SD Department of Environment & Natural Resources
Water Resources Assistance Program
Total Maximum Daily Load

Freeman Lake Watershed
Jackson County, South Dakota
September, 2000

The 1998 303(d) Waterbody List targeted Freeman Lake for TMDL development by listing water quality impairment by measures of trophic state index, nitrates and selenium. A TSI TMDL is not being proposed at this time due to limited data and an uncertainty of the effects of the recommended control practices on phosphorus reductions in the lake system. As Freeman Lake has such a high nitrogen to phosphorus ratio, it is not possible to predict how phosphorus levels will respond to nitrate reductions. Once the practices have been put in place and stabilized, monitoring will continue to track phosphorus response and determine if TSI values have increased or decreased and if use impairment by phosphorus is occurring. TMDLs for nitrates and selenium were developed in accordance with Section 303(d) of the federal Clean Water Act and guidance developed by the US Environmental Protection Agency and are supported below:

TMDL Summary

Waterbody Name	**Freeman Lake**
Hydrologic Unit Code	HUC 10140102
303(d) Status	1998 303(d) Waterbody List, Priority 1, Page 19
Impaired Beneficial Uses	74:51:01:47 - Warmwater permanent fish life propagation; 74:51:01:50 - Immersion recreation; 74:51:01:51 - Limited contact recreation; and 74:51:01:52 - Criteria for fish and wildlife propagation, recreation and stock watering waters.
Applicable Surface Water Quality Standards	74:51:01:05 - Materials causing pollutants to form in waters; 74:51:01:06 - Visible pollutants prohibited; 74:51:01:07 - Acids and alkalis; 74:51:01:08 - Taste- and odor-producing materials; 74:51:01:09 - Nuisance aquatic life; 74:51:01:12 - Biological integrity of waters; 74:51:01:27 - Lakes not allowed a zone of mixing; and 74:51:01:55 - Criteria for toxic pollutants.
TMDL Pollutant	**Nitrate (nitrogen)**
Natural Allocation	Upland seep areas flows during wet cycles (0.154 cfs) accounts for 10% or more of the total lake storage. Approximately 53 kg nitrate enters the lake daily from these seeps November to May.
Water Quality Target	Nitrate - 50 mg/L as a 30 day average Nitrate - 88 mg/L as a daily maximum
TMDL Goal	Reduce nitrate delivery to lake by at least 33,000 Kg/year.
TMDL Pollutant	**Selenium**
Natural Allocation	Flow from seep areas during wet cycles (0.154 cfs) accounts for 10% or more of the total lake storage. Approximately 530 grams of selenium enters the lake daily from these seeps during November through May.

Water Quality Target	Selenium - 5 *ug*/L as a 30 day average Selenium - 20 *ug*/L as a daily maximum
TMDL Goal	Reduce selenium delivery to lake by at least 152.6 Kg/year.

I. Executive Summary:

- ***Waterbody Description and Impairments***

Freeman Lake was formed by an earthen embankment structure built by the Works Progress Administration circa 1939. The South Dakota Lakes Assessment Final Report dated 1996 provided the following data on Freeman Lake:

Location: SE 1/4 of Sec. 8, T2N, R25W, Jackson County, South Dakota
Watershed Area: 3409 acres
Surface Area: 66 acres
Maximum Depth: 16 feet
Total Storage: 449 acre feet

Interstate 90 (I90) and old US Highway 16 (Hwy 16) grades cross the watershed just to the south of the inlet to Freeman Lake and SD Highway 63 (Hwy 63) is located east of the east shoreline. A KOA Campground is located on the east side of the Freeman Lake near the dam embankment. A tourist attraction, the 1880 Town, is located at the northeast intersection of I90 and SD Hwy 63.

For several years, the KOA campground and 1880 Town relied on Freeman Lake water for domestic water supply. Samples from the lake were taken periodically as required for domestic water supply. In 1995, nitrates in the water sample showed an increase that began to exceed state requirements for drinking water.

The South Dakota Department of Agriculture (SDDA) was contacted to see if any type of fertilizer spill or large fertilizer application had occurred in the watershed above Freeman Lake. There was no known fertilizer spill and the area did not have any history of using large quantities of fertilizer. Further observation of the watershed above Freeman Lake revealed there were several active saline seeps. Landowners of lands with the active seeps were contacted for permission to sample the water originating from these seep areas. Samples from at least ten seep areas were collected. Nitrates concentrations ranged from below 1 mg/L to as high as 1,470 mg/L and selenium concentrations ranged from less than 10 ug/L to as high as 8,140 ug/L. In-lake samples have had nitrate concentrations up to 110 mg/L and selenium concentrations up to 778 ug/L. Soil type and soil profile indicate that these areas have been functioning as seeps, long before the dam was constructed. Samples were also collected downstream from the seep areas and above the lake. Generally, concentrations decreased where the flow occurred in a vegetated watercourse.

The high concentration of nitrate exceeds the criterion for domestic water supply is not of adequate quality for drinking purposes without advanced treatment. The

KOA campground has installed a reverse osmosis system to treat the lake water to provide their domestic water needs. The 1880 Town continues to use the lake water to supply nonpotable water uses and provides bottled water for drinking water. Both businesses operate from May through October and have posted notices advising the public that the water is not suitable for drinking.

Good water quality for domestic use throughout western South Dakota has been a problem since settlement of the area began. Most ground water sources are high in dissolved solids and of questionable quality for animal or human consumption. Surface water also may have quality problems and often the quantity is limited or absent during droughts. Rural water systems have been and continue to be developed where good quality, dependable supplies exist. Most of the shale area did not have a possible supply except for the large reservoirs on the Missouri River. This option has now been funded through the federal government and the Mni Wiconi rural water system is in construction. Water to the area will be available in one to two years. The KOA campground and the 1880 Town have both indicated their intent to use the rural water system for their domestic water supply when it becomes available.

The lake experienced a fish kill that was attributed to winterkill conditions in 1989-90. Stocking attempts since have not been successful. The South Dakota Game Fish and Parks (SDGF&P) is basically managing the lake for waterfowl benefits and is not presently managing the area as a fishery.

The lake shoreline has had a significant increase in population of cattails and other aquatic plants. The campground owner is having problems keeping access to open water for boating and swimming.

There are no active farmsteads in the watershed and the only livestock activity involves 30 to 40 head of cattle grazed in the vicinity of the 1880 town. There have been no reports of livestock problems or losses because of nitrates or selenium toxicity. Normally selenium problems are more evident during dry cycles and the last few years have been above normal in annual moisture. Murdo, located about 22 miles east of Freeman Lake maintains a national weather station and average precipitation is 16 - 18 inches. Records from the Murdo weather station show there has not been a year below 20 inches of annual precipitation since 1990.

Freeman Lake is included in the South Dakota Lakes Assessment Program which is part of the South Dakota Department of Environment and Natural Resources' (SDDENR) on-going activities. The lake is sampled every four years and a Trophic State Index (TSI) for each lake is determined for Secchi disk, total phosphorous and chlorophyll. The Trophic State trend for Freeman Lake has been increasing slightly but the lake is still in a eutrophic condition. The TSI has been computed, based on water samples taken in 1979, 1989, 1994, 1996, 1998 and 1999 (see table in appendix). The average TSI for Secchi disk is 60.4, chlorophyll 59.3 and phosphorous 61.4.

- ***Stakeholder Description***

Nitrate concentration exceeded state water quality standards for drinking water in the water samples obtained from Freeman Lake in 1995. SDDENR contacted SDDA to determine if the area had any record of a fertilizer spill or if the area used an abnormal amount of fertilizer for growing crops which might account for the high nitrate levels. Both of these factors proved negative and SDDA and SDDENR started to make field observations of the watershed. The area above the lake has several active "saline seeps". Permission to sample the "seeps" was obtained by SDDENR and samples were taken from several sites. Local area residents became aware of the nitrate problem in the lake and the Jackson County Conservation District became involved. The Upper Bad River Demonstration Project coordinator also took an active part in the sampling and gathering of watershed data.

SDDA and SDDENR continued to work together on the sampling of Freeman Lake and the flowing seeps. Samples were collected from 1995 through September of 1999. Concentrations of nitrate in the lake ranged from 23.9 ppm to 110 ppm. Selenium was not checked in the lake until May of 1997 when a sample indicated 318 ppb. Since that time selenium samples in the lake have ranged from 254 ppb to 778 ppb. The seep areas were sampled in May of 1997 and in February and August of 1999. The highest concentrations of nitrate and selenium were collected in two seep areas between I90 and old US Hwy 16. These two areas were also sampled in September of 1997. Concentrations of nitrate in the west seep numbered 4F ranged from 544 to 1,066 mg/L and in the east seep area numbered 7C from 1,115 to 1,470 mg/L. Concentrations of selenium in the west seep area (4F) were 3,190 to 8,140 ug/L and in the east seep area (7C) ranged from 3,490 to 4,840 ug/L.

The South Dakota Geological Survey conducted test borings of the area and sampled test cores to determine if these deposits could be the source of nitrate and selenium. Monitoring wells were installed near the two seep areas with the highest concentration of nitrate and selenium. The wells were sampled in September of 1997. The nitrate concentration in the well near site 4F was 752 mg/L and near the east site 7C was 870 mg/L. Selenium in the well near the west seep area 4F was 4,172 ug/L and near the east site 7C was 3,290 ug/L. Geological Survey also determined that the fractured shale located in the lower portion of the soil profile was the natural source of the nitrate and selenium (see letter from State Geologist Derric Iles).

When the high concentrations of nitrate and selenium were found in the seeps at Freeman Lake, state officials became concerned that this condition may exist in other portions of the state. Selenium has been a problem in parts of South Dakota for many years especially in the shale soils. The problem has usually occurred during dry cycles. Also, nitrate has been a problem in stock dams during dry cycles. The Freeman Lake situation was the first recorded condition where high concentrations of nitrate and selenium were found during a wet cycle. Representatives from SDDA, SDDENR and South Dakota Extension Service (ES) met and decided to have field agents from ES collect water samples at seep sites throughout the Pierre Shale area located predominately in western South Dakota. Samples were collected and several sites contained high selenium or nitrate or both. A report entitled "Report of Results: Nitrate and Selenium Reconnaissance Project" has been developed but a final copy has not been published at this time.

- ***Intent to Submit as a Clean Water Act Section 303(d) TMDL***

  In accordance with Section 303(d) of the federal Clean Water Act, the SDDENR submits for EPA, Region VIII review and approval, the nitrate and selenium TMDLs for Freeman Lake as provided in this summary and attached documents. These TMDLs have been established at levels necessary to protect the assigned beneficial uses of Freeman Lake with consideration of seasonal variation and a margin of safety. Designated beneficial uses that may benefit by the general improvement in water quality are: warm water permanent fish life propagation; immersion recreation; limited contact recreation; and fish and wildlife propagation, and stock watering.

II. Problem Characterization:

- ***Waterbody description/Maps***

  Freeman Lake is a 66 acre (26.6 ha) reservoir located in the northeast portion of Jackson County in the western part of south central South Dakota. The entire county is a part of the Missouri River Basin. Freeman Lake is located in the upper portion of Brave Bull Creek watershed, which is part of the Bad River watershed.

  The lake was created in 1939 by construction of an earthen embankment across an intermittent draw as part of the Works Progress Administration program. The SDGF&P is responsible for the management and operation of the lake and is open to public. A state game refuge is located west of the lake and is maintained in permanent vegetation. The land east of the lake is privately owned and is maintained in grass. The principal land use of the watershed when the lake was developed was native grassland with some small tracts of cropland used for forage and cash crops.

  Through the years, a large portion of the land in the watershed has been plowed to raise crops. Today about 1,050 acres of the 3,409 acre watershed still remain in permanent grassland vegetation with another 350 acres vegetated through the Conservation Reserve Program (CRP). The remainder is cropland and is usually planted to winter wheat. Part of the permanent vegetation is in alfalfa / grass that is harvested for hay. In most years, one cutting of hay is taken. In some years, an additional cutting is removed depending on the amount of moisture available. There are a limited number of livestock (about 30 - 40 head) grazed in the area near and above the 1880 Town. These animals are wintered in the area below and west of the embankment structure for Freeman Lake. These are the only livestock currently grazing in the watershed area.

A KOA Campground has been established on the east shore of the lake near the emergency spillway. The lake was a successful warmwater fishery for many years until it experienced a fish kill in 1989-90. Attempts to restock the fishery have been unsuccessful and the lake presently is managed for waterfowl benefits.

- ***Maps***

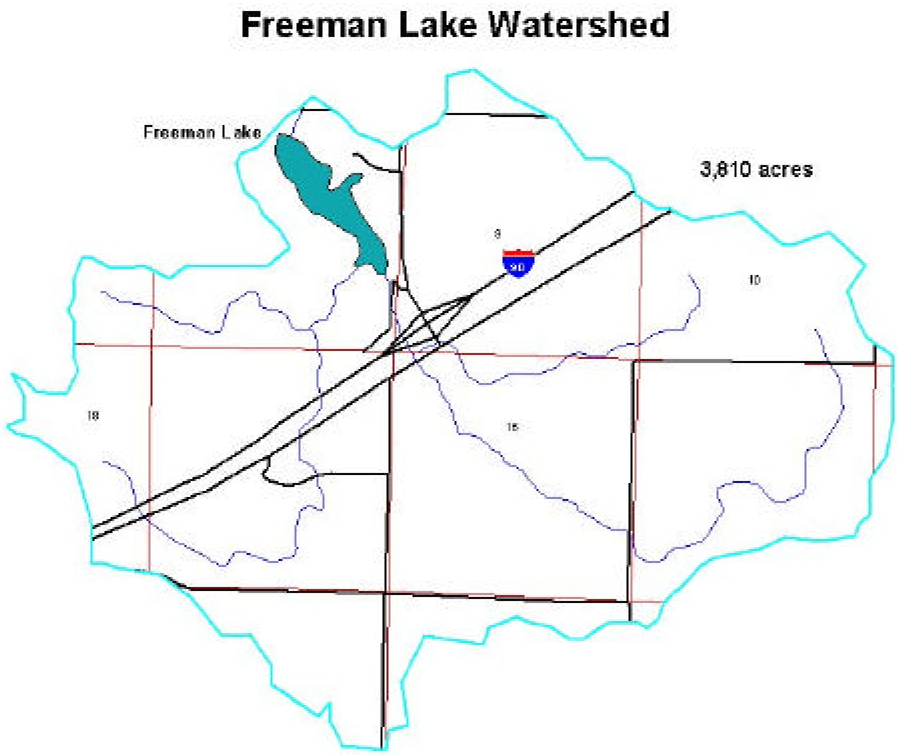


Figure 1. Freeman Lake Watershed Map

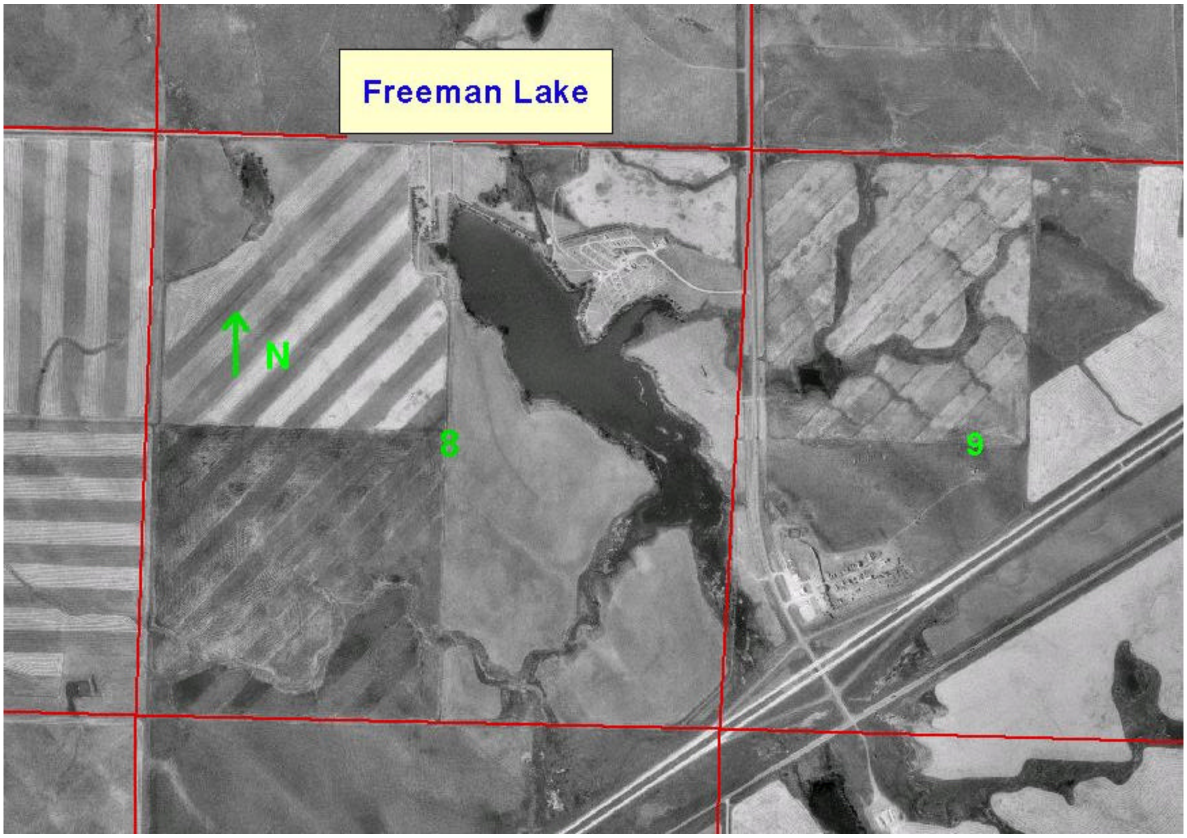


Figure 2. Aerial Map of Freeman Lake

- ***Waters Covered by TMDL***
  Freeman Lake is the waterbody targeted by this TMDL.

- ***Rationale for Geographic Coverage***
  The 66 acre (26.6ha) lake receives flows from the 3,409 acre (1,374.6 ha) watershed which is about 3 1/2 miles wide and 2 1/2 miles deep with gently rolling to steep topography. The drainage channels all have positive gradients with a straight to slightly meandering pattern.

  By 1960, areas of the watershed were being broken to cropland to raise wheat. Today the watershed is predominately cropland producing wheat and some alfalfa/grass for hay. The land producing wheat is usually fallowed (left idle with no crop planted and the weeds controlled) every other year. Annual rainfall for the area based on precipitation data from 1960 - 1990 averages 16 to 18 inches per year. Currently weather data shows that the annual rainfall has exceeded the average from 1990 through 1999.

  The immediate watershed of Freeman Lake consists of a single soil association:

  Pierre-Promise-Samil (SD041): Moderately deep and deep, well drained, nearly level to strongly sloping, clayey soils on uplands.

The lake has been in existence for about 60 years with a current depth of over 16 feet, so sediment accumulation has not been considered a problem.

- ***Pollutant(s) of Concern***

  The pollutants of concern are nitrate, selenium, and phosphorous. Surface water quality standards for fish and wildlife propagation, recreation and stock watering require that nitrate concentrations do not exceed 50 mg/L over a thirty day period with a daily maximum not to exceed 88 mg/L. Protection of aquatic life require that dissolved selenium concentrations do not exceed 20 ug/L daily maximum and 5 ug/L over a thirty day period. Water samples from the lake have consistently exceeded the selenium standards. The last test sample of 9/20/99 had selenium exceeding state standard and nitrate in compliance. This was the first time nitrate met compliance for fish and wildlife propagation, recreation and stock water since November of 1997. South Dakota does not have an applicable numeric criterion established for phosphorous but the effects from high phosphorous concentrations are prohibited by narrative water quality standards.

- ***Use Impairments or Threats***

  The existing water treatment plant for the KOA Campground and the 1880 Town has not been used since 1995. A reverse osmosis system was installed to provide domestic water needs for the KOA Campground and the 1880 Town now uses bottled water for drinking water and cooking.

  The excessive growth of cattails has limited access to the lake, and boating and water contact recreation basically have been eliminated. The excessive nutrients have increased the growth of aquatic plants, especially cattails.

  Fish stocking has not been successful since the winter fish kill in 1989-90. Attempts to restock the lake have failed since this event and the SDGF&P has determined to not make another attempt to restock until the water quality improves to a point suitable to maintain a fishery.

  The TSI has increased slightly through the years that Freeman Lake has been monitored. The average TSI is presently 60.4. The lake does experience heavy algae blooms during summer.

  The high selenium concentrations are a potential problem for livestock and wildlife. Livestock that encounter excess selenium may show symptoms including: distorted growth or sloughing of hoofs or horns, loss of hair, irritation of the eyes and mucous membranes, coughing, sore feet, or reduced productivity and reproduction rates. Continued exposure to toxic levels of selenium can result in livestock death. The landowner below the dam has indicated that he has experienced some livestock problems that may resemble symptoms related to selenium toxicity. However, these symptoms have not been confirmed to be caused by toxic levels of selenium.

- ***Probable Sources***

When the nitrate concentration started to exceed state standard for drinking water, SDDENR sent a request to SDDA to determine if an agricultural operation may be causing the high nitrate concentrations. SDDA and SDDENR conducted field surveys of the area and found a large number of saline seeps occurring in the watershed above the dam. Samples from the natural seeps showed high concentrations of nitrate and selenium. Findings of the cooperative investigation were submitted and the South Dakota Geological Survey (SDGS) continued to investigate the area.

The SDGS completed test drilling of the areas in the proximity of the existing seeps and installed monitoring wells. A letter from Derric Iles, State Geologist at Vermillion, South Dakota, indicated that "the shallow ground water contained in the Pierre Shale which feeds the seeps contains naturally occurring high concentrations of selenium and nitrate".

Saline seeps are common in western South Dakota and occur commonly in the Pierre shale soils. The USDA Agricultural Research Service (ARS) conducted several studies of these type of seeps. ARS published a document entitled "Saline-Seep Diagnosis, Control, and Reclamation" which listed ten factors that contribute water to saline-seep problems in the Northern Great Plains, including:

1. Fallow
2. High precipitation periods
3. Poor surface drainage
4. Snow accumulation
5. Gravelly and sandy soils
6. Drainageways
7. Constructed ponds and dugouts that leak
8. Artesian water
9. Roadbeds across natural drainageways
10. Crop failure

Factors number 1,2,4,6,7, 9 and 10 could all be potential factors in the present seep condition in this watershed.

Water samples have been taken from the lake since the KOA Campground began operation in 1965. For many years, the nitrate concentration in the water was well below the drinking water standard. Nitrate concentrations started to increase in 1990 and exceeded the drinking water standard in 1995.

Highways have existed in the area prior to the construction of the dam. Interstate Highway 90 was constructed in the late 1960's. Dams and ponds have been built since the homestead days with major government construction programs between 1950 and 1980. Snow accumulation is governed by amount of snow, existing ground cover, buildings, roadways, etc. Some of the areas have a cropping history back to the days of the Homestead Act with the major change to cropland occurring in the late 1970's and early 1980's. The fallow practice commonly used on the cropland adds moisture to the soil profile during the year that no crop is grown. Fallow and the existing ponds are the most likely human factors adding moisture to the soil profile. The precipitation has exceeded annual amounts since 1990 and has undoubtedly added to the problem. Trying to solve the problem by addressing only one factor is not a viable solution. The problem has emerged as a result of several factors. The ultimate goal is to reduce the flow of water from selected seep areas. This can be achieved be reducing the amount of recharge water occurring in the soil profile by increasing vegetation and removing other factors that cause soil profile recharge (such as dams).

III. TMDL Endpoint:

- ***Description***

The seep areas with highest concentrations of nitrate and selenium are located between I90 and old Hwy 16 and have been farmed. These areas have been too wet to farm recently and are either void of vegetation or have annual type grasses. There are some other areas along the major watercourses in Sections 16, 17 and the SW part of Section 9 that have medium to high concentrations of nitrate and selenium.

There are four drainage areas south of I90 that presently yield seep flow to lake. The areas north of I90 are mainly in permanent vegetation and very little seepage occurs in this area. The yield from the four drainages has been estimated as follows:

Site 4: Drains the western part of the watershed, flows through a culvert in I90 west of Freeman Lake and enter the lake in the west arm.

Flow 0.009 cfs (6%) Nitrate 5.53 kg / day (7.1%) Selenium 17 g / day (3.2%)

Site 5: Drains the central and south eastern part of the watershed and flow directly north into Freeman Lake through a box culvert in Interstate 90. Site 5 drainages joins with Sites 6 & 7 just before it enter the culvert.

Flow 0.075 cfs (48%) Nitrate 32.3 kg / day (61%) Selenium 290 g / day (54.7%)

Site 6: Drains the eastern part of the watershed and joins with Site 7 drainage just below SD Hwy 16 and east of SD Hwy 63. This flow joins with Site 5 flow at the box culvert.

Flow 0.042 cfs (28%) Nitrate 7.7kg / day (14.6%) Selenium 63 g / day (11.9%)

Site 7: Drains the area between I 90 and SD Hwy 16 and east of SD Hwy 63.

Flow 0.024 cfs (18%) Nitrate 9.1 kg / day (17.3%) Selenium 160 g / day (30.2%)

The high concentrations of nitrate and selenium can be reduced to non-problematic levels entering Freeman Lake if the flows from the seep areas are reduced to near zero. This can be accomplished through establishment or maintenance of vegetation in the watercourses in Sections 16, 17 and the seeding to perennial, deep rooted crops in the recharge zones for the seep areas south of I90 in the SW1/4 of Section 9 and the NW1/4 of Section 16, T2S, R25E. Vegetation does exist in some areas and is of the type that would be desired. Other areas have no vegetation or only annual plants with little long-term value towards the effort to reduce seepage waters. A plan to reestablish and maintain the vegetation will need to be developed.

The recharge areas for the seeps will need to be located through soil mapping. The major portion of these recharge areas have been farmed and need to be converted to permanent vegetation. The dam just south of old Hwy 16 in the NW1/4 of 16 and the dam in the SW1/4 of 9 should be breached.

An effort should be put forth to determine vegetation that will exist under the seep conditions. This vegetation could then be established through seeding, plugging or other acceptable methods. Over 60 % of the land with the wettest condition has very sparse vegetation at the present time.

The vegetated area along the major watercourses should serve as a waterway and a buffer strip and average about 100 - 150 feet in width with consideration for farming needs. Existing vegetation should not be disturbed. Where new seeding is planned a native grass mixture that will tolerate the soil and seep conditions should be seeded.

This project will be voluntary and landowners must agree to the plan before any seeding is carried out. Funding for these efforts could be obtained from various State and Federal programs.

Once the seeding has been established, the seep areas will have to be monitored to determine if the vegetation is reducing the amount of flow. The area to be seeded to permanent vegetation is the minimum area that will reduce the seepage. Any additional area in the south one half of section 9 and any area in sections 16 or 17 that would be seeded to permanent vegetation or a long-term crop such as alfalfa that develops a deep root would be beneficial to the project. Also, annual cropping in place of fallow every other growing season, would provide a reduction in the build up of subsurface moisture.

When the seepage has been reduced to control the nitrate and selenium loadings to Freeman Lake, there may be some need to lower the nitrate and selenium levels in the lake. Control of cattails by removal is an effort to consider. This measure is strictly for improving the water quality and related beneficial uses of the lake.

- ***Endpoint Link to Surface Water Quality Standards***

The goal of this TMDL was developed on field studies conducted by the SDDA and SDDENR. The studies indicated that soils in the area have concentrations of nitrate, selenium and phosphorus that are water-soluble and can be carried by overland and underground flow. The topography and geology of the land in the area provides sites where the underground flow comes to the surface. Samples of flow from some seep sites in Sections 9, 16, and 17 have consistently exceeded standards for nitrates for domestic water and fish and wildlife propagation, recreation and stock water beneficial uses. Samples have also exceeded the selenium standard for aquatic life. Modeling indicates that un-vegetative cropland areas contribute to the phosphorus loading to the lake.

Samples from Freeman Lake have been taken periodically since the middle 60's when the KOA Campground was started and the lake was used for drinking water. However, the samples did not exceed the 10 mg/L nitrate standard for drinking water and domestic water beneficial use until 1995. In-lake samples for selenium were not taken until May of 1997. In the future, the lake will not include use for drinking water or domestic water needs as both the KOA campground and the 1880 Town will receive water from the Mni Wiconi rural water system.

The goal of this TMDL is to return the lake to water quality conditions that meet its designated beneficial uses. To meet this goal, the nitrate delivery to the lake will need to be less than 50 mg/L over any 30 day period and less than 88 mg/L in any daily sample; and selenium delivery will need to be less than 5 ug/L averaged over any 30 day period and less than 20 ug/L in any daily sample.

The loading to the lake is directly related to the amount of seepage flow entering the lake. This varies throughout the year and is directly related to the amount of available free ground water. In wet cycles loading to the lake may occur during most of the year. Field trips to the watershed indicate that seepage yield approaches zero in July, August and September. Flow begins to increase as vegetative growth decreases and reaches a constant flow by the beginning of December. This flow will continue throughout the winter and may even increase after the spring thaw. Flow starts to diminish in late April and usually approaches zero by July. In dry cycles such as is occurring in 2000 the available ground water has been used up by vegetation and no seepage flow is occurring. It is doubtful that any of the seeps will function the remainder of 2000 during the period when no vegetative growth will occur.

The loading being related to seepage is reflected by the concentrations of nitrogen and selenium found in the lake during the non-growing season. Samples from the lake taken on November 27, 1997 tested 327 ppb of selenium and 34.5 ppm of nitrate. Samples taken February 23, 1998 tested 660 ppb selenium and 80.4 ppm of nitrate. Surface runoff can significantly reduce the lake concentration. The summer of 1998 was very high in rainfall and the lake discharged through the spillway on several occasions. Samples taken September 10, 1998 tested 347 ppb selenium and 47.7 ppm nitrate. Seepage flows were strong during the winter of 1998-99 and samples taken on April 27, 1999 tested 714 ppb selenium and 108 ppm nitrate. Both selenium and nitrate can be removed from the lake by plant growth and nitrate will volatilize. Some spring runoff did cause the lake spillway to run but very little overflow occurred before the next sample was taken on July 27, 1999 when selenium tested 765 ppb and nitrate measured 77.5 ppm. Visual observations and attempts to obtain samples from the seepages areas revealed that seepage flow at this time was approaching zero. In early September of 1999 over seven inches of rain fell on the Freeman Lake watershed in less than 24 hours. The spillway ran for over a week. A sample taken on September 20, 1999 showed 355 ppb selenium and 37.0 ppm nitrate.

Based on these field observations and using professional judgment the following statements on loading can be made.

a. Lake loading of selenium and nitrates is non-existent during dry cycles when available ground water is diminished and seepage stops. The lake concentration may increase because of evaporation reducing the total volume of water in the structure. This will be truer of selenium than the nitrate that will reduce to recycling levels. This fact is borne out by the fact that nitrate samples have been taken in Freeman Lake since the middle 60's and the nitrate level remained very low until the early 90's when the abnormal precipitation period began. This indicates that the seepage areas were not contributing significantly for 25 or more years.
b. Lake loading is significant during the non-growing season. Lake concentrations increased over 100 percent during these periods where collected data was available. Some of this increase can be attributed to the decay of in-lake plants.
c. Lake loading during the growing season is strongly affected by surface runoff. Large runoff events flush a large portion of the selenium and nitrate downstream. Observed events show reductions of over 50 percent.
d. Lake loading from seepage areas appears to decrease during the growing season. This would follow field observations that which indicate that seepage flow decreases during the growing season due to the water uptake of growing vegetation even if ground water supplies are available.
e. Based on these observations lake loadings will approximate the nitrate and selenium loading shown in the table for natural loading allocations in wet cycles during the months of December thru March. The months of April thru June will decrease approaching zero at the end of June. July thru September will approach zero loading and loading will start in October and continue to increase thru November to where it reaches a constant again by December. In dry cycles, which are occurring now, loading will be zero through out the year.

IV. TMDL Analysis and Development:

- ***Data Sources***

  Data was obtained from SDDENR through the SDGS Program, the Division of Financial and Technical Assistance and the Division of Environmental Services, SDDA, ES, and USDA ARS. Data was collected in 1996, '97, '98 and '99. ARS has been researching saline and alkaline soils and seeps since the 1950's. The Upper Bad River Water Quality Demonstration Project has assisted in gathering samples. TSI data and trend was obtained from the South Dakota Lakes Assessment Program.

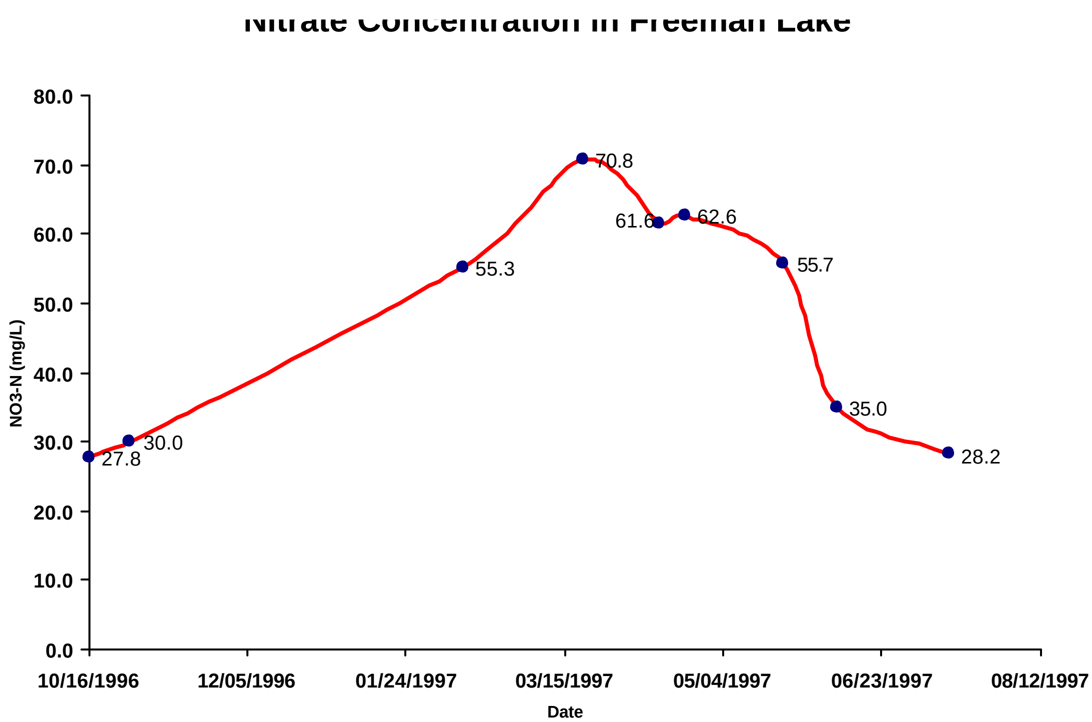
- ***Analysis Techniques or Models***

  Field parameter, water quality samples were collected and Quality Assurance / Quality Control was conducted in accordance with the Standard Operating Procedures for Field Samplers, State of South Dakota, Department of Environment and Natural Resources, Watershed Protection Program. The South Dakota State Health Laboratory conducted chemical analyses of the water samples. Phosphorous loading and erosion estimates were developed using the ARS AGNPS model.

  Each sample location was determined by a use of a Trimble Global Positioning System or its equivalent. A Geographic Information System (GIS) was used to develop the watershed maps. AGNPS data was obtained from the Jackson County Soil Survey, Farm Service Agency cropping history, NRCS hydrologic data, USGS Quadrangle sheets and existing aerial photos.

  Due to the lack of site-specific water quality data, a computer model was selected in order to assess the Nonpoint Source (NPS) loadings throughout the Freeman Lake watershed. The model selected was the Agricultural Nonpoint Source Pollution Model (AGNPS), version 3.65. This model was developed by the USDA - Agricultural Research Service to analyze the water quality of runoff events from watersheds. The model predicts runoff volume and peak rate, eroded and delivered sediment, and nitrogen and phosphorus concentrations in the runoff for a single storm event for all points in the watershed.

  This model was developed to estimate subwatershed or tributary loadings to a waterbody. The AGNPS model is intended to be used as a tool to objectively compare different subwatersheds within a watershed and to estimate the percent reduction that could be achieved in the watershed by installing various Best Management Practices. The entire Freeman Lake watershed was divided into 98 cells each of which had an area of 40 acres. The AGNPS analysis of the Freeman Lake watershed consisted of the collection of 21 field parameters for each cell and the calculation of nonpoint source pollution yields for each cell and subwatershed. Proceeding from the headwaters to the lake outlet, the pollutants are routed in a step-wise fashion so the flow at any point may be examined.



The AGNPS data shows that 1755 tons of sediment, 4.54 tons of nitrogen and 1.87 tons of phosphorous are delivered to the lake annually. The watershed contains about 2040 acres of cropland and about 1880 acres of grassland. Using the AGNPS model, a 36% reduction in sediment delivered to the lake could be achieved if 200 acres of cropland in subwatershed #28 and 800 acres of cropland in subwatershed #30 were converted to no-till or native grasses. This would also reduce the total amount of nitrogen delivered to the lake by 24% and total phosphorous delivered to the lake by 29%.

The model was also used to estimate loading reductions by installing buffer strips and grassed waterways along the major channels within subwatershed #28 and #30. When these practices were installed, the model predicted that the amount of sediment delivered to the lake would be reduced by 22%, the total nitrogen would be reduced by14% and the total phosphorous could be reduced by 17%.

Current Watershed Conditions										
	Drainage	Sediment		Total nitrogen		Total phosphorous				
Subwatershed	area	yield		yield		yield				
outlet #	(acres)	(tons)	(tons/acre)	(lbs/acre)	(tons)	(lbs/acre)	(tons)			
8	360	31	0.09	0.88	0.16	0.28	0.05			
28	1520	578	0.38	2.13	1.62	0.87	0.66			
30	1760	1146	0.65	3.14	2.76	1.32	1.16			
Total load to	3640	1755	0.48	2.49	4.54	1.03	1.87			
Freeman Lake										
Reductions from converting 5 cells in subwatershed #28 and 20 cells in subwatershed #30										
from wheat or fallow using conventional tillage to no-till or native grasses										
	Drainage	Sediment			Total nitrogen			Total phosphorous		

Subwatershed	area	yield			yield			yield		
outlet #	(acres)	(tons)	(tons/acre)	reduction	(lbs/acre)	(tons)	reduction	(lbs/acre)	(tons)	reduction
8	360	31	0.09	0.0%	0.88	0.16	0.0%	0.28	0.05	0.0%
28	1520	452	0.30	21.8%	1.83	1.39	14.1%	0.72	0.55	17.2%
30	1760	634	0.36	44.7%	2.17	1.91	30.9%	0.83	0.73	37.1%
Total load to	3640	1117	0.31	36.3%	1.90	3.46	23.8%	0.73	1.33	29.1%
Freeman Lake										
Reductions from installing buffer strips and grassed waterways along the										
major water courses in subwatershed #28 and #30										
	Drainage	Sediment			Total nitrogen			Total phosphorous		
Subwatershed	area	yield			yield			yield		
outlet #	(acres)	(tons)	(tons/acre)	reduction	(lbs/acre)	(tons)	reduction	(lbs/acre)	(tons)	reduction
8	360	31	0.09	0.0%	0.88	0.16	0.0%	0.28	0.05	0.0%
28	1520	467	0.31	19.2%	1.87	1.42	12.2%	0.74	0.56	14.9%
30	1760	874	0.50	23.7%	2.64	2.32	15.9%	1.07	0.94	18.9%
Total load to	3640	1372	0.38	21.8%	2.14	3.90	14.0%	0.85	1.55	17.0%
Freeman Lake										

- ***Seasonality***
  The major use of ground water by crops occurs in the spring and early summer and depends on available moisture and root depth. Alfalfa will use moisture in the soil profile to a depth of 6 or 7 feet while a wheat crop will only use moisture to a depth of 3 feet. Native grassland will grow all season if moisture is available and a variety of species is present. In western South Dakota, native rangeland uses the available moisture so that very little free ground water exists, especially in the Pierre Shale soils.

  Seeps occur when there is free moisture in the soil and an impervious layer causes the free water to flow out on the soil surface. The amount of flow depends on the amount of free water available, the size of the recharge area, and the time of the year. Seeps are more likely to flow when vegetation is dormant or growing slowly and at times of heaviest precipitation; therefore, flow is usually heaviest in the spring. The flow may be reduced or stop altogether during the late spring and summer and start again after frost has occurred in the fall.

  The water from the seep areas will reach Freeman Lake when flow is occurring and vegetative growth does not use up the available flowage. The watershed was predominately grassland when the dam was constructed and has had a large portion of the grass converted to cropland. The cropping sequence for this area uses fallow in the rotation. Studies by the USDA ARS has shown that fallow can be a significant factor in the increase of ground water and the development of saline seeps in the Pierre Shale soil types which exist in this watershed. These studies also indicate that excess moisture, road grades, stock dams, snow accumulation, drainage ways and crop failure can influence seep areas. All of these factors are present along with excess precipitation since 1990.

An opportunity to reduce the seepage is to remove groundwater in the soil profile. The establishment of deep-rooted permanent vegetation that is suitable for these soils and other environmental conditions serve to reduce recharge pressure through transpiration compared to present land-use of cropland in the problem seep areas. By establishing permanent vegetation in designated problem seep areas, the seepage rates will be reduced to where selenium and nitrate loadings to Freeman Lake will be reduced. The waterways and buffer strips will trap sediment and slow runoff to reduce phosphorous delivery. The lake can then again be managed for its beneficial uses.

Research in California has shown that wetlands produce vegetation that processes selenium into environmentally acceptable forms and also use nitrate. The existing stock dams in the watershed are functioning as wetlands and contain vegetation that the California research has found to process selenium. The area with the major seep problems exists between the two highways where there is limited space to create a wetland. Also, the vegetation produced by the wetland should be harvested and moved to a less vulnerable area. Harvesting could prove to be a problem because of expense and the wet conditions induced by the created wetland.

- ***Margin of Safety***

  The farming methods in western South Dakota have changed to more annual cropping in the last few years. As annual cropping occurs, there will be less chance for groundwater build up to feed the seepage area. Economics in farming and increased awareness of conservation practices is encouraging farmers to implement reduced tillage methods. Reduced tillage reduces the amount of sheet and rill erosion and, in turn results in a reduction in the amount of phosphorous delivery. Economics also can cause the type of crops to change. Low crop prices encourage producers to enroll in existing farm programs that result in fields seeded to permanent vegetation that grows through out the growing season and thus reduces groundwater in the soil profile. The KOA Campground and the 1880 Town plan to hook into the Mni Wiconi rural water system as soon as water is available. These factors were not considered in the TMDL.

V. *Allocation of TMDL Loads or Responsibilities:*

- ***Wasteload Allocation***

  There are no known point sources of pollutants in this watershed, therefore the "wasteload allocation" component of the TMDL is considered zero. The TMDL is considered wholly included in the "load allocation" component of the TMDL.

- ***Natural Load Allocation***

  There are four drainage areas south of I90 that presently yield seep flow to lake. The areas north of I90 are mainly in permanent vegetation and very little seepage occurs in this area. The yield from the four drainages is as follows:

Site Number	Flow	Nitrate	Selenium
4	0.009 cfs (6%)	5.5 kg / day (7.1%)	17 g / day (3.2%)
5	0.075 cfs (48%)	32.3 kg / day (61.0%)	290 g / day (54.7%)
6	0.044 cfs (28%)	7.7 kg / day (14.6%)	63 g / day (11.9%)
7	0.026 cfs (18%)	9.1 kg / day (17.3%)	160 g / day (30.2%)
Total	0.154 cfs	52.9 kg / day	530 g / day

The flow is a result of several factors, but mainly due to 10 years of above normal precipitation and the use of fallow as part of the cropland farming practice. Flow would occur in high precipitation periods even if the land had remained in native vegetation. Soil evaluation in the seep area indicates that seeps have occurred periodically through time. It is unknown if historical saline seep flows have delivered similar levels of selenium and nitrate as what was experienced in recent history.

- ***Load Allocation***

  The recommended goal for improving water quality of Freeman Lake is to reduce flow of the saline seeps contributing high concentrations of nitrate and selenium to the lake. This will be accomplished by reestablishing permanent vegetation in the recharge areas to herbaceous and woody plants with deep developing root systems, consisting of a mixture of warm and cool season plants. A management plan will be developed to insure a healthy, aggressive plant community throughout the growing season.

- ***Allocation of Responsibility***

  Ten factors influence the development of seepage areas. Seven of these factors are present in the watershed above Freeman Lake. The three most likely to cause problems are increased annual precipitation, existing stock dams and fallow of cropland.

  Annual precipitation is not controllable but reseeding cropland to permanent vegetation in the recharge areas near the existing seepage areas can be accomplished and selected dams can be breached which will be beneficial. Permanent vegetation will use more available moisture than the current land management practices in use. Some seep sites have shown higher nitrate and selenium concentrations than others and will be the first areas to be planted to permanent vegetation.

  Land management efforts rely upon voluntary participation of willing owners or operators. There are government programs through USDA and EPA that may help fund reseeding, and in some cases may pay a rental rate for the areas seeded to permanent vegetation.

This project will be a phased project where each phase must be implemented and functioning before the next phase is started. The first phase will be the establishment of permanent vegetation to increase evapotranspiration of ground water or soil moisture. Monitoring must occur throughout the project to determine if seepage area flow is being reduced. The second phase will be to incorporate other treatments to reduce seepage flow, if needed.

When seepage flow is reduced to an acceptable level, other methods for water quality improvement (such as aquatic vegetation removal) should be evaluated.

VI. Schedule of Implementation:

An implementation plan will be developed in cooperation with the Jackson County Conservation District. The plan will be developed in consultation with the affected land-owners and agencies that are involved. The goals will be to develop the implementation plan within one year of TMDL approval and complete the first phase of the project within three years.

VII. Post-Implementation Monitoring:

Monitoring will be conducted to determine if the efforts to reduce the seepage and water quality improvement has been documented. If the seepage is controlled, then the lake will be monitored to determine if the nitrogen and selenium are returning to targeted levels and how in-lake phosphorus levels are responding.

VIII. Public Participation:

- ***Summary of Public Review***

Meetings have been held with the stakeholders and South Dakota agency representatives formally on two occasions. Many other meetings have occurred with various individuals as the TMDL was developed. The following table provides a chronological order of the various review efforts carried out.

Public Meetings	*Participants*	*Public Comments Received*
December 9, 1998, Pierre, SD	Stakeholders	Discussed project needs to develop TMDL
January 19, 1999, Belvidere, SD	Landowner & Stakeholders	Reviewed need for TMDL and TMDL Content.
December 21, 1999 Pierre, SD	Stakeholders	Discussed content of TMDL and needed changes.
February 24, 2000 Kadoka, SD	Jackson County Cons. Dist.	Review and discussion of TMDL
March 1, 2000 Kadoka, SD	Landowners & Stakeholders	Review and discussion of TMDL

Public Meetings	*Participants*	*Public Comments Received*
Electronic media	***Mailings***	***Document Distribution***
May 2000 TMDL Summary advertised on department website	**Interested parties** May 5, 2000 **Stakeholders** May 5, 2000 **Daily Newspapers** May 5, 2000	Comments received during project meetings and review of the draft report and findings were considered

- ***Project Information and Education Efforts***
  The meeting in January in Belvidere, SD had several of the landowners and users of Freeman Lake in attendance. This meeting served two purposes:

  To educate the landowners and users on the reason for developing the TMDL and what would be included in the TMDL document.

  To get comments and suggestions from the local people on Freeman Lake problems and needs as related to water quality.

IX. Supporting Development Document(s) (attached):

Letter from Kurtis Reitsma discussing the actions that South Dakota Department of Agriculture has conducted on the Freeman Lake nutrient problems, 6/30/99.

Letter from Derric Iles discussing the studies and findings on the nitrate and selenium problems in the seepage flow entering Freeman Lake that were conducted by the South Dakota Geological Survey, 7/20/99.

Data sheet on the AGNPS study for the Freeman Lake watershed.

Water quality sample results, SD DENR, 1979 - 1999.

Saline-Seep Diagnosis, Control and Reclamation, US Department of Agriculture, Agricultural Research Services, Conservation Research Report Number 30, May 1983.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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DENVER, CO 80202-2466
http://www.epa.gov/region08

February 7, 2001

Ref: 8EPR-EP

Steven M. Pirner, Secretary
Department of Environment & Natural Resources
Joe Foss Building
523 East Capitol
Pierre, SD 57501-3181

Re: TMDL Approvals
Blue Dog Lake
Clear Lake
Freeman Lake
Punished Woman Lake
Upper Lake Sharpe

Dear Mr. Pirner:

We have completed our review of the total maximum daily loads (TMDLs) as submitted by your office for the waterbodies listed in the enclosure to this letter. In accordance with the Clean Water Act (33 U.S.C. 1251 *et. seq.*), we approve all aspects of the TMDLs as developed for the water quality limited waterbodies as described in Section 303(d)(1).

Based on our review, we feel the separate TMDL elements listed in the enclosed review table adequately address the pollutants of concern, taking into consideration seasonal variation and a margin of safety. Please find enclosed a detailed review of these TMDLs.

For years, the State has sponsored an extensive clean lakes program. Through the lakes assessment and monitoring efforts associated with this program, priority waterbodies have been identified for cleanup. It is reasonable that these same priority waters have been a focus of the Section 319 nonpoint source projects as well as one of the priorities under the State's Section 303(d) TMDL efforts.

In the course of developing TMDLs for impaired waters, EPA has recognized that not all impairments are linked to water chemistry alone. Rather, EPA recognizes that *"Section 303(d) requires the States to identify all impaired waters regardless of whether the impairment is due to toxic pollutants, other chemical, heat, habitat, or other problems."* (see 57 Fed. Reg. 33040 for July 24, 1992). Further, EPA states that "*...in some situations water quality standards – particulary designated uses and biocriteria – can only be attained if nonchemical factors such as* *hydrology, channel morphology, and habitat are also addressed. EPA recognizes that it is appropriate to use the TMDL process to establish control measures for quantifiable non-chemical parameters that are preventing the attainment of water quality standards.*" (see Guidance for Water Quality-based Decisions: The TMDL Process; USEPA; EPA 440/4-91-001, April 1991; pg. 4). We feel the State has developed TMDLs that are consistent with this guidance, taking a comprehensive view of the sources and causes of water quality impairment within each of the watersheds. For example, in several of the TMDLs, the State considered nonchemical factors such as lake depth and its relationship to the impaired uses. Further, we feel it is reasonable to use factors such as lake depth as surrogates to express the final endpoint of the TMDL.

Thank you for your submittal. If you have any questions concerning this approval, feel free to contact Vernon Berry of my staff at 303/312-6234.

Sincerely,

Jerry Anderson for

Max H. Dodson
Assistant Regional Administrator
Office of Ecosystems Protection and
Remediation

Enclosure

Enclosure

APPROVED TMDLS

Waterbody Name*	TMDL Parameter/ Pollutant	Water Quality Goal/Endpoint	TMDL	Section 303(d)1 or 303(d)3 TMDL	Supporting Documentation (not an exhaustive list of supporting documents)
Blue Dog Lake*	phosphorus	TSI ≤ 65	30% reduction in phosphorus loads	Section 303(d)(1)	■ Phase I Watershed Assessment Final Report, Blue Dog Lake, Day County, South Dakota (SD DENR, Sept. 1999) ■ Report on the Activities and Expenditures of the Blue Dog / Enemy Swim Lake Watershed Assessment Study (Day Conservation District, January 1999)
Clear Lake*	phosphorus	TSI ≤ 61	20% reduction in average annual tributary phosphorus loads	Section 303(d)(1)	■ Phase I Watershed Assessment Final Report, Clear Lake, Deuel County, South Dakota (SD DENR, June 1999)
	sediment	Increase average lake depth by 4 feet over 116 surface area acres	Remove 750,000 cubic yards of lake sediment	Section 303(d)(1)	
Freeman Lake*	nitrate	nitrate - 50 mg/L as a 30 day average nitrate - 88 mg/L as a daily maximum	reduce nitrate delivery to the lake by 33,000 Kg/year	Section 303(d)(1)	■ Water Quality Sample Results (SD DENR, 1979-1999) ■ Freeman Lake Watershed AGNPS Study Results ■ Saline-Seep Diagnosis, Control and Reclamation (USDA, Conservation Research Report No. 30, May, 1983)
	selenium	selenium - 5 μg/L as a 30 day average selenium - 20 μg/L as a daily maximum	reduce selenium delivery to the lake by 152.6 Kg/year	Section 303(d)(1)	

Waterbody Name*	TMDL Parameter/ Pollutant	Water Quality Goal/Endpoint	TMDL	Section 303(d)1 or 303(d)3 TMDL	Supporting Documentation (not an exhaustive list of supporting documents)
Punished Woman Lake*	sediment	Increase average lake depth in mid-lake area to 12 - 15 feet	■ 50% reduction of in-lake sediment ■ Remove 421,000 cubic yards of lake sediment	Section 303(d)(1)	■ 1993 South Dakota Lakes Assessment Final Report (SD DENR, March 1994) ■ Punished Woman's Lake Diagnostic / Reasibility Study Report (SD DWNR, April 1991) ■ South Dakota Lakes Classification and Inventory Final Report (SD DWNR, 1981) ■ Classification, Preservation, Resoration of lakes in Northeastern South Dakota (State Lakes Preservation Committee, 1977)
	nutrients	50% reduction of pondweed, cattail, and bulrush 15% reduction of in-lake sediment	Remove 421,000 cubic yards of lake sediment	Section 303(d)(1)	
Upper Lake Sharpe*	sediment	re-vegetate 45% of stream channel types F and G (Rosgen's Stream Channel Classification)	30% reduction of annual sediment delivery to Lake Sharpe by the year 2010	Section 303(d)(1)	■ Lower Bad River Basin Study Final Report (USDA, NRCS, revised June 1994) ■ Upper Bad River Basin Study (USDA, NRCS, October 1998) ■ Bad River Phase II Water Quality Project Final Report (Stanley County Conservation District, 1996) ■ Report on Factors Affecting Sediment Yield in the Pacific Southwest Area and Selection and Evaluation of Measures for Reduction of Erosion and Sediment Yield (Pacific Southwest Inter-Agency Committee, October 1968)

* An asterisk indicates the waterbody has been included on the State's Section 303(d) list of waterbodies in need of TMDLs.

■ TMDL Checklist ■

EPA Region VIII

State/Tribe: South Dakota
Waterbody Name: Blue Dog Lake, Day County
Point Source-control TMDL: Nonpoint Source-control TMDL: X (check one or both)
Date Received: December 12, 2000 Date Review completed: January 10, 2001 VEB

Review Criteria (All criteria must be met for approval)	Approved (check if yes)	Comments
■ **TMDLs result in maintaining and attaining water quality standards**	X	The waterbody classification uses which are addressed by this TMDL are warmwater marginal fish life propagation, immersion recreation, and limited contact recreation.
■ **Water Quality Standards Target**	X	Water quality targets were established based on trophic status. This is a reasonable approach because the trophic status of the waterbody relates to the uses of concern.
■ **TMDL**	X	The TMDL is expressed in terms of annual phosphorus load reduction. This is a reasonable way to express the TMDL for this lake because it provides an effective surrogate that reflects both aquatic life and recreational needs, and reflects the long response time of lakes of this type to pollutant controls within the watershed.
■ **Significant Sources Identified**	X	Significant sources were adequately identified in a categorical and/or individual source-by-source basis. All sources that need to be addressed through controls were identified.
■ **Technical Analysis**	X	Monitoring, empirical relationships, AGNPS modeling, and best professional judgement were used in identifying pollutant sources, and in identifying acceptable levels of pollutant control. This level of technical analysis is reasonable and appropriate because of the character of the pollutants, the type of land use practices, and the waterbody type.
■ **Margin of Safety and Seasonality**	X	An appropriate margin of safety is included by performing ongoing monitoring to assure water quality goals are achieved and by application of additional nonpoint source BMPs for croplands within the watershed. Seasonality was adequately considered by evaluating the cumulative impacts of the various seasons on water quality and by tailoring the BMPs to seasonal needs.
■ **Allocation**	X	The allocation for the TMDL was a "load allocation" attributed to nonpoint sources. Allocation was attributed to such sources as animal feeding areas and croplands.
■ **Public Review**	X	Public review and participation was conducted through meetings, electronic media, and mailings. The extent of public review is acceptable. Further, the review process sponsored by the State was adequate for purposes of developing a TMDL that will be implemented because of public acceptance.
■ **EPA approved Water Quality Standards**	X	Standards upon which this TMDL was based have been formally approved by the EPA. No tribal waters were involved in this TMDL.

■ TMDL Checklist ■

EPA Region VIII

State/Tribe: South Dakota
Waterbody Name: Clear Lake, Deuel County
Point Source-control TMDL: Nonpoint Source-control TMDL: X (check one or both)
Date Received: December 12, 2000 Date Review completed: January 10, 2001 VEB

Review Criteria (All criteria must be met for approval)	Approved (check if yes)	Comments
■ **TMDLs result in maintaining and attaining water quality standards**	X	The waterbody classification uses which are addressed by this TMDL are warmwater marginal fish life propagation, immersion recreation, and limited contact recreation.
■ **Water Quality Standards Target**	X	Water quality targets were established based on trophic status and lake depth. This is a reasonable approach since it relates to the trophic status of the waterbody as well as the physical nature of the lake, which in turn, relate to the uses of concern.
■ **TMDL**	X	The TMDL is expressed in terms of annual phosphorus load reduction and removal of lake sediment. This is a reasonable way to express the TMDL for this lake because it provides an effective surrogate that reflects both aquatic life and recreational needs.
■ **Significant Sources Identified**	X	Significant sources were adequately identified in a categorical and/or individual source-by-source basis. All sources that need to be addressed through controls were identified (including the removal of lake bottom sediments, if needed).
■ **Technical Analysis**	X	Monitoring, empirical relationships, AGNPS modeling, and best professional judgement were used in identifying pollutant sources, and in identifying acceptable levels of pollutant control. This level of technical analysis is reasonable and appropriate because of the character of the pollutants, the type of land use practices, and the waterbody type.
■ **Margin of Safety and Seasonality**	X	An appropriate margin of safety is included by augmenting the watershed land use controls with in-lake dredging, and urban BMPs for lawn fertilization. The in-lake dredging will further reduce the amount of available nutrients into the lake because of increased depth and provide further aquatic life habitat. Seasonality was adequately considered by evaluating the cumulative impacts of the various seasons on water quality and by tailoring the BMPs to seasonal needs.
■ **Allocation**	X	The allocation for the TMDL was a "load allocation" attributed to nonpoint sources. Allocation was attributed to such sources as animal feeding areas and croplands.
■ **Public Review**	X	Public review and participation was conducted through meetings, electronic media, and mailings. The extent of public review is acceptable. Further, the review process sponsored by the State was adequate for purposes of developing a TMDL that will be implemented because of public acceptance.
■ **EPA approved Water Quality Standards**	X	Standards upon which this TMDL was based have been formally approved by the EPA. No tribal waters were involved in this TMDL.

■ TMDL Checklist ■

EPA Region VIII

State/Tribe: South Dakota Waterbody Name: Freeman Lake, Jackson County Point Source-control TMDL: Nonpoint Source-control TMDL: X (check one or both) Date Received: January 16, 2001 Date Review completed: January 30, 2001 VEB		
Review Criteria (All criteria must be met for approval)	**Approved** (check if yes)	**Comments**
■ **TMDLs result in maintaining and attaining water quality standards**	X	The waterbody classification uses which are addressed by this TMDL are warmwater permanent fish life propagation, immersion recreation, limited contact recreation, and criteria for fish and wildlife propagation, recreation and stock watering.
■ **Water Quality Standards Target**	X	The 30-day average and daily maximum numeric standards for nitrate and selenium were used as quantified endpoints.
■ **TMDL**	X	The TMDLs are expressed in terms of annual nitrate load reduction, and annual selenium load reduction. These are reasonable ways to express the TMDLs for this lake because they provide effective surrogates that reflect both aquatic life and recreational needs, and reflect the long response time of lakes of this type to pollutant controls within the watershed.
■ **Significant Sources Identified**	X	Significant sources were adequately identified in a categorical and/or individual source-by-source basis. All sources that need to be addressed through controls were identified.
■ **Technical Analysis**	X	Monitoring, empirical relationships, AGNPS modeling, and best professional judgement were used in identifying pollutant sources, and in identifying acceptable levels of pollutant control. This level of technical analysis is reasonable and appropriate because of the character of the pollutants, the type of land use practices, and the waterbody type.
■ **Margin of Safety and Seasonality**	X	An appropriate margin of safety is included by performing ongoing monitoring to assure water quality goals are achieved and possibly by application of additional nonpoint source BMPs. Seasonality was adequately considered by evaluating the cumulative impacts of the various seasons on water quality and by tailoring the BMPs to seasonal needs.
■ **Allocation**	X	The allocation for the TMDL was a "load allocation" attributed to nonpoint sources. Allocation was attributed to saline seeps which are compounded by factors such as fallow croplands and poor surface drainage.
■ **Public Review**	X	Public review and participation was conducted through meetings, electronic media, and mailings. The extent of public review is acceptable. Further, the review process sponsored by the State was adequate for purposes of developing a TMDL that will be implemented because of public acceptance.
■ **EPA approved Water Quality Standards**	X	Standards upon which this TMDL was based have been formally approved by the EPA. No tribal waters were involved in this TMDL.

■ TMDL Checklist ■

EPA Region VIII

State/Tribe: South Dakota
Waterbody Name: Punished Woman Lake, Codington County
Point Source-control TMDL: Nonpoint Source-control TMDL: X (check one or both)
Date Received: December 12, 2000 Date Review completed: January 10, 2001 VEB

Review Criteria (All criteria must be met for approval)	**Approved** (check if yes)	**Comments**
■ **TMDLs result in maintaining and attaining water quality standards**	X	The waterbody classification uses which are addressed by this TMDL are warmwater semi-permanent fish life propagation, immersion recreation, and limited contact recreation.
■ **Water Quality Standards Target**	X	Water quality targets were established based on lake depth and reduction of in-lake aquatic vegetation and sediment. These are reasonable targets because they relate to the impaired uses of concern.
■ **TMDL**	X	The TMDL is expressed in terms sediment load reduction and removal of lake sediment. Lake depth is a particularly important factor related to both the recreational use and fisheries use of the lake.
■ **Significant Sources Identified**	X	Significant sources were adequately identified in a categorical and/or individual source-by-source basis. All sources that need to be addressed through controls were identified.
■ **Technical Analysis**	X	Monitoring, empirical relationships, AGNPS modeling, and best professional judgement were used in identifying pollutant sources, and in identifying acceptable levels of pollutant control. This level of technical analysis is reasonable and appropriate because of the character of the pollutants, the type of land use practices, and the waterbody type.
■ **Margin of Safety and Seasonality**	X	An appropriate margin of safety is included by performing ongoing monitoring to assure water quality goals are achieved and possibly by application of additional nonpoint source BMPs. Seasonality was adequately considered by evaluating the cumulative impacts of the various seasons on water quality and by tailoring the BMPs to seasonal needs.
■ **Allocation**	X	The allocation for the TMDL was a "load allocation" attributed to nonpoint sources. Allocation was attributed to such sources as shoreline erosion and bank sloughing.
■ **Public Review**	X	Public review and participation was conducted through meetings, electronic media, and mailings. The extent of public review is acceptable. Further, the review process sponsored by the State was adequate for purposes of developing a TMDL that will be implemented because of public acceptance.
■ **EPA approved Water Quality Standards**	X	Standards upon which this TMDL was based have been formally approved by the EPA. No tribal waters were involved in this TMDL.

■ TMDL Checklist ■

EPA Region VIII

State/Tribe: South Dakota
Waterbody Name: Upper Lake Sharpe, Jones & Stanley Counties
Point Source-control TMDL: Nonpoint Source-control TMDL: X (check one or both)
Date Received: December 12, 2000 Date Review completed: January 10, 2001 VEB

Review Criteria (All criteria must be met for approval)	Approved (check if yes)	Comments
■ **TMDLs result in maintaining and attaining water quality standards**	X	The waterbody classification uses which are addressed by this TMDL are coldwater permanent fish life propagation, immersion recreation, and limited contact recreation.
■ **Water Quality Standards Target**	X	Water quality targets were established based on re-vegetation of Bad River channels (i.e., F & G types according to Rosgen's Stream Channel Classification) flowing into the lake. This is a reasonable approach because the majority of sediment delivered to the lake originates in the Bad River watershed. This target relates to the uses of concern in the lake.
■ **TMDL**	X	The TMDL is expressed in terms of annual sediment load reduction. This is a reasonable way to express the TMDL for this lake because the measure reflects both aquatic life and recreational needs and reflects the long response time of lakes of this type to pollutant controls within the watershed.
■ **Significant Sources Identified**	X	Significant sources were adequately identified in a categorical and/or individual source-by-source basis. All sources that need to be addressed through controls were identified.
■ **Technical Analysis**	X	Monitoring, empirical relationships, modeling (e.g., PSIAC, USLE, EGEM), and best professional judgement were used in identifying pollutant sources, and in identifying acceptable levels of pollutant control. This level of technical analysis is reasonable and appropriate because of the character of the pollutants, the type of land use practices, and the waterbody type.
■ **Margin of Safety and Seasonality**	X	An appropriate margin of safety is included by performing ongoing monitoring to assure water quality goals are achieved and by application of additional nonpoint source BMPs (e.g., improved grazing management) within the Bad River and Antelope Creek watersheds. Seasonality was adequately considered by evaluating the cumulative impacts of the various seasons on water quality and by tailoring the BMPs to seasonal needs.
■ **Allocation**	X	The allocation for the TMDL was a "load allocation" attributed to nonpoint sources. Allocation was attributed to such sources as gully and channel erosion from poor landuse management practices (e.g., grazing).
■ **Public Review**	X	Public review and participation was conducted through meetings, electronic media, and mailings. The extent of public review is acceptable. Further, the review process sponsored by the State was adequate for purposes of developing a TMDL that will be implemented because of public acceptance.
■ **EPA approved Water Quality Standards**	X	Standards upon which this TMDL was based have been formally approved by the EPA. No tribal waters were involved in this TMDL.