff from cropland, runoff from concentrated livestock feeding and wintering operations, and hydrologic modifications. Hydrologic modifications, such as wetland drainage, channelization, and ditching, increase the runoff and delivery rates to lakes and reservoirs, in effect, increasing the size of a lake’s watershed. Nutrients, sediment, and organic matter, which would be retained in wetlands under normal conditions, become part of the lake's external budget. Other sources of nutrient loading which affect lakes in the state are point source discharges from municipal wastewater treatment facilities, urban/stormwater runoff, and shoreline development.

Recreation use (e.g., swimming, waterskiing, boating, sailing, sunbathing) was assessed for 687,315 lake and reservoir acres in the state. Of this total, 49 lakes, representing 147,057 acres, were assessed as partially supporting use for recreation. The primary cause of use impairment is excessive nutrient loading, which results in nuisance algal blooms and noxious aquatic plant growth. Fifty-two lakes totaling 28,881 acres were assessed as threatened. Nutrient loading and siltation are also linked to the negative water quality trends these lakes are experiencing. If left unchecked, these lakes will degrade to the point where frequent algal blooms and/or excessive weed growth will negatively affect recreation.

Twenty-one lakes and reservoirs, totaling 518,175 acres, were considered partially supporting fish consumption use. The remaining 198 lakes and reservoirs which support a sport fishery were not assessed for this report. The 21 lakes and reservoirs assessed as partially supporting fish consumption use were so designated because each one has a fish consumption advisory. The advisory for each lake limits the consumption of fish due to methyl-mercury. Sources of methyl-mercury in fish remain largely unknown. Potential sources of mercury include natural sources, atmospheric deposition, and runoff from cropland containing grain that was treated with a mercury-based fungicide. (Note: The use of these fungicides is now prohibited.)

Four reservoirs (Lake Sakakawea, Homme Dam, Bisbee Dam, and Mt. Carmel Reservoir) are currently used either directly or indirectly as municipal drinking water supplies, while two others (Patterson Lake and Renwick Dam) serve as backup water supplies in the event the primary water supplies should fail.

Lake Sakakawea was assessed as fully supporting drinking water supply use. The remaining reservoirs were assessed as fully supporting but threatened for drinking water supply use. The primary threats are frequent algal blooms stimulated by excessive nutrient loading and siltation. Algal blooms affect the taste and odor of a drinking water supply and increase treatment costs. Siltation decreases reservoir volume, thereby reducing reservoir storage capacity as a drinking water supply. Agricultural runoff from cropland and concentrated animal feeding operations are the primary sources of nutrients and sediment which threaten drinking water supply use. Poor grazing management of pasture land, range land, and along riparian areas is also a significant source of sediment to water supply lakes and reservoirs. In particular, riparian area grazing destroys streambank vegetation, creating bank erosion which can be a significant source of sediment to lake and reservoirs.

Wetlands have long been regarded as nuisance areas or wastelands which only serve to impede agriculture, urban, or transportation development. Only recently have the ecological and social functions and values of wetlands been realized. It is now scientifically proven that wetlands are important for the storage of flood waters, providing fish and wildlife habitat, recharging ground water, and retaining and cycling chemical pollutants and particulates. Wetlands have also recently been recognized as a significant source for carbon sequestration. It is estimated that 2.5 million acres of wetlands remain of the approximately 4.9 million acres of wetlands which covered North Dakota prior to development. This represents a 49 percent reduction in wetlands.

Wetland integrity should be thought of in terms of whether a wetland performs a set of functions or uses which would be expected for natural or “reference” wetlands of a similar class or type. Therefore, whenever a wetland’s function is diminished, it can be said that wetland integrity is diminished. Hydrologic manipulation (e.g., drainage, wetland consolidation, channelization, and filling) continues to be the greatest impact on the integrity of the state’s wetland resource. While not as dramatic, other factors such as chemical contamination, nutrient loading (i.e., eutrophication), and sedimentation can also affect a wetland’s function and, therefore, the chemical, physical, and biological integrity of the wetland.

Ground water in North Dakota occurs in two major rock types -- unconsolidated rock and the underlying bedrock. Aquifers in the unconsolidated rock are primarily the result of glacial outwash deposits of the Quaternary Age and are called glacial drift aquifers. Glacial drift aquifers are typically more productive and generally yield less mineralized water than that of the underlying bedrock. At the present time, approximately 206 glacial drift aquifers have been identified and delineated throughout the state. Bedrock aquifers typically are more continuous and widespread than aquifers in the unconsolidated rocks. Water from bedrock aquifers tends to be more mineralized and occurs primarily along fractures in the rock. The major bedrock aquifers include the Dakota, Pierre, and Fox Hills-Hell Creek Aquifers of the Cretaceous Age and the Fort Union Aquifer of the Tertiary Age.

It is estimated North Dakota has approximately 470 million acre-feet (MAF) of water stored throughout the various aquifer systems. Although these systems are abundant and widely dispersed, consumptive use demands, accessibility, and overall quality has limited the use of ground water for beneficial applications in some areas. When compared to the total quantity of ground water stored in the state’s aquifers, less than 1 percent of the ground water resource is used.

Consumption of ground water in North Dakota has historically been categorized as agricultural (e.g., irrigation or livestock watering), industrial, and domestic (private or public) use. In 1998, it was estimated that the highest consumptive use of ground water was related to irrigation. Other uses such as public water supply, industrial, domestic (private water wells), and livestock followed in decreasing consumptive use quantities.

Contamination of ground water from manmade and natural sources has been detected in every county of the state. The degree to which contamination incidents are investigated or remediated is a function of the contaminant, its impact on the beneficial use of the resource, and the overall risk it poses to the public or environment.

To determine where to spend the limited financial and human resources required to implement ground water assessment and protection activities, the Health Department’s Division of Water Quality developed the Geographic Targeting System (GTS). This prioritization system is currently used to target aquifer systems for increased protection, education, and monitoring activities.

Ambient ground water quality monitoring activities are conducted by several state agencies, with the primary activities being conducted by the North Dakota State Water Commission (SWC) and the Health Department. The monitoring programs have been developed to assess ground water quality and/or quantity in the major aquifer systems located throughout the state. Monitoring conducted by the department is designed to evaluate the condition of ground water quality as it relates to inorganic/organic chemical constituents and the occurrence of selected agricultural chemical compounds. Additional water quality information is developed as part of the Safe Drinking Water Act requirements through the monitoring of public drinking water supply systems.

In 1992, the Health Department’s Division of Water Quality initiated an ambient ground water monitoring program to determine the occurrence of 50 selected agricultural pesticides in the 50 most vulnerable aquifer systems within a 5-year period. Sample locations are selected based upon well construction integrity, well location, and the presence of water treatment systems. Since its initiation in 1992, approximately 1200 wells in the 50 most vulnerable aquifer systems have been monitored.

The North Dakota Pollutant Discharge Elimination System (NDPDES) Permit Program regulates the release of wastewater and stormwater from point sources into waters of the state. All point source dischargers, both municipal and industrial, are required to obtain an permit. These permits outline technology-based and water quality-based limits for wastewater discharges.

Since 1975, approximately 400 discharge permits (25 percent industrial and 75 percent municipal) have been issued to point source dischargers of wastewater. In 1992, the NDPDES Program established permit coverage for stormwater discharges from industrial facilities in response to the addition of stormwater to the National Pollutant Discharge Elimination System. Currently, there are about 500 facilities covered under general permits for stormwater discharges.

The Health Department has an aggressive inspection and operator training program. Program staff are primarily responsible for inspecting all components of public treatment works and for conducting operator training. One of the goals of the inspection program is to conduct an inspection of each municipal treatment system at least once a year. In addition to verifying proper system operation, the inspections reaffirm to the operator the importance of proper operation in protecting the state's water resources. The inspectors also serve as primary instructors for the Health Department's wastewater operator training and certification seminars conducted during the winter and spring months. In addition to the seminars, the program provides individual training and assistance to facilities encountering treatment problems. The inspection program is largely responsible for the improvement in the quality of municipal wastewater discharges. North Dakota regulations require a certified operator for municipalities with populations of greater than 500.

The impact to waters from livestock and feeding operations continues to be an increasing concern in North Dakota. The state's livestock regulations require Health Department approval for: 1) concentrated feeding operations with more than 200 animal units, 2) operations with more than 100 animal units and located in a floodplain, 3) operations located where the distance to surface water is less than 2 feet per animal unit, and 4) operations that cause or are likely to cause pollution to waters of the state. The department reviews the design plans for these facilities to ensure that the waste can be adequately contained and disposed of to prevent impacts to waters of the state. If the facility is properly designed, an approval is issued.

Currently, there are more than 900 livestock operations on record as having been approved by the Health Department. Most of these are cattle wintering operations, hog operations, and dairy operations that farmers have as a part of their total farming operations. However, over the past few years there has been an increase in facilities that are strictly large, concentrated, feeding operations for turkeys, hogs, and dairy cattle. With an increase in these larger operations, the department has updated its approval process to require better management practices for the increased volume of waste that is handled. This helps to ensure operators take responsibility for proper land application of waste to minimize odors or other nuisances that may impact nearby residents.

NPS pollution control efforts to maintain or improve the beneficial uses of North Dakota's water resources are primarily accomplished through the North Dakota NPS Pollution Management Program. The state's NPS program was developed through three major components, as required by Section 319 of the Clean Water Act. These components are the *NPS Pollution Assessment Report*, the *NPS Pollution Management Program Plan*, and the creation of the NPS Pollution Task Force.

The *NPS Pollution Assessment Report*, provided to EPA in December 1988, was written to identify the extent of NPS pollution problems in the state. Submitted to EPA in January 1990, the *NPS Pollution Management Program Plan* provides an overview of the state's program, as well as a summary of NPS pollution management goals. This report was most recently updated in August 1999 to define the NPS Program's mission and to establish short- and long-term goals for program delivery, coordination, and evaluation. The NPS Program's mission statement and long-term goal is "to protect or restore the chemical, physical, and biological integrity of the waters of the state by promoting locally sponsored, incentive-based, voluntary programs where those waters are threatened or impaired due to nonpoint sources of pollution."

The NPS Pollution Task Force is comprised of representatives from several public agencies and private groups. The Task Force provides input and recommendations on local projects funded through Section 319, as well as various NPS program activities (e.g., assessment reviews, BMP reviews).

The North Dakota NPS Pollution Management Program has provided financial support to 71 projects since 1990. Of these projects, 39 are currently active, and 32 have been completed. While the size, type, and target audience of these projects may vary significantly, they all share the same basic goals. These common goals are to: 1) increase public awareness of NPS pollution, 2) assess/monitor NPS pollution impacts to beneficial uses, 3) reduce/prevent the delivery of NPS pollutants to waters of the state, and 4) disseminate information on effective solutions to NPS pollution.

North Dakota projects funded through Section 319 can be grouped into three separate categories. Placement of a given project into any one of these categories is simply based on the project's primary tasks and objectives. These project categories include: 1) development/assessment phase, 2) watershed, and 3) educational.

Costs associated with municipal point source pollution control have been extensive. Capital investments in the form of additions to and construction of new wastewater treatment facilities account for the largest expenditure of funds. While the Construction Grants and State Revolving Fund (SRF) programs have been the major sources of funding, many communities have upgraded wastewater treatment facilities at their own expense.

The SRF replaced the Construction Grants Program in the early 1990s. In federal fiscal years 1998 and 1999, approximately $29 million has been obligated from the SRF for the construction of wastewater system improvements. During the last ten years, over $143.4 million has been invested in wastewater system improvements. The cumulative amount since passage of the Clean Water Act in 1972 is approximately $344 million. In addition to the capital costs, an estimated $7 million per year is spent operating and maintaining wastewater treatment systems.

There have been many improvements in water quality since passage of the Clean Water Act in 1972. Secondary wastewater treatment has been achieved for every municipality in the state. Source water protection programs are being developed for public drinking water supplies relying on surface and ground water. There is an increased public awareness of nonpoint sources of pollution and a renewed commitment to voluntarily control NPS pollution by both public agencies and the private sector. Increased inspections will assure that concentrated animal feeding operations are managed in such a way that waste and runoff will not reach surface or ground water resources. Biological measures are being integrated into ambient monitoring for water quality assessment. These are but a few of the successes. Much remains to be done, however, if the goal of restoring and maintaining the chemical, physical, and biological integrity of the state's and nation's waters is to be achieved.

PART II. BACKGROUND

Table II-1. Atlas

Topic	Value
State Population[1]	638800.00
State Surface Area (Sq. Miles)	70665.00
Total Miles of Rivers and Streams[2]	54427.35
Total Miles of Rivers and Streams by Stream Class[3]	
Class I, IA, and II Streams	5482.88
Class III Streams	48944.47
Total Miles of Rivers and Streams by Basin	
Red River (including Devils Lake)	11881.26
Souris River	3645.00
Upper Missouri (Lake Sakakawea)	13877.43
Lower Missouri (Lake Oahe)	22271.01
James River	2752.65
Border Miles of Shared Rivers and Streams[4]	427.03
Total Number of Lakes and Reservoirs[5]	223
Number of Natural Lakes	89
Number of Manmade Reservoirs	134
Total Acres of Lakes and Reservoirs	71490.10
Acres of Natural Lakes	172042.20
Acres of Manmade Reservoirs[6]	542867.80
Acres of Freshwater Wetlands[7]	2500000.00

[1] Based on the 1990 Census.
[2] Total miles based on the U. S. EPA RF3 file.
[3] Stream classes are defined in the *State Water Quality Standards* (Health Dept., 1991). In general, Classes I, IA, and II streams are perennial, while Class III streams are intermittent or ephemeral.
[4] Includes the Bois de Sioux River and the Red River of the North.
[5] Number includes only the lakes and reservoirs which are publicly owned and are in the ADB.
[6] Estimates based on surface acreage at full pool elevation.
[7] Estimate provided by Dahl, T.E., *Wetlands - Losses in the United States: 1780's to 1980's*, Washington, D.C., U. S. Fish and Wildlife Service Report to Congress, 1990.

Total Waters

The Health Department currently recognizes 223 lakes and reservoirs for water quality assessment purposes. Of this total, there are 134 manmade reservoirs and 89 natural lakes. All lakes and reservoirs included in this assessment are considered significantly publicly owned.

Reservoirs are defined as waterbodies formed as a result of dams or dugouts constructed on natural or manmade drainages. Natural lakes are waterbodies having natural lake basins. A natural lake can be enhanced with outlet control structures, diversions, or dredging. Based on the state's ADB tracking system, the 134 reservoirs have an areal surface of 542,868 acres. Reservoirs comprise about 76 percent of North Dakota's total lake/reservoir surface acres. Of these, 480,731 acres or 67 percent of the state's entire lake and reservoir acres are contained within the two mainstem Missouri River reservoirs (Lake Sakakawea and Lake Oahe). The remaining 132 reservoirs share 62,137 acres, with an average surface area of 471 acres.

The 89 natural lakes in North Dakota cover 172,042 acres with approximately 125,000 acres or 73 percent attributed to Devils Lake. The remaining 88 lakes average 535 acres with half being smaller than 200 acres.

There are 54,427 miles of rivers and streams in the state. Estimates of river stream miles in the state are based on EPA's RF3. RF3 is derived from the USGS's 1:100,000 scale Digital Line Graph (DLG) data. The DLG data contains all hydrologic features which are found on paper maps of the same scale. Due to the detail of these maps and the resultant DLG data, total river miles increased significantly from estimates made in previous years.

In this report, the state has been divided into five basins: Red River (including Devils Lake), Souris River, Upper Missouri River (or Lake Sakakawea), Lower Missouri River (or Lake Oahe), and James River (Figure II-1). The atlas provided in Table II-1 provides a basin-by-basin estimate of total river and stream miles.

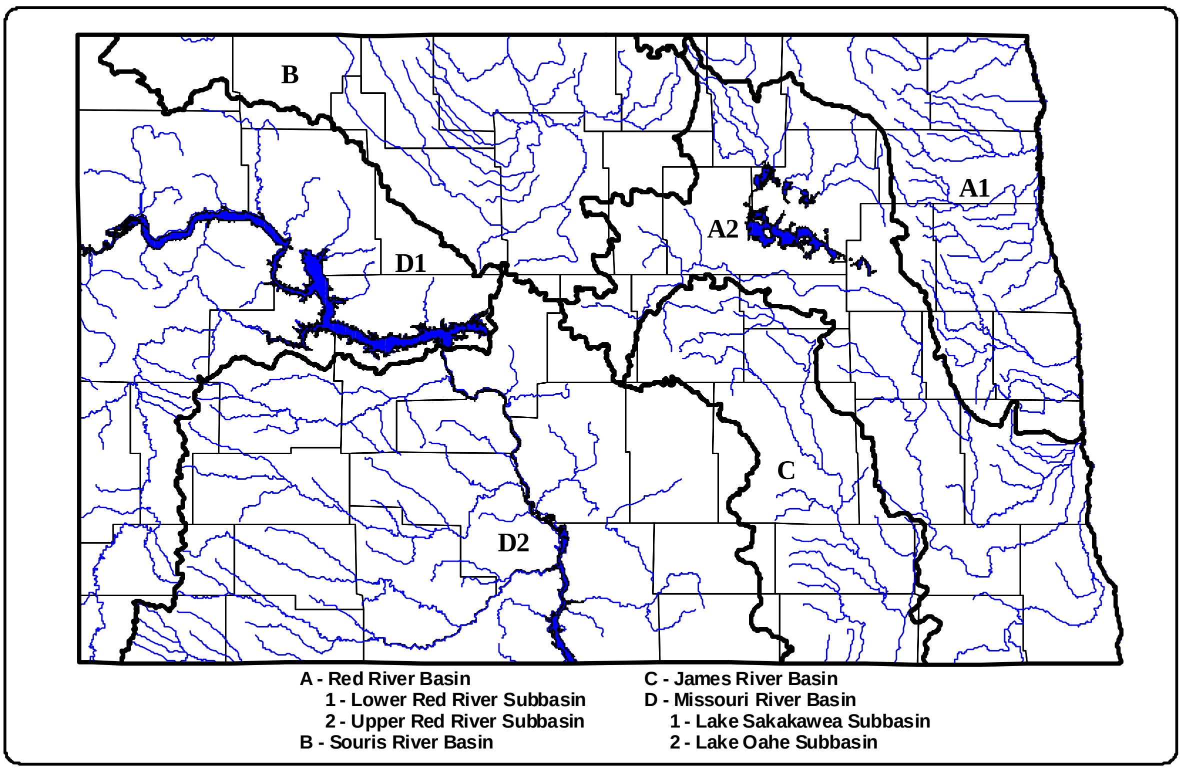

Figure II-1. Major Hydrologic Basins in North Dakota

Water Pollution Control Program

Chapter 1. Water Quality Standards Program

The State of North Dakota periodically updates the standards of water quality. The standards delineate the policy of the state which is to protect, maintain, and improve the quality of water for use as public and private water supplies; for propagation of wildlife, fish, and aquatic life; and for domestic, agricultural, industrial, recreational, and other legitimate beneficial uses.

The state classifies its water into five categories. The assignment of a waterbody into a particular classification is based on the water quality of record (1967), existing uses at that time, hydrology, and natural background factors.

The standards identify specific numeric criteria for chemical, biological, and physical parameters. The specific numeric standard assigned to each parameter ensures protection of the beneficial uses for that classification. The standards also contain general conditions applicable to all waters of the state. These general conditions contain provisions not specifically addressed in numeric criteria. These conditions add an extra level of protection for water quality.

The beneficial uses of wetlands are currently under consideration. Wetlands are waters of the state and, therefore, protected by general conditions.

The state is also in the process of developing “biological criteria.” These criteria will define ecological conditions in state waters and set goals for their attainment.

An antidegradation implementation procedure is currently under development. This procedure will delineate the specific process the Health Department’s Division of Water Quality will use to support the antidegradation policy.

Chapter 2. Point Source Control Program

The NDPDES permit program regulates the release of wastewater and stormwater from point sources into waters of the state. All point source dischargers, both municipal and industrial, are required to obtain an permit. These permits outline technology-based and water quality-based limits for wastewater discharges.

Since 1975, approximately 400 discharge permits (25 percent industrial and 75 percent municipal) have been issued to point source dischargers of wastewater. In 1992, the NDPDES Program established permit coverage for stormwater discharges from industrial facilities in response to the addition of stormwater to the National Pollutant Discharge Elimination System. Currently, there are about 500 facilities covered under general permits for stormwater discharges.

Facilities covered under a general permit for stormwater discharges must implement pollution prevention plans to improve the quality of stormwater discharges. In addition, periodic sampling of stormwater discharges is required. This sampling information will enable the Health Department to evaluate the effectiveness of the pollution prevention practices.

In addition to general permits, the department has been working with the major municipalities on development and implementation of a guidance document for snow disposal/storage.

Wastewater impoundments are the most widely used and accepted manner of wastewater treatment and storage in North Dakota. The primary reasons for their acceptance are their low operation and maintenance costs and the availability of land in the state. A facility that receives permission to discharge wastewater to a surface waterbody is required to monitor and report information on the quantity and quality of the discharge. The Health Department reviews this information and maintains it in a computer database. The overall quality of wastewater is commonly indicated by 5-day biochemical oxygen demand (BOD-5) and total suspended solids (TSS). Typically, high concentrations of BOD and TSS indicate poor treatment system performance and present an environmental concern.

Figure II-2 consists of the mean 5-Day BOD concentration, and Figure II-3 is the mean TSS concentration. Both figures relate only to municipal discharges. Data used to generate these graphs are for the years 1981 through December of 1999. Figure II-2 indicates a gradual increase in the mean concentration of BOD starting in 1993 until 1996, followed by a gradual regression through 1999. Figure II-3 continues a slight downward regression in the mean concentration of TSS with a slight increase from 1998 to1999.

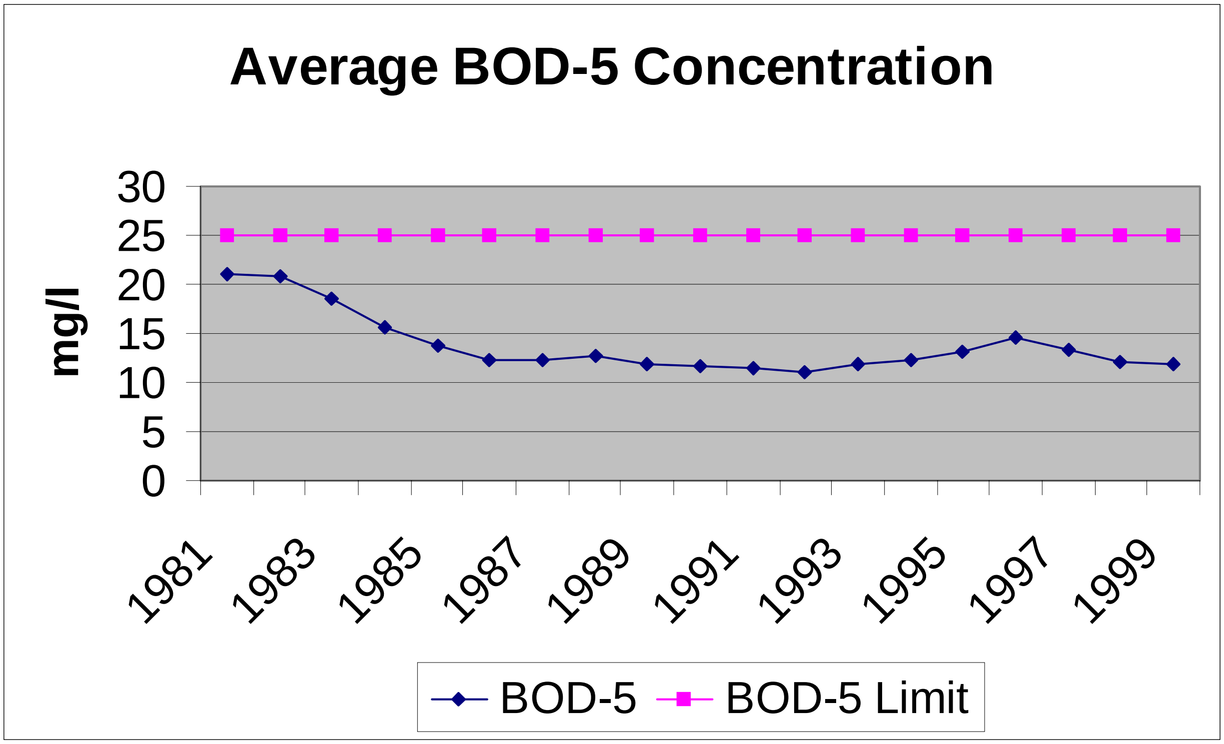

Figure II-2. Mean 5-Day BOD Concentration for Municipal Sewage Discharges (1981-1999)

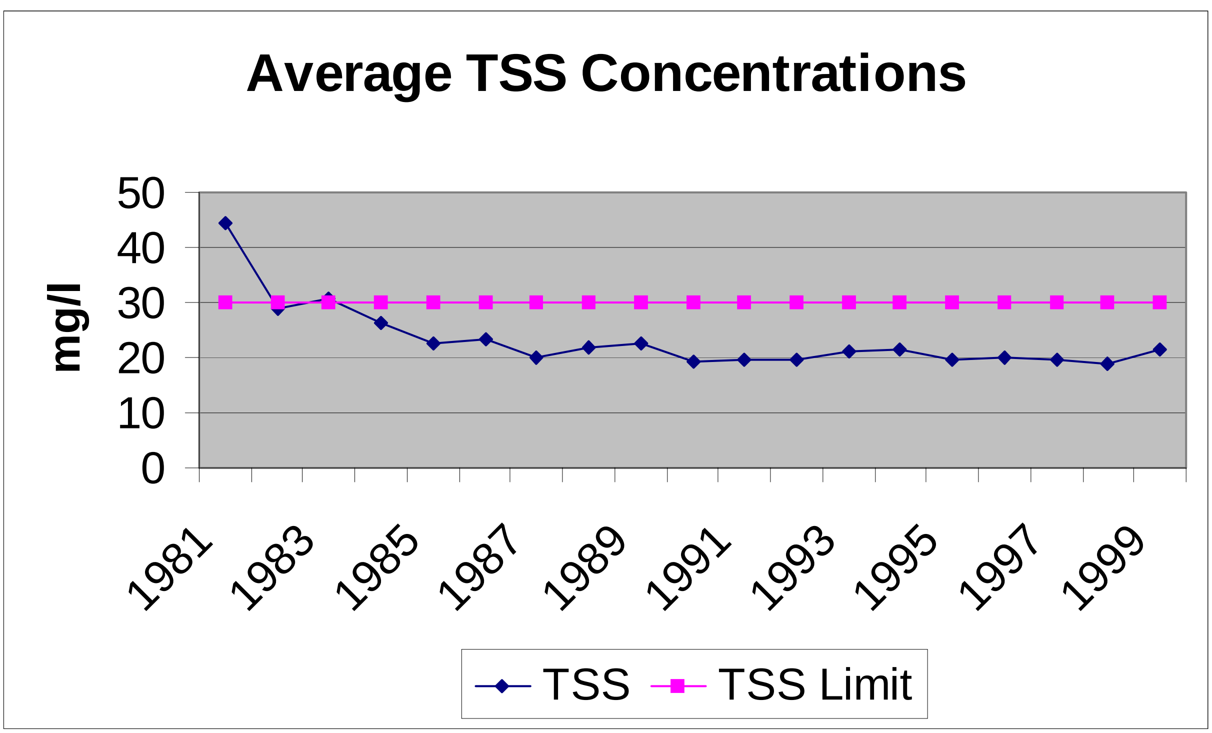

Figure II-3. Mean TSS Concentration for Municipal Discharges (1981-1999)

The control of toxic pollutants in wastewater discharges is an important concern, particularly for the larger cities and industries in the state. The primary means of controlling toxic pollutants in wastewater is through the industrial pretreatment program administered in North Dakota by the EPA. This program regulates the individual industries using municipal sewer systems. The department has been exploring the option of taking over the pretreatment program from EPA Region VIII. A draft program package will be developed and submitted to EPA for comments.

In addition to the monitoring of conventional wastewater pollutants, Whole Effluent Toxicity (WET) testing of the treated wastewater discharges from all major permittees (including both municipalities and industries) is required on a regular basis. Should the results from these tests indicate the effluent is toxic to aquatic organisms, a toxicity identification evaluation (TIE) may be required.

In an effort to determine the city of Mandan's sources of toxicity, the Health Department and the city participated in a Mirotox study in February and March of 1994. Due to the bacteria's sensitivity to pH fluxes, the results indicated that some industries may have a pH problem. However, the study did not reveal any blatant sources of toxicity that may inhibit the treatment process at the wastewater plant.

The Health Department has an aggressive inspection and operator training program. Program staff are primarily responsible for inspecting all components of public treatment works and for conducting operator training. One of the goals of the inspection program is to conduct an inspection of each municipal treatment system at least once a year. In addition to verifying proper system operation, the inspections reaffirm to the operator the importance of proper operation in protecting the state's water resources. The inspectors also serve as primary instructors for the Health Department's wastewater operator training and certification seminars conducted during the winter and spring months. In addition to the seminars, the program provides individual training and assistance to facilities encountering treatment problems. The inspection program is largely responsible for the improvement in the quality of municipal wastewater discharges. North Dakota regulations require a certified operator for municipalities with populations of greater than 500.

Several cities and industries have selected biological treatment methods to improve their wastewater treatment systems. The biological treatment unit at the Amoco Refinery in Mandan is providing consistent, advanced treatment of wastewater. On average, the effluent contains less than 40 percent of the loading allowed by the NDPDES permit for limited pollutants.

Devils Lake's “Lemna” system was specifically designed to remove phosphorus from the wastewater. Although the system generally provides an advanced level of nutrient removal, recent regional flooding has taxed the system beyond its design capabilities. An interim phosphorus limit has been instituted to compensate for the adverse operational conditions which currently prevail.

In 1992, artificial wetland treatment additions at the city of Minot and American Crystal Sugar at Hillsboro became fully operational. A similar system at American Crystal Sugar in Drayton was completed in 1994. With the wetland systems, these facilities have been able to maintain low concentrations of ammonia in the final effluent during the summer discharge months. This is particularly beneficial to Minot's facility, which discharges to the Souris River. The Souris River has a history of poor river quality and low or no flow conditions during the summer season. With the addition of the wetland, Minot is capable of continuously discharging a quality effluent during the spring and summer, thereby adding to the river flow and enhancing aesthetic river qualities.

American Crystal Sugar has chosen to use wetlands to improve wastewater quality and to expand the capacity of its wastewater systems. The effluent consistently surpasses the federal effluent criteria for suspended solids and oxygen demand by a significant degree. Additionally, these systems serve as full-scale models for other facilities exploring artificial wetlands as a cost-effective means of improving wastewater systems.

A major expansion and upgrade at the city of Fargo's wastewater treatment plant was completed in the fall of 1995. The city went from an intermittent to a continuous discharger. The upgrade increased the plant's hydraulic capacity from 9 million gallons a day (MGD) to 15 MGD. The upgrade consisted of the following: a new pretreatment/odor control facility, two new primary clarifiers, new media and increased size of the three trickling filters, two new nitrification filters, two new final clarifiers, a new disinfection facility, and covers for all clarifiers and filters. Fargo still maintains its six, 90-acre wastewater stabilization ponds which can be used to contain the effluent from the mechanical plant should its quality threaten to exceed the state's water quality standards for the Red River. The upgrade and the capability of using the ponds provide greater flexibility in managing discharges to the Red River.

The impact to waters from livestock and feeding operations continues to be an increasing concern in North Dakota. The state's livestock regulations require Health Department approval for: 1) concentrated feeding operations with more than 200 animal units, 2) operations with more than 100 animal units and located in a floodplain, 3) operations located where the distance to surface water is less than 2 feet per animal unit, and 4) operations that cause or are likely to cause pollution to waters of the state. The department reviews the design plans for these facilities in ensure that the waste can be adequately contained and disposed of to prevent impacts to waters of the state. If the facility is properly designed, an approval is issued.

Currently, there are more than 900 livestock operations on record as having been approved by the Health Department. Most of these operations are cattle wintering operations, hog operations, and dairy operations that farmers have as a part of their total farming operations. However, over the past few years there has been an increase in facilities that are strictly large, confined, feeding operations for turkeys, hogs, and dairy cattle. With an increase in these larger operations, the department has updated its approval process to require better management practices for the increased volume of waste that is handled. This helps to ensure operators take responsibility for proper land application of waste to minimize odors or other nuisances that may impact nearby residents.

The Health Department is continuing to provide educational materials to livestock producers and the public on the impacts livestock waste has on waters of the state. The department has participated in numerous presentations to producer groups throughout the state on livestock waste pollution. In addition, the Health Department is continuing to work closely with the Natural Resources Conservation Service (NRCS) and local health units on livestock waste systems. The department is also working with the North Dakota State University Agriculture Extension Service and a number of livestock producer groups in the state such as the North Dakota Pork Producers and the North Dakota Turkey Federation. Many of these groups are taking steps to educate their members on pollution concerns and state regulations. The department is taking steps to maintain better contact with approved livestock operations by mailing information on livestock waste management and state regulations.

The Health Department works closely with local zoning boards and county commissions to help them recognize sensitive areas where livestock operations could cause problems and to encourage them to limit the expansion of operations in these areas. The Health Department works through its NPS Pollution Management Program and Ground Water Program during the review process for proposed livestock waste control systems.

The department issued a permit to ProGold LCC in July 1995 for a 200,000-bushel-per-day, corn wet milling facility located near Wahpeton. The discharge consists primarily of treated wastewater from the processes involved with the wet milling of corn to produce and refine high fructose corn syrup and related feed co-products. The discharge is to the Red River, which is a Class I stream in the state. The review and issuance of this permit were very time-consuming and controversial. Both a public meeting and a formal hearing were held prior to writing the final permit language. Canadian agencies, EPA Region VIII, several state and federal agencies in North Dakota and Minnesota, and numerous municipalities along the Red River provided comments on the draft permit. The final permit reflected all comments and concerns, resulting in a common-sense approach which maintained water quality standards in both states. Strong NDPDES, operator training and facility inspection, and feedlot programs, combined with wastewater treatment facility upgrades, have all contributed to the improvement of the quality of wastewater discharges to the waters of North Dakota.

Chapter 3. NPS Pollution Control Program

Background

Surface water and ground water are two of North Dakota's most valuable natural resources. Water quality is affected by both natural and cultural, point source and NPS pollution, with NPS pollution being the major factor affecting surface water quality. Ground water quality has remained relatively unaffected by major sources of pollution. However, some aquifers have experienced minor water quality impairments (see Part IV. Ground Water Assessment).

All rivers, streams, reservoirs, and lakes assessed within the state are impacted to some degree by NPS pollution. Impacts can generally be attributed to agricultural activities. Ground water impacts have resulted from the improper use of agricultural chemicals, leaking underground petroleum storage tanks and pipelines, wastewater impoundments, oil and gas exploration activities, septic systems, and improperly located and maintained solid waste disposal sites.

NPS pollution control efforts to maintain or improve the beneficial uses of North Dakota's water resources are primarily accomplished through the North Dakota NPS Pollution Management Program. The state's NPS program was developed through three major components, as required by Section 319 of the Clean Water Act. These components are the *NPS Pollution Assessment Report*, the *NPS Pollution Management Program Plan*, and the creation of the NPS Pollution Task Force.

The *NPS Pollution Assessment Report*, provided to EPA in December 1988, was written to identify the extent of NPS pollution problems in the state. Submitted to EPA in January 1990, the *NPS Pollution Management Program Plan* provides an overview of the state's program, as well as a summary of NPS pollution management goals. This report was most recently updated in August 1999 to define the NPS Program's mission and to establish short- and long-term goals for program delivery, coordination, and evaluation. The NPS Program's mission statement and long-term goal is "to protect or restore the chemical, physical, and biological integrity of the waters of the state by promoting locally sponsored, incentive-based, voluntary programs where those waters are threatened or impaired due to nonpoint sources of pollution."

The long-term goal of the North Dakota NPS Program is "to initiate a balanced program focused on the restoration and maintenance of the beneficial uses of the state's water resources (i.e., streams, rivers, lakes, reservoirs, wetlands, aquifers) impaired by NPS pollution." Based on the 1998 Section 305(b) report and the related 1998 Section 303(d) list of impaired waters needing Total Maximum Daily Loads (TMDLs), there are 131 individual river/stream reaches and lakes/reservoirs which are water quality-limited due to nonpoint sources of pollution. When analyzed on a 14-digit hydrologic unit scale, it is estimated that these 131 waterbodies can be combined into 114 watersheds. In order to meet its long-term goal, the North Dakota NPS Management Program plans to complete TMDLs for each of the 131 waterbodies (114 watersheds) by 2013 and to initiate watershed restoration projects (i.e., project implementation plans) in 75 of the 114 watersheds by 2013. The program will accomplish this objective by initiating an average of five watershed restoration projects each year through 2013.

While the long-term goal of the program is to initiate 75 watershed restoration projects by 2013, it is the Health Department's experience, over the past nine years, that it requires between seven and ten years to complete a watershed restoration project. Therefore, watershed restoration projects initiated in 2013 should not be expected to be completed until 2020-2023.

It should also be recognized that the state's water quality monitoring and assessment program is a dynamic process. Each year, new surface waterbodies are re-sampled and new assessments completed. Due to this dynamic process, it is likely that additional lakes, reservoirs, rivers, and streams will be identified as water quality-limited in future years. This will become even more evident as basin management committees develop their own strategies for delineating and assessing priority 14-digit hydrologic units in their basins.

As new waterbodies are identified as water quality-limited, the NPS Management Program Plan will be evaluated and revised to meet new priorities and demands for program assistance, based on available resources, funding, and staff. Progress toward meeting long- and short-term program goals and objectives will be evaluated on a five-year basis. Performance measures used to evaluate program progress will include the number of NPS pollution TMDLs completed, the number of watershed restoration projects initiated, and water quality assessment information included in the 2004-2005, 2010-2011, and 2014-2015 Section 305(b) reports, or their equivalents.

The NPS Pollution Task Force is comprised of representatives from several public agencies and private groups. The Task Force provides input and recommendations on local projects funded through Section 319, as well as various NPS program activities (e.g., assessment reviews, BMP reviews). Agencies and groups represented on the Task Force are listed in Table II-2.

Table II-2. NPS Pollution Task Force Member Agencies and Groups

- EPA
- Farm Service Agency
- Medora County Grazing Association
- NRCS
- North Dakota Association of Soil Conservation Districts
- North Dakota Department of Agriculture
- North Dakota Farmers Union
- North Dakota Forest Service
- North Dakota Game and Fish Department
- North Dakota Grain Growers Association
- North Dakota Parks and Recreation Department
- North Dakota Pork Producers
- North Dakota Soil Conservation Committee
- North Dakota Department of Health
- North Dakota Farm Bureau
- North Dakota Geological Survey
- North Dakota State University Extension Service
- North Dakota State Water Commission
- North Dakota Water Resource Districts Association
- North Dakota Wetlands Trust
- North Dakota Wildlife Federation
- Rural Development
- Rural Water Users Association
- Spirit Lake Tribe
- The International Coalition
- Three Affiliated Tribes
- University of North Dakota Energy & Environmental Research Center
- U. S. Department of Agriculture - Agriculture Research Service
- U. S. Bureau of Land Management
- U. S. Bureau of Reclamation
- U. S. Fish and Wildlife Service
- U. S. Forest Service
- U. S. Geological Survey

As the lead state water quality agency, the Health Department is responsible for the administration and coordination of the state's NPS Pollution Management Program. This nonregulatory program is designed to encourage and support local NPS pollution control/abatement initiatives. The Health Department, in cooperation with the NPS Task Force, provides technical assistance and financial support to local sponsors addressing NPS pollution issues within approved priority areas. Financial support, provided through Section 319 of the Clean Water Act, is available to the sponsors through a competitive grant application process.

During this process, project work plans must be reviewed and approved by both the Task Force and EPA before Section 319 funds are allocated for the project. Following approval of the project, the Section 319 funds are administered by the Health Department and appropriated to the local sponsoring entities through annual contractual agreements. These funds are generally used to employ staff, implement BMPs, conduct information and education (I&E) activities, document water quality improvements, assess NPS pollution impacts, or a combination of the above.

Technical assistance is provided throughout the review process, as well as during work plan development. Daily management and implementation of the locally sponsored projects is usually accomplished through such entities as the soil conservation district (SCD) and/or the water resource district (WRD). Table II-3 lists the various organizations and groups which have sponsored Section 319 projects in North Dakota.

Table II-3. Local and State Agencies or Groups Which Have Sponsored or Co-Sponsored NPS Pollution Control Projects

Soil Conservation Districts
Water Resource Districts
Resource Conservation and Development Councils
Extension Service
Universities
Grazing Associations
County Commissions
City Councils
State Water Commission
North Dakota Department of Agriculture

In addition to the Section 319 NPS Pollution Management Program administered by the Health Department, there are many other state and federal programs which either directly or indirectly control NPS pollution. Table II-4 summarizes these programs.

Table II-4. Federal, State, and Local Programs Which Directly or Indirectly Control NPS Pollution

Program	Administering Agency Local	State	Federal	Program Area	Water Quality Effectiveness
Resource Conservation & Development Fund*	Local unit		NRCS	Statewide	Partially
Small Watershed Protection Project*			NRCS[1]	Local	Partially
Environmental Quality Incentive Program*			NRCS	Local	Fully
Wetland Reserve Program*			NRCS	Local	Partially
Conservation Reserve Program*			FSA[2]	Statewide	Partially
Swampbuster Act*	SCDs[3]		FSA NRCS	Statewide	Partially
401 Water Quality Certification*		Health Dept.	COE[4]	Local	Fully
Governor's Discretionary Funds*		Health Dept.	EPA	Statewide	Fully

Table II-4 (cont.) Federal, State, and Local Programs Which Directly or Indirectly Control NPS Pollution

Program	Local	Administering Agency State	Federal	Program Area	Water Quality Effectiveness
Revolving Loan Fund*					
603(2)(C)		Health Dept.	EPA	Statewide	Partially
604(b) Title VI		Health Dept.	EPA	Statewide	Partially
205(G)*		Health Dept.	EPA	Statewide	Partially
106*		Health Dept.	EPA	Statewide	Partially
Interest - Game and Fish Reserve Funds		Game & Fish		Local	Locally
Pesticide Applicator		Ag. Dept.		Statewide	Partially
Chemigation Program		Ag. Dept.		Statewide	Partially
No Net Wetland Loss		SWC[5]		Statewide	Partially
Land and Water Conservation Fund		Parks and Recreation Dept.		Statewide	Partially

Table II-4. (cont.) Federal, State, and Local Programs Which Directly or Indirectly Control NPS Pollution

Program	Administering Agency			Program Area	Water Quality Effectiveness
	Local	State	Federal		
Water Education for Teachers		SWC		Statewide	Partially
Prevention/Reduction of Contamination from Ag. Chemicals and Practices		Extension Service		Statewide	Fully
Improving Water Quality for Human and Livestock Consumption		Extension Service		Statewide	Fully
Soil and Water Conservation		Extension Service		Statewide	Partially

* Federal financial assistance and development programs
[1] Natural Resources Conservation Service
[2] Farm Service Agency
[3] Soil Conservation Districts
[4] U. S. Army Corp of Engineers
[5] North Dakota State Water Commission

Summary of Section 319 Projects

The North Dakota NPS Pollution Management Program has provided financial support to 71 projects since 1990. Of these projects, 39 are currently active, and 32 have been completed. While the size, type, and target audience of these projects may vary significantly, they all share the same basic goals. These common goals are to: 1) increase public awareness of NPS pollution, 2) evaluate/monitor NPS pollution impacts to beneficial uses; 3) reduce/prevent the delivery of NPS pollutants to waters of the state, and 4) disseminate information on effective solutions to NPS pollution.

To meet these goals, project sponsors use demonstrations, educational programs, etc. to familiarize the public with the types of NPS pollution impacts in the state or project area, as well as the various methods available for NPS pollution control. In conjunction with the educational activities, many of the projects, particularly the watershed projects, also provide financial and technical assistance to promote the implementation of BMPs to reduce NPS pollution. Ultimately, the success of these projects is dependent on the sponsors' ability to thoroughly educate the public on potential NPS pollution impacts. Chances for success are also enhanced when sponsors demonstrate that NPS pollution control and water quality improvements can profitably coexist with agribusiness.

North Dakota projects funded through Section 319 can be grouped into three separate categories. Placement of a given project into any one of these categories is simply based on the project's primary tasks and objectives. These project categories include: 1) development/assessment phase, 2) watershed, and 3) educational. The following paragraphs briefly describe each project type. Tables II-5 through II-8 list all the active and completed projects under each category that have been funded through the state NPS Pollution Management Program.

*** Development/Assessment Phase Projects ***

Given the competitive nature of the Section 319 funding process and the limited financial resources of state and local entities, the Health Department and NPS Task Force have recognized the need to better define NPS pollution impacts, as well as cost-effective solutions, within priority watersheds. To accomplish this, the NPS program has provided financial support to several development/assessment projects.

The primary purposes of development phase projects are to identify beneficial use impairments or threats to specific waterbodies and to determine the extent to which those threats or impairments are due to NPS pollution. Work activities during a development phase project generally involve an inventory of existing data and information and supplemental monitoring, as needed, to allow an accurate assessment of the watershed. Through these efforts the local project sponsors are able to: 1) determine the extent to which beneficial uses are being impaired; 2) identify specific sources and causes of the impairments; 3) establish preliminary pollutant reduction goals or TMDL endpoints; and 4) identify practices or management measures needed to reduce the pollutant sources and restore or maintain the beneficial uses of the waterbody. Development phase projects are generally one to two years in length. In conjunction with the data collection efforts, project sponsors may also implement a limited number of I&E activities to strengthen public awareness and support for future NPS pollution control efforts.

North Dakota has supported 20 development phase projects since 1994. Sixteen of these projects have been completed, and the others are scheduled for completion in 2000 and 2001. All of these projects have been implemented to more clearly define current NPS pollution impacts to beneficial uses within the project areas. Data collected within the project areas will be used to develop comprehensive watershed management plans. Table II-5 lists the specific development/assessment project initiated in the state.

Table II-5. Locally Sponsored Assessment/Development Phase Projects as of October 1999

Project	Project Type	Waterbody Type	NPS Category	Section 319 or 604(b) Allocation	Status
Upper Sheyenne Watershed - Phase I Development Project	Development	Lake/River	Agriculture	$30,110	Complete
Hay Creek Water Quality Improvement - Phase I	Development	Stream	Agriculture/ Urban	$27,130	Complete
Lake LaMoure Water Quality Assessment Project	Development	Lake/Stream	Agriculture	$6,256	Complete
Sheyenne River Monitoring (Barnes Co.)	Development	River	Agriculture/ Urban	$11,328	Complete
Beaver Creek Watershed Project	Development	Lake/Stream	Agriculture/ Urban	$40,030	Complete
Patterson Lake Watershed	Development	Lake/Stream	Agriculture	$52,875	Complete
Watershed Project Planner/Development	Development	All Types	Agriculture	$44,639	Complete
Cedar Creek Watershed Assessment	Development	Lake/Stream	Agriculture	$54,650*	Ongoing
Otter Creek Watershed Assessment	Development	Stream	Agriculture	$1,416**	Complete
Phase I Wild Rice Watershed Assessment	Development	Stream	Agriculture	$3,748	Complete
Richland County Water Quality Assessment	Development	Stream/River	Agriculture	$516	Complete
Mirror Lake Watershed	Development	Lake/Stream	Agriculture/ Urban	$0****	Complete
Antelope Creek Watershed	Development	Stream	Agriculture/ Urban	$13,180***	Complete
Upper /Lower Square Butte Creek Watershed	Development	Stream	Agriculture	$2,806**	Complete
Crown Butte & Otter Creek Watersheds (Morton Co.)	Development	Lake/Stream	Agriculture	$5,471**	Complete
Pipestem Reservoir Watershed	Development	Stream	Agriculture	$2,562	Ongoing

Table II-5. (cont.) Locally Sponsored Assessment/Development Phase Projects as of October 1999

Project	Project Type	Waterbody Type	NPS Category	Section 319 or 604(b) Allocation	Status
Buffalo Springs/Lightning Creek Watersheds	Development	Stream	Agriculture	$16,000***	Complete
Maple Creek Watershed (Dickey Co.)	Development	Stream	Agriculture	$67,080	Ongoing
McHenry Co. Souris River Subwatershed Assessment	Development	Stream	Agriculture	$8,994**	Complete
Cannonball Creek Watershed	Development	Stream	Agriculture	$14,559	Ongoing

* Includes $6,055 in 604(b) funding.

** 604(b) funding allocation.

*** The Section 319 funding for this project was part of the budget for an ongoing watershed project. Therefore, the assessment phase budget has been estimated.

**** The Health Department provided technical assistance and analytical support.

*** Educational Projects ***

Educational projects are those designed to disseminate information on NPS pollution issues. These projects can be one to five years in length and may focus on a variety of local and statewide NPS pollution concerns. Educational tools typically used by project sponsors include brochures, all media (TV, radio, newspaper, etc.), workshops, tours, and demonstrations. The common goal of all educational projects is to increase public awareness of the impacts of NPS pollution and possible solutions. As a secondary benefit, many of the educational projects help build public support for future NPS pollution control activities by increasing local residents' understanding of proposed corrective measures.

All educational projects funded through the NPS Pollution Management Program are included in the *NPS Pollution Management Program Information/Education Strategy*. This document was developed to establish long-range goals and objectives for the state NPS I&E program and to identify specific types of activities needed to strengthen existing NPS educational efforts. Currently, there are 11 active educational projects within the state. Seventeen were completed prior to 1999. Table II-6 lists the educational projects initiated to date.

Table II-6. State and Locally Sponsored Information/Education Projects as of October 1999

Project	Project Type	Waterbody Type	NPS Category	Section 319 Allocation	Status
Logging Camp Ranch Demonstration	Education	River/Stream	Agriculture	$19,447	Complete
Barnes Co. Abandoned Well Sealing Demonstration	Education	Ground Water	Agriculture	$14,056	Complete
Barnes Co. ECO-ED	Education	All Types	Crosscuts Categories	$31,686	Complete
Waterbank Demonstration	Education	Wetlands	Agriculture	$46,500	Complete
Zero Tillage Production Manual	Education	All Types	Agriculture	$48,502	Complete
Low Energy Precision Application (LEPA)	Education	All Types	Agriculture	$18,008	Complete
Area IV Abandoned Well Sealing Demonstration	Education	Ground Water	Agriculture	$6,684	Complete
CRP Grazing and Haying Demonstration	Education	All Types	Agriculture	$28,030	Complete
LaMoure Co. Abandoned Well Sealing Demonstration	Education	Ground Water	Agriculture	$6,701	Complete
Area II Abandoned Well Sealing Demonstration	Education	Ground Water	Agriculture	$8,325	Complete
Water Education for Teachers (WET)	Education	All Types	Crosscuts Categories	$425,176	Ongoing
Foster Co. Regional Env. Education Series (TREES)	Education	All Types	Crosscuts Categories	$293,012	Ongoing
Red River Basin Riparian Demonstration - Phase I	Education	Rivers/Streams	Agriculture	$102,158	Complete
Riparian Systems Workshop	Education	River/Streams	Crosscuts Categories	$13,011	Complete
Barnes Co. Livestock Waste Management Demonstration	Education	River/Streams	Agriculture	$543	Complete
GPS Site-Specific Management Demonstration	Education	All Types	Agriculture	$51,782	Complete

Table II-6. (cont.) State and Locally Sponsored Information/Education Projects as of October 1999

Project	Project Type	Waterbody Type	NPS Category	Section 319 Allocation	Status
Wells Co. Livestock Waste Management Demonstration	Education	All Types	Agriculture	$16,000	Ongoing
Livestock Waste Management Technical Assistance and Information Program	Education	All Types	Agriculture	$357,500	Ongoing
GIS Applications to Ground Water Protection Demonstration (Pesticides)	Education	Ground Water	Agriculture	$31,747	Complete
Statewide ECO-ED Camp	Education	All Types	Agriculture	$582,253	Ongoing
Southwest ND I&E Project	Education	All Types	Agriculture	$200,000	Ongoing
Zero Till - Advancing the Art Manual	Education	All Types	Agriculture	$93,970	Complete
Barnes Co. Livestock Waste & Streambank Management Demonstration	Education	Stream	Agriculture	$96,555	Ongoing
NDSU Deep Soil Nitrate Assessment	Education	Ground Water	Agriculture	$66,666	Ongoing
UND Aquifer Denitrification Assessment	Education	Ground Water	Agriculture	$71,905	Ongoing
NDSU GIS Nitrate Assessment System	Education	Ground Water	Agriculture	$39,008	Ongoing
Annual Zero-Till Conference Support	Education	All Types	Agriculture	$3,000	Complete
Riparian Restoration Demonstration - Upper Missouri	Education	River	Agriculture	$5,817	Ongoing

*** Watershed Projects ***

The watershed projects are the most comprehensive projects currently implemented through the NPS Pollution Management Program. These projects, the most long-term in nature, are designed to address documented NPS pollution impacts within approved priority watersheds.   The primary goal of the watershed projects is to restore and maintain designated beneficial uses impaired by NPS pollution. This is accomplished by: 1) promoting the voluntary application of BMPs, 2) providing technical and financial assistance for BMP implementation, 3) disseminating information on effective solutions to NPS impacts, and 4) evaluating the project's progress and benefits. Local sponsors use Section 319 funding, USDA cost-share assistance, or both to employ staff, cost-share BMPs, conduct I&E events, and monitor water quality and land use trends. The watershed projects are generally five to ten years in length, depending on the size of the watershed and extent of NPS pollution impacts.

To provide direction for selecting future watershed projects and ensure limited funding is used efficiently, the Health Department and NPS Pollution Task Force have revised the NPS Program's waterbody prioritization process. Lakes, reservoirs, streams, rivers, and aquifers and their watersheds will be separated into one of three different categories or tiers. Placement of a particular waterbody into Tier I, II, or III will be based on the data or "evidence" available on the impairments/threats to the waterbody's beneficial uses and the extent to which those are due to NPS pollution.

Tier I waterbodies will include all lakes, streams, and rivers where beneficial use impairments/threats are well documented and the problems are known to be predominantly due to NPS pollution.   Each Tier I waterbody will have sufficient monitoring/modeling information available to document the percent contribution from all sources of pollution within the waterbody's watershed. Tier I waterbodies and their watersheds will be eligible for Section 319 implementation phase funding.

Waterbodies in the Tier II category will include lakes, streams, and rivers where there is sufficient evidence that beneficial uses are being impaired or threatened. However, there is not sufficient information available to accurately identify the causes of these impairments/threats or to indicate whether the impacts are due wholly or partially to NPS pollution. Information regarding beneficial use impairments of Tier II waterbodies may be based on "hard" monitoring data or "soft" data such as best professional judgment or questionnaire feedback. Waterbodies and their watersheds, evaluated as Tier II, will be eligible for Section 319 financial assistance to support assessment and/or public educational efforts.

The development and assessment activities for Tier II waterbodies will generally last one to two years and include, at a minimum, a water quality monitoring plan and a watershed inventory. These assessment activities will be initiated to obtain sufficient information to accurately identify the causes of water quality problems and the extent to which the problems are due to NPS pollution. Educational efforts within Tier II watersheds will focus on increasing public awareness and understanding of local NPS pollution concerns and effective solutions to those concerns. These educational projects may last up to five years and be conducted concurrently with the assessment activities.

Tier III waterbodies are lakes, rivers, streams, and their watersheds for which there is no information or evidence of beneficial use impairments/threats. In addition, there is no information as to the causes of NPS pollution. Due to this lack of information, Tier III waterbodies are targeted for other Health Department monitoring and assessment activities (e.g., lake water quality assessment, ambient stream monitoring, fish tissue surveillance, or volunteer monitoring). Waterbodies under this category will not be eligible for Section 319 funding.

The development of the three-tiered waterbody prioritization process is the first step toward creating a more structured system for targeting and approving future NPS pollution control projects.

As this prioritization process evolves, there may also be a need to further rank or prioritize waterbodies within Tier I and Tier II. Criteria considered for further prioritization of Tier I and Tier II waterbodies may include the type and number of impaired or threatened beneficial uses, severity of NPS pollution impacts to beneficial uses, recreational value of the waterbody, waterbody/watershed size, state or national significance of the waterbody, and degree of local support for proposed project efforts.

To date, 23 locally sponsored watershed projects have been funded through the NPS Pollution Management Program. These projects have similar goals and objectives and were implemented to address the impacts of NPS pollution originating on agricultural lands. Table II-7 lists the watershed projects funded through the NPS Pollution Management Program since 1990.

Table II-7. Locally Sponsored Watershed Projects as of October 1999

Project	Project Type	Waterbody Type	NPS Category	Section 319 Allocation	Status
Bowman-Haley Watershed	Watershed	Lake/Stream	Agriculture	$636,670	Complete
Fordville Aquifer Study	Watershed	Ground Water	Agriculture	$21,086	Complete
Sheyenne River Improvement	Watershed	River	Agriculture	$38,017	Complete
Renwick, Homme, Mt. Carmel Watershed	Watershed	Lake/River/ Ground Water	Agriculture	$345,800	Complete
Bisbee-Big Coulee	Watershed	Lake/Stream	Agriculture	$188,128	Complete
Goodman Creek Watershed	Watershed	Stream	Agriculture	$153,519	Complete
Mulberry Creek Watershed	Watershed	Lake/Stream	Agriculture/ Urban	$64,117	Complete
Pipestem Creek Watershed	Watershed	Lake/Stream	Agriculture	$411,650	Ongoing
Upper Sheyenne Watershed Project - Phase II	Watershed	Lake/River	Agriculture	$460,257	Ongoing
Griggs County Water Quality Project	Watershed	River/Stream	Agriculture	$1,635,550	Ongoing
NPS BMP Engineering Team	Watershed	All Types	Agriculture	$483,945	Ongoing
Beaver Creek Watershed Project - Phase II	Watershed	Lake/Stream	Agriculture	$839,132	Ongoing
Cottonwood Creek Watershed Project	Watershed	Lake/Stream	Agriculture	$221,013	Complete
Hay Creek Water Quality Improvement Demonstration - Phase II	Watershed	Stream	Urban	$222,460	Ongoing
Antelope Creek Watershed	Watershed	Stream	Agriculture/ Urban	$189,834	Ongoing
Renwick Watershed	Watershed	Lake/Stream	Agriculture	$283,736	Ongoing
Mirror Lake Watershed	Watershed	Lake/Stream	Agriculture/ Urban	$197,600	Ongoing
Red River Riparian Project - Phase II	Watershed	River	Agriculture	$1,659,846	Ongoing

Table II-7. (cont.) Locally Sponsored Watershed Projects as of October 1999

Project	Project Type	Waterbody Type	NPS Category	Section 319 Allocation	Status
ND Waterbank Program	Watershed	Wetlands	Agriculture	$444,509	Ongoing
Hay Creek Watershed - Phase III	Watershed	Stream	Urban	$65,295	Ongoing
Cedar Lake Watershed	Watershed	Lake/Stream	Agriculture	$618,829	Ongoing
Wild Rice Watershed (WRAS)	Watershed	Stream/Wetlands	Agriculture	$305,000	Ongoing
Pembina River (WRAS)	Watershed	River/Stream	Agriculture	$151,572	Ongoing

*** Ground Water Monitoring/Assessment ***

Maintenance of the state's ground water resources is also an important component of the North Dakota NPS Pollution Management Program. Nearly all the locally sponsored projects address NPS pollution impacts to ground water to some degree. Locally sponsored activities may include implementation of BMPs, abandoned well sealing demonstrations, and irrigation system management workshops. The NPS program, in cooperation with the Health Department's Ground Water Program, has also supported two statewide ground water assessment studies. These projects include the GTS and the State Ground Water Monitoring Project. Table II-8 lists the ground water projects funded through the NPS Pollution Management Program.

The GTS was created to assess the relative vulnerability of the state's aquifers. The primary goal of this system was to prioritize the aquifers within North Dakota. Of particular concern was the impact agricultural chemicals and fertilizers may have on the state's ground water resources.

The GTS was not initiated to map recharge areas or identify critical areas within aquifers. Rather, the project was implemented to compare aquifers or portions of aquifers with one another. This was accomplished by utilizing the DRASTIC system for evaluating aquifer sensitivities (Aller, et al., 1987) (see page IV-13 in Part IV. Ground Water Assessment). The DRASTIC system involves rating each of the individual parameters for the site and multiplying the rate by a weighting (relative importance) factor to obtain a total DRASTIC score. Parameter weights were assigned for generic contaminant types and also to specifically reflect the agricultural usage of pesticides. Information compiled during the project will be used to provide direction for future ground water quality monitoring efforts.

The State Ground Water Monitoring Project was initiated in June 1994. This project is a direct follow-up to the GTS completed in 1993. Based on information collected through the targeting system, Ground Water Program personnel develop an annual schedule for monitoring specific priority aquifers. Sample collection is accomplished by utilizing existing domestic, stock, irrigation, public supply, and monitoring wells. Within each aquifer, sampling grids are developed, and within each grid block, one well is sampled. The size of the grid blocks are one section or 1 square mile. Wells chosen for sample collection are the shallowest wells in each grid block having verifiable drilling/construction logs. If more than one well is available, and they are screened at the same depths, the one nearest the center of the grid block is sampled. An inventory is also conducted at each well sampled to correlate potential site conditions with water quality observations.

Table II-8. State-Sponsored Projects Focusing on Ground Water Assessment as of October 1999

Project	Project Type	Waterbody Type	NPS Category	Section 319 Allocation	Status
LEPA Irrigation Monitoring	Assessment	Ground Water	Agriculture	$53,330	Complete
Aquifer Geographic Targeting System	Assessment	Ground Water	Agriculture	$7,562	Complete
Ground Water Monitoring	Assessment	Ground Water	Agriculture/ Urban	$287,722	Ongoing

Chapter 4. Coordination With Other Agencies

North Dakota has two rivers of international significance. The Souris River originates in the Canadian province of Saskatchewan, loops through North Dakota, and returns to the province of Manitoba (Figure II-1). The Red River of the North originates at the confluence of the Bois de Sioux and Ottertail Rivers at Wahpeton, North Dakota. The Red River flows north, forming the boundary between North Dakota and Minnesota before entering Manitoba. The Health Department participates in two cross-border cooperative efforts to jointly manage these rivers..

The Souris River Bilateral Water Quality Monitoring Group was established on October 26, 1989, in accordance with the Canada-United States Agreement for Water Supply and Flood Control in the Souris River Basin. Objectives of the group include: 1) designing a monitoring plan for the Souris River and 2) overseeing the review, interpretation, and annual reporting of water quality conditions in the Souris River Basin. In addition to the Health Department, other members of the group include Environment Canada, Saskatchewan Environment, Manitoba Environment and Public Safety, the USGS, and EPA.

The other international water quality effort in which the Health Department is involved is the International Red River Water Pollution Board. Created by the International Joint Commission (IJC), the Board monitors Red River water quality. The Board also informs the IJC of trends and exceedances of water quality objectives, documents discharges and control measures, establishes a spill contingency plan, and identifies future water quality issues. Board activities are detailed in annual reports. Other members of the Board include Environment Canada, Manitoba Environment and Public Safety, Manitoba Department of Natural Resources, EPA, and the Minnesota Pollution Control Agency.

The Health Department monitors water quality in Devils Lake and distributes historical and current data to various federal and state agencies. Information and technical expertise is provided to sponsoring agencies that are planning mitigative measures for rising lake levels.

The International Coalition is an active group with members from Canada, Minnesota, and North Dakota. The Coalition promotes basin-wide, natural resource management in the Red River Basin by serving as an information clearinghouse. In February 1996, a Leaders Summit convened to discuss how to address water resource concerns. Later that year, the Red River Basin Board (RRBB) was created at the International Coalition’s annual conference in Winnipeg, Manitoba.

The RRBB is not intended to replace governmental agencies or local boards that have water management responsibilities in the basin. Rather, it was created to develop a comprehensive plan on a scale never before attempted. Another purpose of the RRBB is to foster the inter-jurisdictional coordination and communication needed to implement such a plan and to resolve disputes that inevitably will arise among varied interests during the planning process.

Today's RRBB consists of 21 individuals who primarily represent local governmental entities, including cities, counties, rural municipalities, watershed boards, water resource districts, joint powers boards, tribal governments, a water supply cooperative, and a lake improvement association. The states of Minnesota, North Dakota, and South Dakota, and the province of Manitoba are represented.

Cost/Benefit Assessment

Costs associated with municipal point source pollution control have been extensive. Capital investments in the form of additions to and construction of new wastewater treatment facilities account for the largest expenditure of funds. While the Construction Grants and SRF programs have been the major sources of funding, many communities have upgraded wastewater treatment facilities at their own expense.

The SRF replaced the Construction Grants Program in the early 1990s. In federal fiscal years 1998 and 1999, approximately $29 million has been obligated from the SRF for the construction of wastewater system improvements. During the last ten years, over $143.4 million has been invested in wastewater system improvements. The cumulative amount since passage of the Clean Water Act in 1972 is approximately $344 million. In addition to the capital costs, an estimated $7 million per year is spent operating and maintaining wastewater treatment systems.

While the costs of construction are relatively easy to compile, monetary benefits cannot be so easily quantified. Qualitative benefits include the reduction or elimination of waste loads to receiving waters (Figures II-2 and II-3 in Part II, Chapter 2) and the elimination of public health threats such as malfunctioning drainfield systems and sewer backups.

Special State Concerns and Recommendations

Surface Water

The following are recommendations the Health Department believes should be considered to further reduce pollution to North Dakota's rivers, streams, lakes, and reservoirs.

Watershed Approach

The "watershed approach" is not a new or unique concept in water quality protection programs. The concept of conducting watershed planning and management first arose with Section 208 of the original 1972 Clean Water Act. The watershed approach is also a key element in EPA's Clean Water Action Plan. This cooperative approach involves state, tribal, federal, and local governments, and the public identifying the watersheds with the most critical water quality problems and then working together to focus resources and implement effective strategies to solve those problems.

It is the Health Department's recommendation that a watershed approach be implemented for all of its water quality monitoring, assessment, and control programs. Local governmental entities (e.g., SCDs, WRDs, county commissions, cities) should be the primary sponsors in implementing watershed management, however.

North Dakota's NPS Pollution Management Program has used the watershed management approach since its inception. The Health Department has also initiated this approach with its monitoring and assessment programs. The state is divided into six watershed basins, with each basin monitored intensively for one year. The purpose is three-fold: 1) to increase the miles of assessed rivers and streams, 2) to gain a better understanding of all the pollutant sources in a watershed, and 2) to set priorities for those water quality problems which are the most severe. With the watershed approach, both point and NPS pollution controls and management measures can be addressed simultaneously to improve water quality.

Other Recommendations

As the dominant land use in North Dakota, agriculture has been the primary focus of the state's NPS Pollution Management Program. Over the past seven years, the Health Department has directed a majority of Section 319 funds to projects addressing agricultural NPS pollution. Given the magnitude and complexity of the agricultural industry, the Health Department has developed a close working relationship with the USDA's NRCS to ensure sufficient resources are available to adequately address NPS pollution within the state. The combined resources from both the Section 319 program and the USDA have proven essential for a balanced NPS Pollution Management Program. To maintain this coordinated effort, continued funding through Section 319 and the USDA programs will be necessary.

It would also be beneficial if state funds, administered through grants to priority NPS pollution watersheds, could be made available. These funds could provide a portion of the state/local match required for Section 319 funding and provide an incentive to sponsors contemplating volunteer NPS pollution management efforts.

Public awareness of environmental issues, along with the trend toward larger, more concentrated livestock operations, has brought increased concern over these operations and their potential impacts to water quality. The Health Department has taken a more aggressive role in addressing pollution concerns from animal feeding operations by focusing more attention on public education and by increasing inspections of existing livestock facilities. In addition, more local and producer-oriented groups are providing operators of animal feeding operations with educational, technical, and financial assistance to update their facilities so they will not impact waters of the state.

The department is also implementing more thorough and documented guidelines, detailing minimum requirements livestock facilities must meet to ensure their manure handling systems are adequate to prevent livestock waste pollution. All new livestock facilities or those that need to be updated must meet these minimum standards. The department's nutrient management plan guidelines for manure are also being updated to be more comprehensive. The Health Department will continue to work closely with the NRCS and other entities providing assistance to implement approved livestock waste systems.

The Health Department has taken an active approach in conducting its Stormwater Program. General permits have been issued for stormwater discharges from industrial, construction, and mining activities. Stormwater pollution prevention plans are constantly being updated. Departmental review of notices of intent is also ongoing. The Stormwater Program has cooperated with the Section 319 NPS Pollution Management Program to assist small communities located within watershed projects to prevent pollutants from entering runoff.

The Health Department is also working to bring stakeholders together in an effort to implement Phase II of the Stormwater Program. The department will continue these efforts until a successful program has been developed to addresses construction disturbances under five acres, light industry, and small muncipalities.

Biological assessment techniques and methods should be further incorporated into the Health Department's water quality monitoring program. It is generally believed that the instream biological community (e.g., fish aquatic insects, algae) exposed to pollutant stresses on a continual basis is the best measure of aquatic life use.

The Health Department is in the process of revising its standards of water quality. The standards delineate the policy of the state which is to protect, maintain, and improve the quality of water for use as public and private water supplies; for propagation of wildlife, fish, and aquatic life; and for domestic, agricultural, industrial, recreational, and other legitimate beneficial uses. These standards identify specific numeric criteria for chemical, biological, and physical parameters. The specific numeric standard assigned to each parameter ensures protection of the beneficial uses for that classification.

The anti-degradation policy is also being refined by the Health Department. Under this policy and implementation procedure, all waters of the state are afforded one of three different levels of anti-degradation protection. All existing uses, and the level of water quality necessary to protect those uses, shall be maintained and protected. Anti-degradation requirements are necessary whenever a regulated activity is proposed that may have some impact on water quality and/or the ability of a waterbody to maintain its beneficial use designation. The department will conduct an anti-degradation review of all proposed regulated activities affecting waters of the state. The level of detail of the review will depend upon the anti-degradation protection applicable to various classes of water.

EPA's Section 314 Clean Lakes Program has been recognized as a success by both the private and public sectors. Recreational and fishing benefits have been restored on untold numbers of lakes nationwide as a result of Clean Lakes funding. In North Dakota, both Spiritwood and Mirror Lakes were improved and restored with Section 314 funding. While there is an ever growing list of potential clean lakes projects, funds have disappeared. Dedicated federal funding through Section 314 should be re-established for the Clean Lakes Program, and limited state funds should be made available to local sponsors willing to invest in the restoration of lakes in North Dakota.

Ground Water

Many different federal, state, and local agencies are concerned with ground water quality issues across the nation. In North Dakota, agencies including the USGS, EPA, the Health Department, and the SWC are involved in sample collection and analysis of ground water as well as the study of activities which exhibit the potential to impact ground water quality. Problems associated with the involvement of multiple agencies are the lack of interagency communication, data sharing, and data incompatibility.

Communication among all levels of federal, state, county, and city government, as well as private interests, is crucial to the effective management of water resources in North Dakota. Improper communication, duplicating efforts, gearing funds toward activities not identified as state priorities, and the lack of a water quality data clearinghouse all act to reduce the effectiveness of limited funding in the state. Consistent, compatible data sharing is essential to providing for the effective assessment of water quality and the activities that impact its use. A standard data format and storage clearinghouse is important to promote cooperation among the interested parties. With the growth of GIS in the ground water field, a standard format should include those elements critical to GIS.

Conclusion

There have been many improvements in water quality since passage of the Clean Water Act in 1972. Secondary wastewater treatment has been achieved for every municipality in the state. Wellhead protection programs are being developed for public drinking water supplies relying on ground water. Increased inspections will assure that concentrated animal feeding operations are managed in such a way that waste and runoff will not reach surface or ground water resources. Biological measures are being integrated into ambient monitoring for water quality assessment. These are but a few of the successes. Much remains to be done, however, if the goal of restoring and maintaining the chemical, physical, and biological integrity of the state's and nation's waters is to be achieved.

PART III. SURFACE WATER ASSESSMENT

Chapter 1. Surface Water Quality Monitoring Program

Rivers and Streams Monitoring and Assessment

Historically, water quality monitoring conducted by the department consisted of a statewide network of chemical monitoring stations. Many of these stations were located immediately below point source discharges or near the confluences of major streams. Sampling at these stations ranged from a quarterly to a monthly sampling frequency. Typical water quality variables sampled for and analyzed were temperature, DO, pH, major ions, nutrients (i.e., total phosphorus, ammonia, nitrate), and fecal coliform bacteria. Trace elements were also sampled and analyzed at a few select sites across the state. At its peak, in 1993, the Health Department's monitoring network included 61 ambient chemical monitoring sites on 31 rivers and streams. The primary purpose of this historic monitoring program was to assess the general chemical character of the state's rivers and streams and, to the extent practical, assess point source discharge compliance with *State Water Quality Standards*.

While effective in its original purpose, this historic strategy was largely ineffective in assessing trends in water quality across the state, nor did it provide enough spatial resolution necessary to conduct beneficial use assessments for any significant number of stream miles in the state. Where data was available, it was still difficult to make beneficial use assessments, since much of it was only indirectly related to beneficial use impairment. For example, copper concentrations which exceed the state copper standard are believed to have a toxic effect on the biological community. Therefore, the occurrence of copper concentrations exceeding the state standard should be an indicator of potential aquatic life use impairment. It is not a substitute for direct measures of the biological community as a measure of aquatic life use impairment, however. In addition, traditional monitoring also ignored the effects of other pollutants (e.g., nutrients, sediment) and the effects of habitat alterations on the aquatic life use of our streams.

In response to this growing need for better water quality assessment information, the department initiated a biological monitoring program in 1993 to run through 1994. This program, a cooperative effort with the Minnesota Pollution Control Agency and the USGS's Red River National Water Quality Assessment Program, involved approximately 100 sites in the Red River Basin. The result of this initial program was development of the IBI for fish in the Red River Basin. This program continued in the Red River Basin in 1995 and 1996 (100-plus biological monitoring sites), in the Souris River Basin in 1997, in the James River Basin in 1998, and in the Lake Sakakawea subbasin of the Missouri River Basin in 1999 (Figure III-1). The Upper Red River Basin, including the Sheyenne River and its tributaries, was sampled in 1995, while the Lower Red River Basin was sampled in 1996. Beginning in 1995, biological monitoring was expanded to include macroinvertebrate sampling. This basin approach to biological monitoring allows for more intensive water quality monitoring and assessment. The result has been better resolution in the Health Department's monitoring program, an increase in the percentage of

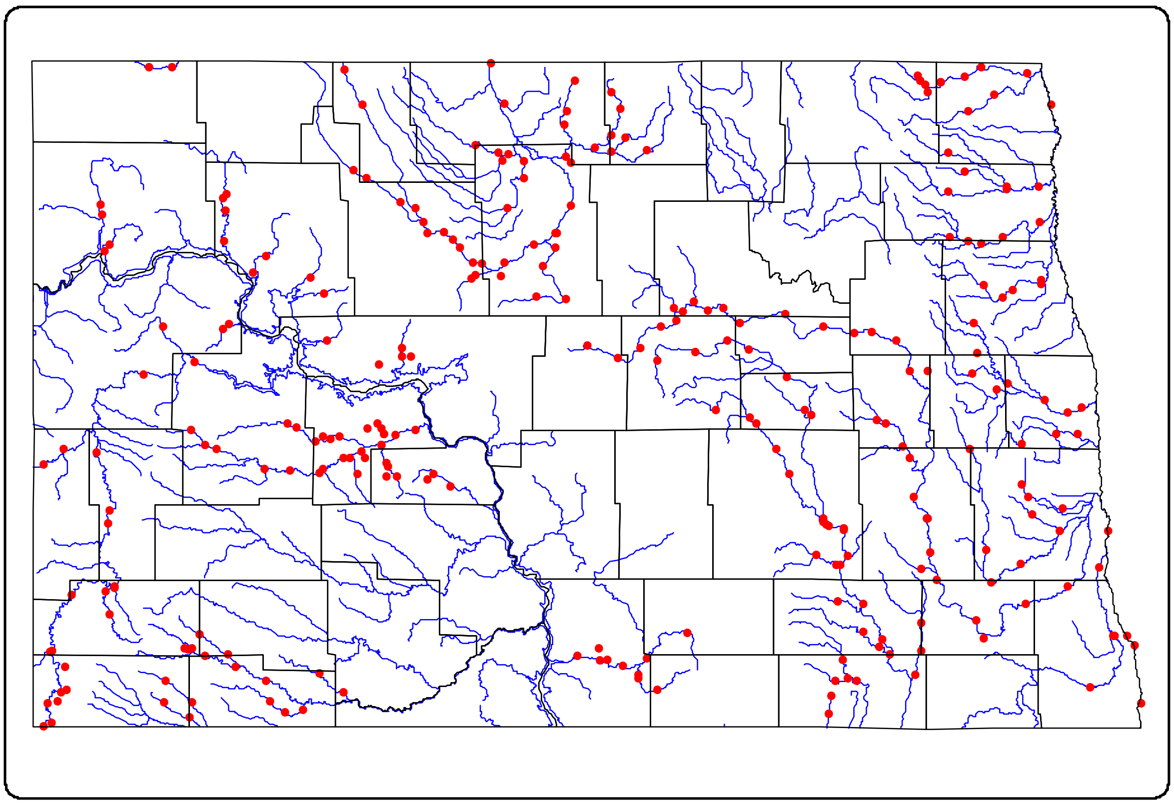

Figure III-1. North Dakota Biological Monitoring Stations 1993-1999

rivers and streams assessed, and a direct assessment of aquatic life use support for the state's rivers and streams, rather than relying on surrogate measures such as chemical concentration data.

In 1997, 1998, and 1999, the department focused its intensive basin survey efforts on the Souris River Basin, the James River Basin, and the Lake Sakakawea subbasin, respectively. In addition to chemical monitoring, biological monitoring was conducted at approximately 50 sites in each basin each year. At each site the fish and macroinvertebrate communities were sampled. In addition, a habitat assessment was conducted at each site following the Rapid Bioassessment Protocols published by EPA. The purpose of this biological monitoring program is to:
1) develop an IBI for fish and macroinvertebrates; and 2) provide an assessment of aquatic life use attainment for those stream reaches which were assessed.

At the same time the department was increasing its commitment to biological monitoring, it reduced the number of ambient chemical monitoring sites. Since 1994, the department has operated a network of 26 to 27 ambient monitoring sites. Where practical, sites are co-located with USGS flow gauging stations, thereby facilitating the analysis of chemical data with stream hydrologic data. All of these sites are established as basin or subbasin integrator sites, where the chemical character measured at each of these sites reflects water quality effects in the entire watershed. It is the department's intention to maintain these as long-term monitoring sites for the purpose of assessing water quality trends and to describe the general chemical character of the state's major river basins. Sites sampled in 1998 and 1999 as part of the department's ambient monitoring network are shown in Figure III-2 and Table III-1.

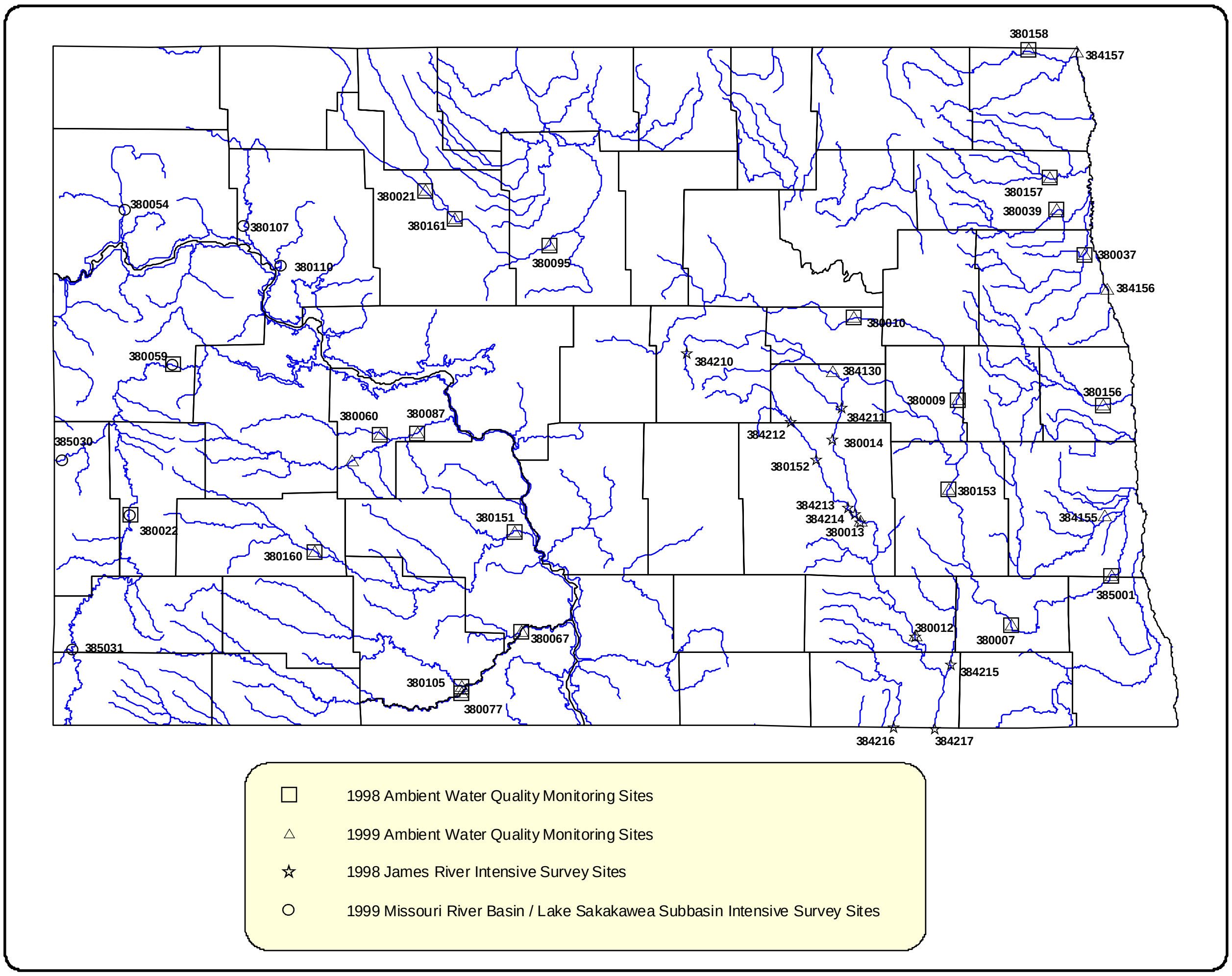

Figure III-2. 1998-1999 Water Quality Sampling Sites

Table III-1. 1998 and 1999 Sampling Sites - Ambient Stream Monitoring - Statewide

Station ID	River	Location	Station ID	River	Location
380007	Sheyenne	Lisbon	380157	Park	Grafton
380009	Sheyenne	Cooperstown	380158	Pembina	Neche
380010	Sheyenne	Warwick	380160	Heart	South of Richardton
380012[2,3]	James	LaMoure	380161[1,2]	Souris	West of Minot
380013[2,3]	James	Jamestown	384130[2]	James	Grace City
380014[3]	James	East of Edmunds	384131[2]	Knife	Golden Valley
380021	Des Lacs	Foxholm	384155[2]	Maple	Mapleton
380022[1,4]	Little Missouri	Medora	384156[2]	Red	Grand Forks
380037	Turtle	Manville	384157[2]	Red	Pembina
380039	Forest	Near Minto	384210[3]	James	Near Manfred
380054[4]	Little Muddy	Northeast of Williston	384211[3]	James	Above Arrowwood
380059[1,4]	Little Missouri	Hwy 85	384212[3]	Pipestem	Near Melville
380060	Spring Creek	Zap	384213[3]	Pipestem	Below Pipestem Dam
380067	Cannonball	South of Breien	384214[3]	James	Below Jamestown Dam
380077	Cedar Creek	South of Raleigh	384215[3]	Bear Creek	Near Oakes
380087	Knife	South of Hazen	384216[3]	Maple	Near Ellendale
380095	Souris	Verendrye	384217[3]	James	Near Ludden
380105	Cannonball	Raleigh	385001	Sheyenne	Kindred
380107[4]	White Earth	Near Hwy 1804	385030[4]	Beaver Creek	Near Trotters
3801104[4]	Little Knife	Near New Town	385031[4]	Little Missouri	At Marmarth
380151	Heart	West of Mandan			
380152[3]	Pipestem	West of Pingree			
380153	Sheyenne	Baldhill Dam			
380156	Goose	Hillsboro			

[1]Sampled in 1998 as part of statewide ambient monitoring.
[2]Sampled in 1999 as part of statewide ambient monitoring.
[3]Sampled in 1998 as part of the James River Basin Intensive Survey.
[4]Sampled in 1999 as part of the Missouri River Basin/Lake Sakakawea Subbasin Intensive Survey.

In 1997, the Health Department began full implementation of its intensive survey approach to water quality monitoring and assessment. The approach complements the ambient water quality monitoring network maintained by the department and other program monitoring activities (e.g., lake water quality assessments, NPS pollution monitoring and assessment, point source compliance monitoring). The approach integrates chemical monitoring at targeted sites with biological monitoring at sites throughout the basin. Six basins will be sampled intensively for one year on a rotating basin approach. The Souris River Basin, James River Basin, and the Missouri River/Lake Sakakawea subbasin were sampled in 1997, 1998, and 1999, respectively. Sampling is scheduled for the Missouri River/Lake Oahe subbasin in 2000 and for the Upper and Lower Red River Basins in 2001 and 2002, respectively.

*** 1997 Souris River Intensive Survey - Summary of Activities***

Chemical monitoring was conducted at 14 sites in the Souris River Basin in 1997-1998. Five sites were located on tributaries to the Souris River, while the remaining nine sites were located on the mainstem Souris River (Figure III-2 and Table III-2). Sites were sampled 11 times during the survey. Samples were collected every two weeks beginning the week April 21 through June 16. Monthly samples were collected July through November, and one set of samples was collected under ice cover in February 1998. All samples collected were analyzed for major cations and anions, trace elements (total recoverable and dissolved), nutrients, TSS, fecal coliform bacteria, and fecal streptococcus bacteria (Table III-5). Samples collected in August and September were also analyzed for selected pesticides (Table III-5).

Biological monitoring was also conducted in the Souris River Basin in 1997. Forty-six sites were sampled for fish and macroinvertebrates (Figure III-1). Based on results from this monitoring, a draft IBI for fish has been developed for the Souris River.

Table III-2. Souris River Basin Chemical Monitoring Sites

Station ID	Description	USGS Co-located Station
384135	Long Creek near Noonan, ND	05113600
380091	Souris River near Sherwood, ND	05114000
380100	Souris River at Foxholm, ND	05116000
380021	Des Lacs River at Foxholm, ND	05116500
380161	Souris River above Minot, ND	05117500
380098	Souris River below Minot, ND	--
380099	Souris River at Ward/McHenry Co. Line	--
380095	Souris River near Verendrye, ND	05120000
384107	Wintering River near Karlsruhe, ND	05120500
380018	Souris River near Towner, ND	--
380094	Souris River near Bantry, ND	05122000
384132	Willow Creek near Willow City, ND	05123400
384133	Deep Creek near Upham, ND	05123510
380090	Souris River near Westhope, ND	05124000

*** 1998 James River Basin Intensive Survey - Summary of Activities ***

Water quality monitoring was conducted for chemical constituents at 13 sites in the James River Basin in 1998-1999. Eight sites were located on the mainstem of the James River, while five sites were on tributaries to the James. Three were located on Pipestem Creek, one was on the Maple River, and one on Bear Creek (Figure III-2 and Table III-3).

Sites were sampled ten times during the survey. Samples were collected every two weeks from March 8 through June 16. Monthly samples were collected July through October, and one set of samples was collected under ice cover in late February/early March 1999. All samples collected were analyzed for general chemistry variables, nutrients, trace elements (total recoverable and dissolved), TSS, fecal coliform, and fecal streptococcus bacteria (Table III-5). Samples collected in May, June, and July were also analyzed for selected pesticides and organic contaminants (Table III-5).

As part of the James River Basin Intensive Survey, fish and macroinvertebrates were collected in the James River Basin at 38 sites. Data generated from these samples will be used to construct a multimetric IBI for fish and macroinvertebrates.

Table III-3. James River Basin Chemical Monitoring Sites

Station ID	Description	USGS Co-located Station
384210	James River near Manfred, ND	06467600
384130	James River near Grace City, ND	06468170
384211	James River above Arrowwood Lake	06468250
380014	James River below Arrowwood Lake	–
384214	James River below Jamestown Dam	–
384212	Pipestem Creek near Melville, ND	–
380152	Pipestem Creek near Pingree, ND	06469400
384213	Pipestem Creek below Pipestem Dam	–
380013	James River at Jamestown, ND	06470000
380012	James River at LaMoure, ND	06470500
384215	Bear Creek near Oakes, ND	06470800
384217	James River near Ludden, ND	06470875
384216	Maple River near Ellendale, ND	06471200

*** 1999 Missouri River/Lake Sakakawea Subbasin Intensive Survey - Summary of Activities ***

Chemical monitoring was conducted at seven sites in the Lake Sakakawea subbasin of the Missouri River Basin in 1999. Four sites were located on the Little Missouri River and its tributary, Beaver Creek. The remaining three sites were on the Little Muddy River, White Earth River, and the Little Knife River (Figure III-2 and Table III-4).

Sites were sampled nine times during the survey. Sites were sampled every two weeks beginning the week of March 29 through May 26, 1999. Monthly samples were collected June through October. No samples were collected in the winter. All samples collected were analyzed for major cations and anions, trace elements (total recoverable and dissolved), nutrients, TSS, fecal coliform bacteria, and fecal streptococcus bacteria (Table III-5). There were no samples collected and analyzed for pesticides as part of this survey.

During the survey, biological monitoring was conducted at 41 sites. Fish and macroinvertebrate samples collected at these sites will be aggregated with similar samples collected for the Missouri River/Lake Oahe subbasin in 2000 and in previous years. These aggregate data will be used to construct a multimetric IBI for the entire Missouri River Basin.

Table III-4. Missouri River/Lake Sakakawea Subbasin Chemical Monitoring Sites

Station ID	Description	USGS Co-located Station
385031	Little Missouri River at Marmarth, ND	06335500
380022	Little Missouri River at Medora, ND	–
385030	Beaver Creek near Trotters, ND	06336600
380059	Little Missouri River near Watford City, ND	06337000
380054	Little Muddy River near Williston, ND	06331000
380107	White Earth River near Hwy 1804	–
380110	Little Knife River near New Town, ND	–

Table III-5. Chemical, Physical, & Bacteriological Water Quality Variables Analyzed From Sites in Souris, James, and Missouri River/Lake Sakakawea Subbasins

	Laboratory Analysis				
Field Measurements	Gen. Chemistry	Nutrients[1]	Trace Elements[2]	Pesticides	Biological
Temperature	Sodium	Ammonia	Boron	Aldrin	Fecal Coliform
pH	Potassium	Nitrate +	Aluminum	BHC	Fecal Strep.
Specific Conductance	Magnesium	Nitrite	Manganese	Lindane	
Dissolved Oxygen	Potassium	Total Kjeldahl	Iron	DDD	
	Calcium	Nitrogen	Beryllium	DDE	
	Chloride	Total	Chromium	DDT	
	Sulfate	Phosphorus	Nickel	Dieldrin	
	Hardness		Copper	Endosulfan	
	Alkalinity		Zinc	Endrin	
	Total Dissolved Solids		Arsenic	Heptachlor	
			Selenium	Methoxychlor	
	Total Suspended Solids[1]		Silver	Hoelon	
			Cadmium	Toxaphene	
			Antimony	Chlordane	
			Barium	Nonachlor	
			Thallium	Endrin	
			Lead	Alachlor	
				Chlorpyrifos	
				Diazinon	
				Malathion	
				Parathion	
				Fenvalerate	
				Cyanazine	
				Triallate	
				Trifluralin	
				Simazine	
				Ethalfluralin	
				Atrazine	
				Prowl	
				Metribuzine	
				Methylchlor	
				2,4-D	
				Dicamba	
				Dinoseb	
				MCPA	
				Tordon	
				2,4,5-T	
				Silvex	
				Pentachlorophenol	
				Aciflurfen	
				3,5 Dichlorobenzoic Acid	
				Bromoxynil	
				Dichlorprop	
				Bentazon	

[1]Analyzed from a depth/width integrated sample. [2]Analyzed as total recoverable and as dissolved.

*** Other Data Sources ***

The department also uses data collected by the USGS. The USGS maintains and operates several water quality monitoring sites which provide data used by the department for assessment purposes. Many of these sites are maintained through cooperative agreements with other agencies (e.g., SWC, U. S. Bureau of Reclamation, COE), through international agreements (e.g., the Souris River Bilateral Agreement), or with the department itself.

An example of one such project is a cooperative study in the upper Red River Basin. This study, which was initiated in 1997 and concluded in September 1999, was a cooperative study between the USGS, the Health Department, and the Minnesota Pollution Control Agency. Objectives of the study are to determine loading contributions from different subbasins of the Upper Red River Basin and to evaluate the effects of constituent concentrations and loads in the aquatic community of the Red River. Physical, chemical, and sediment data were collected from 11 sites on the Red River and its tributaries in 1997 and from eight sites in 1998 and 1999.

In addition to the 27-station, ambient chemical monitoring network and the intensive basin survey program, the Health Department cooperates with local project sponsors (e.g., SCDs and WRDs) in small watershed monitoring and assessment projects. The approach of these monitoring and assessment projects is similar to the highly successful Clean Lakes - Phase I Diagnostic/Feasibility Studies. These projects entail intensive water quality monitoring, stream flow measurements, land use assessments, and biological assessments. Where lake water quality is a concern, lake monitoring is also included in the sampling and analysis plan. The goal of these small watershed monitoring projects is to estimate pollutant loadings to the lake or stream and, where appropriate, set target load reductions necessary to improve beneficial uses (e.g., aquatic life, recreation). Most of these projects are followed by Section 319 NPS Pollution Management Program Watershed Implementation Projects (see Part II, Chapter 3. NPS Pollution Control Program).

Lakes and Reservoirs Monitoring and Assessment

In 1991, through a grant from the EPA Clean Lakes Program, the Health Department initiated the LWQA Project. Through 1997, the LWQA Project has completed sampling and analysis for 111 lakes and reservoirs in the state (Table III-6). In addition to normal LWQA monitoring, five reservoirs were revisited in 1994 to investigate the effects, if any, of flooding which occurred in the summer of 1993. The objective of the assessment project is to describe the general physical and chemical condition of the state's lakes and reservoirs.

Table III-6. North Dakota Lakes and Reservoirs Assessed From 1991 Through 1999

1991-92 Lakes

Armourdale Dam
Bisbee-Big Coulee Dam
Blacktail Dam
Brewer Lake
Brush Lake
Cedar Lake
Clausen Springs Dam
Crooked Lake
Epping-Springbrook Dam
Green Lake
Harvey Dam
Indian Creek Dam
Kulm-Edgeley Dam
Lake Hoskins
Lake LaMoure
Long Lake
Matejcek Dam
McGregor Dam
Nieuwsma Dam
North Carlson Lake
North Golden Lake
Northgate Dam
Pheasant Lake
Rice Lake
Short Creek Dam
South Golden Lake
Strawberry Lake
Velva Sportsman's Dam
Welk Dam
Whitman Dam

1992-93 Lakes

Alkali Lake
Arnegard Dam
Balta Dam
Baukol Noonan Dam
Beaver Lake
Braddock Dam
Carbury Dam
Clearwater Lake
Crown Butte Dam
Dead Colt Creek Dam
Fordville Dam
Froelich Dam
Heinrich Martin Dam
Hiddenwood Lake
Kota-Ray Dam
Lake Elsie
Lake Isabel
Lake Metigoshe
Lake Tschida
Lake Williams
LaMoure Dam
McVille Dam
Mirror Lake
North Lemmon Lake
Odland Dam
Patterson Lake
Red Willow Lake
Riverdale Spillway Pond
Sheep Creek Dam
Silver Lake
Skjermo Lake
Smishek Lake
Sweet Briar Dam
Tolna Dam
Warsing Dam
White Earth Dam

1993-94 Lakes

East Park Lake
Fish Creek Dam
Heckers Lake
Lehr Dam
Nelson Lake
New Johns Lake
Nygren Dam
Schlecht-Thom Dam
Schlecht-Weixel Dam
West Park Lake
Wilson Dam

1994-95 Lakes

Bowman-Haley Reservoir
Danzig Dam
Davis Dam
Dickinson Dike
Lake Brekken
Lake Holmes
Leland Dam
McDowell Dam
South Buffalo Cap
Spring Lake Dam

1994 Flood Lakes

Brewer Lake
Renwick Dam
Sweet Briar Dam
Velva Sportsman's Dam

Table III-6. (cont.) North Dakota Lakes and Reservoirs Assessed From 1991 Through 1999

<u>1995-96 Lakes</u>

Buffalo Lodge Lake	Gravel Lake	Pelican Lake
Carbury Dam	Hooker Lake	School Section Lake
Carpenter Lake	Jensen Lake	Strawberry Lake
Dion Lake	Lake Upsilon	
George Lake	Long Lake	

<u>1996-96 Lakes</u>

Bylin Dam	Lake George	Niagara Dam
Homme Dam	Lake Tobiason	Renwick Dam
Kolding Dam	Mt. Carmel Dam	Wood Lake

<u>1997-98 Lakes</u>

Lake Darling	Upper Des Lacs Reservoir

<u>1998-99 Lakes</u>

Jamestown Reservoir	Pipestem Dam

<u>1999-2000 Lakes</u>

Lake Sakakawea	Lake Oahe

The lakes and reservoirs targeted for assessment were chosen in conjunction with the North Dakota Game and Fish Department. Criteria used during the selection process were geographic distribution, local and regional significance, fishing and recreational potential, and relative trophic condition. Lakes without much historical monitoring information were given the highest priority.

The results from the LWQA Project have been prepared in a functional atlas-type format. Each lake report discusses the general description of the waterbody, general water quality characteristics, plant and phytoplankton diversity, trophic status estimates, and watershed condition. The following is a brief description of the sections found in each lake assessment, the techniques used in sample collection, and data interpretation.

General water quality for lakes and reservoirs sampled as part of the LWQA Project is described, using samples collected in the deepest areas of the waterbody. Samples are collected three times during the assessment period: twice during the summer and once during the ice-cover period. A complete list of analyzed water quality variables is provided in Table III-7.

Table III-7. Water Quality Parameters Analyzed During the LWQA

Total Alkalinity ($CaCO_3$)	Sodium Absorption Ratio
Ammonia (NH_3)	Conductivity
Carbonate (CO_3)	Total Kjeldahl Nitrogen
Chloride (Cl)	Nitrate + Nitrite as N
Total Hardness as Calcium (as $CaCO_3$)	Calcium (Ca)
pH	Iron (Fe)
Percent Sodium	Magnesium (Mg)
Sulfate (SO_4)	Manganese (Mn)
TDS	Potassium (K)
Total Phosphate as Phosphorus	Sodium (Na)
Cation Sum	Anion Sum

Samples are collected at three discrete depths if the lake is greater than 4 meters deep or thermally stratifies, and at two depths if the lake was 3.5 meters deep or less. During periods of thermal stratification, samples are collected at: 1) the 1-meter depth interval to represent the epilimnion, 2) just below the thermocline to represent the transition zone between the epilimnion and the hypolimnion, and 3) just above the bottom to represent the hypolimnion. In lakes that exceed 10 meters and are experiencing well-defined thermal stratification, a fourth sample is collected just above the thermocline to identify any significant changes in the epilimnion.

A volume-weighted mean is calculated for each lake using this stratified sampling technique to describe its general chemical characteristics. The volume-weighted mean is calculated by weighting the analyzed water quality variable by the percentage of water volume represented at each depth interval. For example, if the epilimnion represented 60 percent of the total water volume, the transition zone 10 percent, and the hypolimnion 30 percent, the concentrations of the corresponding parameters would be multiplied by 0.6, 0.1, and 0.3, respectively. The resulting concentrations would then be totaled to equal the volume-weighted mean.

A qualitative survey of the macrophyte community is also conducted in each lake or reservoir. The survey is conducted in either July or August to coincide with the period of maximum plant growth. The survey is performed by sampling transects bisecting the entire width of the waterbody. The macrophyte specie(s) present are identified and relative density determined at 1-meter intervals.

Phytoplankton and chlorophyll-a samples are collected twice at approximately one-month intervals during July and August. A 6-foot depth, integrated sample is collected over the deepest area of the lake. A measured amount of sample is filtered for chlorophyll-a analysis, while an aliquot of the sample is preserved for phytoplankton identification and enumeration.

One of the most useful measures of lake water quality is trophic condition. Trophic condition is a means of expressing a lake's productivity as compared to other lakes in a district or geographical area. In general, oligotrophic lakes are deep, clear lakes with low primary production, while eutrophic lakes are shallow and contain macrophytes and/or algae. Eutrophic lakes are considered moderately to highly productive.

The trophic condition or status is assessed for each of the lakes and reservoirs included in the LWQA. Accurate trophic status assessments are essential for making sound preservation or improvement recommendations. In order to minimize errors in classification, a multiple indicator approach was initiated.

Since trophic status indices specific to North Dakota waters have not been developed, Carlson's TSI was chosen to delineate the trophic status of an LWQA Project lake or reservoir. To create a numerical TSI value, Carlson's TSI (Carlson, 1977) uses a mathematical relationship based on three indicators: secchi disk transparency in meters, surface total phosphorus in $\mu g\ L^{-1}$, and chlorophyll-a in $\mu g\ L^{-1}$.

This numerical value then corresponds to a trophic condition ranging from 0 to 100, with increasing values indicating a more eutrophic condition. Carlson's TSI estimates are calculated using the following equations:

Trophic status based on secchi disk (TSIS):
$TSIS = 60 - 14.41 \ln (SD)$
Where SD = Secchi disk transparency in meters.

Trophic status based on total phosphorus (TSIP):
$TSIP = 14.20 \ln (TP) + 4.15$
Where TP = Total phosphorus concentration in $\mu g\ L^{-1}$.

Trophic status based on chlorophyll-a (TSIC):
$TSIC = 9.81 \ln (TC) + 30.60$
Where TC = Chlorophyll-a concentrations in $\mu g\ L^{-1}$.

Trophic status using Carlson's TSI is depicted graphically in Figure III-3. A major drawback to using Carlson's TSI is that it was developed for lakes that are primarily phosphorus limited. Because most North Dakota lakes and reservoirs have an abundance of phosphorus, ancillary information (e.g., DO concentrations, frequency of nuisance algal blooms, phytoplankton community structure, and macrophyte biomass) was combined with Carlson's numerical TSI to prevent misclassification. Since interpretation of ancillary information can be subjective, the largest available database (incorporating both historical and LWQA data) was used to promote consistency between assessing scientists.

Due to variations in geological and ecological regions and lake type (manmade, natural), numerical trophic status assessments are not assigned to waterbodies during the LWQA Project. Instead, the general trophic condition of the waterbody (e.g., mesotrophic, eutrophic, hypereutrophic) is identified.

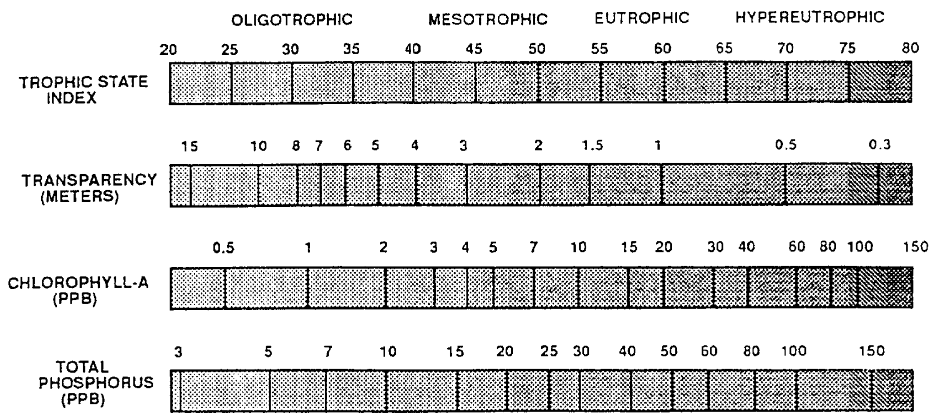

Figure III-3. A Graphic Representation of Carlson's TSI

Each LWQA Project lake was also assessed for contaminant pollutants (i.e., trace elements and organic compounds). Bottom sediments are collected from the inlet, littoral, and deepest areas of each lake or reservoir assessed. One sediment sample is collected at each location using a standard 2-inch core sampler. Each sample is analyzed for selected trace elements, PCBs, and organic compounds. Contaminants analyzed in the sediment samples are listed in Table III-8.

An effort is made to collect littoral samples in areas typical of each individual lake. For purposes of the LWQA Project, the littoral area is defined as the shallow water shoreline area where submergent vegetation is present. The deepest area of the lake is defined using lake maps and a depth finder. Sediment samples from the deepest area are collected at the same location as water quality samples. Inlet samples are collected as far into the center of the inlet as possible.

Fish sampled for contaminant analysis are collected in cooperation with the North Dakota Game and Fish Department. At each lake or reservoir, an effort is made to collect at least two types of fish from the following groups: bottom feeders (e.g., white sucker, carp, bullhead), piscivores (e.g., northern pike, walleye, bass), and insectivores (e.g., crappie, bluegill). Table III-8 lists the contaminants analyzed in whole fish samples.

Table III-8. Contaminants Analyzed and Their Detection Limits in Sediment and Whole Fish Samples Collected During the LWQA

Parameter	Detection Limit(μg g[1])	Parameter	Detection Limit(μg g[1])
Copper	1.400	Endosulfan I	0.002
Zinc	0.900	Endosulfan II	0.002
Barium	0.900	Endosulfan Sulfate	0.002
Mercury	0.010	Endrin	0.002
Chromium	0.020	Heptachlor	0.001
Arsenic	0.020	Methoxychlor	0.004
Selenium	0.100	Hoelon	0.010
Cadmium	0.020	PCB (Total)	0.010
Lead	0.020	Nonachlor	0.010
Aldrin	0.001	Alachlor	0.001
BHC-Alpha	0.001	Parathion Ethyl	0.003
BHC-Beta	0.001	Parathion Methyl	0.002
Lindane	0.001	Fenvalerate	0.020
Chlordane	0.002	Triallate	0.002
DDD	0.001	Trifluralin	0.001
DDE	0.001	Pendimethalin	0.002
DDT	0.001	Metolachlor	0.001
Dieldrin	0.001		

[1]Detection limit values are based on a 1-gram sample.

In addition to the chemical monitoring and analysis, a land use assessment is completed for each lake. Each lake's watershed is assessed to identify the major sources of point and NPS pollution. Land use and land use practices are inventoried by interviewing local NRCS field office staff and state NRCS personnel. This inventory was verified in the field in the late fall. An aerial watershed survey was also performed on approximately one-third of all lakes assessed.

Point source assessments were accomplished for each watershed with the assistance of the department's NDPDES Permit Program staff. All contributing point sources were identified, and an estimate was made of the probable nutrient and organic loading to each lake or reservoir and its impact.

Beginning in 1997, LWQA Project activities were integrated into the department's rotating basin monitoring strategy. Lake Darling and the Upper Des Lacs Reservoir were sampled as the department focused its monitoring activities in the Souris River Basin in 1997, while Pipestem Dam and Jamestown Reservoir were sampled in 1998. Lake Sakakawea was the focus of LWQA activities in 1999.

In addition to its inclusion in the annual LWQA Project, Devils Lake has received special attention. Devils Lake has increased in elevation 20 feet since 1993. In response to questions regarding water quality changes resulting from these water level increases, the department initiated a comprehensive water quality monitoring program in 1993 for Devils Lake. Devils Lake is sampled approximately five times per year, including once during the winter.

Fish Tissue Monitoring

Analysis of fish tissue has become a regular part of the Health Department's water quality program. Based on the April 1999 fish consumption advisory, advisory information for mercury exists for 20 lakes and two rivers in North Dakota. The advisory is not intended to discourage people from eating fish, but offers advice on how fish caught in the state can be safely eaten. The monitoring of fish flesh for mercury and other contaminants continues each year with the collection of fish from additional rivers and lakes, as well as from those under existing consumption advisories. The fish consumption advisory is expanded and updated annually. Information regarding each waterbody affected by mercury is available from EPA's National Inventory of Fish Consumption Advisories. The EPA contact person is Jeff Bigler (202-260-1305).

Biological Monitoring

The impetus for biological monitoring stems from the Clean Water Act goals for restoring and maintaining not only the chemical integrity of the nation's surface waters, but also the physical and biological integrity. Biological monitoring for water quality started in North Dakota in 1993, but efforts were postponed in 1994 due to heavy rains and flooding rivers. The first project was a cooperative venture with the Minnesota Pollution Control Agency, EPA Regions V and VIII, and the USGS's National Water Quality Assessment program. This project focused on the Lake Agassiz Plain ecoregion (commonly known as the Red River Valley). Natural resource agencies from both states also cooperated in this effort.

The project resulted in an IBI for fish, which uses a multi-metric framework to interpret biologically based expectations for assessing water resource quality. Community-based structural and functional attributes are a principal component of numerical biological criteria. Ultimately, it is the goal of the Health Department to establish biological criteria as: 1) narrative general statements of attainable conditions of biological integrity and water quality, or 2) numerical indices that serve as biological criteria and describe expected attainable community attributes for aquatic life use.

Following the initial fish IBI development project in 1993 and 1994, the department began to implement biological monitoring and assessment projects using a rotating basis framework. In 1995 and 1996, the department conducted biological assessments in the Upper and Lower Red River Basins, respectively. In 1997, 1998, and 1999, the department sampled the Souris River Basin, James River Basin, and the Missouri River/Lake Sakakawea subbasin, respectively.

In addition to fish community sampling, macroinvertebrates are also collected at each site and are used to develop a multimetric IBI for macroinvertebrates. In some instances, macroinvertebrate data will be used in conjunction with the fish IBI as an assessment of aquatic life use and biological integrity. In other cases, macroinvertebrate data may be the only biological assemblage present with which to make an assessment. Figure III-1 (see Part III. Chapter 1. Surface Water Quality Monitoring Program) shows the spacial distribution of biological assessment sites sampled between 1993 and 1999.

Chapter 2. Assessment Methodology

The purpose of this report is to assess and report on the extent to which beneficial uses of the state's rivers, streams, lakes, reservoirs, and wetlands are met. Section 305(b) of the Clean Water Act requires states to submit this assessment report every two years; therefore, the information presented in this report is for the reporting period of 1998-1999. This report is not a trends report, nor should the data or information in this report be used to assess water quality trends. Factors which complicate and prohibit comparisons between reporting years include changes to the estimated river/stream miles, an increase in the number of sites, and an improvement in quality of data upon which assessment information is based.

Waterbody Delineation Method

With an estimated 54,427 miles of rivers and streams and 714,910 acres of lakes, it is impractical to assess each and every mile of stream or every acre of lake every two years for this report. However, the department believes it is important to accurately assess those waters for which beneficial use assessment information is available and to account for those stream miles and lake acres that are not assessed every two years. As a result, the department has adopted the "Assessment Database" (ADB) to manage water quality assessment information for the state's rivers, streams, lakes, and reservoirs.

The ADB is a Microsoft ACCESS 97-based "accounting"/database management system developed by EPA, which provides a standard format for water quality assessment information. It includes a software program for adding and editing assessment data, generating reports, and transferring assessment data between the personal computer and EPA. Assessment data, as compared to raw monitoring data, describes the overall health of the waterbody by describing beneficial use impairment and, for those waterbodies where beneficial uses are impaired, the causes and sources of pollution affecting the beneficial use.

To create the state's ADB database management system, the state's 54,427 miles of rivers and streams and 223 lakes and reservoirs have been delineated into 1,681 discreet waterbodies. This includes 1,458 river and stream waterbodies and 223 lake and reservoir waterbodies. Each of these waterbodies are then assessed individually, based on data availability. The individual waterbody assessments are then compiled through the ADB reporting software into summaries, which form the basis for this report. In order to delineate waterbodies used in the ADB, the department followed a general set of guidelines:

1. Each waterbody was within the eight-digit USGS hydrologic unit.

2. Each river and stream waterbody was comprised of stream reaches of the same water quality standards classification (I, IA, II, or III).

3. To the extent practical, individual waterbodies were within the same ecoregion.

4. Mainstem perennial rivers were delineated as separate waterbodies. Where these rivers join with another major river or stream within the eight-digit hydrologic unit, the river was further delineated into two or more waterbodies.

5. Tributary rivers and streams, which are named on USGS 1:100,000 scale planimetric maps, were delineated as separate waterbodies. These waterbodies may have been further delineated, based on stream order or water quality standards classification.

6. Unnamed ephemeral tributaries to a delineated waterbody were consolidated into one unique waterbody. This was done primarily for accounting purposes, so that all tributary stream reaches identified in the RF3 are included in the ADB.

7. Stream reaches, which were identified in the RF3 and on USGS 1:24,000 scale maps and which did not form either an indirect or direct hydrologic connection with a perennial stream, were not included in the ADB. This would include small drainages which originate and flow into closed basin lakes or wetlands. (Note: This delineation criteria does not apply to tributaries to Devils Lake.)

The ADB provides an efficient accounting and data management system. It also allows for the graphical presentation of waterbody assessment information by linking waterbody assessments contained in the ADB to the RF3 river reach file through geographic information systems (GIS). In order to facilitate the GIS datalink, the department has “reach-indexed” waterbodies in the ADB to the RF3 file. The product of this process is a GIS coverage which can be used to graphically display water quality assessment data entered in the ADB. An example can be seen in Figure III-4 which depicts each of the reach-indexed waterbodies delineated in the Souris River Basin.

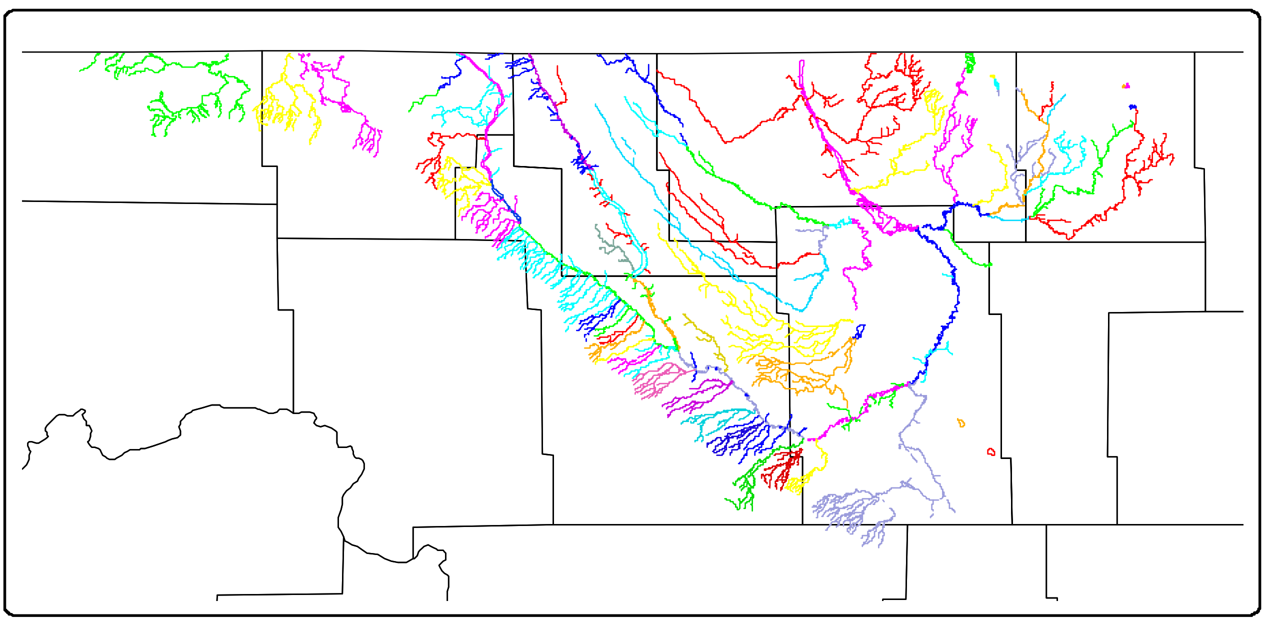

Figure III-4. Map of Reach-Indexed Waterbodies Delineated in the Souris River Basin

Beneficial Use Designation

As stated previously, the purposes of this report are to: 1) describe the extent to which beneficial uses of the state's rivers, streams, lakes, and reservoirs are being met and 2) describe the causes and sources of pollutants limiting beneficial use attainment for those waterbodies not meeting beneficial uses. In order to conduct this assessment, each waterbody must be assigned beneficial uses. Beneficial uses are assigned to waterbodies utilizing the *State Water Quality Standards.* These regulations define the protected beneficial uses of the state's rivers, streams, lakes, and reservoirs.

Four beneficial uses (aquatic life, recreation, drinking water, and fish consumption) were assessed for purposes of this report. All waterbodies entered into the ADB and, therefore, all stream classes (I, IA, II, and III) and all lake classes (1-5) were assigned aquatic life and recreation beneficial uses. All Class I, IA, and II rivers and streams and all lakes were assigned the drinking water beneficial use. The fourth beneficial use, fish consumption, has been assigned to all Class I, IA, and II rivers and streams, to those Class III streams known to provide a sport fishery, and to all Class 1 through 4 lakes. While not specifically identified in state standards, the fish consumption use is protected through both narrative and numeric human health criteria specified in the *State Water Quality Standards*. Other beneficial uses identified in the *State Water Quality Standards* are agriculture (e.g., stock watering, irrigation), and industrial (e.g., washing, cooling). These uses were not assessed as part of this report, but are presumed to be fully supporting.

Beneficial Use Assessment Methodology for Rivers and Streams

The following is a description of the assessment methodology or decision criteria for each beneficial use assigned to rivers and streams in the state.

In general, waterbody assessments made for this report fall into two categories: evaluated and monitored. "Evaluated" waterbodies are those for which the use support decision was based on information other than site-specific chemical, physical, or biological monitoring data collected between 1995 and 1999. Types of evaluated assessment information used for this report include land use information, known locations of pollutant sources, spill or fish kill incidents, water quality information provided by local residents or resource managers (e.g., SCDs or WRDs), and water quality monitoring data over five years old. Assessments which are extrapolated from data or assessments from adjacent waterbodies were also considered evaluated.

Waterbody assessments defined as "monitored" are based on fixed station physical and chemical monitoring data and biological data collected within the last five years. Physical and chemical monitoring data used in this report came from two primary data sources: the USGS and the Health Department (see Part III. Chapter 1. Surface Water Quality Monitoring Program). Physical and chemical monitoring data used for this assessment report included conventional pollutants (e.g., DO, pH, ammonia, fecal coliform bacteria) and toxic pollutants (e.g., trace elements and pesticides) data collected between 1995 and 1999. Biological monitoring data used for this report included fish community and macroinvertebrate community data collected by the department between 1993 and 1999. If more than one site occurred within a delineated waterbody, data from all sites and for all years was pooled for analysis.

As stated previously, beneficial use was assessed for aquatic life, recreation, drinking water, and fish consumption. The following is the beneficial use decision criteria utilized for this assessment:

1. Aquatic Life

Aquatic life use, or biological integrity, can be defined as "the ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitats of the region." (Karr, 1981) When aquatic life is similar to that of natural habitats in the region, it is assessed as "fully supporting." When it is not similar, it is assessed as either "fully supporting but threatened," "partially supporting," or "not supporting," depending upon the degree of impairment. Where assessment information or data were not available, aquatic life use was considered "not assessed." Where chemical data were available, aquatic life use support assessment decisions were made using the following decision criteria.

In general, aquatic life use determinations utilizing chemical data were based on the number of exceedances of *State Water Quality Standards* for DO and on the number of exceedances of the acute or chronic standards for un-ionized ammonia, arsenic, cadmium, copper, cyanide, lead, nickel, selenium, silver, zinc, and chromium. Where available, dissolved metals data were used to make use support decisions. Where total recoverable metals data were available, the total recoverable value was converted to a dissolved metals value using the recommended conversion factors provided in Table III-9.

Table III-9. Recommended Factors for Converting Total Recoverable Metal Criteria to Dissolved Metal Criteria

METAL	RECOMMENDED CONVERSION FACTORS	
	CMC[a]	CCC[a]
Arsenic (III)	1.000	1.000
Cadmium[b]		
Hardness = 50 mg/L	0.973	0.938
Hardness = 100 mg/L	0.944	0.909
Hardness = 200 mg/L	0.915	0.880
Chromium (III)	0.316	0.860[c]
Chromium (VI)	0.982	0.962
Copper	0.960	0.960
Lead[b]		
Hardness = 50 mg/L	0.892	0.892
Hardness = 100 mg/L	0.791	0.791
Hardness = 200 mg/L	0.690	0.690
Nickel	0.998	0.997
Selenium	0.922	0.922
Zinc	0.978	0.986

[a] CMC: Criterion Maximum Concentration
CCC: Criterion Continuous Concentration

[b] The recommended conversion factors (CFs) for any hardness can be calculated using the following equations:

Cadmium
CMC: CF = 1.136672 **-** [(In hardness) (0.041838)]
CCC: CF = 1.101672 **-** [(In hardness) (0.041838)]

Lead
CMC and CCC = 1.46203 **-** [(In hardness) (0.145712)]

where:
(In hardness) = natural logarithm of the hardness. The recommended CFs are given to three decimal places because they are intermediate values in the calculation of dissolved criteria.

[c] This CF applies only if the CCC is based on the test by Stevens and Chapman (1984). If the CCC is based on other chronic tests, it is likely that the CF should be 0.590, 0.376, or the average of these two values.

Source: Stephen, C. E., 1995

Fully Supporting: For DO, the standard of 5 milligrams per liter (mg/L) (minimum) was not exceeded at any time. For un-ionized ammonia and other toxic pollutants (e.g., trace elements and organics), the acute or chronic standard was not violated at any time between 1993 and 1997.

Fully Supporting But Threatened: For DO, the standard of 5 mg/L was exceeded in less than 10 percent of the samples. For un-ionized ammonia and other individual toxic pollutants, no more than one violation of the acute chronic standard occurred during any consecutive 3-year period between 1995 and 1999. Aquatic life use support was also assessed as fully supporting but threatened where land use, stream condition, or habitat were believed (using best professional judgement) to cause a threat to aquatic life.

Partially Supporting: For DO, the 5 mg/L standard was exceeded in 11 to 25 percent of the measurements taken between 1995 and 1999. For un-ionized ammonia and other toxic pollutants, the acute or chronic standard was exceeded more than once, but in less than 10 percent of the samples within any consecutive 3-year period between 1995 and 1999.

Not Supporting: For DO, the 5 mg/L standard was exceeded in more than 25 percent of the samples collected between 1995 and 1999. For un-ionized ammonia and other toxic pollutants, the acute or chronic standard was exceeded in more than 10 percent of the samples collected between 1995 and 1999.

While chemical data provides an indirect assessment of aquatic life use impairment, direct measures of the biological community are believed to be a more accurate assessment of aquatic life use or biological integrity. As stated previously, the department began a stream biological monitoring and assessment program in 1993. Since then, biological community assessments have been conducted throughout the Red River Basin, the Souris River Basin, the James River Basin, and the Upper Missouri/Lake Sakakawea subbasin of the Missouri River Basin.

The department has adopted the “multi-metric” index approach to assess biological integrity or aquatic life use support for rivers and streams. The multi-metric index approach assumes that various measures of the biological community (e.g., species richness, species composition, trophic structure, individual health) respond to human-induced pollutant loadings or habitat alterations. Each measure of the biological community, termed a “metric,” is evaluated and scored on a 1, 3, 5 point scale. Using this method, the higher the score, the better the biological condition and, presumably, the lower the pollutant or habitat impact.

For the department’s fish community assessments, 12 metrics are used in the index with a total possible score of 60. For macroinvertebrate community assessments, eight metrics are used with a total possible index score of 40. While the department is currently conducting biological assessments in four basins, it has only developed multimetric indices for the Red River Basin and the Souris River Basin. The following scoring criteria were used to assess aquatic life use impairment for the Red River Basin (Table III-10) and the Souris River Basin (Table III-11).

Table III-10. Aquatic Life and Biological Integrity Scoring Criteria for the Red River Basin

Biological Integrity	Aquatic Life Use	IBI Score	
		Fish	Macroinvertebrates
Excellent	Fully Supporting	51-60	30-40
Good	Fully Supporting	4-50	-
Fair	Fully Supporting but Threatened	31-40	20-29
Poor	Partially Supporting	21-30	10-19
Very Poor	Not Supporting	12-20	0 - 9

Table III-11. Aquatic Life and Biological Integrity Scoring Criteria for the Souris River Basin

Biological Integrity	Aquatic Life Use	Fish IBI Score
Good	Fully Supporting	45-60
Fair	Fully Supporting but Threatened	29-44
Poor	Partially Supporting	12-28
No Fish	Not Supporting	0

Where biological community assessment information was available for both fish and macroinvertebrates and where aquatic life use assessments were different, the assessment decision resulting in the greatest impairment prevailed. In the same manner, where waterbody assessments based on chemical data conflicted with biological assessments, the biological assessment prevailed.

2. Recreation

Recreation use includes swimming, boating, wading, or any recreational activities which rely on water. Recreation use in rivers and streams is considered fully supporting when there is little or no risk of illness through contact with the water. Recreation use determinations were made using fecal coliform data collected between 1995 and 1999. Assessments were defined as monitored if data from a minimum of ten samples were collected from the waterbody during the assessment period 1995-1999. Assessments were considered evaluated if: 1) monitored data were collected prior to 1995, 2) less than ten samples were collected, and/or 3) the assessment was extrapolated from data collected either upstream or downstream from the waterbody. Evaluated assessments which meet the criteria for partially supporting recreational use were assessed as fully supporting but threatened. For each assessment based on fecal coliform data, the following criteria were used:

Criterion 1: The geometric mean of the samples should not exceed 200 colonies per 100 milliliters (mL).

Criterion 2: Not more than 10 percent of the samples should have a density exceeding 400 colonies per 100 mL.

The two criteria were then applied using the following use support decision criteria:

Fully Supporting: Both criteria 1 and 2 are met.

Fully Supporting but Threatened: Meets the decision criteria for partially supporting, based on evaluated data.

Partially Supporting: Criteria 1 or 2 are not met.

Not Supporting: Both Criteria 1 and 2 are not met.

3. Drinking Water Supply

Drinking water is defined as "waters that are suitable for use as a source of water supply for drinking and culinary purposes, after treatment to a level approved by the Department." (*State Water Quality Standards*)

Drinking water use was assessed as monitored when chemical monitoring data was available and as evaluated when the assessment was based on the occurrence of taste and odor complaints. Monitored assessments were conducted by comparing chemical concentration data to the human health standards for Class I, IA, and II rivers and streams. The human health standard for Class I, IA, and II rivers and streams considers two means of exposure: 1) ingestion of contaminated aquatic organisms and 2) ingestion of contaminated drinking water. Therefore, any waterbody with contaminant levels exceeding the human health standard would be considered not fully supporting its drinking water use designation.

In order to make beneficial use determinations for drinking water, the following decision criteria were used:

Fully Supporting: For each human health contaminant, greater than 50 percent of the samples had concentrations lower than the water quality standard, and there are no drinking water complaints on record.

Fully Supporting but Threatened: For each contaminant, greater than 50 percent of the samples had concentrations lower than the standard; however, knowledge of taste and odor problems or increased treatment costs have been associated with pollutants.

Partially Supporting: For at least one contaminant, greater than 50 percent of the samples exceed the human health standard, and/or frequent taste and odor complaints are on record.

Not Supporting: Drinking water supply closure is on record within the period 1993-1997.

4. Fish Consumption
As stated previously, fish consumption is not a beneficial use specifically defined in *State Water Quality Standards*, but is implied through narrative and numeric human health criteria. Fish consumption use is defined as the eating of fish without health effects. For purposes of the state's fish consumption advisory and this analysis, a risk factor of 1 in 1 million is assumed.

The state's fish consumption advisory was used to make use support determinations for fish consumption. The advisory is based solely on human dietary exposure from fish containing mercury. The Health Department annually selects lakes, reservoirs, rivers, and streams in the state and monitors fish tissue mercury concentrations. To date, every waterbody sampled for mercury has been listed in the state's fish consumption advisory. There have been no consumption bans issued in North Dakota. In order to assess the fish consumption use, the following decision criteria were used. These criteria only apply to waterbodies for which fish tissue data and advisory information exist.

Fully Supporting: No consumption restrictions or bans were present during the reporting period.

Partially Supporting: A restricted consumption advisory exists for the general population and/or subpopulations.

Not Supporting: A consumption advisory ban exists for the general population and/or subpopulations.

Since every waterbody tested for mercury in fish tissue has been listed in North Dakota's fish consumption advisory and no consumption bans are present, use determinations fall into two categories: partially supporting and not assessed. Unassessed waterbodies have not been sampled and analyzed for mercury. Waterbodies for which fish tissue data are more than five years old are no longer listed in the state fish consumption advisory and are considered "not assessed."

Beneficial Use Assessment Methodology for Lakes and Reservoirs

1. Aquatic Life and Recreation
Trophic status is the primary indicator used to assess beneficial uses in the state's lakes and reservoirs. Trophic status is the measure of productivity of a lake or reservoir as directly related to the level of nutrients (phosphorus and nitrogen) entering the lake or reservoir from its watershed. Highly productive lakes, termed "hypereutrophic," contain excessive phosphorus and are characterized by large growths of weeds, bluegreen algal blooms, and low DO concentrations. These lakes experience frequent fish kills and are generally characterized as having excessive rough fish populations (carp,

bullhead, sucker) and poor sport fisheries. Due to the frequent algal blooms and excessive weed growth, these lakes are also undesirable for recreational uses such as swimming and boating.

Mesotrophic and eutrophic lakes, on the other hand, have lower phosphorus concentrations, low to moderate levels of aquatic plant growth, and good DO concentrations throughout the year. Mesotrophic lakes do not experience algal blooms, while eutrophic lakes may occasionally experience algal blooms of short duration, typically a few days to a week.

Due to this relationship between trophic status and the aquatic community (as reflected by the fishery), or between trophic status and the frequency of algal blooms, trophic status becomes an effective indicator of aquatic life use and recreation. It has been generally assumed, for purposes of this report, that hypereutrophic lakes only partially support a fishery and are limited in their recreational use; whereas mesotrophic lakes fully support both aquatic life use and recreation. Eutrophic lakes may be assessed as fully supporting, threatened, or partially supporting their uses for aquatic life or recreation. Eutrophic lakes are further assessed based on: 1) information provided by local water resource managers and the public, 2) the knowledge of land use in the lake's watershed, and/or 3) the relative degree of eutrophication.

For example, a eutrophic lake, which has a well-balanced sport fishery and experiences infrequent algal blooms, is assessed as fully supporting. A eutrophic lake, which experiences periodic algal blooms and limited swimming use, would be assessed as partially supporting recreation use. A lake fully supporting its aquatic life and/or recreation use but which, through monitoring, has shown a decline in its trophic status, (i.e., increasing phosphorus concentrations over time), would be assessed as fully supporting but threatened.

It is recognized that this assessment procedure ignores the fact that, through natural succession, some lakes and reservoirs may display naturally high phosphorus concentrations and experience high productivity. While natural succession or eutrophication can cause high phosphorus concentrations, recent research suggests that these lakes are typically eutrophic and that lakes classified as hypereutrophic are reflecting external nutrient loading in excess of that occurring naturally.

2. Drinking Water

All lakes and reservoirs classified in *State Water Quality Standards*, with the exception of Lake George in Kidder County, are assigned the drinking water beneficial use. While most lakes and reservoirs are assigned this use, few are currently used as a drinking water supply. Lake Sakakawea, a drinking water supply for the Southwest Water Pipeline and the cities of Garrison, Parshall, Pick City, and Riverdale, was assessed as fully supporting. All other lakes and reservoirs assigned the drinking water supply beneficial use were not assessed.

3. Fish Consumption

The fish consumption use for lakes and reservoirs was assessed in the same way as the procedure for rivers and streams.

Chapter 3. Rivers and Streams Water Quality Assessment

Statewide Assessment

Table III-12 summarizes use support for rivers and streams by the type of information used in the assessment methodology (evaluated or monitored). Evaluated assessment information was used to assess 6541 miles of streams in the state, while monitoring data alone was used to assess 8423 miles. When compared to the 1998 Section 305(b) report, the number of assessed river miles increased by 26 percent or 3098 miles. This increase is due in large part to the use of biological monitoring data to assess aquatic life use support. Of the 14,965 miles of rivers and streams assessed for this report, 52 percent (7740 miles) fully supported all assessed uses, while the remaining 48 percent (7224 miles) were impaired for at least one use.

Sixty-nine percent (9923 miles) of the rivers and streams assessed for this report fully support the beneficial use designated as aquatic life (Table III-13). Of the streams assessed as fully supporting aquatic life use, 85 percent (8392 miles) are considered threatened. In other words, if water quality trends continue, the stream may not fully support its use for aquatic life in the future. The remaining 31 percent of rivers and streams assessed for this report were either partially supporting or not supporting aquatic life use (Table III-13).

NPS pollution (e.g., nutrient loading, siltation of the streambed, and stream habitat loss or degradation) was the primary cause of aquatic life use impairment (Table III-14). Other forms of pollution causing impairment are trace element contamination, flow alteration, and organic enrichment. Organic enrichment creates conditions in the stream which cause DO to be depleted. Rivers and streams suffering from organic enrichment will display a shift in species composition from an aquatic community comprised of intolerant species (e.g., mayflies, caddisflies, stoneflies, darters) to an aquatic community dominated by tolerant species (e.g., midges, carp, bullheads).

The primary sources of pollutants affecting aquatic life use in the state are cropland erosion and runoff, animal feeding operations, and poor grazing management (Table III-15). Poor grazing management includes riparian grazing and season-long grazing, which result in the deterioration of the plant community or cause a shift in the plant community away from native grass and forbe species to non-native invader species. Evidence of poor grazing practices would include cattle trailing, gully erosion, poor water infiltration rates resulting from soil compaction, and severe streambank erosion. Other sources linked to aquatic life use impairment are point source discharges, urban runoff, and hydrologic modifications (e.g., upstream impoundments, low-head dams, channelization, flow regulation and diversion, riparian vegetation removal, wetland drainage) (Table III-15).

Recreation use was assessed on 9707 miles of rivers and streams in the state. Recreation use was fully supporting, fully supporting but threatened, partially supporting, and not supporting on 3484 miles, 1938 miles, 3537 miles, and 747 miles, respectively (Table III-13). Fecal coliform bacteria data collected from monitoring stations across the state were the primary indicators of recreation use attainment (see Part III. Chapter 2. Assessment Methodology). For this reason, pathogens (as reflected by fecal coliform bacteria) are the primary cause of recreation use impairment in North Dakota (Table III-14). Other factors affecting the use of our rivers and streams for recreation would be eutrophication from excessive nutrient loading, resulting in nuisance algae and plant growth. The primary sources of fecal coliform bacteria contamination in the state are animal feeding operations and riparian area grazing (Table III-15). Point source discharges have also been linked to exceedances of the fecal coliform bacteria standard of 200 colonies per 100 mL. These exceedances occur when a municipality discharges from its sanitary sewer directly to the receiving stream, bypassing the wastewater treatment facility. These circumstances generally occurred in the spring when flooding problems cause infiltration to the sanitary sewer.

Drinking water supply use is classified for 5483 miles of rivers and streams in the state. Of the 474 miles assessed for this report, only 259 miles (55 percent) were assessed as threatened for drinking water supply use (Table III-13). The primary threats are taste and odor problems. While the source of taste and odor has not been specifically identified, potential sources include agricultural field runoff, reservoir releases, wetland drainage, and industrial and/or municipal discharges.

A total of 5548 miles of rivers and streams were identified as capable of supporting a sport fishery from which fish could be used for consumption. One-hundred-forty-seven miles of rivers and streams have been monitored for methyl-mercury in fish, resulting in consumption advisories. Rivers in the advisory include the Missouri River and the Yellowstone River. The Red River of the North, previously listed in the state’s fish consumption advisory, was not listed for this reporting period. The timeframe for data used for the Red River fish consumption advisory exceeded this report’s five-year timeframe for data acceptance. The Red River is considered “not assessed” for this report. These advisories form the basis for fish consumption use impairment in the state (Table III-13). While there are many potential sources of methyl-mercury, both anthropogenic and natural, to date there have been no specific causes or sources identified for the mercury present in North Dakota fish (Tables III-14 and 15).

Table III-12. Summary of Fully Supporting, Threatened, and Impaired Streams in North Dakota (Miles)

Degree of Use Support	Assessment Basis: Evaluated	Assessment Basis: Monitored	Total Assessed Size
Size Fully Supporting All Assessed Uses	354.03	1302.84	1656.87
Sizes Fully Supporting All Assessed Uses but Threatened for at Least One Uses	4080.39	2003.08	6083.47
Size Impaired for One or More Uses	2106.91	5117.27	7224.18
Total Assessed	6541.33	8423.19	14964.52

Table III-13. Individual Use Support Summary for Rivers and Streams in North Dakota (Miles)

Use	Fully Supporting	Fully Supporting but Threatened	Partially Supporting	Not Supporting	Assessed
Aquatic Life	1531.31	8392.00	3968.31	534.80	40000.93
Fish Consumption			146.69		5401.17
Recreation	3483.85	1938.36	3537.07	747.42	44720.65
Drinking Water Supply	214.52	259.11			5009.25

Table III-14. Causes of Beneficial Use Impairment for Rivers and Streams in North Dakota

Cause Categories	Miles
Unknown (0000) [1]	60.80
Pesticides (200)	5.53
Metals (500)	751.58
Mercury (560)	146.69
Ammonia (600)	30.54
Nutrients (900)	3558.29
Siltation (1100)	4020.44
Organic Enrichment/Low DO (1200)	817.74
Organic Enrichment (1210)	92.74
Low DO (1220)	640.68
Salinity/TDS/Chlorides (1300)	60.87
Flow Alteration (1500)	958.28
Stream Habitat Degradation (1600)	4280.72
Pathogens (1700)	4240.10
Fecal Coliform Bacteria(1710)	4240.10
Noxious Aquatic Plants (2200)	5.53

[1]Number in parentheses denotes EPA major/minor cause code.

Table III-15. Sources of Beneficial Use Impairment to Rivers and Streams in North Dakota

Source Categories	Miles
Industrial Point Sources (100)[1]	119.86
Municipal Point Source (200)	422.85
Agriculture (1000)	6013.30
Crop Production (1150)	4134.20
Pasture/Range Grazing (1400/1500)	4453.00
Riparian Grazing (1410/1510)	1177.57
Animal Feeding Operations (1640)	4588.21
Construction (3000)	274.27
Highway/Road/Bridge Construction (3100)	74.03
Land Development (3200)	223.03
Urban Runoff/Storm Sewers (4000)	465.04
Erosion and Sedimentation (4600)	40.00
Resource Extraction (5000)	323.43
Surface Mining (5100)	29.89
Petroleum Activities (5500)	293.54
Land Disposal (6000)	81.34
Septic Tanks (6500)	81.34
Hydromodification (7000)	2061.99
Lowhead Dams (7050)	542.90
Channelization (7100)	888.10
Dam Construction (7300)	26.18
Upstream Impoundments (7350)	646.10
Flow Regulation/Modification (7400)	301.48
Removal of Riparian Vegetation (7600)	555.99
Bank Modification/Destabilization (7700)	331.23
Wetland Drainage (7800)	1938.31
Highway Runoff (8300)	5.53
Contaminated Sediments (8500)	5.53
Internal Cycling (8530)	65.20
Natural Sources (8600)	385.87
Waterfowl (8650)	65.20
Recreation (e.g., golf courses) (8700)	49.53
Salt Storage Sites (8900)	5.00
Ground Water Loadings (8910)	71.10
Unknown (9000)	785.59
Sources Outside State Jursidiction/Borders (9050)	65.02

[1]Number in parentheses denotes EPA major/minor source code.

Basin Assessments

In addition to the statewide water quality assessment previously described, water quality assessment information is available for each of the major river basins in the state (Figure II-1). The following is a summary of beneficial use attainment and a description of the causes and sources of use impairment for the Souris River, Red River (including Devils Lake), Missouri River/Lake Sakakawea, Missouri River/Lake Oahe, and James River Basins.

1. Souris River Basin
There are 3,645 river and stream miles in the Souris River Basin. Forty-four percent (1589 miles) of the total river and stream miles in the basin were assessed for aquatic life use. Of the 1589 miles assessed for aquatic life use, 10 percent (163 miles) fully supported aquatic life use, 44 percent partially supported aquatic life use, and 11 percent (170 miles) were assessed as not supporting aquatic life use. The remaining 33 percent of assessed stream miles fully supported, but were threatened (Table III-16, Figure III-5).

The primary cause of aquatic life impairment in the Souris River Basin is stream habitat degradation, such as channelization, snagging and clearing, and bank stabilization using rock riprap (Table III-17). Other impairments to aquatic life use were nutrients (nitrogen and phosphorus), siltation, and stream flow alteration caused by management of upstream impoundments
(Table III-17).

Sources of nutrients in the basin include NPS runoff from cropland and urban areas, runoff from animal feeding operations, and riparian area grazing (Table III-18). Sources of excessive stream sediment include runoff from poorly managed grazing lands, cropland, and urban areas. Another source, stream bank erosion, can be caused by excessive grazing pressure, poor riparian forest management, and stream bank encroachment and riparian area loss from land development (Table III-18).

Recreation use was assessed on 21.5 percent (783 miles) of rivers and streams in the Souris River Basin, with 48 percent (379 miles) fully supporting its use for recreation (Table III-16, Figure III-6). An additional 13 percent (100 miles) of rivers and streams assessed for this report were categorized as fully supporting, but threatened. Thirty-nine percent (304 miles) of assessed river and stream miles either partially supported or did not support recreation use in the Souris River Basin.

Pathogens, as indicated by fecal coliform bacteria, are the cause of recreation use impairment (Table III-17). The sources of fecal coliform bacteria pollution, as is the case statewide, are concentrated animal feeding operations and riparian grazing. Point source contributions were not identified as a source of pathogen contamination in the Souris River Basin.

A total of 508 miles are classified for drinking water supply use in the Souris River Basin (Table III-16). The Souris River, the Des Lacs River, and Willow Creek are the only rivers and streams in the Souris River Basin classified for drinking water supply use. Drinking water supply use was not assessed for this report.

Table III-16. Individual Use Support Summary for Rivers and Streams in the Souris River Basin

Use Assessed	Fully Supporting	Fully Supporting but Threatened	Partially Supporting	Not Supporting	
Aquatic Life	162.80	555.40	700.80	169.60	2056.40
Fish Consumption					625.20
Recreation	379.20	100.00	107.80	195.90	2862.10
Drinking Water Supply					508.30

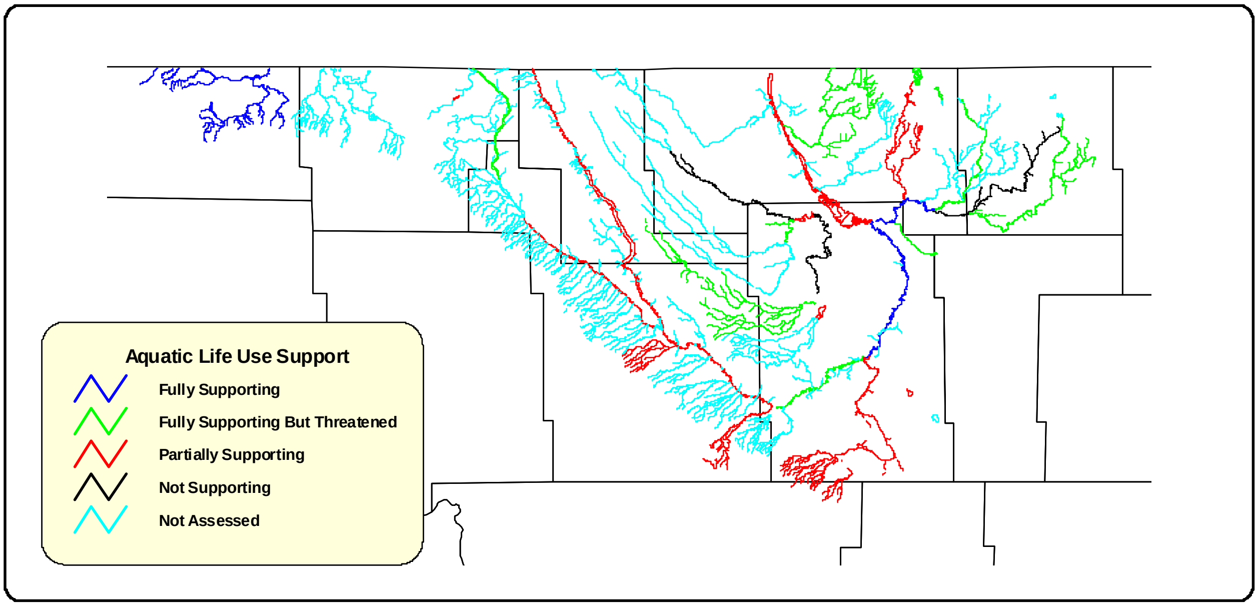

Figure III-5. Aquatic Life Use Support in the Souris River Basin

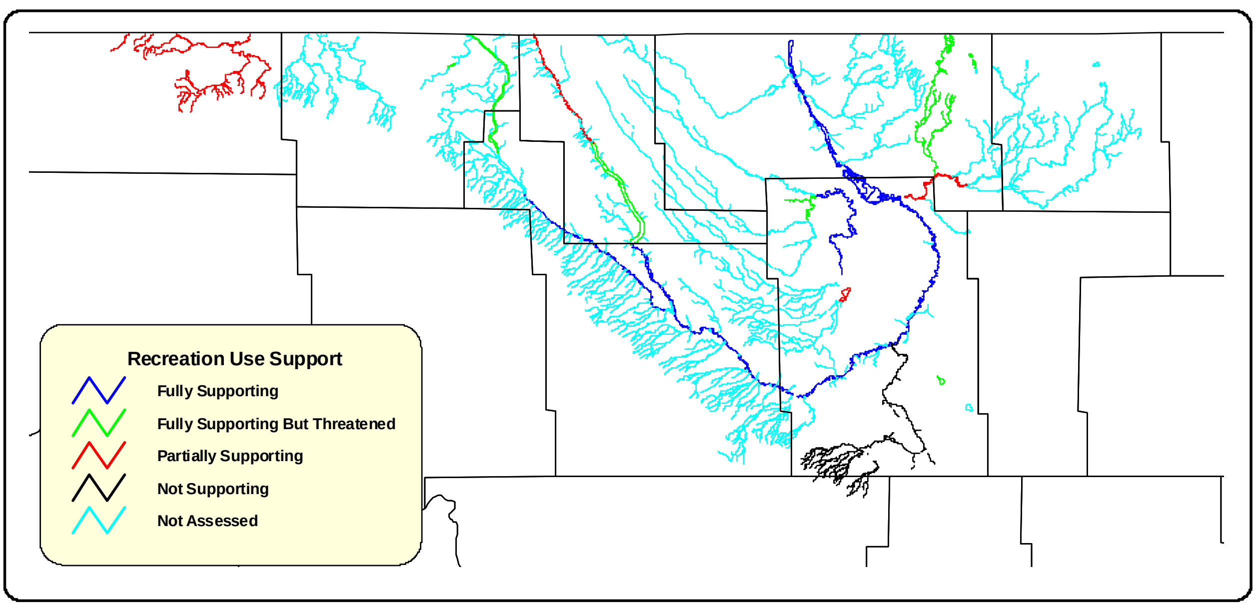

Figure III-6. Recreation Use Support in the Souris River Basin

Table III-17. Causes of Beneficial Use Impairment to Rivers and Streams in the Souris River Basin

Cause Categories	Miles
Unknown (0000)[1]	60.80
Metals (500)	235.90
Nutrients (900)	611.00
Siltation (1100)	714.20
Organic Enrichment/Low DO (1200)	344.50
Low DO (1220)	344.50
Flow Alteration (1500)	249.90
Stream Habitat Degradation (1600)	870.40
Pathogens (1700)	303.70
Fecal Coliform Bacteria (1710)	303.70

[1]Number in parentheses denotes EPA major/minor cause code.

Table III-18. Sources of Beneficial Use Impairment to Rivers and Streams in the Souris River Basin

Source Categories	Miles
Agriculture (1000)[1]	934.80
Crop Production (1150)	674.50
Grazing (1400)	742.30
Riparian Grazing (1510)	30.20
Animal Feeding Operations (1640)	405.00
Construction (3000)	40.00
Land Development (3200)	40.00
Urban/Runoff/Storm Sewers (4000)	40.00
Hydromodification (7000)	362.80
Lowhead Dams (7050)	40.00
Channelization (7100)	261.60
Upstream Impoundments (7350)	141.30
Flow Regulation/Modification (7400)	202.20
Removal of Riparian Vegetation (7600)	172.70
Bank Modification/Destabilization (7700)	164.70
Wetland Drainage (7800)	312.70
Internal Cycling of Nutrients (8530)	65.20
Waterfowl (8650)	65.20
Unknown (9000)	300.10
Source Outside State Jurisdiction/Border (9050)	43.40

[1]Number in parentheses denotes EPA major/minor source code.

2. Red River Basin

Based on the RF3 river file, there are an estimated 11,881 river and stream miles in the Red River Basin. These estimates also include river and stream miles in the Devils Lake subbasin. Aquatic life use was assessed in the Red River Basin through a combination of physical, chemical, and/or biological monitoring data. Of the 3769 river and stream miles assessed for aquatic life use attainment in the Red River Basin, 59 percent (2209 miles) fully support aquatic life use (Table III-19, Figure III-7). The remaining 41 percent (1560 miles) either partially support or do not support aquatic life use.

The primary pollutants causing aquatic life use impairment in the Red River Basin are silt, nutrients, and organic material (Table III-20). Sources of the pollutants are cropland erosion and runoff and wetland drainage. Other sources of nutrients include riparian area grazing and unregulated concentrated livestock feeding operations (Table III-21). Stream habitat degradation and stream flow alteration are other significant causes of aquatic life use impairment in the basin (Table III-20). Stream habitat degradation can be caused by riparian area grazing, lowhead dams, channelization, and excessive snagging and clearing. Stream flow can be altered by upstream reservoir management and the appropriation of water for other uses (e.g., irrigation, municipal, industrial).

Thirteen percent (1574 miles) of the rivers and streams in the Red River Basin were assessed for recreation use support, with 995 miles fully supporting this use. Of the 995 miles fully supporting recreation use, 79 percent (787 miles) were threatened. The remaining 579 miles were partially supporting or not supporting the recreation use designation (Table III-19, Figure III-8).

Pathogens, as indicated by fecal coliform bacteria, are the primary cause of recreation use impairment. Sources of elevated fecal coliform bacteria concentrations in the Red River Basin are livestock feeding operations, riparian area grazing, and urban runoff. To a lesser extent, municipal sewer bypasses also contribute to fecal coliform bacteria contamination in the basin.

Drinking water supply use is classified for 2114 miles of rivers and streams in the basin. Drinking water supply use was assessed for 378 miles of stream, with 31 percent (119 miles) of those streams fully supporting drinking water use. Two-hundred fifty-nine miles of river were assessed as fully supporting but threatened for drinking water use. This assessment is based on taste and odor complaints and the occurrence of periodic exceedences of both the chloride and sulfate standards within that reach of the Red River at Fargo. While specific sources of taste and odor have not been identified, potential sources include agricultural runoff, upstream reservoir releases, wetland drainage, industrial discharges, and municipal discharges. Elevated sulfate and chloride concentrations in the Red River have been related to late winter or summer low flow releases from Mud Lake/Lake Traverse.

The department first issued a fish consumption advisory for the Red River in 1992. This advisory was for methylmercury and was based on data collected in 1990 and 1992. Based on the age of this data and the dynamic nature of fish population structures, it was the department's determination that the advisory was no longer valid. Therefore, advisory information for the Red River was discontinued in April 1998. The Red River is considered "not assessed" with respect to fish consumption use.

Table III-19. Individual Use Support Summary for Rivers and Streams in the Red River Basin, Including Devils Lake

Use	Fully Supporting	Fully Supporting but Threatened	Partially Supporting	Not Supporting	Assessed
Aquatic Life	384.84	1824.05	1195.17	365.20	8112.00
Fish Consumption					
2062.28					
Recreation	1032.04	181.11	632.91	179.78	9855.42
Drinking Water Supply	118.99	259.11			
1736.10					

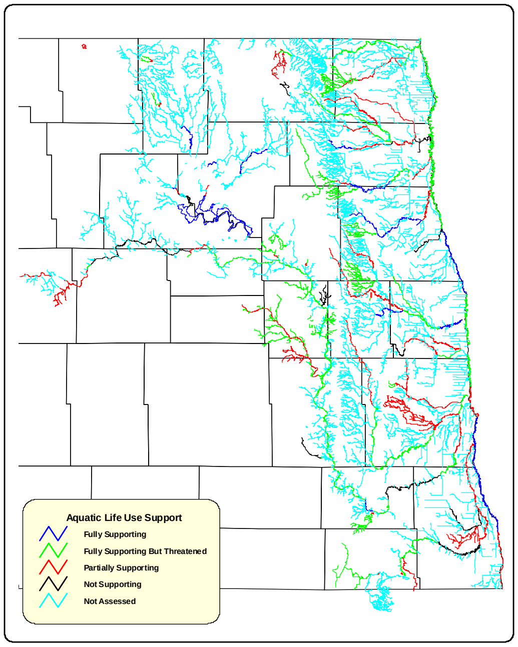

Figure III-7. Aquatic Life Use Support in the Red River Basin, Including Devils Lake

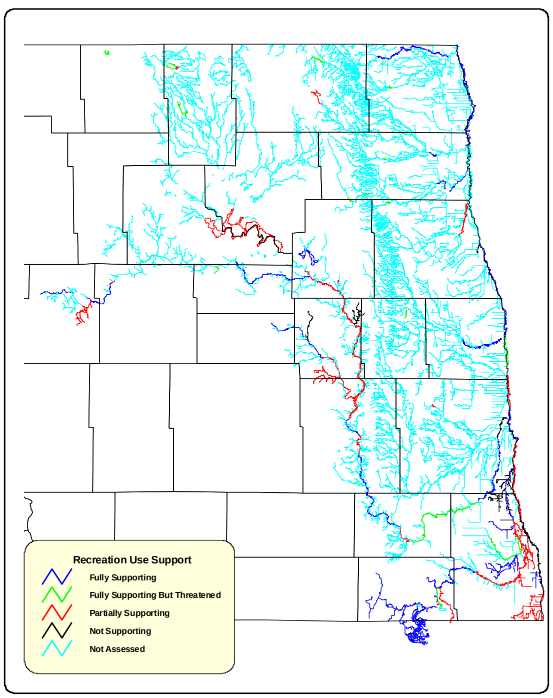

Figure III-8. Recreation Use Support in the Red River Basin, Including Devils Lake

Table III-20. Causes of Beneficial Use Impairment to Rivers and Streams in the Red River Basin, Including Devils Lake

Cause Categories	Miles
Pesticides (200)[1]	5.53
Metals (500)	74.55
Ammonia (600)	30.54
Nutrients (900)	1197.13
Siltation (1100)	1529.00
Organic Enrichment/Low DO (1200)	275.08
Low DO (1220)	221.42
Salinity/TDS/Chlorides (1300)	40.09
Flow Alteration (1500)	410.53
Stream Habitat Degradation (1600)	1511.00
Pathogens (1700)	801.82
Fecal Coliform Bacteria (1710)	801.82
Noxious Aquatic Plants (2200)	5.53

[1]Number in parentheses denotes EPA major/minor cause code.

Table III-21. Sources of Beneficial Use Impairment to Rivers and Streams in the Red River Basin, Including Devils Lake

Source Categories	Miles
Industrial Point Sources (100)[1]	98.54
Municipal Point Sources (200)	241.94
Agriculture (1000)	1852.73
Crop Production (1150)	1547.84
Grazing (1400)	664.42
Riparian Grazing (1510)	741.70
Animal Feeding Operations (1640)	825.36
Construction (3000)	132.03
Land Development (3200)	132.03
Urban/Runoff/Storm Sewers (4000)	323.07
Septic Tanks (6500)	66.93
Hydromodification (7000)	1233.24
Lowhead Dams (7050)	255.88
Channelization (7100)	575.36
Dam Construction (7300)	26.18
Upstream Impoundments (7350)	297.05
Flow Regulation/Modification (7400)	71.60
Removal of Riparian Vegetation (7600)	381.81
Bank Modification/Destabilization (7700)	151.63
Wetland Drainage (7800)	1516.83
Highway Runoff (8300)	5.53
Contaminated Sediments (8500)	5.53
Natural Sources (8600)	57.35
Recreation (e.g., golf courses) (8700)	49.53
Ground Water Loadings (8910)	71.10
Unknown (9000)	300.88

[1]Number in parentheses denotes EPA major/minor source code.

3. Missouri River/Lake Sakakwea Basin

Approximately 66 percent of the state's river and stream miles are within the Missouri River Basin, with over 25 percent (13,877 miles) in the Lake Sakakawea subbasin. While a significant portion of the state's rivers and streams are found within this subbasin, slightly less than 10 percent (1323 miles) were assessed for this report. The lack of quality assessment information for rivers and streams in this basin, relative to other basins in the state, is due in part to the large geographic area which encompasses this basin, limited site access (much of this basin is remote with few roads), the hydrology of the basin (most of the stream miles are represented by intermittent and ephemeral streams), and other statewide priorities.

Of the 1323 river and stream miles assessed for aquatic life use, 20 percent (270 miles) were assessed as partially supporting (Table III-22, Figure III-9). This assessment was due in part to chemical monitoring data which showed elevated trace element (e.g., cadmium, copper, arsenic, lead, selenium, zinc) concentrations exceeding the acute and/or chronic criteria (Table III-23). Most of these exceedances were observed from monitoring stations on the Little Missouri River and are believed to be the result of natural sources, compounded by anthropogenic activities such as oil exploration and drilling. The Little Missouri River drains an area known as the Little Missouri Badlands. The Badlands are a rugged, deeply eroded area, which is well drained through a system of integrated drainages. Soils in this area are mostly regosols and lithosols derived from cretaceous shale deposits. These soils and the underlying substrate are believed to contain naturally high concentrations of trace elements. Through natural erosion processes in the area, sediment with these high trace element concentrations are suspended in the river, contributing to the observed concentrations found in water samples collected from the Little Missouri River and its tributaries. Activities in the watershed, such as oil exploration and road construction, cause additional erosion which contributes to the sediment and trace element load to the river.

Recreation use support was assessed on 7 percent (1019 miles) of the river and stream miles in the basin. Recreation use was fully supported or fully supported but threatened on 495 miles of river and streams in the basin. Recreation use was partially supported on 449 miles of river and streams and not supported on 75 miles (Table III-22, Figure III-10). Pathogens (i.e., fecal coliform bacteria) are the cause of recreation use impairment, with riparian grazing and animal feeding areas the major sources of bacterial contamination (Tables III-23 and III-24).

Fifty-one river miles were assessed as partially supporting fish consumption use (Table III-22). River miles categorized as partially supporting are the Missouri River upstream from Lake Sakakawea, and the Yellowstone River upstream from its confluence with the Missouri River to the North Dakota-Montana border. In both instances, fish consumption use was assessed as partially supporting due to a fish consumption advisory for paddlefish. Methyl-mercury was present in detectable concentrations in paddlefish collected from both the Missouri and Yellowstone Rivers, necessitating the consumption advisory. As is the case with other areas of the state, the source of the mercury contamination is largely unknown.

Table III-22. Individual Use Support Summary for Rivers and Streams in the Missouri River/Lake Sakakawea Basin

Use	Fully Supporting	Fully Supporting but Threatened	Partially Supporting	Not Supporting	Assessed
Aquatic Life	37.72	1015.30	270.40		12554.01
Fish Consumption			51.16		505.58
Recreation	200.51	294.79	449.32	74.61	12858.20
Drinking Water Supply					556.74

Table III-23. Causes of Beneficial Use Impairment for Rivers and Streams in the Missouri River/Lake Sakakawea Basin

Cause Categories	Miles
Metals (500)[1]	329.82
Mercury (560)	51.16
Nutrients (900)	9.89
Siltation (1100)	81.88
Salinity/TDS/Chlorides (1300)	5.00
Stream Habitat Degradation (1600)	135.13
Pathogens (1700)	523.93
Fecal Coliform Bacteria (1710)	523.93

[1]Number in parentheses denotes EPA major/minor cause code.

Table III-24. Sources of Beneficial Use Impairment to Rivers and Streams in the Missouri River/Lake Sakakawea Basin

Source Categories	Miles
Municipal Point Sources (200)[1]	9.89
Agriculture (1000)	320.76
Crop Production (1150)	26.62
Grazing (1400/1500)	249.55
Riparian Grazing (1510)	98.40
Animal Feeding Operations (1640)	396.90
Construction (3000)	51.24
Highway/Road/Bridge Construction (3100)	51.24
Resource Extraction (5000)	278.66
Petroleum Activities (5500)	278.66
Hydromodification (7000)	5.00
Channelization (7100)	5.00
Natural Sources (8600)	300.28
Salt Storage Sites (8900)	5.00
Unknown (9000)	99.41
Sources Outside State Jurisdiction/Border (9050)	21.62

[1]Number in parentheses denotes EPA major/minor source code.

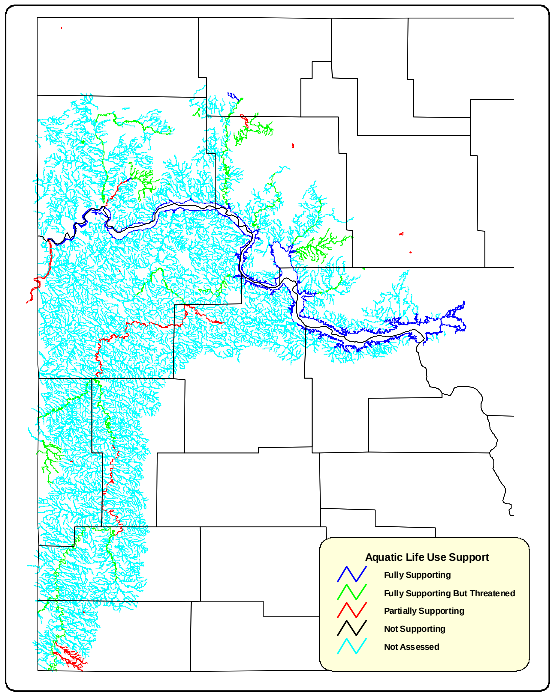

Figure III-9. Aquatic Life Use Support in the Missouri River/Lake Sakakawea Basin

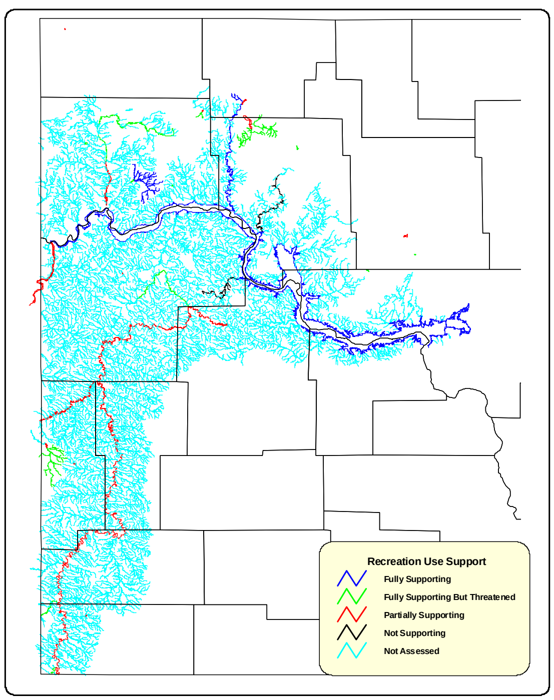

Figure III-10. Recreation Use Support in the Missouri River/Lake Sakakawea Basin

4. Missouri River/Lake Oahe Basin

Forty-one percent (22,271 miles) of the state's river and stream miles are located in the Missouri River/Lake Oahe Basin. This basin is also significant because it contains a 95-mile contiguous reach of Missouri River stretching from the Garrison Dam to Lake Oahe.

Aquatic life use was assessed on 30 percent (6619 miles) of rivers and streams in the basin (Table III-25, Figure III-11), an increase of 8 percent from the previous reporting period. The majority of these assessments were based on chemical monitoring data collected from stations located throughout the basin. Two-hundred forty-nine miles of streams located in the Knife River watershed were assessed, in part, on biological assessment data provided by North Dakota State University. Another 551 miles of streams in the Cedar Creek and North Fork Grand River watersheds were also assessed using biological assessment data collected by the department as part of Section 319 Program assessment projects. Aquatic life use was assessed as partially supporting for 1594 miles of rivers and streams in the basin and fully supporting/fully supporting but threatened for 5024 miles.

Stream habitat degradation and excessive nutrient loading, siltation, and sediment deposition within the stream channel are the primary pollutants causing aquatic life use impairment (Table III-26). Sources of pollutants contributing to aquatic life use impairment in the Missouri River/Lake Oahe Basin are animal feeding operations, riparian grazing, cropland erosion and runoff, and improper pasture and range land grazing (Table III-27).

Recreation use was assessed on 5015 miles of rivers and streams in the basin. Forty-four percent (1957 miles) of the river and stream miles assessed for this report either partially supported or did not support recreation use, 23 percent were assessed as fully supporting but threatened, and 33 percent fully supported recreation use (Table III-25, Figure III-12). Geometric mean fecal coliform bacteria concentrations in excess of the state standard of 200 colonies/100 mL were used as the indicator of pathogen contamination and recreation use impairment for this report (Table III-26). Major sources of bacteria contamination in the basin are animal feeding operations and riparian area grazing along rivers and streams (Table III-27).

The 95-mile reach of the Missouri River from Garrison Dam to Lake Oahe was assessed as partially supporting fish consumption use (Table III-25). This assessment is based on fish consumption advisory information which suggests that health-sensitive persons (e.g., women who are pregnant, women who plan to become pregnant, women who are breast feeding, and children under the age of 7) limit their consumption of channel catfish, northern pike, sauger, or walleye to two meals per month. This consumption advisory is based on elevated methyl-mercury concentrations in fish (Table III-26).

Drinking water supply was assessed as fully supporting for the Missouri River (Table III-25). The remaining 1640 river and stream miles classified for drinking water supply use were not assessed for this report.

Table III-25. Individual Use Support Summary for Rivers and Streams in the Missouri River/Lake Oahe Basin

Use	Fully Supporting	Fully Supporting but Threatened	Partially Supporting	Not Supporting	Not Assessed
Aquatic Life	854.14	4170.10	1594.27		15652.50
Fish Consumption			95.53		1640.31
Recreation	1657.08	1173.62	1957.14	226.72	17256.45
Drinking Water Supply	95.53				1640.31

Table III-26. Causes of Beneficial Use Impairment for Rivers and Streams in the Missouri River/Lake Oahe Basin

Cause Categories	Miles
Metals (500)[1]	111.31
Mercury (560)	95.53
Nutrients (900)	1535.58
Siltation (1100)	1490.67
Organic Enrichment/Low DO (1200)	181.78
Organic Enrichment (1210)	79.34
Low DO (1220)	71.78
Salinity/TDS/Chlorides (1300)	15.78
Flow Alteration (1500)	208.62
Stream Habitat Degradation (1600)	1559.50
Pathogens (1700)	2150.34
Fecal Coliform Bacteria (1710)	2150.34

[1]Number in parentheses denotes EPA major/minor cause code.

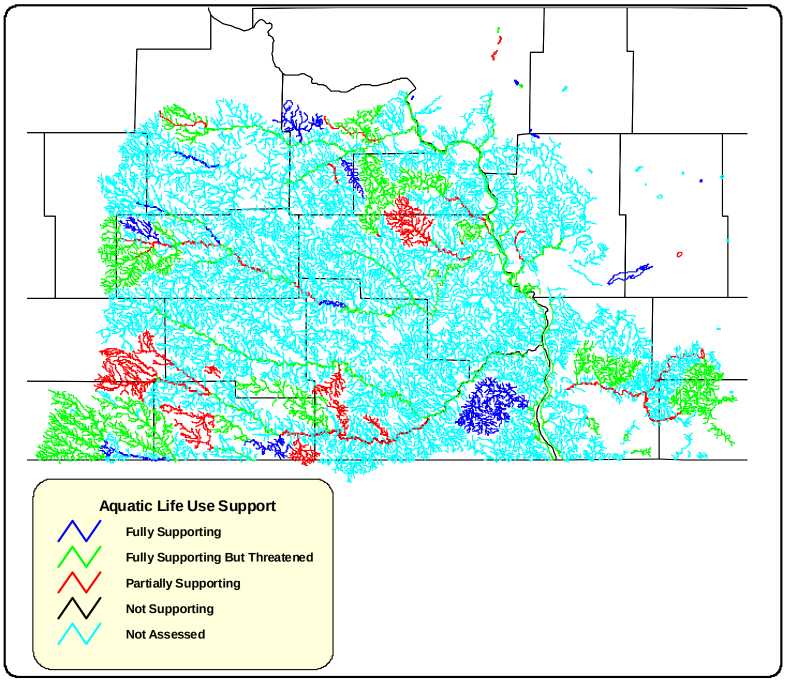

Figure III-11. Aquatic Life Use Support in the Missouri River/Lake Oahe Basin

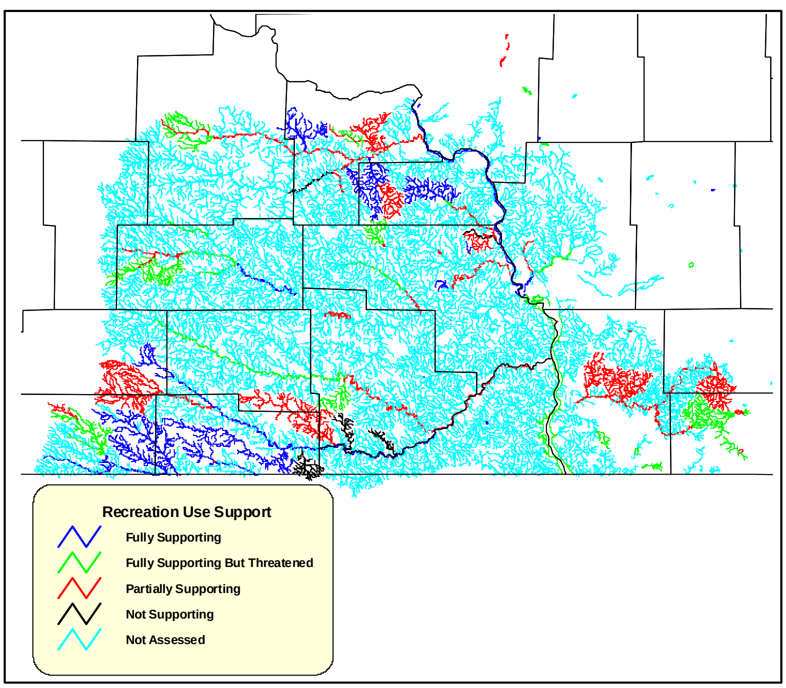

Figure III-12. Recreation Use in the Missouri River/Lake Oahe Basin

Table III-27. Sources of Beneficial Use Impairment to Rivers and Streams in the Missouri River/Lake Oahe Basin

Source Categories	Miles
Industrial Point Sources (100)[1]	21.32
Municipal Point Sources (200)	115.20
Agriculture (1000)	2390.29
Crop Production (1150)	1656.02
Pasture/Range Grazing (1400/1500)	2370.02
Riparian Grazing (1510)	292.86
Animal Feeding Operations (1640)	2555.97
Construction (3000)	49.52
Highway/Road/Bridge Construction (3100)	15.78
Land Development (3200)	49.52
Urban Runoff/Storm Sewers (4000)	86.08
Resource Extraction (5000)	44.77
Surface Mining (5100)	29.89
Petroleum Activities (5500)	14.88
Hydromodification (7000)	291.89
Lowhead Dams (7050)	100.07
Channelization (7100)	46.14
Upstream Impoundments (7350)	147.47
Flow Regulation/Modification (7400)	24.70
Bank Modification/Destabilization (7700)	14.90
Natural Sources (8600)	28.24
Unknown (9000)	81.00

[1]Number in parentheses denotes EPA major/minor source code.

5. James River Basin

Aquatic life and recreation uses were assessed on 41 percent of the river and stream miles in the James River Basin, an increase of 15 percent when compared to the 1998 305(b) report. Fish consumption and drinking water supply use were not assessed.

Of the 1127 river and stream miles assessed for aquatic life use in the James River Basin, 82 percent (919 miles) were fully supporting or were fully supporting but threatened. The remaining 18 percent (208 miles) were partially supporting aquatic life use (Table III-28, Figure III-13). Siltation, nutrient loading, and stream habitat degradation were the major pollutant causes of impairment to the biological community (Table III-29). Sources of these pollutants were assessed as cropland erosion and runoff, animal feeding operations, wetland drainage, and poor grazing management (Table III-30). Poor grazing management occurs in both upland pastures and along riparian areas, resulting in poor vegetative health and degraded pasture condition. Additional sources of pollution affecting the biological integrity of the James River are the numerous small dams which affect flow and change in its riverine characteristics.

Recreation use was assessed for 824 miles of river and streams in the basin (Table III-28, Figure III-14). Fecal coliform bacteria data collected in the basin indicated partial use support on 390 miles, while recreation use was fully supporting and fully supporting but threatened on 175 and 189 miles, respectively (Table III-28). Riparian area grazing and animal feeding areas are the primary sources of fecal coliform bacteria contamination in the James River Basin (Table III-30).

Table III-28. Individual Use Support Summary for Rivers and Streams in the James River Basin

Use	Fully Supporting	Fully Supporting but Threatened	Partially Supporting	Not Assessed
Aquatic Life	91.81	827.15	207.67	1626.02
Fish Consumption				567.80
Recreation	175.02	188.84	389.90	1928.48
Drinking Water Supply				567.80

Table III-29. Causes of Beneficial Use Impairment for Rivers and Streams in the James River Basin

Cause Categories	Miles
Nutrients (900)[1]	204.69
Siltation (1100)	204.69
Organic Enrichment/Low DO (1200)	16.38
Organic Enrichment (1210)	13.40
Low DO (1220)	2.98
Flow Alteration (1500)	89.23
Stream Habitat Degradation (1600)	204.69
Pathogens (1700)	460.31
Fecal Coliform Bacteria (1710)	460.31

[1]Number in parentheses denotes EPA major/minor cause code.

Table III-30. Sources of Beneficial Use Impairment to Rivers and Streams in the

James River Basin

Source Categories	Miles
Municipal Point Sources (200)[1]	55.82
Agriculture (1000)	514.72
Crop Production (1150)	229.22
Pasture/Range Grazing (1400/1500)	500.31
Riparian Grazing	14.41
Animal Feeding Operations (1640)	404.98
Construction (3000)	1.48
Highway/Road/Bridge Construction (3100)	1.48
Land Development (3200)	1.48
Urban Runoff / Storm Sewers (4000)	15.89
Land Disposal (6000)	14.41
Septic Tanks (6500)	14.41
Hydromodification (7000)	169.09
Lowhead Dams (7050)	146.95
Upstream Impoundment (7350)	60.28
Flow Regulation/Modification (7400)	2.98
Flow Diversion (7410)	17.65
Removal of Riparian Vegetation (7600)	1.48
Wetland Drainage (7800)	108.78
Unknown (9000)	4.20

[1]Number in parentheses denotes EPA major/minor source code.

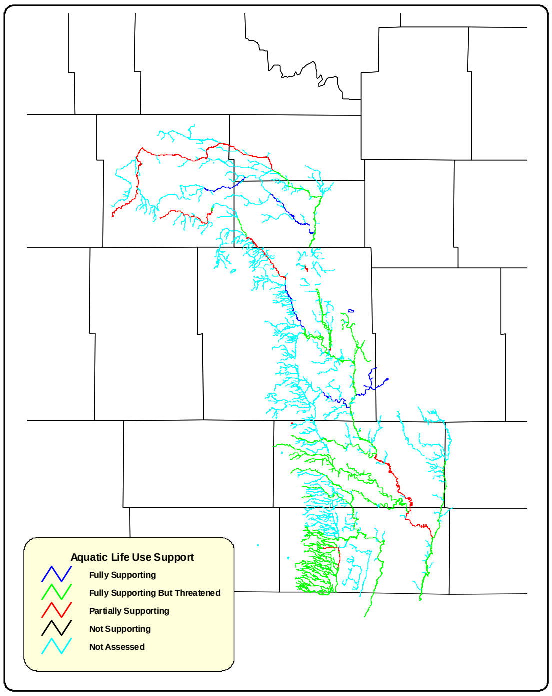

Figure III-13. Aquatic Life Use Support in the James River Basin

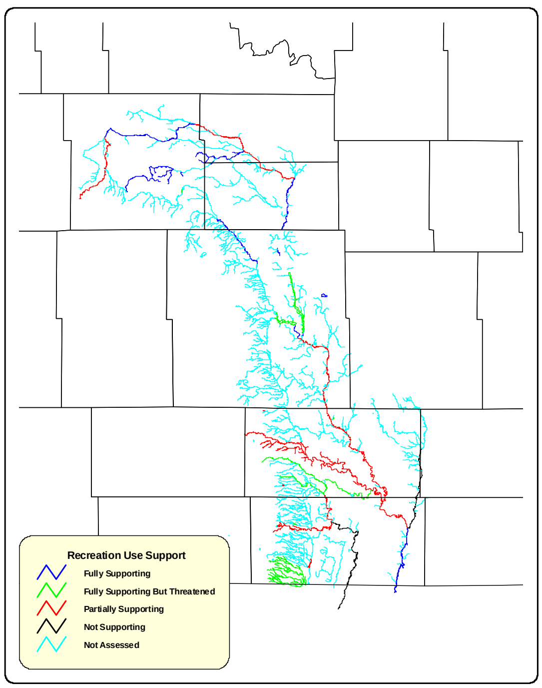

Figure III-14. Recreation Use Support in the James River Basin

Chapter 4. Lakes Water Quality Assessment

Statewide Assessment

A total of 121 lakes and reservoirs (44 natural lakes and 77 reservoirs), representing 702,315 surface acres, were assessed for this report (Table III-31). The remaining 102 lakes and reservoirs not assessed represent 12,595 acres or less than 2 percent of the total lake and reservoir acres in the state.

For purposes of this report, the term “aquatic life use” is synonymous with biological integrity and is defined as the ability of a lake or reservoir to support and maintain a balanced, adaptive community of aquatic organisms (e.g., fish, zooplankton, phytoplankton, macroinvertebrates, vascular plants) having a species composition, diversity, and functional organization comparable to that of least impaired reference lakes and reservoirs in the region (modified from Karr et al., 1981). Seventy-six lakes and reservoirs representing 683,572 acres were assessed as fully supporting aquatic life use (Table III-31); in other words, they are considered capable of supporting and maintaining a balanced community of aquatic organisms. Of this total, 55 lakes and reservoirs representing 32,249 acres are considered threatened (Table III-31). A threatened assessment means that if water quality and/or watershed trends continue, it is unlikely these lakes will continue to support aquatic life use. The lakes and reservoirs will begin to experience more frequent algal blooms and fish kills. They will display a shift in trophic status from a mesotrophic or eutrophic condition to a hypereutrophic condition.

Forty-five lakes and reservoirs, totaling 18,742 surface acres, were assessed as partially supporting aquatic life use (Table III-31). One of the primary causes of aquatic life impairment to the state’s lakes and reservoirs is low DO in the water column (Table III-32). Low DO in lakes can occur in summer (referred to as summer kills), but usually occurs in the winter under ice cover conditions. Low DO conditions and winter kills occur when senescent plants and algae decompose, consuming available oxygen. Because the lake is ice-covered, reareation is minimal, and the lake goes anoxic resulting in a fish kill. While fish kills are the most apparent impact affecting sensitive fish species (e.g., walleye, trout, bass, bluegill, crappie, northern pike), other DO-sensitive aquatic organisms may also be affected. When fish kills occur, low DO-tolerant fish species (e.g., carp, bullhead, white suckers) will be favored, resulting in a lake dominated by these “rough” fish species.

Pollutants which stimulate the production of organic matter, such as plants and algae, can also cause aquatic life impairment. Two such secondary pollutant causes are excessive nutrient loading and siltation (Table III-32).

Major sources of nutrient loading to the state’s lakes and reservoirs are erosion and runoff from cropland, runoff from animal feeding operations such as concentrated livestock feeding and wintering operations, and hydrologic modifications (Table III-33). Hydrologic modifications, such as wetland drainage, channelization, and ditching, increase the runoff and delivery rates to lakes and reservoirs, in effect, increasing the size of a lake’s watershed. Nutrients, sediment, and organic matter, which would be retained in wetlands under normal conditions, become part of the lake’s external budget.

Other sources of nutrient loading which affect lakes in the state are point source discharges from municipal wastewater treatment facilities, urban/stormwater runoff, and shoreline development (Table III-33).

Shoreline or cabin development directly contributes nutrients to lakes in many ways. Typically, lake cabins or homes use septic systems (tanks and drain fields) to contain their wastewater. Many of these systems are poorly designed, poorly maintained, or nonexistent. Poorly designed septic systems provide a direct path of nutrients from the cabin to the lake. In addition, cabins or homes along lakes can contribute nutrients through fertilizer runoff from lawns.

Shoreline development can indirectly lead to increased nutrient loading when development results in a loss of the natural vegetation surrounding the lake. This buffer, between the lake and its watershed, provides for the assimilation of nutrients and retention of sediments contained in the runoff from the surrounding landscape. When this buffer is lost or degraded due to development, nutrients, sediment, and other chemicals (e.g., pesticides, road salts) are afforded a direct path to the lake.

The previously mentioned sources are considered external or watershed-scale sources of nutrient loading. Another source which can represent a significant portion of the nutrient budget at times is internal cycling, particularly in those lakes which periodically go anoxic either during ice cover or through thermal stratification in the summer. Under these circumstances, phosphorus and reduced forms of nitrogen (e.g., ammonia) can be released into the water column. The increased nutrient concentrations impair use by stimulating noxious weed growth and algal blooms.

Recreation use (e.g., swimming, waterskiing, boating, sailing, sunbathing) was assessed for 687,315 lake and reservoir acres in the state. Of this total, 49 lakes, representing 147,057 acres, were assessed as partially supporting use for recreation (Table III-31). The primary cause of use impairment is excessive nutrient loading, which results in nuisance algal blooms and noxious aquatic plant growth (Table III-32). Sources of nutrients causing algal blooms and weed growth were described earlier (Table III-33). Fifty-two lakes totaling 28,881 acres were assessed as threatened (Table III-31). Nutrient loading is also linked to the negative water quality trends these lakes are experiencing. If left unchecked, these lakes will degrade to the point where frequent algal blooms and/or excessive weed growth will negatively affect recreation.

Two-hundred and nineteen lakes and reservoirs, representing 707,615 acres, were assigned the use for fish consumption (Table III-31). Lakes not assigned the fish consumption use are saline lakes which cannot support a sport fishery. These lakes are also not assigned the use for municipal drinking water supply.

Of the 219 lakes entered into the ADB and assigned the use for fish consumption, 21 lakes and reservoirs, totaling 518,175 acres, were considered partially supporting fish consumption use (Table III-31). The remaining 198 lakes and reservoirs which support a sport fishery were not assessed for this report. The 21 lakes and reservoirs assessed as partially supporting fish consumption use were so designated because each one has a fish consumption advisory. The advisory for each lake limits the consumption of fish due to methyl-mercury (Table III-32).

Sources of methyl-mercury in fish remain largely unknown. Potential sources of mercury include natural sources, atmospheric deposition, and runoff from cropland containing grain that was treated with a mercury-based fungicide (Note: The use of these fungicides is now prohibited.) (Table III-33). Results of a report prepared by the Health Department show an increase in mercury concentrations in the fillets of walleye, northern pike, and chinook salmon in Lake Sakakawea following the drought and recent filling of the lake (Pearson et al. 1997). One possible reason for the higher mercury concentrations in fish is that the lake may be experiencing an increase in the rate of mercury methylization due to greater amounts of organic matter in the lake following flooding. The drought of the late 1980s and early 1990s lowered the lake level, allowing vast areas of dry lake bed to revegetate. When the lake began refilling in 1993, the vegetation was flooded and began decomposing. The organic matter provided to the lake during this period is thought to have favored the methylization process. This is a microbial process where bacteria present in the lake convert elemental mercury to its more bioavailable methyl-mercury form. The increase in bioavailable mercury in the lake is reflected in higher mercury concentrations in fish.

Four reservoirs (Lake Sakakawea, Homme Dam, Bisbee Dam, and Mt. Carmel Reservoir) are currently used either directly or indirectly as municipal drinking water supplies, while two others (Patterson Lake and Renwick Dam) serve as back-up water supplies in the event the primary water supplies should fail.

Lake Sakakawea was assessed as fully supporting drinking water supply use (Table III-31). The remaining reservoirs were assessed as fully supporting but threatened for drinking water supply use. The primary threats to use support are frequent algal blooms stimulated by excessive nutrient loading and siltation (Table III-32). Algal blooms affect the taste and odor of a drinking water supply and increase treatment costs. Siltation decreases reservoir volume, thereby reducing reservoir storage capacity as a drinking water supply. Agricultural runoff from cropland and animal feeding operations are the primary sources of nutrients and sediment to threatened drinking water supply reservoirs (Table III-33). Poor grazing management of pasture land, range land, and along riparian areas is also a significant source of sediment to water supply lakes and reservoirs (Table III-33). In particular, riparian area grazing destroys streambank vegetation, creating bank erosion which can be a significant source of sediment to lake and reservoirs.

Table III-31. Individual Use Support Summary for Lakes and Reservoirs in North Dakota

Use	Fully Supporting	Fully Supporting but Threatened	Partially Supporting	Not Assessed
Aquatic Life	651323.6	32248.8	18742.3	12595.3
Fish Consumption			518175.0	189439.7
Recreation	511376.2	28881.4	147057.1	27595.3
Drinking Water Supply	368231.0	2168.0		337215.7

Table III-32. Causes of Beneficial Use Impairment for Lakes and Reservoirs in North Dakota

Cause Categories	Acres
Metals (500)[1]	518175.0
Mercury (560)	518175.0
Nutrients (900)	159811.9
Siltation (1100)	15233.3
Organic Enrichment/ Low DO (1200)	18764.1
Low DO (1220)	18674.1
Salinity/TDS/Chlorides (1300)	104.0
Noxious Aquatic Plants (2200)	73.6
Turbidity (2500)	260.5

[1]Number in parentheses denotes EPA major/minor cause code.

Table III-33. Sources of Beneficial Use Impairment for Lakes and Reservoirs in North Dakota

Source Categories	Acres
Municipal Point Sources (200)[1]	452.5
Agriculture (1000)	159811.9
Crop Production (1150)	159811.9
Pasture/Range Grazing (1400/1500)	158417.2
Animal Feeding Operations (1640)	29172.8
Construction (3000)	805.7
Land Development (3200)	805.7
Urban Runoff/Storm Sewers (4000)	2871.7
Resource Extraction (5000)	260.5
Surface Mining (5100)	260.5
Land Disposal (6000)	2095.9
Septic Tanks (6500)	2040.7
Hydromodification (7000)	136212.7
Channelization (7100)	91.0
Upstream Impoundments (7350)	9458.4
Flow Diversion (7410)	281.5
Bank Modification/Destabilization (7700)	3626.7
Shoreline Erosion (7750)	1605.0
Wetland Drainage (7800)	132477.6
Internal Nutrient Cycling (8530)	26344.0
Natural Sources (8600)	132842.7
Unknown (9000)	516867.0
Waterfowl (9010)	9458.4
Sources Outside State Jursidiction/Border (9050)	9458.4

[1]Number in parentheses denotes EPA major/minor source code.

Trophic Status

Reservoirs and natural lakes were only assessed for trophic status if appropriate data were available. For purposes of this report, "trophic status" refers to the present condition or measure of eutrophication of the waterbody at the time of the assessment.

Accurate trophic status assessments are essential to making sound management decisions. In order to minimize errors in classification, all existing chemical, physical, quantitative, and qualitative data were used in making final trophic status assessments.

Because there are no trophic status indices specific to North Dakota waters, Carlson's Trophic Status Index (TSI) (Carlson, R. E. 1977, "A Trophic State Index for Lakes," *Limnology and Oceanography*, 22(2):361-369) was chosen as the initial method to describe a lake's or reservoir's trophic status. Carlson's TSI was selected because it is commonly used by limnologists and because it was developed for Minnesota, a state close to North Dakota geographically (see section on LWQA Project on page III-11).

An attempt was made to gather enough chemical and ancillary data to group as many of North Dakota's 223 lakes/reservoirs into one of four trophic states (Table III-34). The four trophic states, in order of increasing productivity, are oligotrophic, mesotrophic, eutrophic, and hypereutrophic. Adequate data was available to assess the trophic status of 128 of the 223 lakes entered into the ADB database. The majority of the state's assessed lakes and reservoirs range from eutrophic to hypereutrophic. Twenty-one lakes and reservoirs were assessed as mesotrophic. There were no oligotrophic lakes assessed in the state.

Table III-34. Trophic Status of Lakes and Reservoirs in North Dakota

Trophic Status	Number of Lakes	Acreage of Lakes
Oligotrophic	0	0.0
Mesotrophic	21	503386.0
Eutrophic	51	20386.1
Hypereutrophic	56	158593.0
Not Assessed	95	32544.9
Total Number of Lakes	223	714910.0

Control Methods

NPS pollution, particularly from agricultural lands and feedlots, is the largest source of pollutants leading to the degradation of the state's lakes and reservoirs. North Dakota's NPS Pollution Management Program is very active in reducing agricultural NPS pollution. This program has kept thousands of tons of soil, along with attached contaminants, out of the state's lakes and reservoirs.

The NPS Pollution Management Program has cost-shared on 50 projects in the state and one project extending into South Dakota. These projects treat entire watersheds through the promotion of sustainable agricultural and sound land management practices. Landowner participation is voluntary, with incentives provided by cost-share programs.

Point source pollution has the potential to severely impact individual lakes and reservoirs and is the second largest pollution problem. Protection of lakes and reservoirs from point source discharges is accomplished through the NDPDES Program (see Part II. Chapter 2. Point Source Control Program). Initially, the NDPDES Program permitted, monitored, and regulated only industrial and municipal discharges. Permits for stormwater discharges have recently been added; this will significantly help treat pollutants originating from this source.

While nearly every impoundment on a major river course is affected to some degree by point source pollution discharges, the impacts would be catastrophic without the NDPDES Program. Currently, the program regulates 13 municipal point sources and one industrial point source having the potential to directly impact lakes and reservoirs in North Dakota.

Restoration/Rehabilitation Efforts

No new lake or reservoir restoration projects have been initiated or appear imminent. The Golden Lake Project, located in Steele County, is still operating. Initial water quality results from Golden Lake are encouraging with apparent reductions in total phosphate as phosphorus concentrations. This innovative project uses an adjacent permanent wetland to assimilate nutrients and promote sediment settling.

While no new Phase I, II, or III Clean Lakes projects are planned, there has been a great deal of interest generated with the lake water quality assessment studies. These one-year assessments provide resource managers and the public with information needed to prioritize lakes and reservoirs in their regions for further monitoring and assessment. The assessments have led to several NPS Pollution Management Projects.

Unfortunately, federal Clean Lakes funds are inadequate to complement watershed pollution control activities. Recently, EPA has agreed to allow states to make Section 319 funding available for in-lake restoration without the costly burden of a Phase I study. Also available is a more attractive cost-share percentage than that associated with Clean Lakes restoration funding. Due to this financial opportunity, the Health Department is optimistic about taking a more active role in lake restoration/rehabilitation.

Most restoration/rehabilitation activities in the state are cost-shared through the NPS Pollution Management Program. In-lake restoration has been limited to installation of hypolimnetic drawdowns and aeration systems. Primary financing has been provided by the North Dakota Game and Fish Department, the SWC, local government entities, and sportsmen's groups.

Impaired and Threatened Lakes

As stated earlier, most of the state's assessed lakes and reservoirs are either threatened or impaired for aquatic life and/or recreation. The predominant pollutants causing lake and reservoir impairment are nutrient enrichment and siltation from agricultural nonpoint sources (Tables III-31, III-32, III-33).

Acid Effects on Lakes

Acid precipitation and acid mine drainage pose significant threats to some of the nation's lakes and streams. Most surface waters in North Dakota are naturally alkaline (pH>7), while rainfall is naturally acidic (pH<7). Surface waters are able to resist acidification by what is termed "buffering capacity." In surface waters, buffering capacity is maintained largely by the carbonate (CO_3^{-2}) and bicarbonate (HCO_3^{-1}) ions in solution. These ions are collectively measured with hydroxide ions (OH^{-1}) as total alkalinity. Acidification in surface waters occurs when the buffering capacity is exhausted, thus causing a reduction in pH.

North Dakota's lakes are highly alkaline and, as a result, do not show acidity caused by anthropogenic sources. For a more in-depth discussion of rainfall chemistry in the state, including acid rain, refer to a report published by the Health Department entitled *Ambient Air Quality, Precipitation Chemistry, and Atmospheric Deposition in North Dakota, 1980-1984.*

Toxic Effects on Lakes

Currently, mercury is the only contaminant assessed as causing lake and reservoir use impairment. As stated previously, elevated mercury concentrations in the tissues of fish have resulted in consumption advisories for 21 lakes and reservoirs, totaling 518,175 acres. Again, very little is known about the source of the mercury contamination in fish from these lakes. It is likely, however, that sources are both natural and anthropogenic.

In 1991, the department initiated the LWQA Project, by which the state's lakes and reservoirs were systematically sampled and assessed for trophic status and watershed condition. In addition to data collected to assess the general condition of each lake, data was also collected on the type, concentration, and location of contaminants like trace elements and organic compounds (e.g., pesticides, PCBs).

To date, sediments and fish have been collected from 113 lakes and reservoirs throughout the state. This data should provide useful information for determining baseline contaminant concentrations and for examining patterns in contaminant concentrations in the state's lakes and reservoirs.

Trends in Lake Water Quality

It is difficult to quantify water quality trends for most North Dakota lakes and reservoirs because little, long-term, comparable water quality data is available. However, additional water quality data collected as part of the LWQA Project and as part of NPS Pollution assessment projects should eventually shed some "quantitative light" on this reporting requirement. It is the intention of the Health Department to resample LWQA Project lakes at scheduled intervals (every six to ten years). Trends will be assessed by comparing water quality and land use data collected over time.

While limited quantitative trends data exists for the state's lakes and reservoirs, an attempt was made to qualitatively evaluate trends for this report. Thirty-five lakes were assessed as "stable." Four lakes were assessed as "degrading" (Table III-35). No lakes were assessed as "improving." Where insufficient historical water chemistry, land use, or other ancillary data existed to determine trends, lakes were categorized as "unknown."

Table III-35. Trophic Trends for North Dakota Lakes and Reservoirs

Trend	Number of Lakes	Lake Acres
Improving	0	0.0
Stable	35	425196.5
Degrading	4	448.5
Unknown	184	289265.0

Chapter 5. Wetlands Assessment

Background

Wetlands have long been regarded as nuisance areas or wastelands which only serve to impede agriculture, urban, or transportation development. Only recently have the ecological and social functions and values of wetlands been realized. It is now scientifically proven that wetlands are important for the storage of flood waters, for providing fish and wildlife habitat, for recharging ground water, and for retaining and cycling chemical pollutants and particulates. Recently, wetlands have been recognized as a significant source for carbon sequestration. This could make wetlands an important component in the campaign to prevent global warming.

While these are important wetland functions, probably the best known function of wetlands in North Dakota is that of waterfowl production. Most of North Dakota's remaining wetlands are located in an area known as the Prairie Pothole Region. This area extends from the Missouri Coteau in central North Dakota eastward to the glacial Lake Agassiz Plain, also known as the Red River Valley. The region covers roughly 300,000 square miles and exists as a wide band extending from Central Alberta southwest into northwestern Iowa (Figure III-15). The Prairie Pothole Region, with its many types of wetlands, is arguably the most biologically diverse and productive habitat in North America.

Extent of Wetland Resources

There seem to be as many ways to classify wetlands as there are wetlands themselves. The U. S. Fish and Wildlife Service first began to classify wetlands based on a system developed by Martin et al. (1953). This classification system was then modified by Stewart and Kantrud (1971), specifically for the Prairie Pothole Region of North America. With the Stewart and Kantrud classification system, vegetational zones are described in detail, along with the plant species most commonly found in the zone. These zones are used to identify phases which indicate the wetland's water regime or disturbed bottom soil (e.g., cropland tillage). Seven wetland classes are identified with the Stewart and Kantrud system. These include the familiar Class I - ephemeral ponds, Class II - temporary ponds, Class III - seasonal ponds and lakes, Class IV - semi-permanent ponds and lakes, and Class V - permanent ponds and lakes. Also included in the Stewart and Kantrud system are Class VI - alkali ponds and lakes, and Class VII - fens. Along with each class, there are five subclasses, A through E, based on variations in surface water salinity. Those familiar with the Stewart and Kantrud classification system refer to temporary depressional wetlands as Class II wetlands, seasonal wetlands as Class III wetlands, and semi-permanent wetlands as Class IV.

In 1979, the U. S. Fish and Wildlife Service adopted the Cowardin et al. (1979) classification system for wetlands and deep water habitats of the United States. The Cowardin et al. classification system was developed to be used with the National Wetlands Inventory. In the highest level of classification, wetlands are grouped into five ecological systems: palustrine, lacustrine, riverine, estuarine, and marine. The palustrine class includes only wetlands, whereas each of the four other systems include wetlands and associated deep water habitats. For purposes of classification, deep water habitats are defined as areas where water is greater than 6.6 feet deep. In North Dakota, only the palustrine, lacustrine, and riverine wetland types exist.

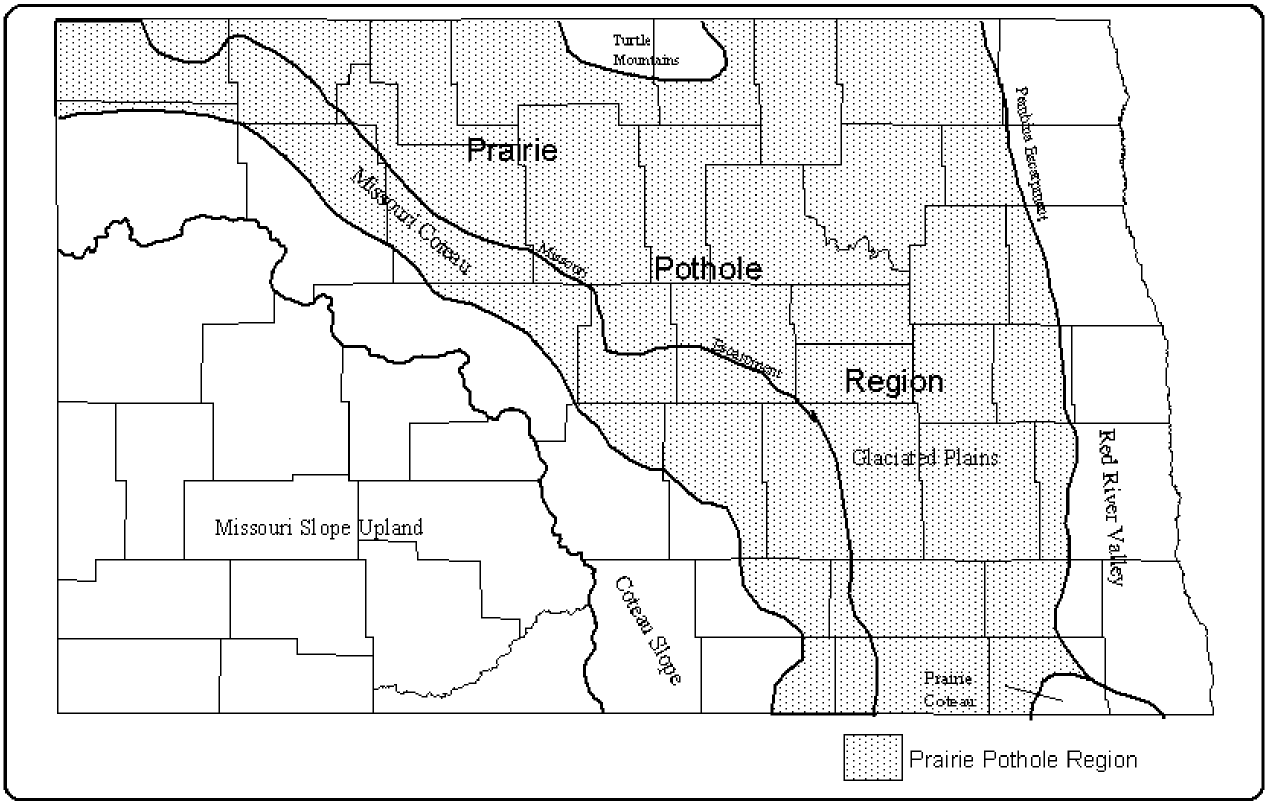

Figure III-15. Prairie Pothole Region

Brinson (1993) developed a classification system for use by the COE. This classification system, termed the Hydrogeomorphic (HGM) classification system, is based upon the wetland's position in the landscape (i.e., geomorphic setting), dominant source of water, and the flow and fluctuation of water in the wetland. Brinson (1993) describes seven HGM wetland classes: riverine, depressional, slope, mineral soil flats, organic soil flats, estuarine fringe, and lacustrine fringe.

In North Dakota, wetlands are classified into four broad categories according to the State Engineer's drainage rules. The state wetland classification includes temporary wetlands, seasonal wetlands, semi-permanent wetlands, and permanent wetlands. The following are brief descriptions of each wetland class, as adopted by the North Dakota State Game and Fish Director and the State Engineer.

"Temporary wetlands" are shallow depressions, which hold water or are waterlogged from spring runoff until early June. In years with normal runoff and precipitation, these areas may be tilled for crop production. In years with high runoff or heavy spring rain, these areas may not dry out until mid-July. They cannot be tilled, but may be used for hayland or pasture. Temporary wetlands frequently reflood during heavy summer and fall rains. Sheet water, as defined in North Dakota's Century Code 61-32-02, does not fall under the temporary wetland classification.

"Seasonal wetlands" are depressions, which normally hold water from spring runoff until mid-July. In years with normal runoff and precipitation, these wetlands cannot be tilled, but may be used for hayland and pasture. In low runoff or dry years, these areas may be tilled for crop production, but commonly reflood with heavy summer and fall rains.

"Semi-permanent wetlands" are located in well-defined depressions or basins. In normal years, these areas hold water throughout the summer. Semi-permanent wetlands generally become dry only in years of below normal runoff and precipitation. Freshwater semi-permanent wetlands (commonly called cattail sloughs) are characterized by a predominance of cattail and bulrush vegetation in scattered areas of open water. Saline semi-permanent wetlands have a preponderance of alkali bulrush in scattered areas of open water.

"Permanent wetlands" are located in well-defined basins, which characteristically hold water throughout the year. The wetlands become dry only after successive years of below normal runoff and precipitation. Freshwater permanent wetlands typically have a border of aquatic vegetation and predominant open-water areas in the interior. Saline permanent wetlands are typically devoid of emergent vegetation and exhibit a white, salt-encrusted shoreline.

As of this report, there are no accurate estimates of state wetland acreage based on wetland class. Statewide, it is estimated there are approximately 2.5 million acres of wetlands. When compared to the approximately 4.9 million acres of wetlands which covered North Dakota prior to development, this represents a 49 percent reduction in wetlands. Stewart and Kantrud (1973) divided the state into four biotic regions: the Prairie Pothole Region, the Lake Agassiz Plain Region, the Coteau Slope Region, and the Southwestern Slope Region. They estimated that 81 percent of the wetlands in the state are located in the Prairie Pothole Region. More than 90 percent of all wetlands in the state are considered natural basin wetlands, commonly referred to as prairie potholes. Furthermore, it is estimated that 78 to 79 percent of wetland basins in the Prairie Pothole Region are less than one acre in size (Ron Reynolds, personal communication). While the rate of wetland loss in the state seems to be decreasing, it is safe to assume that wetland losses still exceed wetland gains.

Integrity of Wetland Resources

Wetland integrity should be thought of in terms of whether a wetland performs a set of functions or uses which would be expected for natural or "reference" wetlands of a similar class or type. The NRCS and the COE have described 11 specific functions within three general functional categories for temporary and seasonal Prairie Pothole wetlands (Lee et al., 1997) (Table III-36). Therefore, whenever a wetland's function is diminished, it can be said that wetland integrity is diminished.

Hydrologic manipulation (e.g., drainage, wetland consolidation, channelization, filling) continues to be the greatest impact on the integrity of the state's wetlands. While not as dramatic, other factors such as chemical contamination, nutrient loading (i.e., eutrophication), and sedimentation can also affect a wetland's function and, therefore, its chemical, physical, and biological integrity.

Landscape level changes outside the edge of the wetland basin can also negatively affect wetland integrity. Changes to the landscape, such as road construction, cropland conversion, urbanization, or the drainage of adjacent wetlands, all affect wetland functions in its landscape. Cowardin et al. (1981) found that in a 3,877-square-mile area of the Prairie Pothole Region, 40 percent of wetlands were cultivated to the wetland edge, 33 percent were in pasture, and 7 percent were hayed.

When viewed on a larger scale, wetlands are part of a larger unit known as a wetland complex. Wetland complexes are aggregates of individual wetland basins which are hydrologically connected. A typical wetland complex includes recharge wetlands, flow-through wetlands, and discharge wetlands. Recharge wetlands are typically located at higher elevations in the landscape and receive the majority of their hydrologic budgets from precipitation and surface runoff. Recharge wetlands get their name because they recharge ground water. Flow-through wetlands, as their name implies, receive surface and ground water inflow, and then outflow to both surface and ground water. Discharge wetlands receive the majority of their hydrologic budgets from ground water discharge, and rarely outflow to surface water. Because recharge wetlands receive most of their water through precipitation and surface water inflow, they tend to be fresher. Discharge wetlands, which receive most of their water from ground water, tend to be higher in TDS.

Due to this hydraulic linkage in the landscape, any land use change which affects or changes the hydrologic relationship of wetlands in the complex can and will affect the hydrologic or physical integrity of each wetland basin in the complex. This, in turn, affects both the chemical and biological integrity of wetlands in the complex.

In order to quantify the extent to which wetlands are performing a prescribed set of functions at their optimal level, it will be necessary to develop and calibrate a set of functional assessment models. These models use a set of indicators, which serve as surrogates for the function. Once these models are developed, it will then be possible to statistically sample wetlands over a large area in order to assess wetland integrity. These same models or tools will also allow wetland managers to assess the integrity of individual wetlands for regulatory purposes (e.g., Swampbuster, Section 404).

Table III-36. Definitions of Functions for Temporary and Seasonal Prairie Pothole Wetlands (Lee et al. 1997)

<u>Physical/Hydrologic Functions</u>

Maintenance of Static Surface Water Storage. The capacity of the wetland to maintain a hydrologic regime that supports static storage, soil moisture in the unsaturated zone, and ground water interactions.

Maintenance of Dynamic Surface Water Storage. The capacity of the wetland to maintain a hydrologic regime that supports dynamic storage, soil moisture in the unsaturated zone, and ground water interactions.

Retention of Particulates. Deposition and retention of inorganic and organic particulates (>0.45 μm) from the water column, primarily through physical processes.

<u>Biogeochemical Functions</u>

Elemental Cycling. Short- and long-term cycling of elements and compounds on-site through the abiotic and biotic processes that convert elements (e.g., nutrients and metals) from one form to another; primarily recycling processes.

Removal of Imported Elements and Compounds. Nutrients, contaminants, and other elements and compounds imported to the wetland are removed from cycling processes.

<u>Biotic and Habitat Functions</u>

Maintenance of Characteristic Plant Community. Characteristic plant communities are not dominated by non-native or nuisance species. Vegetation is maintained by mechanisms, such as seed dispersal, seed banks, and vegetative propagation which respond to variations in hydrology and disturbances, such as fire and herbivores. The emphasis is on the temporal dynamics and structure of the plant community as revealed by species composition and abundance.

Maintenance of Habitat Structure Within Wetland. Soil, vegetation, and other aspects of ecosystem structure within a wetland are required by animals for feeding, cover, and reproduction.

Maintenance of Food Webs Within Wetland. The production of organic matter of sufficient quantity and quality to support energy requirements of characteristic food webs within a wetland.

Maintenance of Habitat Interspersion and Connectivity Among Wetland. The spatial distribution of an individual wetland in reference to adjacent wetlands within the complex.

Maintenance of Taxa Richness of Invertebrates. The capacity of a wetland to maintain characteristic taxa richness of aquatic and terrestrial invertebrates.

Maintenance of Distribution and Abundance of Vertebrates. The capacity of a wetland to maintain characteristic density and spatial distribution of vertebrates (aquatic, semi-aquatic, and terrestrial) that utilize wetlands for food, cover, and reproduction.

Development of Wetland Water Quality Standards

As the lead water quality agency in the state, the Health Department is responsible for developing and implementing water quality standards. In general, the *State Water Quality Standards* are regulations which specify the beneficial uses of lakes, reservoirs, rivers, and streams in North Dakota. The standards include narrative descriptions, numeric criteria, and an antidegradation policy to protect beneficial uses. Common beneficial uses for the state's lakes and rivers are recreation (e.g., swimming, wading, boating, skiing), fishing, drinking water supply, and aquatic life. Agriculture (i.e., stock watering and irrigation) and industrial uses for water are also recognized.

The *State Water Quality Standards* already include wetlands in the state's definition of waters of the state. However, beneficial uses have not yet been assigned to wetlands, nor have numeric limits been assigned to protect those uses. Wetlands have been provided with some water quality protection by applying North Dakota's narrative standards to wetlands. These narrative standards, also known as the "free from" standards, prohibit the disposal of garbage, oil, or any toxic pollutant to wetlands. In order to further develop water quality standards for the protection of the state's wetlands resources, the Health Department has developed a strategy or proposed implementation method. This strategy entitled, *A Summary of Wetland Classification Systems and a Strategy for the Development of Water Quality Standards for Wetlands in North Dakota* (Fritz, 1994), was completed in June 1994.

The following is a brief summary of this strategy. Table III-37 summarizes the state's progress in developing water quality standards for wetlands.

Since wetlands are currently recognized as waters of the state, the first step is to provide a clear definition describing what is (and what is not) a wetland, thereby defining what will (and what will not) be protected by *State Water Quality Standards*. The process of defining a wetland, commonly referred to as wetland delineation, should not be confused with wetlands classification. Wetland delineation is a method of determining the presence of wetlands and their boundaries, whereas classification is any method used to describe a group of wetlands based on a prescribed set of physical, hydrological, and/or biological factors. While the public generally recognizes the presence or absence of lakes, reservoirs, rivers, and streams, there remains considerable confusion as to what is (and what is not) a wetland.

Table III-37. Summary of North Dakota's Progress in Developing Water Quality Standards for Wetlands

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

In January 1994, a Memorandum of Understanding (MOA) was signed by the EPA, USDA, U. S. Department of Interior, and the COE. In this MOA, the parties agreed that the NRCS would be responsible for conducting all wetland delineations on agricultural lands, while the COE and EPA would conduct delineations for Section 404 purposes. The MOA further agreed that the NRCS would use procedures described in the National Food Security Act Manual to delineate wetlands on agricultural lands, while the 1987 COE Wetland Delineation Manual would be used by the COE and EPA. For purposes of the MOA, the term "agricultural lands" refers to those lands intensively used and managed for the production of food and fiber. To the extent that the natural vegetation has been removed, it cannot be used to determine whether the area meets the applicable hydrophilic vegetation criteria necessary to make a wetland delineation.

Since, by definition, wetlands and agricultural lands lack the vegetation necessary to make a delineation using the 1987 Delineation Manual, the NRCS is required to delineate wetlands using a set of mapping conventions. These mapping conventions are used to ensure consistency among NRCS field offices and are to be used as a method to determine whether a wetland exists on agricultural land. For Food Security Act purposes, wetland delineations are the responsibility of the NRCS district conservationist. In most cases, the delineation is done using existing maps (e.g., soil survey maps, National Wetland Inventory maps, Farm Service Agency (FSA) 35-mm color slides, color infrared photography, black and white aerial photography, USGS topographic maps) for "off-site" wetlands determination. If, however, a "scope and effect" determination is required, the producer requests reconsideration or appeals the determination, or a wetland boundary delineation is required, an on-site visit may be required. Where an on-site wetland delineation is performed, the NRCS will utilize those procedures found in the COE 1987 Wetland Delineation Manual.

On "non-agricultural" lands, the COE and EPA jointly regulate wetlands under Section 404 of the Clean Water Act. Under Section 404 of the Clean Water Act, the COE and EPA jointly define wetlands 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." The COE and EPA have translated this definition to a 3-parameter delineation test that includes vegetation, soils, and hydrology. The following are brief descriptions for each of these delineation categories. Furthermore, in order for a wetland to be delineated, a minimum of one positive indicator for each parameter (vegetation, soils, hydrology) must be found.

Vegetation: The prevalent vegetation consists of macrophytes typically adapted to areas having hydrologic and soil conditions prescribed in wetlands, as defined by the COE and EPA. Hydrophytic species, due to morphological, physiological, and/or reproductive adaptation(s), have the ability to grow, effectively compete, reproduce, and/or persist in anaerobic soil conditions.

Soils: Soils are present and have been classified as hydric, or they possess characteristics that are associated with reducing soil conditions.

Hydrology: The area is inundated, either permanently or periodically, at mean water depths less than or equal to 6.6 feet, or soil is saturated to the surface at some time during the growing season.

While federal regulations provide for a method to delineate or define wetlands, North Dakota does not have a prescribed wetland delineation method. In other words, the state does not have a set of methods or criteria for delineating what is (or is not) a wetland. Rather, the state regulates wetland drainage through a set of rules or regulations which require a permit to drain any pond, slough, lake, sheet water, or any series thereof, having a watershed of 80 acres or more.

In developing water quality standards for wetlands, it is likely that North Dakota will adopt the federal definition of wetlands, in conjunction with the use of federal delineation methods. Through this strategy, wetland water quality standards would only apply to waterbodies which are defined or delineated as wetlands through federal law or regulation.

The next step in developing wetland water quality standards is to define beneficial uses for wetlands. It should be recognized that the purpose of protecting wetlands (as is the purpose of protecting or restoring other surface waters) is not to protect the waterbody in and of itself, but to protect its uses, functions, and values deemed beneficial by the public. As stated previously, beneficial uses have been defined for lakes, rivers, and streams. Beneficial uses for wetlands will likely be dependent upon wetland class or type. In much the same way that some Class I, IA, II, and III streams provide different uses, one class of wetlands may provide one set of functions, whereas other classes and types of wetlands may provide a different set of functions. For example, riparian wetlands do not provide the same functions as depressional wetlands, nor do they perform the same functions at the same levels.

Wetland values are related to wetland functions in that the values are those functions considered to be beneficial to society and the environment. Values can also include activities, such as hunting, fishing, or even bird watching. It is these functions and values of wetlands that will be incorporated into the *State Water Quality Standards* as beneficial uses.

The third step in the state's strategy to develop water quality standards for wetlands is to develop narrative criteria, including narrative biological criteria. Narrative criteria are general statements designed to protect a specific designated use or set of uses. Narrative criteria can be statements that prohibit certain actions or conditions (e.g., "free-from" standards) or can be statements which describe what is expected to occur in the water ("Water quality and aquatic life shall be as it naturally occurs."). Narrative water quality criteria will be particularly important for protecting wetlands since many wetland impacts cannot be fully addressed by numeric criteria. Such impacts may result from the discharge of chemicals for which there are no numeric criteria, those which are from nonpoint sources, or from activities that may affect the physical and/or biological integrity of a wetland (e.g., the discharge of dredged and fill material).

Narrative biological criteria are general statements that describe conditions in wetlands necessary to maintain the biological integrity of a wetland and/or those beneficial uses associated with biological integrity (e.g., aquatic life use).

The fourth step identified in the state's strategy is to adopt numeric criteria to protect wetland beneficial uses. Numeric criteria are specific numeric values for chemical constituents (typically expressed as a concentration in water), physical parameters, or biological conditions that are adopted in state standards. These may be values that are not to be exceeded (e.g., toxics), values that must be exceeded (e.g., DO greater than 5 mg/L), or a combination of the two (e.g., pH between 6 and 9). Numeric criteria fall into two categories: criteria to protect human health and criteria to protect aquatic life. Human health water quality criteria are based on the toxicity of the contaminant and the amount of the contaminant consumed through ingestion of water and fish. Aquatic life criteria are numeric limits which are recommended for the protection of fresh water and salt water aquatic life. Aquatic life criteria can be divided into two basic categories: 1) chemicals that cause toxicity to aquatic life, such as metals, ammonia, and chlorine in organics, and 2) other water quality characteristics, such as DO, alkalinity, salinity, pH, and temperature. Since very little is known about the chemical and physical quality of wetlands, it may be necessary to conduct extensive monitoring over a wide range of wetland classes in order to determine the applicability of existing numeric criteria to wetlands.

Anti-degradation policies are also an important part of *State Water Quality Standards* and should include provisions to protect wetlands. Since wetlands are included in the definition of waters of the state, anti-degradation policies and their implementation methods should apply to wetlands in the same way as they do to other surface water resources. It is recognized that, with regard to the issuance of any wetland fill permit under Section 404 of the Clean Water Act, the state anti-degradation policy should be flexible with regard to fills in wetlands if the discharge does not result in "significant degradation" to the aquatic ecosystem.

As stated earlier, the Health Department is implementing its strategy to develop water quality standards for wetlands, and the *State Water Quality Standards* are currently being revised as part of the triennial review. As part of this review, the state will be proposing use classifications for wetlands and developing narrative criteria, including narrative biological criteria, for wetlands. The state's anti-degradation policy is also being revised with wetlands protection in mind.

In support of efforts to develop both narrative and numeric biological criteria, the department has initiated a series of projects to develop an IBI for temporary, seasonal, semi-permanent, and permanent depressional wetlands in North Dakota. These projects, which began in 1995, were supported through the use of EPA Section 104(b)(3) grant funds. In general, direct measures of the aquatic biota in wetlands are used. Through a multi-metric approach, these measurements (or metrics) are combined into an overall IBI for wetlands.

To date, the Health Department has sampled approximately 75 temporary and seasonal depressional wetlands over a wide disturbance gradient, from severely impaired wetlands to pristine wetlands. The department is currently in the process of developing biological metrics for three biological assemblages: macroinvertebrates, vegetation, and phytoplankton. Beginning in 2000, plans call for continuation of this approach by sampling and developing an IBI for semi-permanent depressional wetlands. Other wetland classes are types which should be considered in the development of an IBI, including riverine wetlands and fens. As the state develops IBIs for wetlands, it may also be necessary to further stratify depressional wetlands, based on water chemistry (e.g., fresh water, saline) or ecoregion.

Additional Wetland Protection Activities

State-led wetland protection activities took a step backward in 1995 with the repeal of North Dakota's "no-net-loss" law. The no-net-loss law and accompanying regulations required the State Engineer and the director of the North Dakota Game and Fish Department to jointly review drainage permit applications and to ensure that any wetlands proposed to be drained would be replaced by an equal acreage of replacement wetlands. In order to determine replacement requirements, the area of a wetland was jointly determined with the normal water level for the wetland. Under no-net-loss, it was only necessary to replace wetlands with wetlands of equal size. It was not necessary to replace drained wetlands with restored wetlands of the same type or classification (i.e., similar wetland functions).

Currently, the only remaining state programs which can be used for wetland protection are the State Waterbank Program and the 80-acre drainage permit law and its accompanying regulations. Under state law, landowners are required to obtain a permit to drain any pond, slough, lake, sheet water, or any series thereof, having a watershed of 80 acres or more. The person proposing to drain land must apply to the State Engineer, who must then determine whether the proposed drainage is of "statewide significance." If it is not of statewide significance, the decision to grant a permit is made by the local WRD. If it is of statewide significance, the local WRD is required to make a decision regarding the permit. The WRD then returns its decision to the State Engineer, who is required to hold a hearing, review the permit, and either approve or deny the action taken by the WRD.

The State Waterbank Program was created by state law in 1981. Modeled after the federal Waterbank Program, the program's goal is to protect, enhance, restore, and manage wetland ecosystems in North Dakota through 5- or 10-year renewable leases. Landowners interested in applying for State Waterbank Program assistance can apply at their local NRCS, U. S. Fish and Wildlife Service, or North Dakota Game and Fish Department. Applications are then rated and submitted to a state assessment team for recommendation to the State Commissioner of Agriculture. In order to qualify for State Waterbank Program assistance, tracts of land should have at least a 1:4 ratio of wetlands to uplands. Priority is also given to land with a high wetland destruction potential or to wetlands that have been drained.

Federal laws, regulations, and programs remain the most effective wetland protection tools in North Dakota. Some of the more important laws related to wetlands protection are contained in the 1899 Rivers and Harbors Act, the 1972 Clean Water Act and its amendments, the 1985 Food Security Act, the 1990 Food Agriculture Conservation and Trade Act, and the 1986 Emergency Wetlands Resources Act. Under Section 10 of the Rivers and Harbors Act, the COE has authority to regulate activities, such as diking, deepening, filling, excavating, and the placing of structures in navigable waters.

The 1986 Emergency Wetlands Resources Act was enacted by Congress to help promote the protection of the nation's wetlands for their value as food supply, water supply, water quality, flood control, and fish and wildlife habitat. Through an amendment to the Land and Water Conservation Fund Act, the law required all states to append a wetlands priority plan to their State Comprehensive Outdoor Recreation Plans (SCORP). The wetlands priority plan identifies locations and types of wetlands and public interest in wetlands that should receive priority for state wetland acquisition projects. Wetland priorities should be based on historic wetland losses, functions and values of wetlands, and future threats to wetlands. With funding to states under the Land and Water Conservation Act discontinued, North Dakota's most recent SCORP includes a reference to wetlands but does not include a wetlands priority plan.

The 1986 Emergency Wetlands Resources Act also required the U. S. Fish and Wildlife Service to map and inventory the nation's wetlands (known as the *National Wetlands Inventory*) and to provide updated reports on the status and trends of wetlands in the conterminous United States on a 10-year cycle.

The "Swampbuster" provisions of the 1985 Food Security Act and the 1990 Food Agriculture Conservation and Trade Act provide wetland protection on agricultural lands. Producers enrolled or receiving USDA benefits are prohibited from draining and filling wetlands for agricultural purposes. Wetlands converted for agricultural purposes prior to December 23, 1985, are exempt from the Swampbuster provisions; however, any producer who otherwise drains, fills, or alters a wetland for agricultural purposes after that date is subject to losing USDA benefits.

The 1990 Food Agriculture Conservation and Trade Act also authorizes the federal government to purchase conservation easements from landowners who agree to protect and restore wetlands through the Wetland Reserve Program. Both Swampbuster and the Wetland Reserve Program are administered through the FSA. The NRCS is responsible for determining compliance with Swampbuster provisions and is required to assist farmers in the delineation of wetlands and the development of wetland protection restoration or creation plans.

Of all the federal wetland protection activities, none is probably more well-known than Section 404 of the Clean Water Act. Under Section 404 of the Clean Water Act, the COE issues permits regulating the discharge of dredge or fill material into waters of the United States, including wetlands. All permits issued by the COE are subject to review and possible veto by EPA. In general, normal farming and ranching activities are exempt from Section 404 permits.

Related to Section 404 permits, the Health Department has been granted authority from EPA to give Section 401 Water Quality Certification for all Section 404 permit activities. Some nationwide permits are certified with conditions, while other applicants are denied so they can be considered individually. Individual permits are reviewed for Section 401 certification in the context of physical and chemical water quality criteria. Chemical testing of sediment and/or fill material is required when it is suspected that acute or chronic chemical criteria may be exceeded due to the Section 404 activity. In all cases (nationwide or individual permits), the department's "construction and environmental disturbance" requirements are applied.

Private organizations play an important role in the protection and conservation of wetlands in the state. Among them are Ducks Unlimited and the Nature Conservancy. Ducks Unlimited is an internationally recognized organization that works cooperatively with federal, state, and private landowners to restore and enhance wetlands and associated upland habitats for waterfowl and wildlife production. The Nature Conservancy is involved in preserving rare and unique habitats, including wetland habitats.

A third organization which is unique to North Dakota is the Wetlands Trust. Born out of conflicts over the Garrison Diversion Project, Congress created the Wetlands Trust to "preserve, restore, manage, and enhance wetlands and associated wildlife habitat in North Dakota" (North Dakota Wetlands Trust, 1997). Activities of the trust are managed through a six-member board of directors. By federal law, the board includes: three members appointed by the governor, one appointed by the National Audubon Society, one by the National Wildlife Federation, and one by the North Dakota Chapter of The Wildlife Society. The trust has appointed the North Dakota Game and Fish Director as an ex-officio director.

Funding for the North Dakota Wetlands Trust is provided through Public Law 99-294, which authorizes the Bureau of Reclamation to provide a total of $12 million for the trust. Payment is made on a scheduled proportion of the annual federal appropriation for the Garrison Diversion Unit. Federal law also requires the state of North Dakota to contribute 10 percent ($1.2 million) to the trust.

In order to carry out its mission the trust is authorized to use only the interest monies generated from the principal.

During development of the legislation leading to the creation of the North Dakota Wetlands Trust, the involved parties agreed that the trust should consider innovative approaches to wetland protection and complement existing wetland programs.

While the trust is authorized to acquire land from willing sellers, North Dakota's nonprofit corporate farming law (North Dakota Century Code {NDCC} 10-06-04.3) restricts this activity. The law restricts the trust's land acquisition to a total of 12,000 acres and requires a review and public hearing by both the county commission and a nonprofit acquisition committee composed of representatives of five state agencies, the North Dakota Farm Bureau, and the North Dakota Farmers Union. The law also requires approval from the governor for any land acquisition. Further, the law prohibits the North Dakota Wetlands Trust from transferring land to the federal government and requires all land to be managed to conserve wildlife habitat.

Chapter 6. Public Health/Aquatic Life Concerns

Examples of public health or aquatic life concerns include fishing advisories or bans, pollution-caused fish kills or abnormalities, known sediment contamination, discontinued use of drinking water supplies, closure of swimming areas, or incidents of waterborne disease.

Unlike many other states, North Dakota has had no reported incidents of drinking water supply restrictions or swimming beach closures for the reporting period 1998 to 1999. One site has been identified as having contaminated sediments. This waterbody is English Coulee located near Grand Forks. A site assessment conducted by EPA has shown elevated concentrations of pesticides in stream sediments. Runoff from an abandoned landfill and pesticide formulating plant is suspected to be the source of contamination.

Fish kills occur periodically in the lakes and rivers of the state. When they do occur, it is generally the result of low water conditions, heavy snow cover, or both. Because most fish kills occur during the winter, documenting their occurrence and extent is difficult. In most instances, the occurrence of fish kills is inferred through spring test netting by the North Dakota Game and Fish Department.

The primary public health concern in the state associated with lakes and streams in North Dakota is mercury contamination. In March 1991, the state issued its first fish consumption advisory for lakes and rivers. Each year the Health Department updates the consumption advisory based on new information gathered the year before. As stated previously, the consumption advisory for all rivers and lakes in the state is due to elevated concentrations of methyl-mercury in fish tissues. To date, no specific source of mercury contamination has been identified.

PART IV. GROUND WATER ASSESSMENT

Description

Ground water in North Dakota occurs in two major rock types -- unconsolidated rock and the underlying bedrock. Aquifers in the unconsolidated rock are primarily the result of glacial outwash deposits of the Quaternary Age and are called glacial drift aquifers. Glacial drift aquifers are typically more productive and generally yield less mineralized water than that of the underlying bedrock. At the present time, approximately 206 glacial drift aquifers have been identified and delineated throughout the state. Figure IV-1 indicates the general location and areal extent of the major glacial drift aquifers in the state.

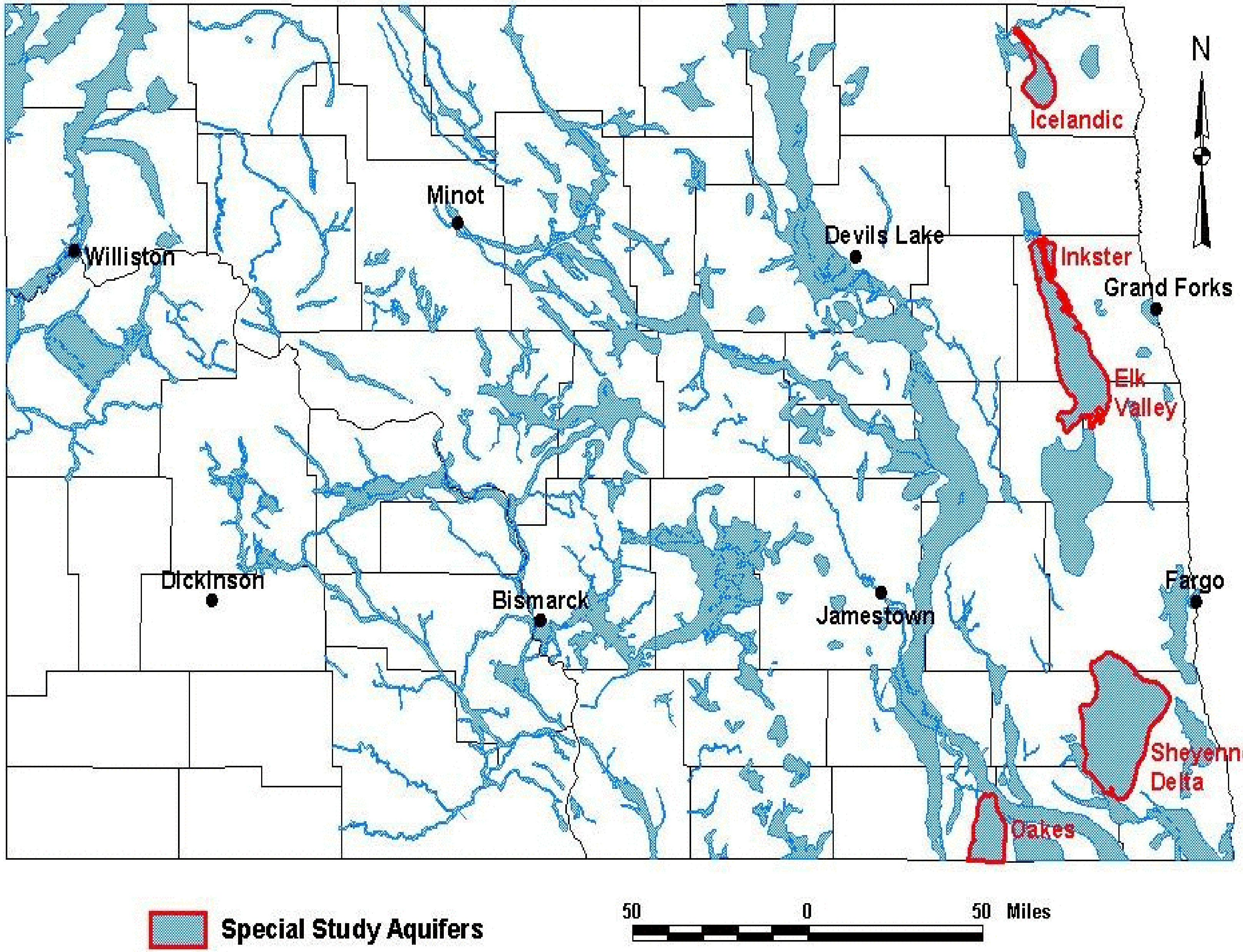

Figure IV-1. Glacial Drift Aquifers in North Dakota

Bedrock aquifers typically are more continuous and widespread than aquifers in the unconsolidated rocks. Water from bedrock aquifers tends to be more mineralized and occurs primarily along fractures in the rock. The major bedrock aquifers include the Dakota, Pierre, and Fox Hills-Hell Creek Aquifers of the Cretaceous Age and the Fort Union Aquifer of the Tertiary Age. Figure IV-2 indicates the general location and areal extent of the primary bedrock aquifers in the state.

Figure IV-2. Location and Extent of North Dakota's Primary Bedrock Aquifers

North Dakota has completed a multi-agency effort to assess and map the major ground water resources found within state boundaries. Information from the individual aquifer assessments are presented in separate county reports. The reports were completed through a cooperative effort of the SWC, the North Dakota Geological Survey, USGS, county WRDs, and county commission boards. This cooperative program resulted in the completion of geological and ground water resource evaluations in the state's 53 counties over a 25-year period. The information is published in three-part reports as described below:

> Part I. Geological Report - This section contains a discussion and map of the surficial geology of the county. Information in the report includes a discussion of county stratigraphy, unit descriptions, lithologies, and subsurface geology.
>
> Part II. Basic Ground Water Data - This portion of the report contains basic ground water data collected during field studies. Information provided includes drilling logs of test holes drilled for the project, descriptive lithologic logs, and

geophysical logs that were completed during the study. Information on selected private and public domestic drinking water wells is provided in each report with well location and construction information included. Ground water elevation data for selected wells is presented, along with chemical analyses for all wells sampled during the project.

Part III. Ground Water Resources - This part contains a description of the primary ground water resources of the county. Each report contains a potential ground water yield map with the general location of the major aquifer boundaries. Information in the text includes aquifer area, thickness, lithology, potential discharge areas, and information regarding regional flows in the aquifer. The water chemistry of each aquifer and the potential uses of the water based upon quality are also discussed.

The final county report was completed in 1985, ending the first phase of the 25-year, county-by-county, ground water resource evaluation program. The reports are used by various agencies involved in the protection and regulation of the state’s ground water resources. The SWC and other federal and state agencies continue to evaluate the ground water resources and expand the available knowledge of the quantity and quality of these resources.

Water Use

It is estimated North Dakota has approximately 470 MAF of water stored throughout the various aquifer systems. Although these systems are abundant and widely dispersed, consumptive use demands, accessibility, and overall quality have limited the use of ground water for beneficial applications in some areas. When compared to the total estimated quantity of ground water stored in the state’s aquifers, less than 1 percent of the ground water resource is used.

Ground water use in North Dakota has historically been categorized as agricultural (e.g., irrigation or livestock watering), industrial, and domestic (private or public). In 1998, it was estimated that the highest consumptive use of ground water was related to irrigation. Other uses such as public water supply, industrial, domestic (private water wells), and livestock followed in decreasing consumptive use quantities. Table IV-1 identifies the consumptive use for each category estimated in 1998, as reported by water appropriation permit holders.

Table IV-1. 1998 Reported Water Use in North Dakota

Use Type	Acre-Feet
Commercial	45
Domestic	56.30
Industrial	8,040.70
Irrigation	91,236.16
Multiple use	212
Municipal	26,307.15
Power generation	24.40
Recreation	3.60
Rural water	10,498.42
Stock	33.20
Total	136,456.93

Note: 1 acre-foot = 325,850 gallons

Ground Water Contamination Sources

Contamination of ground water from manmade and natural sources has been detected in every county of the state. The degree to which contamination incidents are investigated or remediated is a function of the contaminant, its impact on the beneficial use of the resource, and the overall risk it poses to the public or environment. Table IV-2 identifies the highest priority contaminant sources which have caused adverse impacts on the beneficial use of ground water resources throughout the state.

Table IV-2. Major Sources of Ground Water Contamination in North Dakota

Contaminant Source	Highest Priority Sources (✔)	Factors Considered in Selecting a Contaminant Source(1)	Contaminants(2)
Agricultural Activities			
Agricultural chemical facilities	✔	A,D,H	B,E
Animal feedlots	✔	A,D,H	E,J
Drainage wells			
Fertilizer applications			
Irrigation practices			
Pesticide applications			
On-farm agricultural mixing and loading procedures	✔	A,F	B,E
Land application of manure (unregulated)			
Storage and Treatment Activities			
Land application (regulated or permitted)			
Material stockpiles			
Storage tanks (above ground)	✔	A,C,D,G	D,G,E
Storage tanks (underground)	✔	A,C,D,G	D,C
Surface impoundments	✔	D	E,M (SO_4,CL,TDS)
Waste piles			
Waste tailings			
Disposal Activities			
Deep injection wells			
Landfills			
Septic systems			
Shallow injection wells			
Other			
Hazardous waste generators			
Hazardous waste sites			
Large industrial facilities	✔	A,D,G	D,E,M (SO_4,CL,TDS)
Material transfer operations			

Table IV-2. (cont.) Major Sources of Ground Water Contamination in North Dakota

Contaminant Source	Highest Priority Sources (✔)	Factors Considered in Selecting a Contaminant Source[1]	Contaminants[2]
Mining and mine drainage			
Pipelines and sewer lines			
Salt storage and road salting			
Salt water intrusion			
Spills	✔	A,G,H	B,D,E,G
Transportation of materials			
Urban runoff			
Small-scale manufacturing and repair shops			
Other sources (please specify)			
Other sources (please specify)			

(1) Factors considered in selecting a contaminant source - latter designation indicated by order of importance in the above column:

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. Documented from mandatory reporting
H. Geographic distribution/occurrence
I. Other criteria (described in narrative)

(2) Contaminants associated with each factor from previous column:

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. Other (Please add or describe in the narrative.)

Major sources of ground water contamination were determined utilizing a combination of professional experience and a review of existing Health Department - Environmental Health Section computer databases. Several databases, maintained by the department's Division of Water Quality, compile information relating to the type of regulated activity, its size and location, and in some cases, regional ground water quality information. The primary databases used to identify the major sources of ground water contamination are:

- Concentrated Animal Feeding Operations (CAFO) Database
- Underground Injection Control (UIC) (Class V) Database
- Spill Response/Contaminant Release Database
- Ambient Ground Water Quality Monitoring Database

Concentrated Animal Feeding Operations (CAFO) Database

Since 1972, North Dakota has maintained an active concentrated animal feeding operations permit program. The program is designed to protect the quality of the state's water resources through oversight of the construction and management of concentrated animal feeding operations. The program regulates animal feeding operations which maintain at least 200 animal units, and can require design or operational modifications to protect the quality of the waters of the state. Regulatory authority is provided in NDCC 61-28 and North Dakota Administrative Code (NDAC) 33-16, which can require specific actions for construction, water quality monitoring, animal disposal, contingency planning, and animal waste disposal. The CAFO database provides location, operation, and contact information. The database is updated as needed to reflect changes in the program, such as the approval of new operations or modifications to existing operations. Table IV-3, printed from the database, identifies the number, size, and type of animal feeding operations in North Dakota.

Table IV-3. Livestock Distribution in North Dakota

The following livestock operations with more than 200 animal units have been reviewed and approved by the Health Department since January 1, 1980. The data is accurate through February 20, 2000, based on the livestock database. Please note there are many other, unlisted livestock wintering operations of 200 animal units or more not covered by state livestock regulations. There also may be facilities that have not been approved by the department because they have not submitted an application for approval.

NOTE: One beef or dairy cow is considered one animal unit. Columns showing pigs, sheep, and turkeys list the number of facilities with that type of livestock, followed by the actual number of animals corresponding to the number of animal units. Animal units are based on definitions in NDAC 33-16-03.

Number of Animal Units		Total of all Facilities	*Cattle*		*Pigs*			*Sheep*			*Turkeys*		
			Beef Facilities	Dairy Facilities	Pig Facilities	*Number of animals*		Sheep Facilities	*Number of animals*		Turkey Facilities	*Number of animals*	
From	To					From	To		From	To		From	To
200	250	39	24	7	6	800	1,000	2	1,600	2,000	0	6,000	7,500
251	300	19	13	5	1	1,004	1,200	0	2,008	2,400	0	7,530	9,000
301	350	15	7	2	5	1,204	1,400	1	2,408	2,800	0	9,030	10,500
351	400	9	5	1	3	1,404	1,600	0	2,808	3,200	0	10,530	12,000
401	450	6	2	2	2	1,604	1,800	0	3,208	3,600	0	12,030	13,500
451	500	12	8	1	2	1,804	2,000	0	3,608	4,000	0	13,530	15,000
501	550	10	6	2	2	2,004	2,200	0	4,008	4,400	0	15,030	16,500
551	600	5	3	0	2	2,204	2,400	0	4,408	4,800	0	16,530	18,000
601	650	4	2	0	2	2,404	2,600	0	4,808	5,200	0	18,030	19,500
651	700	6	5	0	1	2,604	2,800	0	5,208	5,600	0	19,530	21,000
701	750	2	0	0	1	2,804	3,000	0	5,608	6,000	0	21,030	22,500
751	800	2	1	0	0	3,004	3,200	0	6,008	6,400	0	22,530	24,000
801	850	0	0	0	0	3,204	3,400	0	6,408	6,800	0	24,030	25,500
851	900	0	0	0	0	3,404	3,600	0	6,808	7,200	0	25,530	27,000
901	950	2	2	0	0	3,604	3,800	0	7,208	7,600	0	27,030	28,500
951	1000	6	2	0	2	3,804	4,000	0	7,608	8,000	0	28,530	30,000
1001	1500	8	4	0	3	4,004	6,000	0	8,008	12,000	1	30,030	45,000
1501	2000	5	4	1	0	6,004	8,000	0	12,008	16,000	0	45,030	60,000

Table IV-3. (cont.) Livestock Distribution in North Dakota

Number of Animal Units		Total of all Facilities	*Cattle*		*Pigs*			*Sheep*			*Turkeys*		
			Beef Facilities	Dairy Facilities	Pig Facilities	*Number of animals*		Sheep Facilities	*Number of animals*		Turkey Facilities	*Number of animals*	
From	To					From	To		From	To		From	To
2001	2500	1	1	0	1	8,004	10,000	0	16,008	20,000	0	60,030	75,000
2501	3000	1	0	0	1	10,004	12,000	0	20,008	24,000	0	75,030	90,000
3001	4000	1	2	0	0	12,004	16,000	0	24,008	32,000	0	90,030	120,000
4001	5000	1	0	0	1	16,004	20,000	0	32,008	40,000	0	120,030	150,000
5001	10000	1	1	0	0	20,004	40,000	0	40,008	80,000	0	150,030	300,000
10000	30000	2	1	0	0	40,000	120,000	0	80,000	240,000	1	300,000	900,000
TOTALS		**157**	**93**	**21**	**35**			**3**			**2**		

Underground Injection Control (UIC) (Class V) Database

The Underground Injection Control (UIC) Program regulates the injection of liquid waste into the ground where it may have the potential to adversely impact underground sources of drinking water. The Health Department has regulatory primacy to operate and enforce the Class I and Class V UIC Programs. As part of this effort, the department has completed a statewide Class V survey designed to identify the type, location, and use of small industrial or commercial injection systems. The UIC database was developed to catalog information resulting from the survey and is updated as needed. At present, 2,430 sites are in the database, with a total of 493 identified as facilities that may discharge waste fluids into a Class V well. Table IV-4 lists the waste fluid disposal methods, and Table IV-5 shows a breakdown of injection wells identified in the UIC survey.

Table IV-4. Summary of Waste Fluid Disposal Methods at Facilities in Class V Database

Fluid Disposal Method	Number of Facilities
Total number of facilities in Class V Database	2429
No waste fluids reported	97
Recycle or stored and hauled away for disposal	1695
Discharge to municipal sewer	1780
Discharge to private lagoon or pond	13
Discharge to surface water, stream, or wetland	5
Discharge to ground surface	26
Discharge beneath ground surface to septic tank or Class V system	493

note: not mutually exclusive -- Many facilities use more than one method.

Table IV-5. Class V Subclasses and Operating Status

Class 5 Subclass	Description	Total Wells	Active	Plugged & Abandoned	Temp. Abandoned
5D2	Storm water drainage well	3	3		
5D4	Industrial storm water drainage well	2	1	1	
5W20	Industrial process water disposal well	52	51	1	
5W32	Septic system - drainfield disposal method	152	150	2	
5X28	Motor vehicle service disposal well	179	175	3	1
5X29	Abandoned drinking water well used for waste disposal	1		1	

Spill Response / Contaminant Release Database

The Health Department maintains at least two databases which track the initial response and subsequent follow-up action at locations where contaminants released to the environment impact water quality. Site location, contaminant type, responsible party, and a historical record of activities conducted at the site are maintained. To date, the database provides for tracking the assessment, remediation, and closure activities for the types of operations listed in Table IV-6.

Table IV-6. Operations Requiring Assessment, Remediation, and Closure Activities

Source/Type of Activity	No. of Active Sites Requiring Ground Water Monitoring, Assessment, or Contaminant Remediation
Above ground storage - fuels	49
Underground storage - fuels	54
Other hydrocarbons or fuels	12
Fertilizer/pesticide storage	31
Landfill	3
Superfund	1
Mining / oil production / power plants	11
Other	10
TOTAL	171

Ambient Ground Water Quality Database

The Ambient Ground Water Quality Program was developed to monitor ground water quality in the 50 most vulnerable aquifers in the state. In general, vulnerability was determined based upon natural geologic conditions, total appropriated use, and land use. The program was originally designed to identify the occurrence of up to 63 different pesticides in ground water. The Ambient Ground Water Quality Database maintains all data obtained through the implementation of the monitoring program, which includes sample point location, analytical results, and other site-specific information. The database maintains records for approximately 1393 different wells, from which 1969 samples have been collected to date.

Aquifer Vulnerability

To determine where to spend the limited financial and human resources required to implement ground water assessment and protection activities, the Health Department's Division of Water Quality has developed the Geographic Targeting System (GTS). The GTS was initially developed in 1992 and updated in 1997 in an effort to prioritize aquifers in order of their susceptibility to contamination. This prioritization system is currently used to target aquifer systems for increased protection, education, and monitoring activities.

The GTS was completed using a modified DRASTIC Ground Water Vulnerability Model to calculate the relative aquifer vulnerability score based upon:

D - Depth to Water
R - Recharge
A - Aquifer Media
S - Soil Media
T - Topography
I - Impact of the Vadose Zone
C - Conductivity

In addition to the above-referenced parameters, ground water appropriation and a land use surrogate to identify potential agricultural chemical use were added to the evaluation system. Each aquifer was evaluated as a discrete whole unit if all portions of the aquifer had similar characteristics, or it was subdivided into sub-aquifer units of similar hydrogeologic characteristics. The GTS evaluation does not identify critical recharge areas or areas where special management practices must be applied. Rather, the evaluation identifies aquifer settings where an increased contamination potential exists. Aquifers identified as having an elevated potential for ground water contamination are highlighted as requiring increased assessment and educational activities relating to ground water quality protection.

Figure IV-3 shows the total monitoring scores for identifying the relative priority of major glacial drift aquifers located in the state. Table IV-7 lists the 50 highest priority aquifer systems according to the GTS, in descending order.

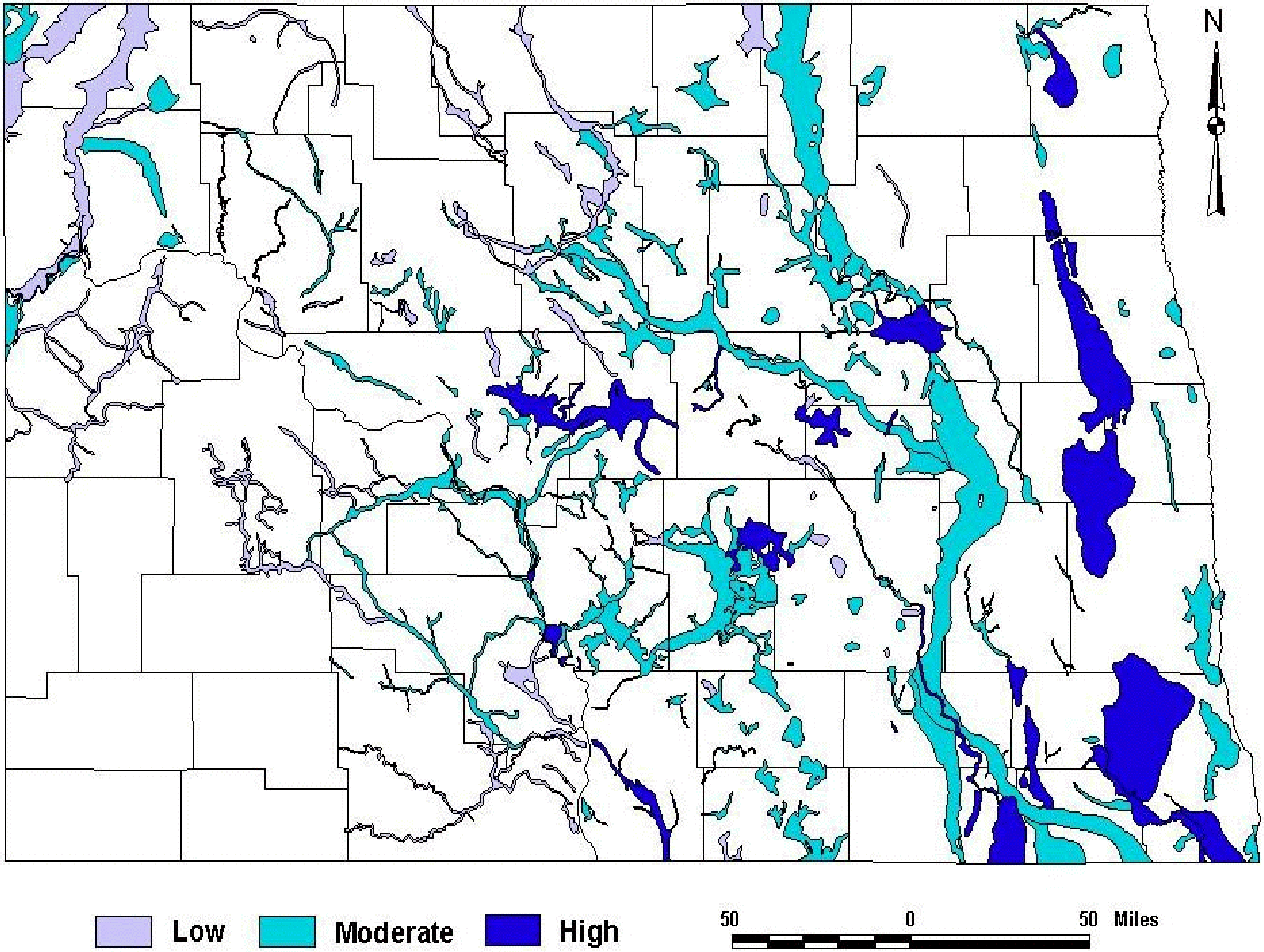

Figure IV-3. Monitoring Priority for Major Glacial Drift Aquifers in North Dakota

Table IV-7. Fifty Highest Priority Aquifer Systems
North Dakota GTS Scoring Ranked by Total Monitoring Score (1997)

Rank	Aquifer Name	Drastic Score	Pest. Drastic Score		Chem. Use Surrogate Score ($/acre)		Permitted Water Use (Acre-feet/year)		Total Monitoring Score	
1	Elk Valley	167	189	(High)	112.9	(High)	16413	(High)	9	(High)
2	Oakes	161	185	(High)	75	(High)	20974	(High)	9	(High)
3	Sheyenne Delta	153	182	(High)	131.04	(High)	17889	(High)	9	(High)
4	Inkster	157	179	(High)	112.9	(High)	3587	(High)	9	(High)
5	Icelandic	140	177	(High)	154	(High)	1860	(High)	9	(High)
6	Fordville	155	167	(High)	144.71	(High)	2703	(High)	9	(High)
7	Galesburg/Page	144	163	(High)	75.44	(High)	15568	(High)	9	(High)
8	Missouri River	159	190	(High)	43.34	(Mod.)	1329	(High)	8	(High)
9	Warwick	156	187	(High)	46.78	(Mod.)	10124	(High)	8	(High)
10	Juanita Lake	169	186	(High)	75.5	(High)	1002	(Mod.)	8	(High)
11	Hankinson	149	185	(High)	131.04	(High)	1000	(Mod.)	8	(High)
12	Sand Prairie	159	181	(High)	67.26	(High)	1304	(Mod.)	8	(High)
13	Edgeley	172	181	(High)	71.55	(High)	801.7	(Mod.)	8	(High)
14	Marstonmoor Plain	162	180	(High)	45	(Mod.)	6682	(High)	8	(High)
15	Medford	147	174	(High)	128.81	(High)	601.7	(Mod.)	8	(High)
16	Strasburg	160	169	(High)	52.56	(Mod.)	1910	(High)	8	(High)
17	Lake Nettie Aq. System	160	169	(High)	40.24	(Mod.)	4981	(High)	8	(High)
18	Jamestown	149	167	(High)	58.68	(Mod.)	7810	(High)	8	(High)
19	Wagonsport	154	165	(High)	41.91	(Mod.)	1221	(High)	8	(High)
20	Manfred	142	165	(High)	60.11	(High)	200	(Mod.)	8	(High)
21	Bismarck	145	163	(High)	41.91	(Mod.)	2301	(High)	8	(High)
22	Milnor Channel	134	156	(Mod.)	131.04	(High)	8616	(High)	8	(High)
23	Englevale	130	155	(Mod.)	76.46	(High)	20155	(High)	8	(High)
24	LaMoure	126	149	(Mod.)	71.69	(High)	8878	(High)	8	(High)
25	Guelph	118	139	(Mod.)	71.69	(High)	2074	(High)	8	(High)
26	Carrington	109	130	(Mod.)	75.5	(High)	7995	(High)	8	(High)
27	Lake Souris	172	190	(High)	37.66	(Low)	1396	(High)	7	(Mod.)
28	Rocky Run	165	187	(High)	60.11	(High)	0	(Low)	7	(Mod.)
29	Tower City	160	179	(High)	123.67	(High)	67	(Low)	7	(Mod.)
30	James River	161	179	(High)	75.5	(High)	54	(Low)	7	(Mod.)
31	Heimdal	161	179	(High)	60.11	(High)	0	(Low)	7	(Mod.)

Table IV-7. (cont.) Fifty Highest Priority Aquifer Systems
North Dakota GTS Scoring Ranked by Total Monitoring Score (1997)

Rank	Aquifer Name	Drastic Score	Pest. Drastic Score		Chem. Use Surrogate Score ($/acre)		Permitted Water Use (Acre-feet/year)		Total Monitoring Score	
32	Stoney Slough	155	174	(High)	67.26	(High)	0	(Low)	7	(Mod.)
33	Pipestem Creek	154	173	(High)	60.11	(High)	89	(Low)	7	(Mod.)
34	Rusland	148	169	(High)	60.11	(High)	0	(Low)	7	(Mod.)
35	Medina	161	169	(High)	58.68	(Mod.)	400	(Mod.)	7	(Mod.)
36	Shell Valley	146	168	(High)	39.45	(Low)	1825	(High)	7	(Mod.)
37	Spring Creek Aq. System	131	168	(High)	53.82	(Mod.)	480.4	(Mod.)	7	(Mod.)
38	Seven Mile Coulee	148	167	(High)	58.68	(Mod.)	540	(Mod.)	7	(Mod.)
39	Tokio	157	166	(High)	45.86	(Mod.)	712	(Mod.)	7	(Mod.)
40	Burnt Creek	137	159	(Mod.)	41.91	(Mod.)	3339	(High)	7	(Mod.)
41	Streeter Outwash	150	159	(Mod.)	55.91	(Mod.)	3143	(High)	7	(Mod.)
42	Horseshoe Valley	152	156	(Mod.)	40.85	(Mod.)	3929	(High)	7	(Mod.)
43	Pembina River	116	139	(Mod.)	154.07	(High)	1011	(Mod.)	7	(Mod.)
44	Apple Creek-lower	114	137	(Mod.)	41.91	(Mod.)	2720	(High)	7	(Mod.)
45	Hillsboro	116	135	(Mod.)	127.32	(High)	430	(Mod.)	7	(Mod.)
46	Spiritwood Aq. System	90	128	(Low)	61.52	(High)	33718	(High)	7	(Mod.)
47	Ellendale	100	124	(Low)	71.69	(High)	1492	(High)	7	(Mod.)
48	West Fargo	75	95	(Low)	123.67	(High)	5286	(High)	7	(Mod.)
49	Goldwin	175	196	(High)	58.68	(Mod.)	0	(Low)	6	(Mod.)
50	Denbigh	162	182	(High)	37.66	(Low)	776	(Mod.)	6	(Mod.)

In an effort to assess the impact of contaminants on specific aquifers, the top five highest priority aquifer systems (as defined by the GTS) were evaluated with respect to potential contaminant sources and application of pollution control programs within the aquifers' boundaries. The five aquifers selected for this report are: 1) Inkster, 2) Elk Valley, 3) Oakes, 4) Icelandic, and 5) Sheyenne Delta. Figures IV-4 to IV-8 show maps of each of the above-referenced aquifer systems. Their associated contaminant evaluations are presented in Tables IV-8 to IV-12.

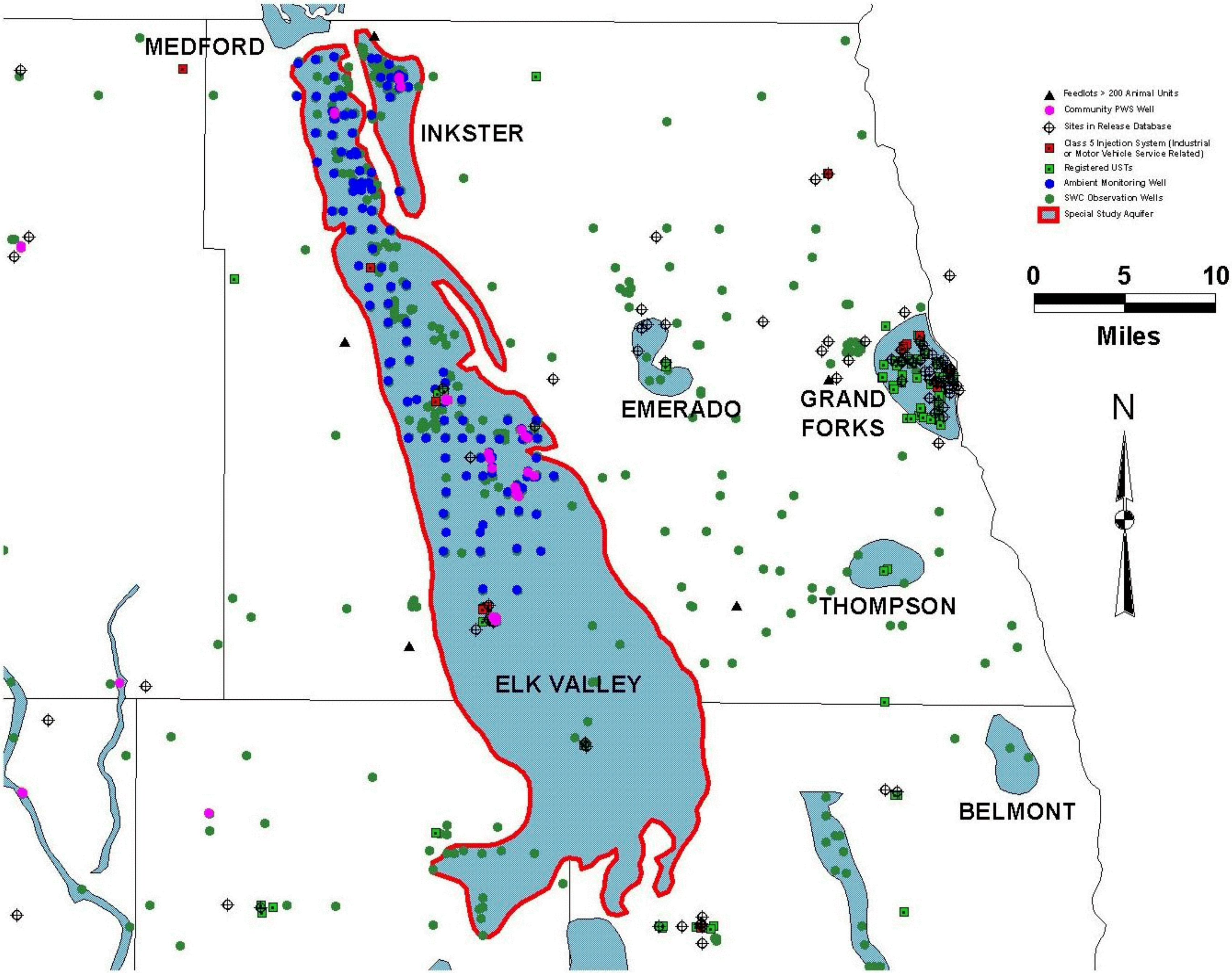

Figure IV-4. Inkster and Elk Valley Aquifers

Table IV-8. Ground Water Contamination Summary - Inkster Aquifer

Aquifer Description: Inkster Aquifer County(ies) (optional): Grand Forks

Aquifer Setting: Sand and Gravel - Rural Longitude/Latitude (optional):

Data Reporting Period: 1998 - 1999

Source Type	Present in Reporting Area (circle)	No. of Sites in Area	No. of Sites That are Listed and/or Have Confirmed Releases	No. With Confirmed Ground Water Contamination	Contam-inants	No. of Site Investigations (optional)	No of Sites That Have Been Stabilized or Have had the Source Removed (optional)	No. of Sites With Corrective Action Plans (optional)	No. of Sites With Active Remediation (optional)	No. of Sites With Cleanup Completed (optional)
NPL	Yes / No									
CERCLIS (non-NPL)	Yes / No									
DOD/DOE	Yes / No									
LUST	Yes / No	0	0							
RCRA Corrective Action	Yes / No									
Underground Injection	Yes / No									
State Sites	Yes / No									
Nonpoint Sources *	Yes / No	1	0							
Other (specify)	Yes / No									
Totals		1	0							

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

* Feedlots

Table IV-9. Ground Water Contamination Summary - Elk Valley

Aquifer Description: Elk Valley County(ies) (optional): Grand Forks / Traill / Steele

Aquifer Setting: Sand and Gravel - Rural Longitude/Latitude (optional): ______

Data Reporting Period: 1998 - 1999

Source Type	Present in Reporting Area (circle)	No. of Sites in Area	No. of Sites That are Listed and/or Have Confirmed Releases	No. With Confirmed Ground Water Contamination	Contami-nants	No. of Site Investigations (optional)	No of Sites That Have Been Stabilized or Have had the Source Removed (optional)	No. of Sites With Corrective Action Plans (optional)	No. of Sites With Active Remediation (optional)	No. of Sites With Cleanup Completed (optional)
NPL	Yes / No	- -								
CERCLIS (non-NPL)	Yes / No	- -								
DOD/DOE	Yes / No	- -								
LUST	Yes / No	9	1		Petroleum					
RCRA Corrective Action	Yes / No	- -								
Underground Injection ***	Yes / No	5	0	0						
State Sites	Yes / No									
Nonpoint Sources *	Yes / No	0	0	0						
Other (specify) **	Yes / No	9	9	3	Petroleum					
Totals		23	10	3						

* Feedlots
** ASTs and Accidental Releases
*** 5X28 or 5W20 Class V systems

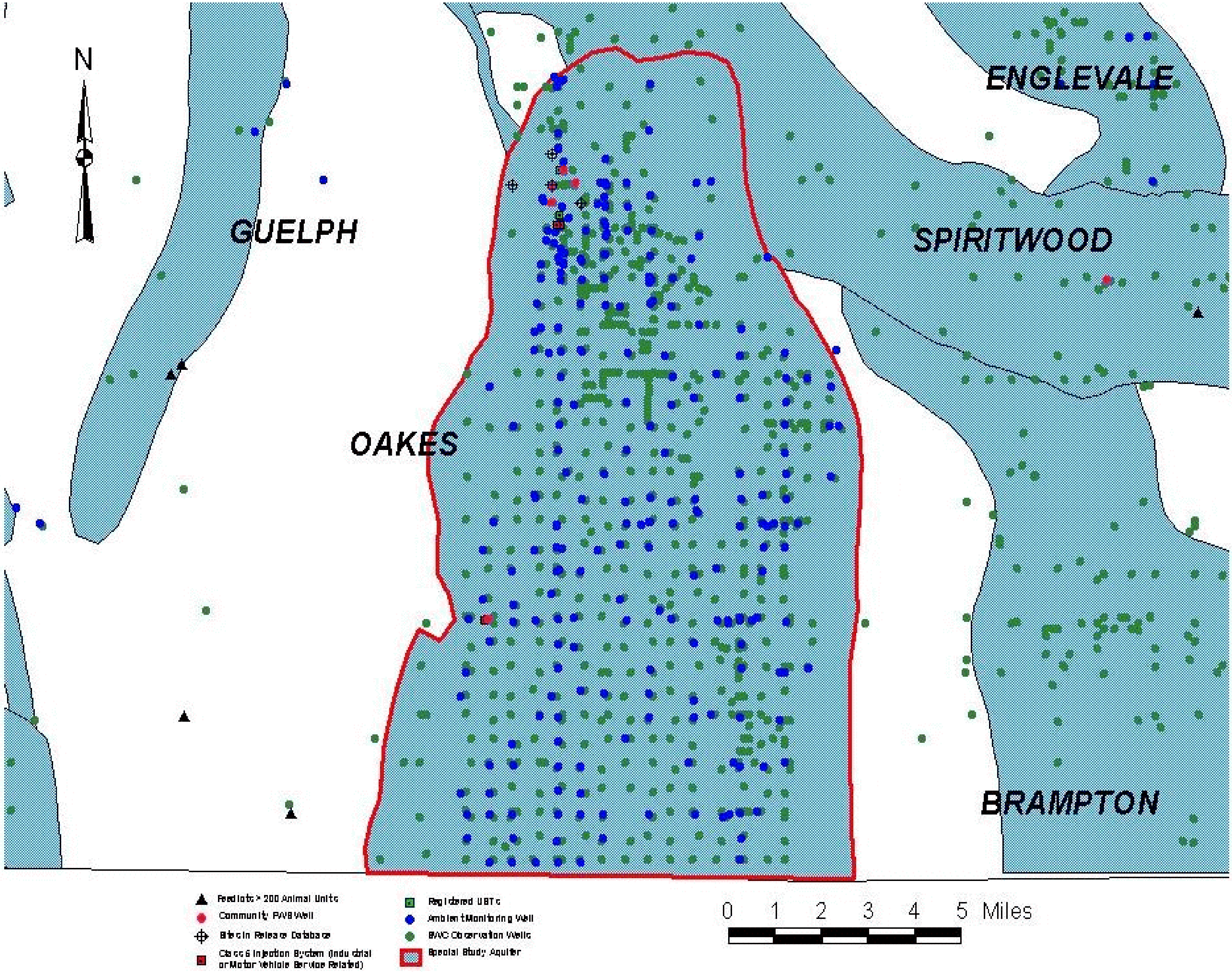

Figure IV-5. Oakes Aquifer

Table IV-10. Ground Water Contamination Summary - Oakes Aquifer

Aquifer Description: Oakes Aquifer County(ies) (optional): Dickey / Sargent

Aquifer Setting: Sand and Gravel - Rural Longitude/Latitude (optional):

Data Reporting Period: 1998 - 1999

Source Type	Present in Reporting Area (circle)	No. of Sites in Area	No. of Sites That are Listed and/or Have Confirmed Releases	No. With Confirmed Ground Water Contamination	Contaminants	No. of Site Investigations (optional)	No of Sites That Have Been Stabilized or Have had the Source Removed (optional)	No. of Sites With Corrective Action Plans (optional)	No. of Sites With Active Remediation (optional)	No. of Sites With Cleanup Completed (optional)
NPL	Yes / No	- -								
CERCLIS (non-NPL)	Yes / No	- -								
DOD/DOE	Yes / No	- -								
LUST	Yes / No	2	0	0	Petroleum					
RCRA Corrective Action	Yes / No	- -								
Underground Injection ***	Yes / No	4	1	1						
State Sites	Yes / No	- -								
Nonpoint Sources *	Yes / No	0	0	0						
Other (specify) **	Yes / No	4	4	- -						
Totals		10	5	1						

* Feedlots

** Fertilizer Storage Facility or Accidental Release

*** 5X28 or 5W20 Class V systems

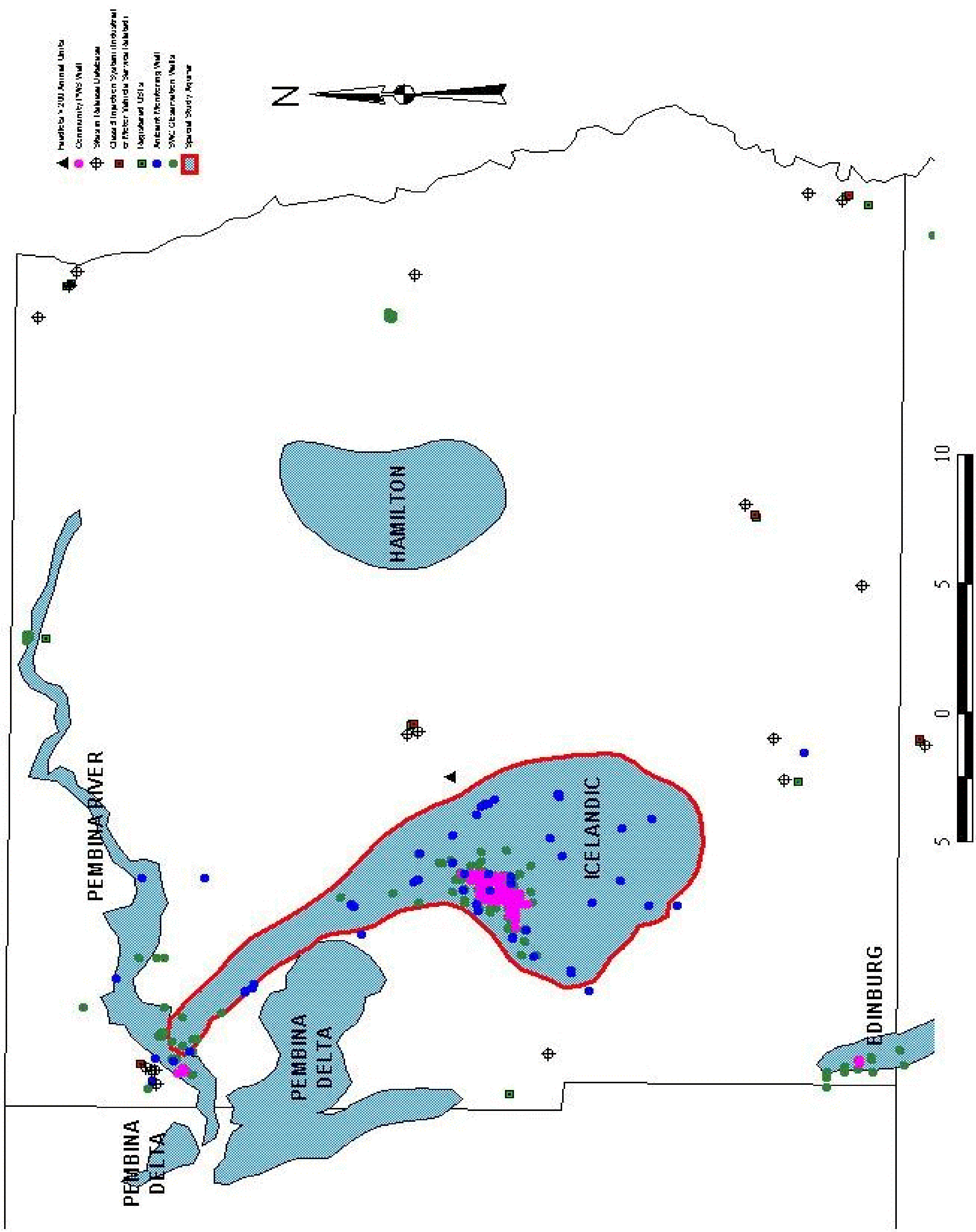

Figure IV-6. Icelandic Aquifer

Table IV-11. Ground Water Contamination Summary - Icelandic Aquifer

Aquifer Description: Icelandic Aquifer County(ies) (optional): Pembina

Aquifer Setting: Sand and Gravel - Rural Longitude/Latitude (optional): ______

Data Reporting Period: 1998 - 1999

Source Type	Present in Reporting Area (circle)	No. of Sites in Area	No. of Sites That are Listed and/or Have Confirmed Releases	No. With Confirmed Ground Water Contamination	Conta-minants	No. of Site Investigations (optional)	No. of Sites That Have Been Stabilized or Have had the Source Removed (optional)	No. of Sites With Corrective Action Plans (optional)	No. of Sites With Active Remediation (optional)	No. of Sites With Cleanup Completed (optional)
NPL	Yes / No									
CERCLIS (non-NPL)	Yes / No									
DOD/DOE	Yes / No									
LUST	Yes / No	0	0	0	Petroleum					
RCRA Corrective Action	Yes / No									
Underground Injection ***	Yes / No	0	- -							
State Sites	Yes / No									
Nonpoint Sources	Yes / No	0	0	0						
Other (specify) **	Yes / No	0	0	0	Petroleum					
Totals		0	0	0						

** ASTs or Accidental Releases
*** 5X28 or 5W20 Class V systems

IV-23

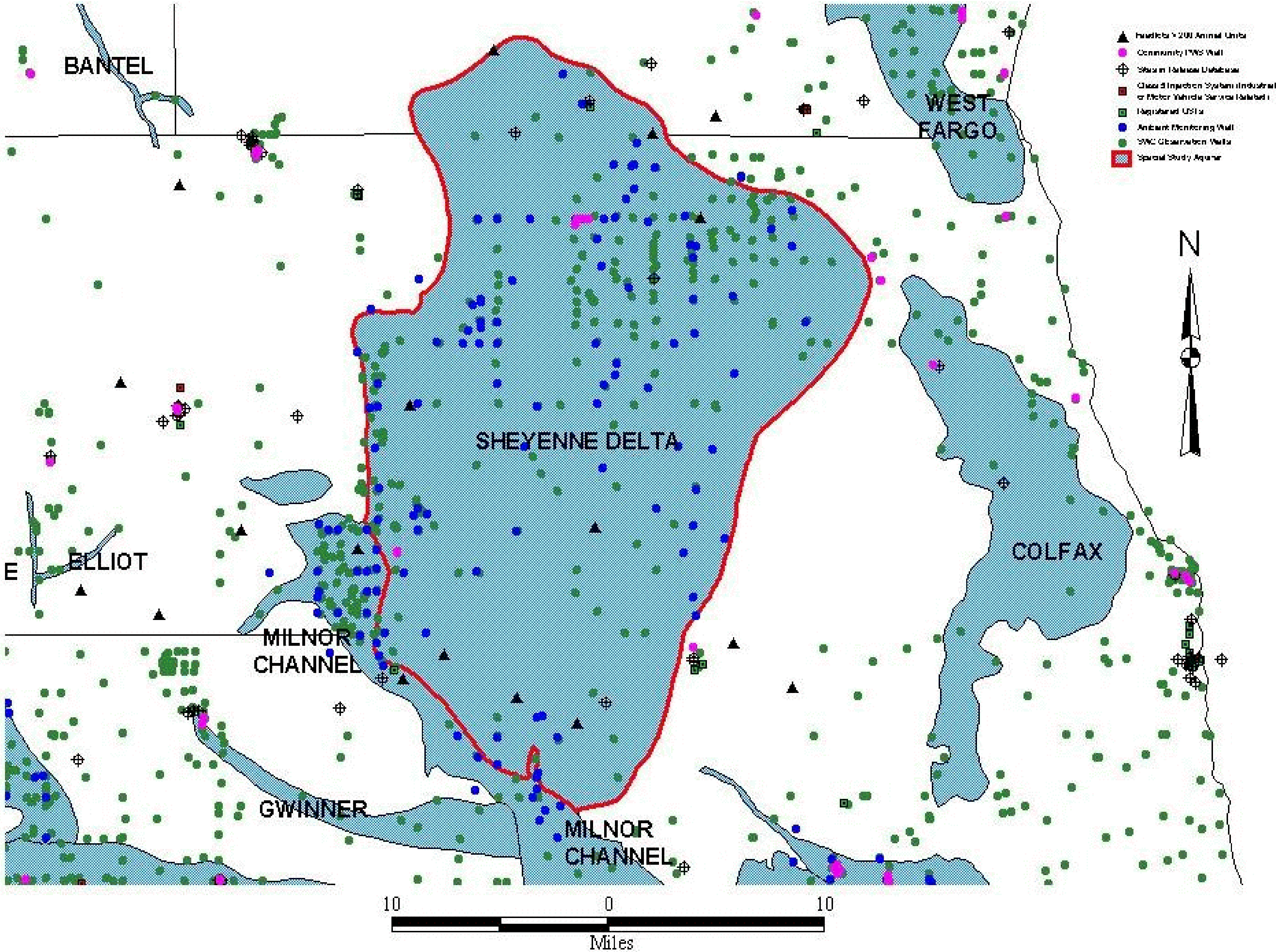

Figure IV-7. Sheyenne Delta Aquifer

Table IV-12. Ground Water Contamination Summary - Sheyenne Delta Aquifer

Aquifer Description: Sheyenne Delta   County(ies) (optional): Richland / Sargent / Ransom

Aquifer Setting: Sand and Gravel - Rural   Longitude/Latitude (optional): ____

Data Reporting Period: 1998 - 1999

Source Type	Present in Reporting Area (circle)	No. of Sites in Area	No. of Sites That are Listed and/or Have Confirmed Releases	No.With Confirmed Ground Water Contamination	Conta-minants	No. of Site Investigations (optional)	No. of Sites That Have Been Stabilized or Have had the Source Removed (optional)	No. of Sites With Corrective Action Plans (optional)	No. of Sites With Active Remediation (optional)	No. of Sites With Cleanup Completed (optional)
NPL	Yes / No	- -								
CERCLIS (non-NPL)	Yes / No	- -								
DOD/DOE	Yes / No	- -								
LUST	Yes / No	1	1	2	Petroleum					
RCRA Corrective Action	Yes / No	- -								
Underground Injection **	Yes / No	0								
State Sites	Yes / No	- -								
Nonpoint Sources *	Yes / No	8	1	1	Nitrates					
Other (specify) ***	Yes / No	3	3		Petroleum Arsenic					
Totals		12	5	3						

* Feedlots
** 5X28 or 5W20 Class V system
*** Arsenic Trioxide Superfund Site/Accidental Releases

Ground Water Protection Programs

In 1967, North Dakota enacted legislation enabling state regulation of activities which have caused or which have the potential to cause adverse impacts to the quality of the waters of the state. NDCC 61-28 entitled, "Control, Prevention, and Abatement of Pollution of Surface Waters," not only defines the statement of policy for surface and ground water quality protection, but also sets specific prohibitions and penalties for violation of the state law. Since the enactment of NDCC 61-28, the state has pursued a policy to:

> "...act in the public interest to protect, maintain, and improve the quality of the waters of the state for continued use as public and private water supplies, propagation of wildlife, fish and aquatic life and for domestic, agricultural, industrial and recreational and other legitimate beneficial uses...."

North Dakota has historically envisioned ground water quality protection to include a mix of financial and technical cooperation among federal, state, and local governmental agencies, and private entities. Since the early 1970s, the Health Department has continued to build upon existing ground water protection capacities through the attainment of primacy for federal programs or through cooperative working relationships with other state, federal, and local entities. Table IV-13 identifies a summary of Ground Water Protection Programs in North Dakota.

Table IV-13. North Dakota Summary of State Ground Water Protection Programs

Programs or Activities	Check (✔)	Implementation Status	Responsible State Agency
Active SARA Title III Program	✔	Fully established	Emergency Mgmt.
Ambient Ground Water Monitoring System	✔	Est. / continuing efforts	Health*
Aquifer Vulnerability Assessment	✔	Fully established	Health
Aquifer Mapping	✔	Est. / continuing efforts	SWC
Aquifer Characterization	✔	Est. / continuing efforts	SWC
Comprehensive Data Management System			
EPA-Endorsed Core Comprehensive State Ground Water Protection Program (CSGWPP)			
Ground Water Discharge Permits			
Ground Water Best Management Practices			
Ground Water Legislation	✔	Fully established	Health*
Ground Water Classification	✔	Fully established	Health
Ground Water Quality Standards			
Interagency Coordination for Ground Water Protection Initiatives	✔	Continuing efforts	Health*
Nonpoint Source Controls			
Pesticide State Management Plan	✔	Est. / continuing efforts	NDAG
Pollution Prevention Program	✔	Fully established	Health
Resource Conservation and Recovery Act (RCRA) Primacy	✔	Fully established	Health
Source Water Assessment Program	✔	Under development	Health
State Superfund			
State RCRA Program incorporating more stringent requirements than RCRA Primacy			
State Septic System Regulations	✔	Fully established	Health
Underground Storage Tank Installation Requirements	✔	Fully established	Health
Underground Storage Tank Remediation Fund	✔	Fully established	NDID
Underground Storage Tank Permit Program	✔	Fully established	Health
Underground Injection Control Program	✔	Fully established	Health
Vulnerability Assessment for Drinking Water/Wellhead Protection	✔	Continuing efforts	Health
Well Abandonment Regulations	✔	Fully established	Health
Wellhead Protection Program (EPA-approved)	✔	Fully established	Health
Well Installation Regulations	✔	Fully established	Health
Other programs or activities (please specify)			

Abbreviations:

Health	=	North Dakota Department of Health
SWC	=	North Dakota State Water Commission
NDAG	=	North Dakota Agriculture Department
NDID	=	North Dakota Insurance Department
*	=	Other agencies involved

Wellhead Protection Program (WHP) and Source Water Assessment Program (SWAP)

The 1996 amendments to the Safe Drinking Water Act reauthorized the Wellhead Protection Program (WHP) and established the Source Water Assessment Program (SWAP) for the purpose of protecting the water resources of public water supply systems.

Since 1992, the North Dakota WHP has been an EPA-approved voluntary program to identify and manage surface and near-surface activities that may contaminate ground water resources. Public water supply systems participating in the WHP are proactive in recognizing the importance of protecting their ground water resources. Participation in the WHP is summarized in Table IV-14.

Table IV-14. North Dakota Wellhead Protection Program Statistics

Total community ground water-dependent systems	193
Ground water-dependent community systems participating in WHP	173 (90 percent)
Ground water-dependent community systems implementing all WHP elements	101 (52 percent)
Total population served by community ground water-dependent systems	179,410
Total population served by ground water-dependent community PWSs participating in WHP	165,000
Total population served by ground water-dependent community PWSs which have implemented all WHP elements	121,000

North Dakota's SWAP received EPA approval in October 1999. The SWAP functions as an "umbrella" of required source water protection for all public water systems, whether ground water- or surface water-dependent, and whether community or noncommunity, unless a system is a 100 percent consecutive user. The Health Department is required to complete the following SWAP elements for 212 community public waters systems that have their own well(s) or surface water intake(s): 1) a delineation of the source water protection area (either a wellhead area or a watershed area); 2) a database inventory of potential contaminant sources; and 3) a determination of the susceptibility of the public water supply to the inventoried contaminant sources.

The source water assessments for all the public water systems must be completed by May 2003. One-hundred-and-twenty delineations have already been completed through the WHP. Under the SWAP umbrella, the WHP will continue for ground water-dependent community public water systems. These systems are encouraged to complete a field inventory of potential contaminant sources and to initiate management and contingency planning, along with a public awareness program, after the delineation has been completed. In addition to the 212 community public water systems, the department must also complete the three SWAP elements described above for 222 noncommunity public water systems by May 2003.

Ground Water Quality

Ambient Ground Water Quality Monitoring

Ambient ground water quality monitoring activities are conducted by several state agencies, with the primary activities being conducted by the SWC and the Health Department. The monitoring programs have been developed to assess ground water quality and/or quantity in the major aquifer systems located throughout the state. Monitoring conducted by the department is designed to evaluate the condition of ground water quality as it relates to inorganic/organic chemical constituents and the occurrence of selected agricultural chemical compounds. Additional water quality information is developed as part of the Safe Drinking Water Act requirements through the monitoring of public drinking water supply systems.

In 1992, the department's Division of Water Quality initiated an ambient ground water monitoring program to determine the occurrence of 50 selected agricultural pesticides in the 50 most vulnerable aquifer systems within a 5-year period. Sample locations are selected based upon well construction integrity, well location, and the presence of water treatment systems. Since its initiation in 1992, approximately 1200 wells in the 50 most vulnerable aquifer systems have been monitored. Tables IV-15 to IV-19 provide a general indication of water quality as it relates to synthetic organic chemical and nitrate detections in selected aquifer systems.

Continued commitment to the ambient ground water monitoring program will depend upon funding and staff availability.

Table IV-15. Aquifer Monitoring Data

Aquifer Description: Inkster Aquifer — County(ies) (optional): Grand Forks

Aquifer Setting: Red River Valley — Longitude/Latitude (optional): 48° 07' N 97° 40' W

Data Reporting Period: 1998 - 1999

Monitoring Data Type	Total No. of Wells Used in the Assessment	Parameter Groups	Number of Wells (or Systems*)								
			No detections of parameters above MDLs or background levels		No detections of parameters above MDLs or background levels and nitrate concentrations range from background levels to less than or equal to 5 mg/l		Parameters are detected at concentrations exceeding the MDL but are less than or equal to the MCLs and/or nitrate ranges from greater than 5 to less than or equal to 10 mg/l	Parameters are detected at concentrations exceeding the MCLs	Removed from service	Special treat-ment	Background parameters exceed MCLs
			ND	No. of wells in sensitive or vulnerable areas (opt)	ND/Nitrate $\leq$ 5 mg/l	No. of wells in sensitive or vulnerable areas (opt)					
Ambient Monitoring Network (Optional)		VOC									
		SOC									
		NO_3									
		Other									
Raw Water Quality Data from Public Water Supply Wells	No Data Available	VOC									
		SOC									
		NO_3									
		Other									
Finished Water Quality Data from Public Water Supply Wells	2 Systems* with 4 wells total. Wells NOT individually sampled	VOC	2	2	0	0	0	0	0	0	0
		SOC	2	2	0	0	0	0	0	0	0
		NO_3	0	0	2	2	0	0	0	0	0
		Other									
Raw Water Quality Data from Private or Unregulated Wells (Optional)		VOC									
		SOC									
		NO_3									
		Other									

Table IV-15. (cont.) Aquifer Monitoring Data

Monitoring Data Type	Total No. of Wells Used in the Assessment	Parameter Groups	Number of Wells (or Systems*)								
			No detections of parameters above MDLs or background levels		No detections of parameters above MDLs or background levels and nitrate concentrations range from background levels to less than or equal to 5 mg/l		Parameters are detected at concentrations exceeding the MDL but are less than or equal to the MCLs and/or nitrate ranges from greater than 5 to less than or equal to 10 mg/l	Parameters are detected at concentrations exceeding the MCLs	Removed from service	Special treat-ment	Background parameters exceed MCLs
			ND	No. of wells in sensitive or vulnerable areas (opt)	ND/Nitrate ≤ 5 mg/l	No. of wells in sensitive or vulnerable areas (opt)					
Other Sources (Optional)		VOC									
		SOC									
		NO_3									
		Other									

Major uses of the aquifer or hydrologic unit (Optional)
✓ Public water supply; ✓ Private water supply; ✓ Irrigation; ___ Thermoelectric; ___ Commercial; ✓ Livestock; ___ Mining; ___ Industrial; ___ Baseflow; ___ Maintenance

Uses affected by water quality problems (Optional)
___ Public water supply; ___ Private water supply; ___ Irrigation; ___ Thermoelectric; ___ Commercial; ___ Livestock; ___ Mining; ___ Industrial; ___ Baseflow; ___ Maintenance

* Public Water Supply Data: 1998-1999. NOTE: Reported values are for number of systems meeting criteria. Agassiz Water Users has 3 wells. Finished water is sampled after blending in treatment system. Individual wells are not sampled. Forest River Community has 1 well.

Table IV-16. Aquifer Monitoring Data

Aquifer Description: Elk Valley
County(ies) (optional): Grand Forks / Traill / Steele
Aquifer Setting: Red River Valley
Longitude/Latitude (optional): 47° 55' N 97° 37' W
Data Reporting Period: 1998-1999

Monitoring Data Type	Total No. of Wells Used in the Assessment	Parameter Groups	Number of Wells (or Systems*)								
			No detections of parameters above MDLs or background levels		No detections of parameters above MDLs or background levels and nitrate concentrations range from background levels to less than or equal to 5 mg/l		Parameters are detected at concentrations exceeding the MDL but are less than or equal to the MCLs and/or nitrate ranges from greater than 5 to less than or equal to 10 mg/l	Parameters are detected at concentrations exceeding the MCLs	Removed from service	Special treat-ment	Background parameters exceed MCLs
			ND	No. of wells in sensitive or vulnerable areas (opt)	ND/Nitrate $\leq$ 5 mg/l	No. of wells in sensitive or vulnerable areas (opt)					
Ambient Monitoring Network (Optional)		VOC									
		SOC									
		NO_3									
		Other									
Raw Water Quality Data from Public Water Supply Wells	No Data Available	VOC									
		SOC									
		NO_3									
		Other									
Finished Water Quality Data from Public Water Supply Wells	3 Systems* with 19 wells total. Wells NOT individually sampled	VOC	3	3	0	0	0	0	0	0	0
		SOC	3	3	0	0	0	0	0	0	0
		NO_3	0	0	3	3	0	0	0	0	0
		Other						0	0	0	0
Raw Water Quality Data from Private or Unregulated Wells (Optional)		VOC									
		SOC									
		NO_3									
		Other									

Table IV-16. (cont.) Aquifer Monitoring Data

Monitoring Data Type	Total No. of Wells Used in the Assessment	Parameter Groups	Number of Wells (or Systems*)								
			No detections of parameters above MDLs or background levels		No detections of parameters above MDLs or background levels and nitrate concentrations range from background levels to less than or equal to 5 mg/l		Parameters are detected at concentrations exceeding the MDL but are less than or equal to the MCLs and/or nitrate ranges from greater than 5 to less than or equal to 10 mg/l	Parameters are detected at concentrations exceeding the MCLs	Removed from service	Special treat-ment	Background parameters exceed MCLs
			ND	No. of wells in sensitive or vulnerable areas (opt)	ND/Nitrate ≤ 5 mg/l	No. of wells in sensitive or vulnerable areas (opt)					
Other Sources (Optional)		VOC									
		SOC									
		NO_3									
		Other									

Major uses of the aquifer or hydrologic unit (Optional)
✓ Public water supply
✓ Private water supply
✓ Irrigation
_____ Thermoelectric
_____ Commercial
✓ Livestock
_____ Mining
_____ Industrial
_____ Baseflow
_____ Maintenance

Uses affected by water quality problems (Optional)
_____ Public water supply
_____ Private water supply
_____ Irrigation
_____ Thermoelectric
_____ Commercial
_____ Livestock
_____ Mining
_____ Industrial
_____ Baseflow
_____ Maintenance

* Public Water Supply Data: 1998-1999. NOTE: Reported values are for number of systems meeting criteria. Grand Forks/Traill Water Users has 13 wells. Larimore has 3 wells. Tri-County Rural Water has 3 wells. Finished water is sampled after blending in treatment system. Individual wells are not sampled.

Table IV-17. Aquifer Monitoring Data

Aquifer Description: Oakes Aquifer
County(ies) (optional): Dickey / Sargent
Aquifer Setting: Central Lowlands Phys. Province
Longitude/Latitude (optional): 46° 08' N 98 ° 05' W
Data Reporting Period: 1998 - 1999

Monitoring Data Type	Total No. of Wells Used in the Assessment	Parameter Groups	Number of Wells (or Systems*)								
			No detections of parameters above MDLs or background levels		No detections of parameters above MDLs or background levels and nitrate concentrations range from background levels to less than or equal to 5 mg/l		Parameters are detected at concentrations exceeding the MDL but are less than or equal to the MCLs and/or nitrate ranges from greater than 5 to less than or equal to 10 mg/l	Parameters are detected at concentrations exceeding the MCLs	Removed from service	Special treat-ment	Background parameters exceed MCLs
			ND	No. of wells in sensitive or vulnerable areas	ND/Nitrate ≤ 5 mg/l	No. of wells in sensitive or vulnerable areas					
Ambient Monitoring Network (Optional)		VOC									
		SOC									
		NO_3									
		Other									
Raw Water Quality Data from Public Water Supply Wells	No Data Available	VOC									
		SOC									
		NO_3									
		Other									
Finished Water Quality Data from Public Water Supply Wells	2 Systems* with 5 wells total.	VOC	2	2	0	0	0	0	0	0	0
		SOC	2	2	0	0	0	0	0	0	0
		NO_3	0	0	2	2	0	0	0	0	0
		Other						0	0	0	0
Raw Water Quality Data from Private or Unregulated Wells (Optional)		VOC									
		SOC									
		NO_3									
		Other									

Table IV-17. (cont.) Aquifer Monitoring Data

Monitoring Data Type	Total No. of Wells Used in the Assessment	Parameter Groups	Number of Wells (or Systems*)								
			No detections of parameters above MDLs or background levels		No detections of parameters above MDLs or background levels and nitrate concentrations range from background levels to less than or equal to 5 mg/l		Parameters are detected at concentrations exceeding the MDL but are less than or equal to the MCLs and/or nitrate ranges from greater than 5 to less than or equal to 10 mg/l	Parameters are detected at concentrations exceeding the MCLs	Removed from service	Special treat-ment	Background parameters exceed MCLs
			ND	No. of wells in sensitive or vulnerable areas	ND/Nitrate ≤ 5 mg/l	No. of wells in sensitive or vulnerable areas					
Other Sources (Optional)		VOC									
		SOC									
		NO_3									
		Other									

Major uses of the aquifer or hydrologic unit (Optional)
✓ Public water supply; ✓ Private water supply; ✓ Irrigation; ___ Thermoelectric; ___ Commercial; ✓ Livestock; ___ Mining; ___ Industrial; ✓ Baseflow; ___ Maintenance

Uses affected by water quality problems (Optional)
___ Public water supply; ___ Private water supply; ___ Irrigation; ___ Thermoelectric; ___ Commercial; ___ Livestock; ___ Mining; ___ Industrial; ___ Baseflow; ___ Maintenance

* Public Water Supply Data: 1998-1999. NOTE: Reported values are for number of systems meeting criteria. City of Oakes has 4 wells. Finished water is sampled after blending in treatment system. Individual wells are not sampled. City of Ludden has 1 well.

Table IV-18. Aquifer Monitoring Data

Aquifer Description: Icelandic Aquifer
County(ies) (optional): Pembina
Aquifer Setting: Red River Valley
Longitude/Latitude (optional): 48° 45' N 97° 45' W
Data Reporting Period: 1998 - 1999

Monitoring Data Type	Total No. of Wells Used in the Assessment	Parameter Groups	Number of Wells (or Systems*): No detections of parameters above MDLs or background levels		No detections of parameters above MDLs or background levels and nitrate concentrations range from background levels to less than or equal to 5 mg/l		Parameters are detected at concentrations exceeding the MDL but are less than or equal to the MCLs and/or nitrate ranges from greater than 5 to less than or equal to 10 mg/l	Parameters are detected at concentrations exceeding the MCLs	Removed from service	Special treat-ment	Background parameters exceed MCLs
			ND	No. of wells in sensitive or vulnerable areas (opt)	ND/Nitrate ≤ 5 mg/l	No. of wells in sensitive or vulnerable areas (opt)					
Ambient Monitoring Network (Optional)		VOC									
		SOC									
		NO_3									
		Other									
Raw Water Quality Data from Public Water Supply Wells	No Data Available	VOC									
		SOC									
		NO_3									
		Other									
Finished Water Quality Data from Public Water Supply Wells	1 System* with 51 wells total. Wells NOT individually sampled	VOC	0	0	0	0	1	0	0	0	0
		SOC	1	1	0	0	0	0	0	0	0
		NO_3	0	0	1	1	0	0	0	0	0
		Other						0	0	0	0
Raw Water Quality Data from Private or Unregulated Wells (Optional)		VOC									
		SOC									
		NO_3									
		Other									

Table IV-18. (cont.) Aquifer Monitoring Data

Monitoring Data Type	Total No. of Wells Used in the Assessment	Parameter Groups	Number of Wells (or Systems*)								
			No detections of parameters above MDLs or background levels		No detections of parameters above MDLs or background levels and nitrate concentrations range from background levels to less than or equal to 5 mg/l		Parameters are detected at concentrations exceeding the MDL but are less than or equal to the MCLs and/or nitrate ranges from greater than 5 to less than or equal to 10 mg/l	Parameters are detected at concentrations exceeding the MCLs	Removed from service	Special treat-ment	Background parameters exceed MCLs
			ND	No. of wells in sensitive or vulnerable areas (opt)	ND/Nitrate ≤ 5 mg/l	No. of wells in sensitive or vulnerable areas (opt)					
Other Sources (Optional)	VOC										
	SOC										
	NO_3										
	Other										

Major uses of the aquifer or hydrologic unit (Optional)
✓ Public water supply
✓ Private water supply
✓ Irrigation
___ Thermoelectric
___ Commercial
✓ Livestock
___ Mining
___ Industrial
___ Baseflow
___ Maintenance

Uses affected by water quality problems (Optional)
___ Public water supply
___ Private water supply
___ Irrigation
___ Thermoelectric
___ Commercial
___ Livestock
___ Mining
___ Industrial
___ Baseflow
___ Maintenance

* Public Water Supply Data: 1998-1999. NOTE: Reported values are for number of systems meeting criteria. North Valley Water Users Phase II has 51 wells. Finished water is sampled after blending in treatment system. Individual wells are not sampled.

Table IV-19. Aquifer Monitoring Data

Aquifer Description: Sheyenne Delta
County(ies) (optional): Richland / Ransom / Sargent / Cass
Aquifer Setting: SE Corner North Dakota
Longitude/Latitude (optional): 46° 30' N 97° 15' W
Data Reporting Period: 1998 - 1999

Monitoring Data Type	Total No. of Wells Used in the Assessment	Parameter Groups	Number of Wells (or Systems*)								
			No detections of parameters above MDLs or background levels		No detections of parameters above MDLs or background levels and nitrate concentrations range from background levels to less than or equal to 5 mg/l		Parameters are detected at concentrations exceeding the MDL but are less than or equal to the MCLs and/or nitrate ranges from greater than 5 to less than or equal to 10 mg/l	Parameters are detected at concentrations exceeding the MCLs	Removed from service	Special treat-ment	Background parameters exceed MCLs
			ND	No. of wells in sensitive or vulnerable areas (opt)	ND/Nitrate ≤ 5 mg/l	No. of wells in sensitive or vulnerable areas (opt)					
Ambient Monitoring Network (Optional)		VOC									
		SOC									
		NO_3									
		Other									
Raw Water Quality Data from Public Water Supply Wells	No Data Available	VOC									
		SOC									
		NO_3									
		Other									
Finished Water Quality Data from Public Water Supply Wells	2 Systems* with 8 wells total. Wells NOT individually sampled	VOC	2	2	0	0	0	0	0	0	0
		SOC	2	2	0	0	0	0	0	0	0
		NO_3	0	0	2	2	0	0	0	0	0
		Other						0	0	0	0
Raw Water Quality Data from Private or Unregulated Wells (Optional)		VOC									
		SOC									
		NO_3									
		Other									

Table IV-19. (cont.) Aquifer Monitoring Data

Monitoring Data Type	Total No. of Wells Used in the Assessment	Parameter Groups	Number of Wells (or Systems*)								
			No detections of parameters above MDLs or background levels		No detections of parameters above MDLs or background levels and nitrate concentrations range from background levels to less than or equal to 5 mg/l		Parameters are detected at concentrations exceeding the MDL but are less than or equal to the MCLs and/or nitrate ranges from greater than 5 to less than or equal to 10 mg/l	Parameters are detected at concentrations exceeding the MCLs	Removed from service	Special treat-ment	Background parameters exceed MCLs
			ND	No. of wells in sensitive or vulnerable areas (opt)	ND/Nitrate ≤ 5 mg/l	No. of wells in sensitive or vulnerable areas (opt)					
Other Sources (Optional)		VOC									
		SOC									
		NO_3									
		Other									

Major uses of the aquifer or hydrologic unit (Optional)
✓ Public water supply
✓ Private water supply
✓ Irrigation
____ Thermoelectric
____ Commercial
✓ Livestock
____ Mining
____ Industrial
✓ Baseflow
____ Maintenance

Uses affected by water quality problems (Optional)
____ Public water supply
____ Private water supply
____ Irrigation
____ Thermoelectric
____ Commercial
____ Livestock
____ Mining
____ Industrial
____ Baseflow
____ Maintenance

* Public Water Supply Data: 1998-1999. NOTE: Reported values are for number of systems meeting criteria. Cass Rural Water Phase II has 6 wells. The City of Walcott has 2 wells (on eastern edge of the Sheyenne Delta aquifer). Finished water is sampled after blending in treatment system. Individual wells are not sampled.

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