SECTION 319 NONPOINT POLLUTION CONTROL PROGRAM

WATERSHED PROJECT FINAL REPORT

ENEMY SWIM LAKE WATERSHED IMPROVEMENT PROJECT

By

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This project was conducted in cooperation with the State of South Dakota and the United States Environmental Protection Agency, Region 8.

Grant # C9998185-01

EXECUTIVE SUMMARY

PROJECT TITLE: Enemy Swim Lake Watershed Improvement Project

PROJECT START DATE: 22 March 2001

PROJECT COMPLETION DATE: 31 March 2005

FUNDING:

	Original Budget	Revised Budget	Expended
EPA 319 Clean Water Grant	$184,542.00	$74,070.35	$62,152.35
SD Coordinated Soil & Water Grant	$29,261.00	$17,768.64	$17,768.64
Federal EQIP Funds	$106,140.00	$23,656.00	$16,028.00
Local Match	$114,108.00	$55,756.74	$52,461.31
Total:	$435,251.00	$171,251.73	$148,410.30

The goal of this implementation project was to reduce in-lake phosphorus by thirty-one percent. In-lake water quality data from a two-year watershed and lake assessment completed in 1998 showed a marked increase in Chlorophyll *a* concentrations during the last decade and an average phosphorus concentration sufficient enough to produce algal blooms. Decreased in-lake phosphorus would move phosphorus and Chlorophyll *a* trophic state indexes (TSIs) from eutrophic to mesotrophic levels and reduce the frequency of nuisance algal blooms. To attain the goal a project implementation plan (PIP) was developed based on the watershed assessment. The PIP included cost share funds for several best management practices (BMPS) designed to reduce phosphorus loading to the lake.

In-lake water quality monitoring indicates the project goal was attained. Water quality monitoring was not part of the original project PIP, however during 2002 the Enemy Swim Sanitary Sewer District funded in-lake sampling. Samples were collected at three in-lake sites from June through August 2002, 2003 and 2004.

The project cost shared the implementation of several best management practices. However, the conversion of 1,444 acres of cropland to grassland through the Natural Resources Conservation Services Conservation Reserve Program (CRP) was determined to be the most beneficial program in the watershed. CRP and other best management practices implemented by this project reduced the number of cropland acres in the watershed by fifty-one percent. Cost share funds were also used to improve grazing management on 3,404 acres of rangeland, the majority land use in the watershed, and install 4,271 lineal feet of fence to protect riparian areas along Enemy Swim Lake and its tributaries.

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INTRODUCTION

Project Area

The Enemy Swim Lake watershed is part of the North Big Sioux Couteau watershed, Hydrologic Control Unit #10160010. The watershed comprises 24,774 acres (10,030 hectares) of land located in northeastern Day County and west central Roberts County, South Dakota. The major land-use in the watershed is grazing. Seventy-three percent of the watershed is comprised of native range, pasture or former cropland enrolled in the Conservation Reserve Program (CRP). Only twelve percent of the watershed was utilized as cropland during the watershed assessment (1996-1998).

Waterbody Description

Enemy Swim Lake is a 2,146 acre (868.8 hectare) natural lake located in northeast Day County, South Dakota (Figure 1). The lake has a maximum depth of 26 feet (7.9 meters), a mean depth of 16 feet (4.9 meters) and a shoreline length of approximately 11.8 miles (18.9 kilometers). The ordinary high water mark elevation of Enemy Swim Lake is 1854.4 ft above msl. Enemy Swim Lake has only one major tributary, an unnamed perennial stream entering the northeast corner of the lake. The outlet of Enemy Swim Lake flows to Blue Dog Lake when the lake's elevation is higher than 1853.6 ft above msl, the elevation of the outlet weir located on the southwest corner of Campbell Slough.

Fisheries personnel describe Enemy Swim “as one of a few South Dakota lakes having a complex lake basin with highly variable substrates including rock, boulders, gravel, cobble, sand, and silt.” This complex lake basin supports twenty-one species of fish, and several species of aquatic macrophytes and invertebrates rarely found elsewhere in the State of South Dakota.

Enemy Swim is classified with these beneficial uses:
(4) warm water permanent fish life propagation
(7) immersion recreation
(8) limited contact recreation
(9) wildlife propagation and stock watering

The watershed assessment report (Stueven and Bren 2000) listed increasing algal blooms due to sufficient in-lake phosphorus concentrations as the major water quality impairment to the lake.

NPS Pollutants

The assessment report listed nonpoint sources of phosphorus as on-site septic systems, waste from animal feeding areas, or unincorporated fertilizer from watershed cropland. The Agricultural Nonpoint Source Pollution Model (AGNPS), identified areas or critical cells in Enemy Swim Lake’s watershed that could be contributing phosphorus and other nonpoint source pollutants to the lake. Critical AGNPS cells receiving treatment during the project are listed in Table 4.

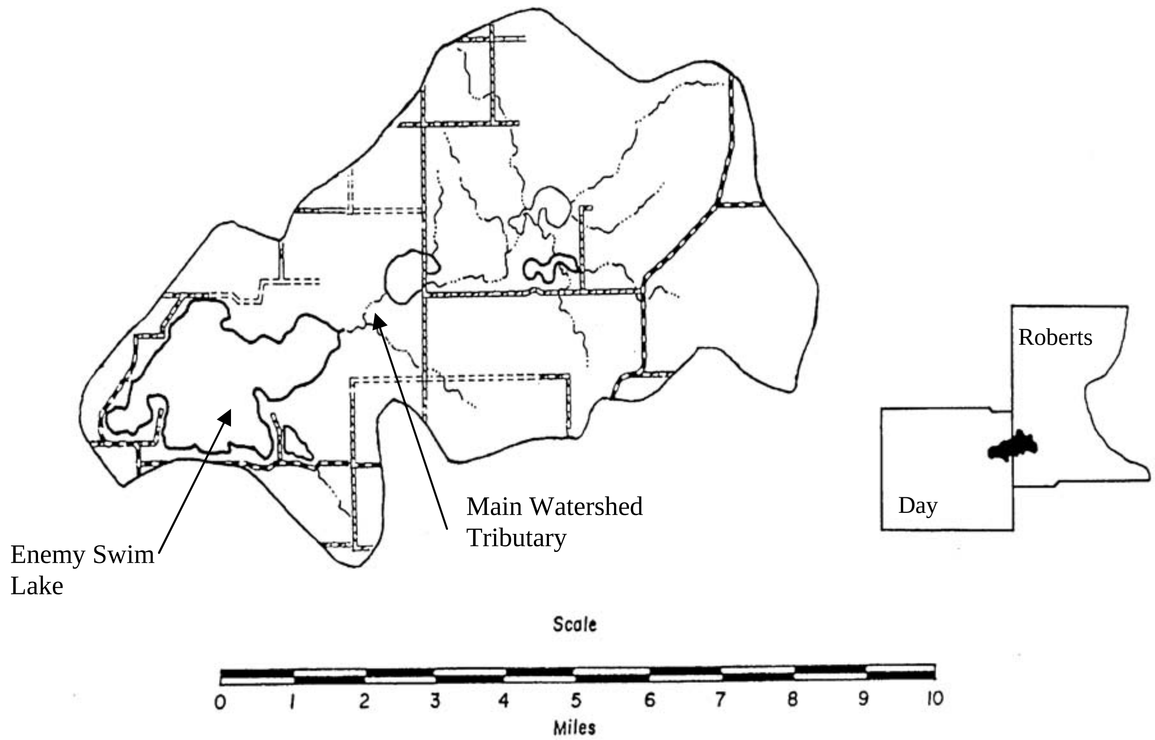


Figure 1. Enemy Swim Watershed

Summary of Project Activities

Several best management practices were selected to attain the project goal of reducing in-lake phosphorus by thirty-one percent. Cost share for implementing these practices were funded by a Section 319 Nonpoint Source Pollution Control Program Grant, a South Dakota Dept. of Agriculture Conservation Commission Grant, and through the Natural Resources Conservation Service's Environmental Quality Incentive Program (EQIP). Best management practices cost shared included construction of clean water diversion systems and animal nutrient management systems, grass waterways, cattle stream crossings, fencing and water development to improve grazing management, conversion of cropland back to grass in critical areas, and pasture renovation.

The project also funded a feasibility study for constructing an enclosed sanitary sewer system for lakeshore dwellings and businesses. The study provides opinions of probable cost for four design options the Enemy Swim Sanitary Sewer District Board of Directors will consider for construction in the near future.

Several information and education activities were funded. These included developing and implementing a program aimed at teaching area fifth and sixth grade students the value and ecology of a lake. A total of 301 students completed the "Lakes Are Cool" course. Watershed and lake property owners were provided information on the project through the release of several fact sheets, news articles, newsletters, and information booths at several community events. Several fact sheets were aimed at changing how the 227 lakeshore property owners manage their lawns. The most notable change is many lakeshore property owners are now using lawn fertilizers with no phosphorus.

Table 1 contains a comparison of planned versus completed project activities.

Table 1, Planned and Completed Project Activities

Activity	Original Workplan	Amended* Workplan	Completed
Objective 1 - Task 1			
Animal Waste Nutrient Mgt. System	1	0	0
Clean Water Diversion Systems	6	0	0
Nutrient Testing	25 AFO	0	0
Objective 2 - Task 2			
Cattle Stream Crossing	5	1	1
Grass Waterway	3	0	0
Pasture Renovation	200 acres	48 acres	48 acres
Critical Area Planting	150 acres	55 acres	54.5 acres
Grass Buffer Strips	100 acres	0	0
Well Decommissioning	8	0	0
Grazing Systems - Fence	61,600 lf.	67,175 lf.	70,686 lf.
Grazing Systems - Water			
Tanks/Pipelines	8	1	0
Water Wells	4	0	0
New Dugouts	7	3	3
Dugout Expansion	4	1	1
Nose Pumps	4	4	4
Solar Pump	1	1	1
Objective 3 - Task3			
Lakes Are Cool Field Trips	32	16	13
Demonstration Site Sign	1	1	1
Lake Friendly Farmer Signs	10	0	0
Newsletters	5	2	2
Fact Sheets	6	6	7
In-Lake Sampling	0	27 samples	33 samples
Objective 3 - Task 4			
Mapping Software	1	0	0
Objective 4			
Wastewater Engineering Feasibility Study	1	1	1
Objective 5			
Project Coordinator	1 FTE**	1 FTE	1 FTE
Business Manager	0.5 FTE	0.5 FTE	0.5 FTE
GRTS Annual/Semiannual Reports	8	8	8
Monthly Financial Reports	48	48	48
Progress Reports	48	32	32
Annual District/Legislative Reports	4	4	4
Reimbursement Requests			10

* Approved February 7, 2005

** FTE = 2,080 Hours

PROJECT ACTIVITIES

Project Goals and Objectives

Project objectives and tasks were developed based on water quality assessment results reported in May 2000 Phase 1 Watershed Assessment Final Report for Enemy Swim Lake published by the South Dakota Department of Environment and Natural Resources. Best management practices (BMPS) that would reduce the amount of sediments and nutrients reaching the lake were chosen for each objective to support attaining the project goal of reducing in-lake phosphorus by thirty-one percent. Producers were encouraged to implement these BMPS through news releases, fact sheets, and direct contacts by NRCS personnel and the Project Coordinator. BMPS were cost shared utilizing EPA 319 grant funds, SD Conservation Commission grant funds, and the Natural Resources Conservation Service's (NRCS) Environmental Quality Incentive Program (EQIP) funds. BMP costs were taken from the South Dakota Cost List docket published yearly by the South Dakota NRCS Technical Committee. Cost share payments ranged from 60 percent to 75 percent of the BMP cost. Producers receiving cost share payments were required to sign contracts listing several requirements and conditions to insure the BMP is properly maintained over the practices life expectancy. Producer participation in this project was strictly voluntary.

Planned and Completed Milestones and Products

Objective 1/Task 1: Reduce Phosphorus Loading from Animal Feeding Operations

The AGNPS model identified seven animal feeding operations (AFOs) for which installing BMPS to control animal waste runoff would result in a seven percent reduction in phosphorus loads to the lake. The original Project PIP provided funds to plan, design and construct one animal nutrient management system, six clean water diversion systems, and fund twenty-five soil and manure tests for nutrient management plans developed for watershed animal feeding operations.

Products:

Product 1: Animal Waste Nutrient Mgt. Systems
Milestone
Original PIP: 1
Amended PIP: 0
Completed: 0

Product 2: Clean Water Diversion Systems
Milestone
Original PIP: 6
Amended PIP: 0
Completed: 0

Product 3: Nutrient Testing
<u>Milestone</u>
Original PIP: soil/Manure testing on 25 AFO
Amended PIP: 0
Completed: 0

Producers showed little to no interest in the above activities. Therefore, all products for this task were discontinued in the revised project PIP. One producer was interested in relocating a feedlot. However, interest went no further than a few on-site visits. Four producers with AGNPS rated feedlots either eliminated or reduced their cattle herds during the project, reducing the number of feedlots requiring treatment. These four included one AFO adjacent to the lakes shoreline (Figure 2). As of this report there are no concentrated animal feeding operations (CAFOs) as defined by South Dakota Department of Environment and Natural Resource's criteria. Table 2 lists the current status of all the AGNPS rated feedlots in the watershed. The shaded area denotes feedlots rated over 50 by the AGNPS model. The AGNPS model rates animal feeding operations (AFOs) from 0 to 100 based on soils, slope, number and type of livestock, and number of days livestock are confined to a feedlot. A rating of 50 or above indicates the animal feeding operation is a significant source of nonpoint source pollution.

Figure 2. Dairy feedlot adjacent to Enemy Swim Lake - one of two AFOs rated above 50 by AGNPS that are no longer being used. The feedlot pictured was located approximately 300 feet from the lake shore.

Table 2: AGNPS Rated Animal Feeding Operations & Current Status

AGNPS Cell #	AGNPS Rating	No. Animals Beef	Dairy	Sheep	Current Status
364	69	125			AFO no change
602	67	300			AFO not near any conveyance
189	61	100			AFO no change
627	58	150			AFO - herd reduced to 35 yearlings
244	57	55	24		no longer in use
214	54	30			AFO no change
346	50	37		12	no longer in use
209	48	25			AFO no change
359	48	95		60	AFO no change
459	45	150			no longer in use
669	35	37			AFO no change
483	32	25			AFO no change
334	32	30			AFO no change

Objective 2/Task 2: Reduce Nutrient and Sediment Loading from Watershed Pasture, Rangeland, and Cropland

Practices listed under this objective were chosen to improve 6,800 acres of pasture and rangeland, and the 1,520 acres of cropland identified by the AGNPS model as critical for nutrient and sediment runoff.

Products:

Product 1: Cattle Stream Crossings
Milestone:
Original PIP: 5
Amended PIP: 1
Completed: 1

One cattle stream crossing was constructed on an intermittent drainage leading directly to the lake. A second producer was interested in installing a crossing, but did not complete the plan.

Product 2: Grass Waterways
Milestone:
Original PIP: 3
Amended PIP: 0
Completed: 0

There was no interest in this practice. The Conservation Reserve Program (CRP) was a better option for producers interested in installing grass waterways. CRP pays a higher cost share rate and incentives than the 319 program. Grass waterways were installed using the CRP program.

Product 3: Pasture Renovation
Milestone:
Original PIP: 200 acres
Amended PIP: 48 acres
Completed: 48 acres

The project paid for two years of deferred grazing (or rest) to improve upland and riparian conditions on a 48 acre overgrazed pasture adjacent to Enemy Swim Lake (Figure 3). This pasture renovation was one of the more publicly visible water quality improvements implemented during the project. Lake property owners had expressed concern about cattle standing in the lake and the deteriorating condition of the shoreline. The operator was allowing cattle access to the lake and severely overgrazed the upland and adjacent riparian areas. This pasture is tribal trust land managed by the Sisseton Wahpeton Sioux Tribe. The Sisseton Wahpeton Sioux Tribe applied for and obtained an EQIP contract, however in the interim, the former leaseholder removed all perimeter fencing. EQIP funds will not cost share perimeter fence so EPA 319 grant funds were utilized for perimeter and buffer fences around this pasture. A cross fence and alternate water source will be completed under the EQIP contract during 2005. Photographs of this pasture show improvements in vegetative cover after two years of deferred grazing (Figures 4a and 4b). A plan map generated using the Natural Resources Conservation Service's Toolkit program and ArcView is shown in Figure 5.

Figure 3. Degraded Upland Pasture and Shoreline Due to Overgrazing.

Figure 4a. Pasture and Shoreline Before Deferred Grazing.

Figure 4b. Pasture and Shoreline Improvements After Two Years of Deferred Grazing.

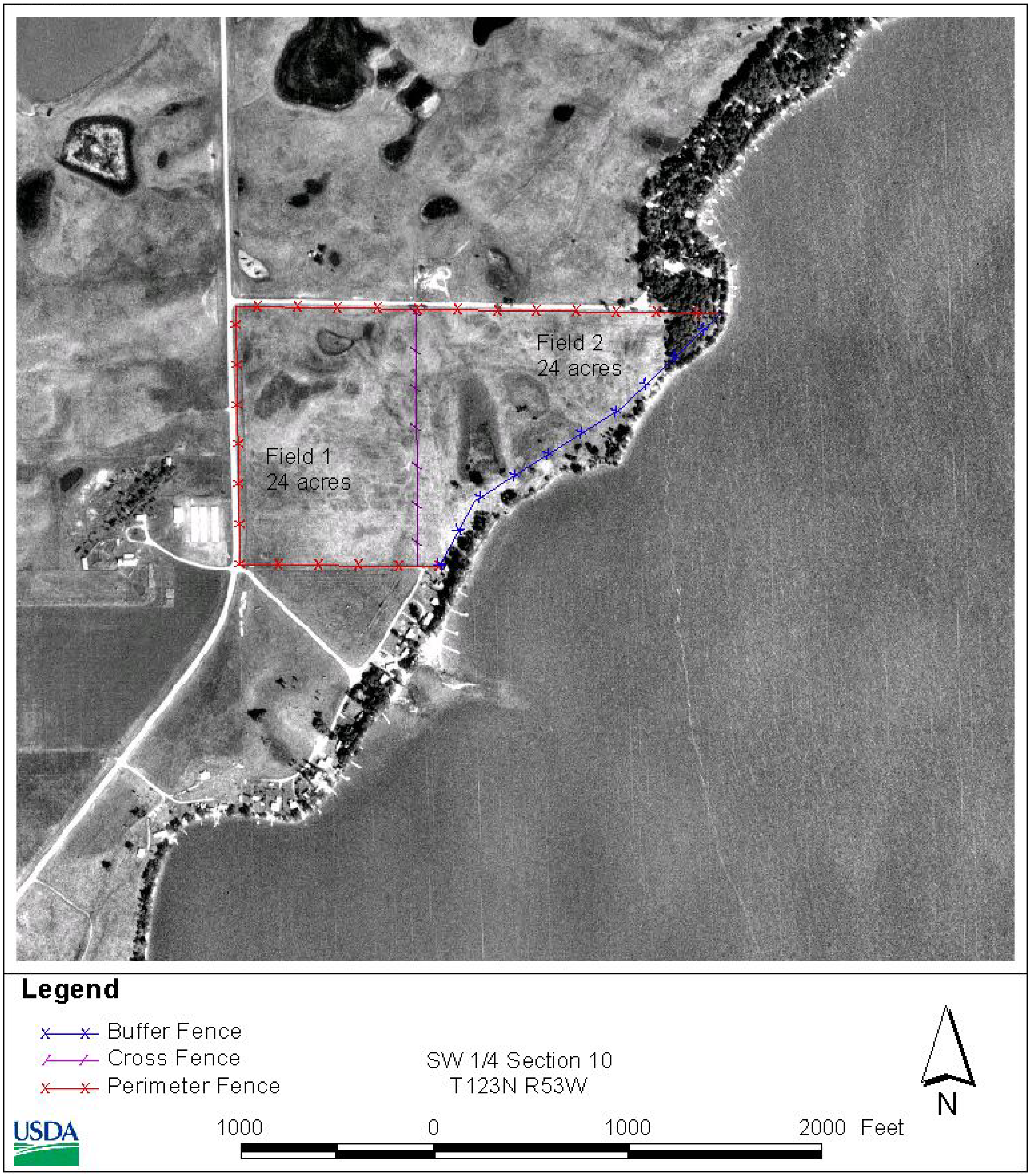


Figure 5. Conservation Plan Map for Pasture Shown in Figures 4a – 4b.

Product 4: Critical Area Planting
<u>Milestone:</u>
Original PIP: 150 acres
Amended PIP: 55 acres
Completed: 54.5 acres grant funds; 1,444 acres CRP

Producers showed little interest in this practice. The Conservation Reserve Program (CRP) paid a higher cost share rate and incentives. 319 grant funds were utilized to plant 54.5 acres of cropland to grass on two fields which were highly susceptible to wind erosion. When planted to row crops, these two fields had an estimated soil loss of 4.7 tons/acre/year and 3.3 tons/acre/year from wind erosion according to the RUSLE2 model. The field with the estimated loss of 4.7 tons/acre/year was at 1.7 tons above acceptable soil loss tolerances. Planting these two fields to grass reduced wind erosion rates to near zero. During the project, a 0.5 acre washout in a pasture draining to Enemy Swim Lake was seeded using EQIP Priority Funds and 1,444 acres were treated using CRP.

Product 5: Grass Buffer Strips
Milestone:
Original PIP: 100 acres
Amended PIP: 0 acres
Completed: 0

There was no interest in this product.

Product 6: Well Decommissioning
Milestone:
Original PIP: 8
Amended PIP: 0
Completed: 0

There was no interest in this product.

Product 7: Grazing System Fence
Milestone:
Original PIP: 61,600 lf.
Amended PIP: 5,575 lf. additional fence = 67,175 lf.
Completed: 70,686 lf.

The project cost shared installation of 66,415 lineal feet of perimeter and cross fence on 3,404 acres of range and pastureland in the watershed. New perimeter fence will allow producers to graze grasslands, especially expired Conservation Reserve Program (CRP) contracts that were cropland prior to the project. Cross fence will allow the producer to evenly distribute grazing across his pasture to better utilize vegetation. The RUSLE2 Model indicates a decrease to near zero tons/acre/year soil loss from wind and water erosion when cropland is converted to grassland and properly managed pastures.

Four thousand two hundred seventy-one lineal feet of buffer fence was installed along the lake's shoreline and main tributary. These buffer fences will exclude livestock from shorelines and creek beds protecting these sensitive areas from erosion, and providing vegetative buffers that will trap nonpoint source pollutants (Figures 6-7).

Figure 6. Buffer Fence Installed Along The Lake's Main Tributary.

Figure 7. Buffer Fence Along Lake Shore.

Product 8: Pasture Watering Systems

Tanks and Pipelines
<u>Milestone:</u>
Original PIP: 8
Amended PIP: 1
Completed: 0 (One tank and pipeline were to be implemented under an EQIP contract during 2005 but has been cancelled since the amended PIP was approved.)

Water Wells
<u>Milestone:</u>
Original PIP: 4
Amended PIP: 0
Completed: 0

New Dugouts
<u>Milestone:</u>
Original PIP: 7
Amended PIP: 1 to be funded with EPA 319 grant funds
Completed: 3

Dugout Expansion
<u>Milestone:</u>
Original PIP: 4
Amended PIP: 1
Completed: 1

Nose Pumps
<u>Milestone:</u>
Original PIP: 4
Completed: 4

Nose pumps installed in a pasture adjacent to Enemy Swim Lake provided an alternative source of water for livestock that formerly used the lake (Figures 8-9).

Water development improved grazing distribution and provided alternate watering sources on 987 acres of rangeland and pasture in the Enemy Swim watershed.

Table 3 lists the number of contracts written to receive cost share for the products listed under Objective 2. In some instances EQIP contracts were cancelled or not completed during the watershed implementation project period.

Figure 8. Nose Pumps Installed In A Pasture Near Enemy Swim Lake Provided An Alternate Water Source. (See plan map page 18)

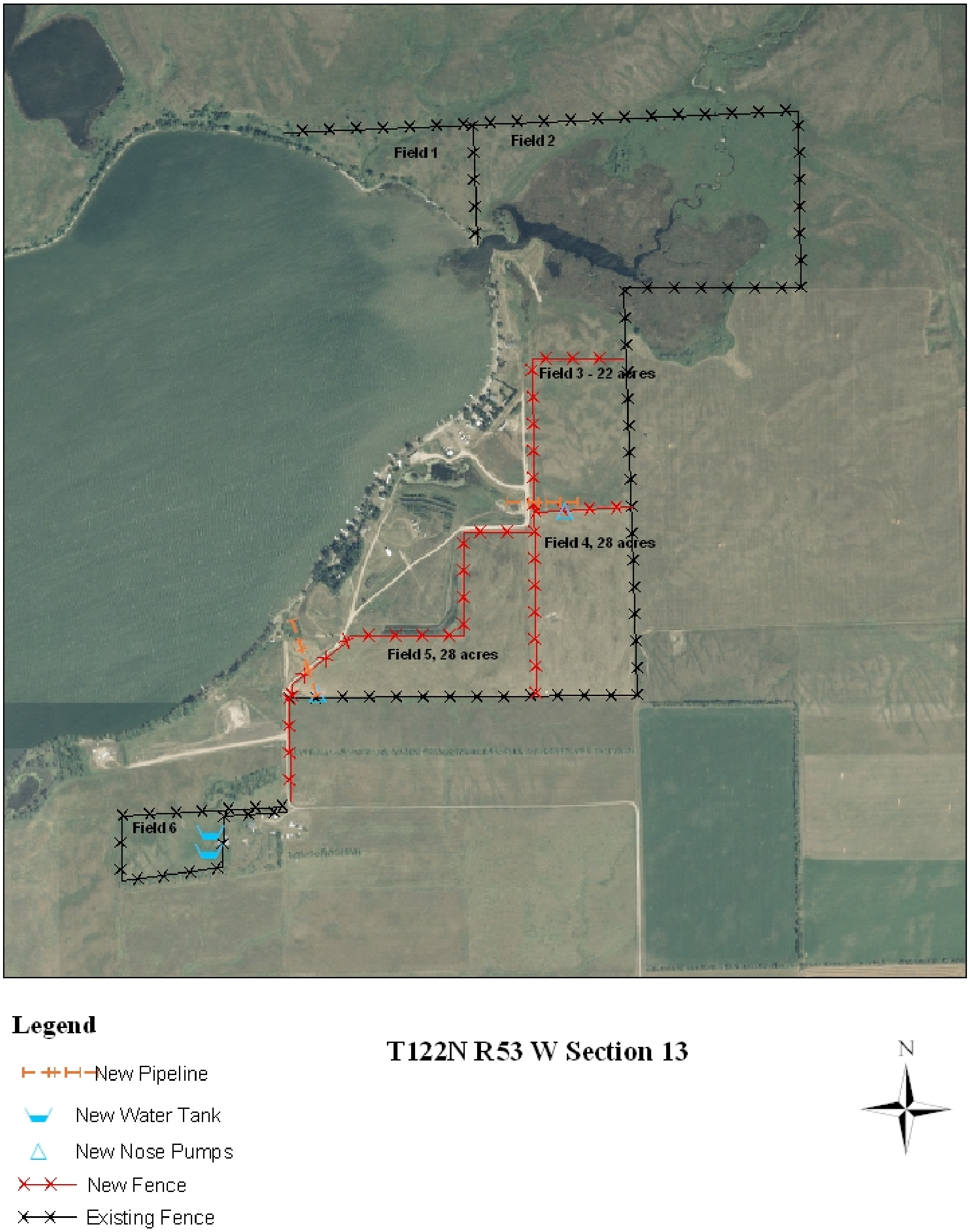


Figure 9. Conservation Plan Map for East Lake South Pasture.

Table 3: Cost Share Contracts and Completed Practices

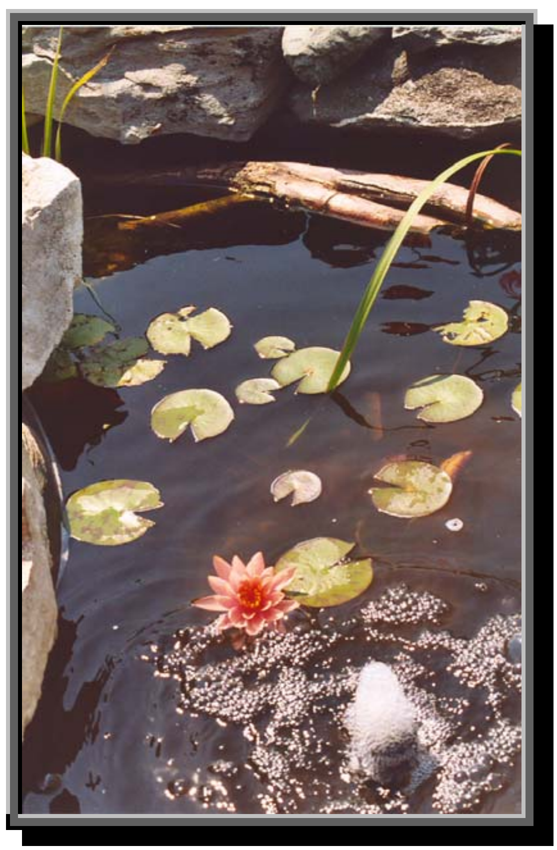
Contract #	Completed Practices	Acres	Contract Completed
1	stream crossing (1), cross fence (2,564 lf.) critical area seeding (0.5 acres)	94	no (EQIP cancelled)
2	nose pumps (4), cross fence (2,070 lf.) perimeter fence (3,270 lf.)	78	yes
3	cross fence (7,783 lf.)	1,424	yes
4	perimeter fence (28,651 lf.) cross fence (9,814 lf.)	865	yes
5	dugout expansion (1), buffer fence (875 lf)	295	yes
6	pond (1), cross fence (2,122 lf.), critical area planting	331	no (EQIP)
7	buffer fence (1,426 lf.)	40	yes
8	cross fence (5,383 lf.)	329	yes
9	pond (1)	75	yes
10	perimeter fence (4,758 lf.) buffer fence (1,970 lf.) deferred grazing (2 years)	48	no (EQIP)
11	pond (1)	160	yes

Product 9: Solar Pump Demonstration Project
Milestone:
Original PIP: 1
Completed: 1

Because no producer was willing to host a demonstration site the Day County Conservation District constructed a site adjacent to the Webster, South Dakota Farm Service Agency Building. At the site, producers can see first hand how a solar powered pump watering system is constructed and operates. Lake Region Electric provided in-kind assistance wiring and mounting the solar panels (Figures 10). Electricity generated by the solar panels operates a pump that filters water through the demonstration sites butterfly garden pond (Figure 11).

Figure 10. The local electrical cooperative, Lake Region Electric, provided in-kind assistance with mounting and wiring the solar panels and pond pump. Several area producers are now considering this renewable energy source as an alternate means to provide water in remote pastures.

Figure 11. Electricity generated by solar panels is used to operate the electrical pump that provides aeration and filtration to the butterfly garden pond.



Objective 3 Task 3: Implement an Information and Education Program

The project funded several activities that provided information and education on project goals, objectives, progress, and best management practices to the general public, local schools, lakeshore and watershed property owners and operators. Outreach material included newsletters, fact sheets, press releases, demonstration sites, workshops, and information booths at public events. Funding for press releases, workshops, and information booths were provided in the Blue Dog Lake Watershed Improvement Project PIP which ran concurrent with this project. Information and education activities were implemented each year of the project.

Products:

Product 1: Lakes Are Cool Field Trips
Milestone:
Original PIP: 32 field trips
Amended PIP: 16 field trips
Completed: 13 field trips

Nine elementary school districts located within or near the Enemy Swim Lake watershed were invited to participate in the "Lakes Are Cool" program. These included Bristol, Roslyn, Sisseton, Summit, Waubay, Webster and Wilmot, and two schools operated by the Sisseton Wahpeton Sioux Tribe – the Enemy Swim Day School and Tiospa Zina. A total of 301 fifth and sixth grade elementary students from seven schools attended the program.

Participating elementary schools were:

2001: Bristol, Waubay, Webster, Wilmot
2002: Waubay, Webster
2003: Roslyn, Summit, Waubay, Webster
2004: Enemy Swim Day School, Waubay, Webster

The Lakes Are Cool program was held at the Ne-So-Dak Environmental Learning Center located on Enemy Swim Lake in northeast Day County, South Dakota. Students arrived at camp around 9:00 am and began the day learning about water chemistry (dissolved oxygen, pH), and collecting and identifying aquatic invertebrates to assess the lakes water quality. Students learned how to use a variety of nets and traps to collect aquatic organisms (Figure 12). After lunch, students were given instructions on canoeing and then (weather permitting) took a two hour canoe trip around the lake (Figure 13). A copy of the Lakes Are Cool program brochure is found in Appendix A.

Figure 12. Students pulling a seine net to collect macroinvertebrates and small fish on Enemy Swim Lake.

Figure 13. Canoeing 101!

Product 2: Demonstration Site Sign
<u>Milestone:</u>
Original PIP: 1
Completed: 1

Funds were utilized to place a sign (Figure 14a) marking the Day Conservation Districts Native Plant Demonstration Site and Arboretum. The site promotes soil and water conservation on agricultural lands and backyard conservation for urban dwellers through native plant demonstration plots, solar pump demonstration, pasture nose pump demonstration, butterfly garden, conservation tree and shrub arboretum. The local Webster FFA Range Judging Team often visits the site to hone their plant identification skills (Figure 14b)

Figure 14a. Demonstration site sign.

Figure 14b. Webster FFA range judging team hone their grass id skills at the native plant demonstration plot and arboretum.

Product 3: Lake Friendly Farmer Program
Milestone:
Original: 10 signs
Amended: discontinued
Completed: 0

There was no producer interest in the program. This activity was based on a similar program in Minnesota that recognized agricultural producers who implemented best management practices beneficial to water quality. Recognition was to be made at awards banquets, through press releases and by the placement of a yard sign denoting their commitment to water quality and conservation.

Product 4: Newsletters
Milestone:
Original: 5
Completed: 14

Two newsletters solely dedicated to project information were mailed to all watershed landowners/operators, and lakeshore property owners along Enemy Swim Lake. Twelve issues of the Day County Conservation District's newsletter contained information about watershed project activities. Copies of project newsletters are found in Appendix A.

Product 5: Fact Sheets
Milestone:
Original PIP: 6
Completed: 7

Seven fact sheets were completed and distributed to watershed landowners/operators and lakeshore property owners through mailings, lake association meetings, sanitary sewer district meetings, and local farm/home/sports shows. Examples of fact sheets written for this project are found in the Appendix A.

Fact sheets included the following titles:

Controlling Shoreline Erosion
Enemy Swim Lake (history, facts)
Enemy Swim Lake Levels (historic and recent)
Nonpoint Source Pollution – A Primer for Landowners & Operators
Reducing Nonpoint Source Pollution - Protection Tips for Lake Property Owners
Upper Waubay Watershed Improvement Project
WaterWise Boating.

Product 6: In-Lake Sampling
Milestone:
Original PIP: no in-lake sampling planned
Amended PIP: monthly samples collected at three in-lake sites from June through August 2002 – 2003, and May through September 2004.
Completed: 11 monthly samples

This product was not part of the original project PIP, however the Enemy Swim Sanitary Sewer District was interested in a continuation of lake water quality monitoring that began during the Enemy Swim Watershed Assessment Project. The sewer district agreed to pay the lab fees for water quality analysis beginning the summer of 2002. The project coordinator and the Water Resources Institute located on the campus of South Dakota State University (SDSU) collected a total of eleven monthly surface and bottom sample sets during the months of June through August 2002 and 2003, and May through September 2004 at three in-lake sites (Figure 15). Sampling site locations were the same as those used during the Enemy Swim Watershed Assessment Study, 1996-1998. Sampling protocol followed SD Dept. of Environment and Natural Resources Standard Operating Procedures. Monitoring results from 2002-2004 begin on page 32.

Figure 15. SDSU grad student using a VanDorn Collection Bottle while sampling Enemy Swim Lake during 2004.

Objective 3 Task 4: Obtain Software to Map Project Activities; Enhance Reports and Other Information and Education Activities

> **Products: Plan Maps, Watershed Maps**
> <u>Milestone:</u>
> Original PIP: purchase Arc View software
> Amended PIP: discontinued
> Completed: 6

The original project PIP provided funds to purchase Arc View software to produce the products listed above; however the Natural Resources Conservation Service provided this software with their ToolKit program made available to the project coordinator. The Toolkit program generated plan maps, conservation plan schedules and contracts. Examples of plan maps generated by this program are found in Figures 5 and 9.

Objective 4: Waste Treatment Feasibility Study

> **Product: Enemy Swim Lake Wastewater Collection and Treatment Feasibility Study**
> <u>Milestone:</u>
> Original PIP: study cost not to exceed $10,000.00
> Amended PIP: study completed for $6,750.00
> Completed: cost $6,750.00

Clark Engineering of Aberdeen, South Dakota submitted the lowest bid and was selected to conduct a study to provide an evaluation and opinion of probable cost for the construction of a Septic Tank Effluent Collection System on developed property around Enemy Swim Lake's shoreline. The study was completed during summer 2004. A final report was submitted to the project coordinator and the Enemy Swim Sanitary Sewer District Board of Directors who will oversee the construction and operation of the system. The sewer district has submitted this report as part of their application to be listed on the South Dakota State Water Plan to obtain funding in the near future to construct the system. The Board of Directors will hold public meetings for lake property owners to discuss the systems design and cost in the near future. The Enemy Swim Lake Assessment final report determined a twenty percent reduction of in-lake phosphorus could be reached by constructing a central waste collection system. A copy of the engineering feasibility study is found in Appendix B.

Objective 5/Task 6: Project Management and Administration

Products: Project Coordinator and Business Manager
Milestone:
Original PIP: wages and benefits for one year FTE (wages and benefits for the first three years of this project included in the Blue Dog Lake Watershed Implementation Project which ran concurrent with this PIP), semi-annual/annual reports, financial records, reimbursement vouchers, final project report.

Milestone	Completed
Project Coordinator	1,825 hours
Business Manager	947 hours
GRTS Annual and Semiannual Reports	8
Monthly Financial Reports	48
Progress Reports	32
Annual District/Legislative Reports	4
Reimbursement Requests	10

A Project Coordinator was hired to:

- coordinate project activities with other agencies and groups
- prioritize, track, and measure project milestones and goals
- contact watershed landowners on priority lists
- report on project activities and progress
- voucher for grant funds
- assist NRCS personnel with developing and writing contracts with watershed landowners
- lead information and education activities including conducting field trips, workshops and meetings, writing lake ecology curriculum, newsletters, fact sheets and press releases
- attend board meetings of supporting groups and agencies
- provide photo points of project activities
- locate BMPS and project activities utilizing GPS technology.

The project reimbursed the Day County District Business Manager for bookkeeping, issuing checks for wages, and issuing 319 cost share payments to watershed landowners. The Day County Conservation District Board of Supervisors reviewed project progress at monthly board meetings.

EVALUATION OF PROJECT GOALS AND OBJECTIVES

The goal of the Enemy Swim Lake Watershed Implementation Project was to reduce in-lake phosphorus by thirty-one percent, moving the lakes phosphorus and chlorophyll *a* TSI from a eutrophic to a mesotrophic state. In-lake water quality testing from 2002 through the summer of 2004 showed that both phosphorus and chlorophyll *a* trophic state indexes have shifted to a mesotrophic state. In-lake phosphorus levels were reduced by 37%, exceeding the projects goal. Data used to determine the current trophic state of the lake are presented beginning on page 32.

Since actual in-lake phosphorus levels were measured during the project, the AGNPS land-use model was not utilized to determine post project load reductions resulting from the implementation of best management practices in the watershed.

The Conservation Reserve Program (CRP) was the most successful conservation program available in the Enemy Swim Lake watershed during the project period. Because of the Conservation Reserve Program payment structure, there was little to no interest by producers in many of the best management practices that were to be cost shared with EPA 319 and Coordinated Soil and Water grant funds obtained for the project.

A total of 1,444 acres of the Enemy Swim Lake watershed were enrolled into the CRP program during the project period. All but 121 acres of the 915 acres of CRP documented during the watershed assessment project from 1996 to 1998 were reenrolled in the CRP program during the project. One CRP contract for 77 acres will expire during 2005; all other contracts will begin to expire during the period 2008 through 2014. The 1,444 acres of CRP and the 54 acres of critical area planting funded by 319 funds reduced the acres of cropland in the watershed from 2,840 acres to 1,386 acres, a fifty-one percent reduction. The effects CRP had on land use in the watershed can be seen by comparing data in Figures 17 and 18.

The AGNPS model identified eight cells with erosion rates higher than 5 tons/acre, thirty-seven cells with an annual nitrogen output of 10 lbs./acre or more, and eight cells above the 4 lbs./acre phosphorus cutoff. Of these cells, four of the eight sediment cells, eleven of the thirty-seven nitrogen cells, and two of the eight phosphorus cells were enrolled in CRP during the project and were, therefore, converted to grassland (Table 4). Thirty-two percent (480 acres) of the 1,520 watershed acres identified as critical by AGNPS received treatment with CRP. The RUSLE2 model indicates that conversion of cropland to grassland reduces wind and water erosion to near zero. Thus, soil erosion in Enemy Swim's watershed for critical cells listed in Table 4 has been reduced by at least 26 tons/acre/year.

Table 4: AGNPS Critical Cells Treated During Implementation Project

Critical Cell	Erosion ton/acres	Total Phosphorus lbs/acre	Total Nitrogen lbs/acre	Preproject Landuse	Current Landuse	Treatment
22			10.92	beans	grass	CRP - 2010
41		4.14	13.99	beans	grass	CRP - 2010
42			11.44	beans	grass	CRP - 2010
515	5.94			small grain	grass	CRP - 2008
547	7.2	6.95	16.99	beans	grass	CRP - 2008
555			11.34	corn	grass	CRP - 2007
647			11.09	beans	grass	CRP - 2007
648			11.4	beans	grass	CRP - 2008
649			11.4	beans	grass	CRP - 2008
658	5.14		10.14	small grain	grass	CRP - 2008
660	8.31		11.16	beans	grass	CRP - 2008
661			10.11	beans	grass	CRP - 2008
Total:	**26.59 ton/acres**	**11.09 lbs/acre**	**129.98 lbs/acre**			

Twenty-six critical cells identified by AGNPS were not enrolled into the CRP program. However, most of these cells are now buffered by CRP fields and no-till/minimum till has been implemented on a majority of the remaining cropland acres.

Sixty-five percent of the Enemy Swim watershed is rangeland (Figure 18). The majority of producers participating in the implementation project received cost share for implementing rangeland management practices to improve grazing distribution and rotations. Improvements were made on 3,404 acres of rangeland, fifty percent of the project goal of 6,800 acres.

Locations of all best management practices installed during the project are shown in Figure 16.

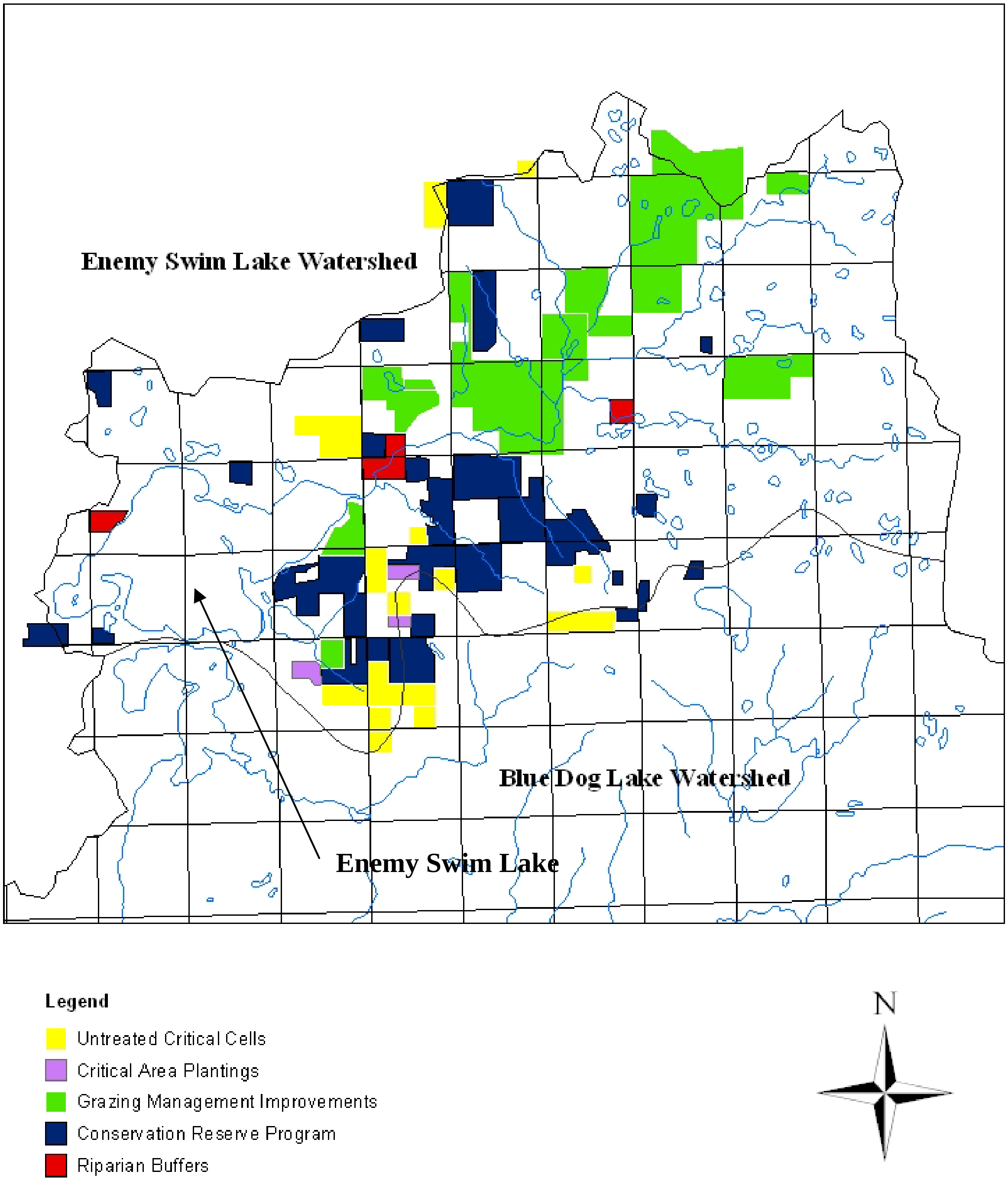


Figure 16. BMP Locations and Critical AGNPS Cells, Enemy Swim Lake Watershed

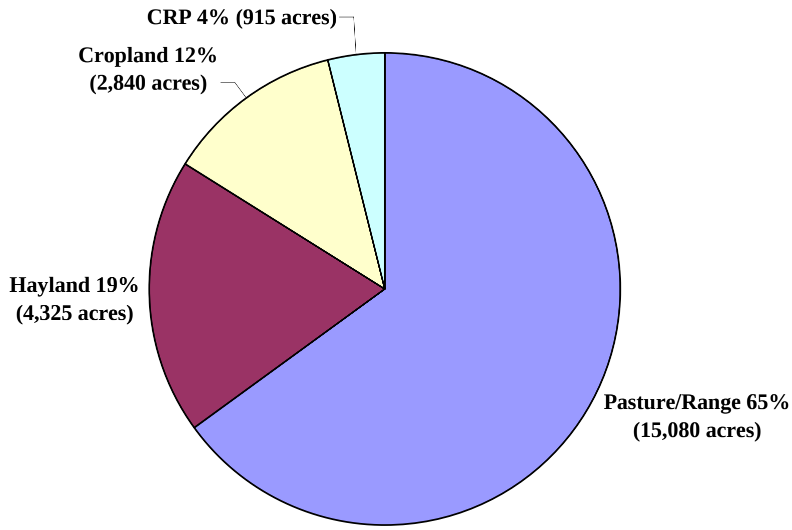


Figure 17. Watershed Landuse Pre-Implementation

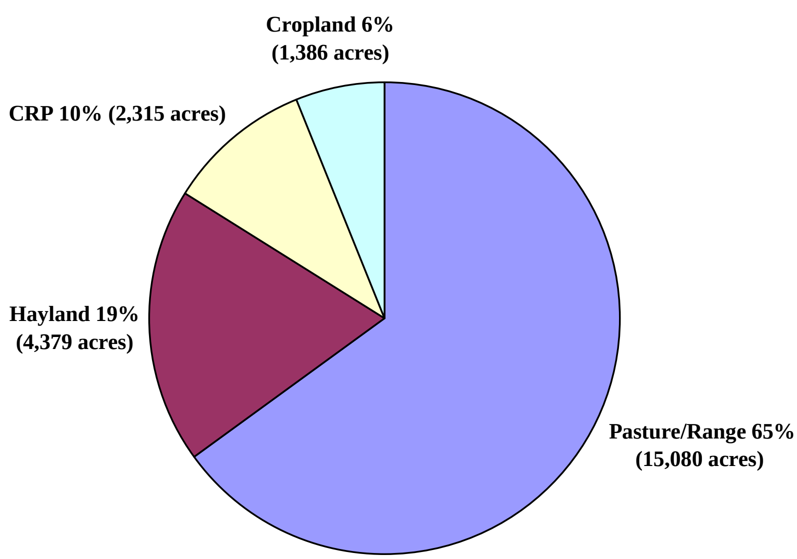


Figure 18. Watershed Landuse Post Implementation

MONITORING RESULTS

Water quality monitoring was not part of the original PIP, however beginning 2002 the Enemy Swim Sanitary Sewer District agreed to pay analysis costs associated with in-lake monitoring. The project coordinator collaborated with SDSU Water Resources Institute for sample collection and analysis. Water quality monitoring of Enemy Swim Lake during the project period was conducted for two purposes. First, examine the current condition of the lake and second compare the results of the analysis to past data to identify water quality changes over time. Sources of historical data are described in the next section. Results of historical monitoring are included in the discussion of Trophic State Index (TSI) trends.

The monitoring plan also allowed evaluation of the effectiveness of implementation activities for the project as a whole by comparing pre-project in-lake phosphorus concentrations with post-project in-lake phosphorus concentrations. Monitoring at specific implementation sites and to evaluate individual BMPS was beyond the scope of the monitoring program.

Past Water Quality Monitoring

One of the earliest sources of water quality data for Enemy Swim Lake comes from a 1975 study by Lois Haertel (SDSU). Samples were collected from May through July at two in-lake sites representing the deepest parts of the east and west basins. The samples were analyzed at the SDSU Water Quality Lab.

During 1979 and 1989 the SD Department of Environmental and Natural Resources (DENR) collected in-lake water quality samples at Enemy Swim Lake as part of a statewide lake assessment project (Koth, 1981; SD DENR 1993). The samples were analyzed at the State Health Lab located in Pierre.

In-lake water quality sampling was conducted at Enemy Swim Lake during mid June, July and August each year from 1991 through 1995 by the Water Resources Institute as part of a study of 20 lakes in South Dakota designated for a lake protection program. The study was funded through the EPA 319 program administered by DENR. The samples were analyzed at the SDSU Water Quality Lab.

A two-year water quality assessment of Enemy Swim Lake was initiated by DENR and the Day County Conservation District during 1996. Water quality data was collected throughout the year. The study included in-lake sampling, a septic leachate survey, and watershed land use modeling to determine the current trophic status of the lake's water quality. The water quality samples were analyzed at the State Health Lab.

The assessment also identified areas in the watershed that contribute non-point source pollution to the lake. The data indicated that Enemy Swim Lake had become more eutrophic over the previous decade. An increase in nutrient loads to the lake from cropland runoff, animal feeding operations, and leaching septic systems were identified as probable causes of increased Chlorophyll *a* concentrations and the resulting decrease in water quality.

Sampling and Analysis Techniques

In-lake water quality samples were collected using a Van Dorn-type water sampler from the same three mid-lake stations on Enemy Swim that were used in the 91-95 study (German, 1997). Composite samples were collected within six days of mid-month in June, July and August. Vertical profiles of dissolved oxygen and temperature were collected at the same three mid-lake stations which included the deepest point in the lake using an YSI model 51B or an YSI 95.

Surface and bottom water samples were collected at three in-lake sites and a surface composite and a bottom composite were formed using equal amounts of water from each of the three sites. The samples were filtered and preserved in the field then transported to the lab on ice for analysis. Standard methods were used for laboratory analysis (AAPH, 1989) Field parameters that were collected at each site included vertical profiles of temperature and dissolved oxygen and Secchi depth. Analysis for pH was taken from the composite sample.

Parameters analyzed in the laboratory included:

1. Total phosphorus
2. Total dissolved phosphorus
3. Organic nitrogen
4. Ammonia
5. Nitrate

Parameters analyzed in the field included:

1. pH
2. Air and water temperature
3. Dissolved oxygen
4. Secchi depth

Field equipment used included the following:

1. D.O. meter with 50 ft. cord
2. Secchi disk
3. Filtration equipment
4. Coolers and sample bottles
5. pH meter and buffers
6. Van Dorn sampler

Summary of Data Collected

Results of chemical analysis of in-lake samples collected from 2002 to 2004 are presented in Table 5 and parameters measured in the field are presented in Table 6. Results of the 2002-2004 monitoring are discussed in the following section. All available data from other sources was used for the discussion of trophic state and water quality trends.

Suspended Solids

Suspended solids ranged from 2 mg/l in surface samples during May and July 2004 to 13 mg/l in the bottom sample during June 2003 (Table 5). This is well below the State Standard of 90 mg/l needed to maintain a permanent warm water fishery. In Enemy Swim Lake, suspended solids concentrations are primarily a reflection of the small plants and animals that live in the open water (plankton) rather than the suspended sediment that is often present in shallower lakes and reservoirs. The depth and bottom composition of Enemy Swim Lake prevents, to a large degree, wind re-suspending sediment. Recreational use of the lake and ability to support a healthy fishery are apparently not limited by suspended solids in Enemy Swim Lake at this time.

Table 5--Enemy Swim Lake Chemical Parameters for 2002-2004

Date Sampled	Sample Description	Nitrate Nitrogen mg/L(ppm)	Ammonia Nitrogen mg/L(ppm)	Organic Nitrogen mg/L(ppm)	Total Kjeldahl Nitrogen (TKN) mg/L(ppm)	Total Dissolved Phosphorus mg/L(ppm)	Total P mg/L(ppm)	Total Suspended Solids mg/L(ppm)
6/15/2002	Surface	0.044	0.01	0.65	0.65	0.022	0.032	3
	Bottom	0.060	0.02	0.63	0.65	0.030	0.030	3
7/16/2002	Surface	0.020	0.00	0.74	0.74	0.002	0.025	5
	Bottom	0.000	0.02	0.74	0.76	0.000	0.026	6
8/16/2002	Surface	0.074	0.05	0.79	0.84	0.003	0.033	8
	Bottom	0.074	0.06	0.75	0.81	0.010	0.032	10
6/16/2003	Surface	0.024	0.04	0.72	0.76	0.002	0.014	3
	Bottom	0.024	0.05	0.87	0.92	0.011	0.032	13
7/13/2003	Surface	0.010	0.05	0.75	0.80	0.017	0.020	7
	Bottom	0.011	0.09	0.83	0.92	0.015	0.041	8
8/16/2003	Surface	0.042	0.04	0.70	0.74	0.014	0.032	6
	Bottom	0.042	0.03	0.83	0.86	0.006	0.027	8
5/18/2004	Surface	0.020	0.12	0.67	0.79	0.007	0.006	2
	Bottom	0.020	0.11	0.86	0.96	0.003	0.027	6
6/16/2004	Surface	0.030	0.07	0.76	0.83	0.014	0.020	5
	Bottom	0.020	0.06	0.98	1.04	0.012	0.023	5
7/14/2004	Surface	0.040	0.05	0.70	0.75	0.007	0.014	2
	Bottom	0.040	0.20	0.77	0.98	0.008	0.035	5
8/13/2004	Surface	0.030	0.07	0.86	0.93	0.002	0.019	6
	Bottom	0.040	0.06	0.87	0.93	N.D.	0.031	8
9/14/2004	Surface	0.030	0.05	0.69	0.75	0.010	0.018	5
	Bottom	0.030	0.07	0.83	0.90	0.008	0.027	7

Transparency

The transparency of lake water is what many people associate with a clean lake. It is an indicator of algal populations in lakes such as Enemy Swim that usually do not have much suspended sediment. Secchi disc transparency measured during the summer months are also used to calculate TSI values (Carlson, 1977). Summer transparency in Enemy Swim Lake ranged from 5.1 feet during August 2003 to 14.9 feet during June 2002 (Table 6). Transparencies in this range are common in mesotrophic to eutrophic lakes. High transparency occasionally occurs in Enemy Swim Lake in May or June. For example, during June 1993 a transparency of 15.6 feet was reported by German (1997). These exceptionally clear periods are often associated with large zooplankton populations. TSIs based on these high transparencies can indicate trophic state of better quality than is supported by other parameters.

Table 6--Enemy Swim Lake Field Parameters for 2002-2004

Date Sampled	Sample Location	Air Temp °C	Water Temp	Secchi Disk (Feet)	Secchi Disk (Meters)	DO	pH
6/15/2002	Surface	N.D.	19.73	14.9	4.5	10.97	8.90
	Bottom		18.60			10.80	8.92
7/16/2002	Surface	N.D.	24.10	6.9	2.1	8.40	8.74
	Bottom		23.73			7.73	8.63
8/16/2002	Surface	17.0	21.20	5.3	1.6	8.43	8.52
	Bottom		21.20			8.43	8.86
6/16/2003	Surface	N.D.	22.70	7.9	2.4	8.83	8.85
	Bottom		18.27			8.17	8.78
7/13/2003	Surface	N.D.	22.50	5.9	1.8	7.60	8.72
	Bottom		22.00			6.67	8.58
8/16/2003	Surface	N.D.	24.00	5.1	1.5	10.24	8.76
	Bottom		23.40			8.45	8.66
5/18/2004	Surface	13.3	14.03	13.0	4.0	9.53	8.52
	Bottom		11.67			9.13	8.28
6/16/2004	Surface	16.1	19.10	8.0	2.4	7.13	8.86
	Bottom		18.97			7.07	8.84
7/14/2004	Surface	N.D.	24.67	8.7	2.6	7.37	8.71
	Bottom		21.67			5.20	8.38
8/13/2004	Surface	18.9	19.37	6.2	1.9	7.50	8.85
	Bottom		18.97			7.17	8.78
9/14/2004	Surface	N.D.	19.67	6.3	1.9	7.37	8.62
	Bottom		19.37			7.23	8.63

Phosphorus

Phosphorus is required for the growth of all forms of algae, but relatively small quantities are needed. If other nutrients are available, one pound of phosphorus can produce 500 pounds of algae (Wetzel, 1983). Phosphorus is often the nutrient that limits the growth of algal populations. Therefore, it is also the nutrient that must be controlled in order to maintain good water quality. Summer total phosphorus concentrations are also used to calculate TSI values (Carlson, 1977). Total phosphorus concentrations in Enemy Swim Lake surface samples ranged from 0.006 on 5/18/04 to 0.033 mg/l on 8/16/02 (Table 5).

The assessment (Stueven and Bren 2000) proposed phosphorus loadings be reduced by 50 percent to lower the Chlorophyll *a* TSI and improve the lake's water quality. Watershed modeling determined a 30 percent reduction in phosphorus loads could be reached by implementing conservation practices aimed at reducing runoff from cropland and animal feeding operations. It was determined a further 20 percent reduction in phosphorus loads could be realized by constructing a central sewer collection system around Enemy Swim Lake.

Dissolved phosphorus is the most available form for use by algae and other plants. It is rapidly consumed by algae and seldom reaches high concentrations in surface waters unless other factors are limiting algal growth. Dissolved phosphorus enters lakes from runoff and is also released from sediments under anoxic conditions (oxygen levels near zero). Dissolved phosphorus concentrations for Enemy Swim Lake surface samples ranged from below detection limits to 0.030 mg/l in the bottom sample on 6/15/02 (Table 5). Dissolved phosphorus concentrations were occasionally higher in bottom samples compared to surface samples (Table 5).

Nitrogen

Nitrogen is present in lakes in several forms, both inorganic and organic. The inorganic forms (ammonia, nitrite and nitrate) are important nutrients available for plant growth. Organic nitrogen represents nitrogen incorporated into living (or once living) material and can be used to define trophic state. Wetzel, (1983) reports that mesotrophic lakes worldwide generally range from 0.4 to 0.7 mg/l and eutrophic lakes have up to 1.2 mg/l of organic N. Organic N in Enemy Swim Lake surface samples ranged from 0.65 on 6/15/02 to 0.86 mg/l on 8/13/04. This indicates productivity in the mesotrophic to lower eutrophic range.

Ammonia is generated as an end product of bacterial decomposition of dead plants and animals and is also a major excretory product of aquatic animals. Ammonia is directly available for plant growth and is the most easily used form of nitrogen. It can support the rapid development of algal blooms if other nutrients are present. Ammonia concentrations in surface and bottom samples ranged from below detection limits on 7/16/02 in the surface sample to 0.20 mg/l in the bottom sample on 7/14/04 (Table 5). Ammonia concentrations were occasionally higher in bottom samples compared to surface samples. For example, on 7/14/04 a concentration of 0.20 mg/l was observed in the bottom sample compared to 0.05 mg/l in the surface sample (Table 5). Like dissolved phosphorus, ammonia is also released from sediments into the water under anoxic conditions. This may indicate that low oxygen concentrations may occur for relatively short periods of time near the bottom sediments.

Nitrate and Nitrite are other inorganic forms of nitrogen that are also directly available for algal growth. Low concentrations of nitrate were observed on most sampling dates in both surface and bottom waters in the 2002 to 2004 period (Table 5). Nitrite was not measured. Concentrations of nitrate ranged from below detection limits to 0.074 mg/l in both surface and bottom samples on 8/16/02 (Table 5).

Dissolved Oxygen

Adequate dissolved oxygen is necessary to maintain a healthy lake. Lakes with good oxygen concentrations throughout the year are more likely to have a diverse population of aquatic organisms. Low oxygen concentrations are detrimental to the population of many organisms and usually reduce diversity and stability in a lake ecosystem. Lakes with occasionally poor oxygen concentrations often are dominated by a few hardy species.

Oxygen concentrations can also affect other chemical parameters in lakes. For example, when anoxic conditions form at the bottom of a lake, dissolved phosphorus, ammonia, and hydrogen sulfide and other undesirable substances are released from the lake sediments into the water column. These nutrients can contribute to algal growth when stratified lakes turn over or shallow, non-stratified lakes are mixed by wind. Ammonia and hydrogen sulfide may also be toxic to aquatic organisms if they are present in sufficient concentrations.

Oxygen concentrations in Enemy Swim Lake surface samples were consistently above the state standard of 5.0 mg/l during the 2002-2004 time frames (Table 6). This was also true of measurements taken from 1991 to 1995 (German, 1997). Thermal stratification is not usually observed in Enemy Swim Lake (Table 6) and sufficient oxygen, even in near-bottom waters apparently prevents release of phosphorus from the sediments most of the time. Efforts to keep productivity in the mesotrophic range are important to prevent loss of oxygen and release of phosphorus and ammonia from the sediments.

pH

The acidity of water is represented by pH. Each pH point represents a 10-fold increase or decrease in hydrogen ion concentration. The pH of lake water governs many chemical and biological processes. Biological activity can, in turn, affect pH. Carbon dioxide is used by algae during photosynthesis. Depletion of carbon dioxide causes an increase in pH. Large, actively growing blooms of algae can raise pH by one or two points.

The state standard for pH for warmwater permanent fish life propagation is 6.5-9.0 (SD DENR, 2004). There were no violations of this standard during 2002-2004. Observed pH in Enemy Swim Lake ranged from 8.38 in the bottom composite on 7/14/04 to 8.92 in the bottom composite on 6/15/02 (Table 6). Enemy Swim Lake is a well buffered lake and pH values in this range are typical.

Water Quality Trends

Trophic state is a way of describing how productive or enriched a lake is compared to other lakes. Trophic State Indexes (TSIs) are also useful to describe changes in lakes over time. Total phosphorus, Secchi disk transparency, and Chlorophyll *a* are parameters commonly used to describe a lake's trophic state by calculating TSI values (Carlson, 1977).

Lakes range from nutrient poor (oligotrophic), too moderately rich (mesotrophic), to highly enriched (eutrophic), to excessively enriched (hyper-eutrophic). Enemy Swim Lake is one of the few natural lakes in South Dakota that could be described as mesotrophic.

TSIs based on phosphorus using all available data from 1975 to 2004 are presented in Figure 19. The overall trend from 1975 to 2004 is toward improving water quality with an R^2 value of 0.48. When only the most recent (1991 to 2004) phosphorus-based TSI values are plotted, no overall trend is indicated but periods of improving and declining water quality are apparent (Figure 20).

TSIs based on Secchi disk transparency from 1991 to 2004 are presented in Figure 21. Secchi disk TSIs show the same pattern as phosphorus TSIs (Figure 20) except for 2004, where transparency was high in June (Table 6) and the average Secchi disc based TSI was lower than the TSI based on total phosphorus. Combined phosphorus and Secchi disk TSIs are presented in Figure 22. Averaging the TSI trends to smooth out the curve and reduce the effect of unusually high or low values gives a better picture of trends.

Fluctuations in mean TSIs (Figure 22) do not appear to be random but rather exhibit a pattern of gradual change from 1991 to 2004. Improving water quality was observed from 1991 to 1994 followed by a decline from 1994 to the end of the decade. Water quality similar to that of the late 1970s in Enemy Swim Lake had declined to a lower eutrophic condition by the end of the 1990s. No monitoring was conducted from 1999 to 2001 but an improving trend was observed during the project period of 2002 to 2004.

This data indicates that Enemy Swim Lake is very sensitive to changes in phosphorus loadings. It is likely that if conditions in the watershed change and phosphorus loadings increase, it may drift to a more eutrophic condition, as it did during the mid 1970s and the late 1990s.

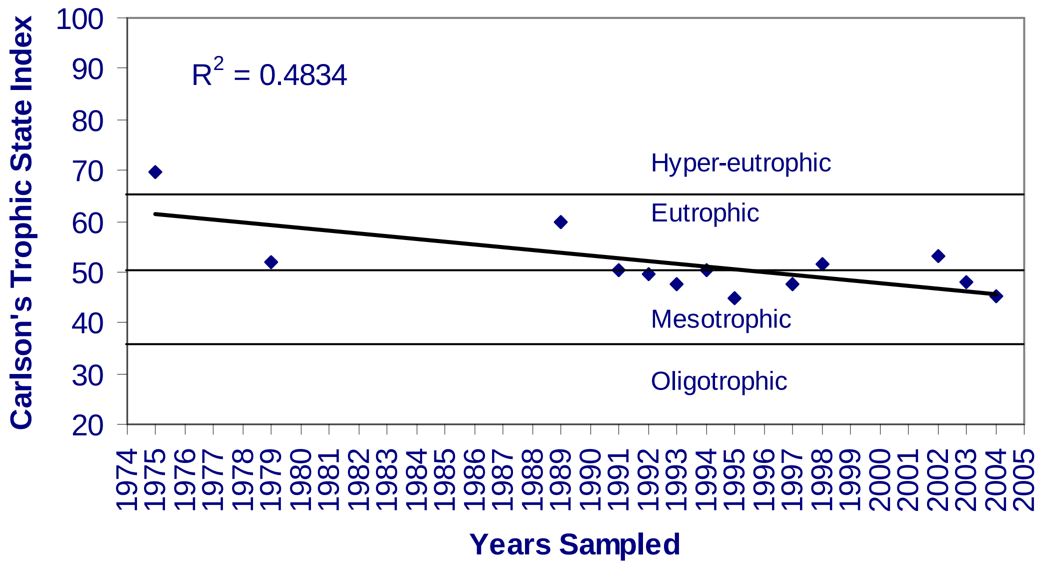


Figure 19. Enemy Swim Lake Trophic State Index – Average Summer TSI Based On Phosphorus 1975 - 2005

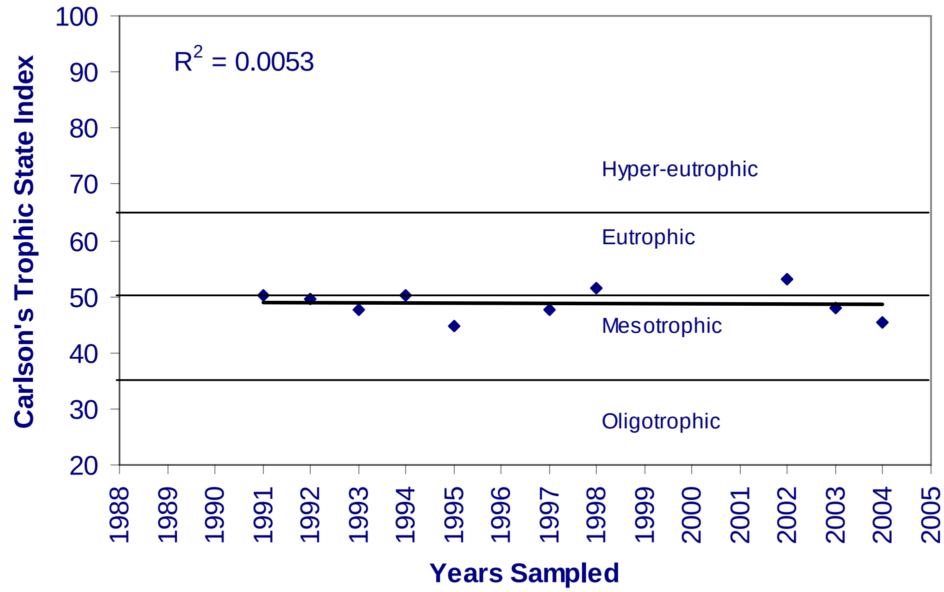


Figure 20 – Enemy Swim Lake Trophic State Index – Average Summer TSI Based On Phosphorus 1988 - 2005

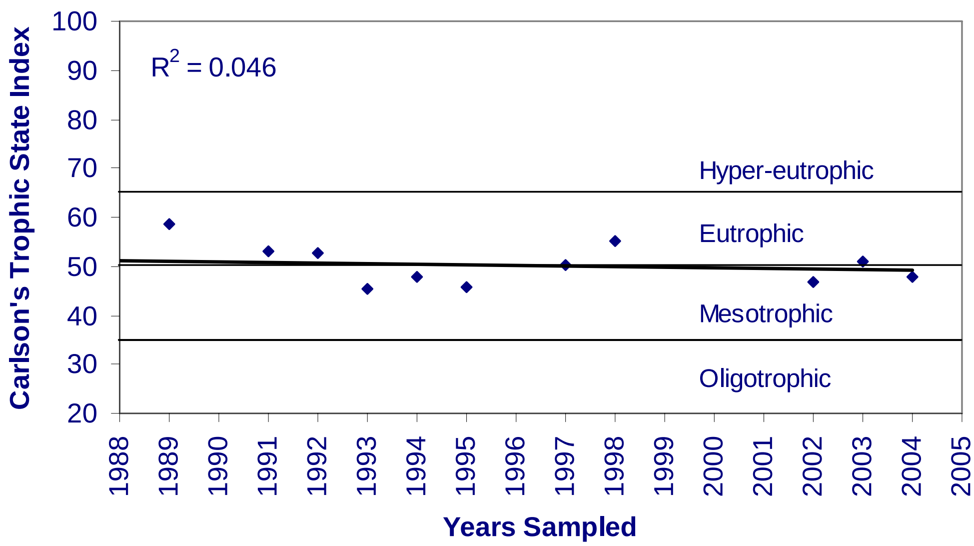


Figure 21. – Enemy Swim Lake Trophic State Index – Average Summer TSI Based on Secchi Disk (Meters)

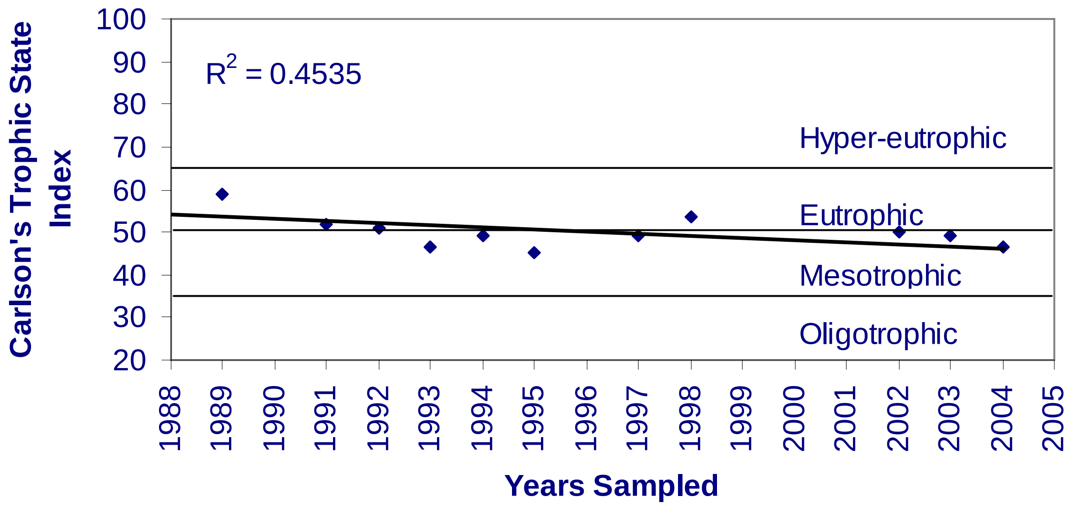


Figure 22. – Enemy Swim Trophic State Index – Mean Summer TSI Based on Secchi and Phosphorus

<u>Attainment of Project Goal</u>

Enemy Swim Lake lies in an agricultural watershed with cottage developments along the shoreline. The major external factors contributing nutrients to the lake were identified as soil erosion, animal waste, human waste, and fertilizer applied to cropland and residential areas (Stueven and Bren 2000). Historically, soil erosion from the watershed was probably the largest source of phosphorus loading to Enemy Swim Lake.

The goal of the Enemy Swim Lake Watershed Implementation Project was to reduce phosphorus loadings from the watershed and to reduce in-lake phosphorus by thirty-one percent, moving the lake phosphorus and Chlorophyll *a* TSIs from a eutrophic to a mesotrophic state. The project implementation plan did not call for any post project watershed modeling so load reductions from implemented BMPS and CRP will not be calculated. There were visible improvements to the watershed and improvements based on in-lake water quality parameters including the following:

- In-lake phosphorus concentrations from 1998 to 2004 were reduced by 37 percent.
- The lake Trophic State Index moved from a eutrophic to a mesotrophic state.
- Improvement of water clarity as demonstrated by increased Secchi disk transparency.

Evaluation of in-lake phosphorus concentrations permits an evaluation of system-wide effectiveness of the implementation project. During the problem identification monitoring conducted during 1998 a mean summer concentration of 0.028 mg/l was observed based on surface samples (Stueven and Bren 2000). In-lake phosphorus concentrations declined each year during implementation from 2002 to 2004. During 2004, the last year of the project, mean summer phosphorus concentrations had declined to 0.019 mg/l. This represents a decline of 37 percent during the project.

Conversion of 1,444 acres of cropland to grassland using the Conservation Reserve Program probably accounted for the largest reduction of phosphorus loadings to the lake. The 1,444 acres of CRP and the 54 acres of critical-area planting reduced the acres of cropland in the watershed from 2,840 acres to 1,386 acres, a 51 percent reduction. Load reductions realized from CRP and BMPs installed during this project may be responsible for recent improvements in water quality (Figures 19-22).

Although the amount of cropland in the watershed has been reduced since the first CRP signups in the early 1980s and animal numbers in the watershed have remained stable, shoreline development has increased. Seasonal cottages are being converted to four season homes and new larger homes are being developed at an accelerated pace. The combination of WEB water availability and installation of high-water use appliances has increased wastewater disposed into drain fields and increased the movement of water toward the lake. Shoreline development tends to increase phosphorus loadings of lakes and results in declining water quality (Ramstack et al., 2004; Hall, 1996). This is especially true of developments that rely on septic tanks and drain fields for sewage disposal.

The effect of shoreline development and septic tank leachate on water quality has probably been masked by the changes in the watershed because of use of CRP. The data presented in Figures 19-22 indicate that Enemy Swim Lake is very sensitive to changes in phosphorus loading. This is typical of mesotrophic lakes world wide (EPA, 1990). This indicates that management of phosphorus loads to the lake will be important to maintain good water quality in the future.

Future Water Quality Concerns

The current water quality of Enemy Swim Lake supports all designated beneficial uses and provides stable habitat for a diverse population of fish and invertebrates. Several factors could have a negative affect on water quality and, therefore, result in the loss of beneficial uses and habitat. These water quality concerns include:

- Conversion of Conservation Reserve Program (CRP) acres back to cropland.

Returning the 1,444 acres of land currently enrolled in CRP back to cropland will, most likely, have a negative affect on phosphorus loading. Soils in this lakes watershed are highly susceptible to wind and water erosion and typically have soil losses above tolerance when planted to rowcrops. The combined increase in phosphorus loadings from cropland and shoreline development will probably result in declining water quality in Enemy Swim Lake. Resource personnel should work to continue these contracts and expand the number of acres enrolled in Conservation Reserve Programs.

- Location of large feeding operations in the watershed

Animal numbers in the watershed were stable during the project period. However, if large animal feeding operations are located in the watershed in the future, proper disposal of manure without increasing in-lake phosphorus loads maybe challenging. The small amount of cropland acres available for nutrient management could become saturated with phosphorus. It is likely the build up of phosphorus in the soils in the watershed would lead to increased concentrations of dissolved phosphorus carried by runoff to Enemy Swim Lake (Schindler et al. 2003).

- Lakeshore Development

If the large amount of undeveloped land that comprises most of the shoreline of Enemy Swim Lake is developed, nutrient loads to the lake can be expected to increase. Short term effects are increased erosion due to construction of houses and roads, and shoreline disturbance. Long term effects include increased phosphorus loads due to human activities like lawn fertilizers, sewage disposal, wood fires and trash burning on beaches, and erosion from roads and foot trails.

- Continued use of septic tanks

It is critical that phosphorus loadings from on-site septic systems be reduced through the construction of a central sewer collection system around the Lake. The Enemy Swim Lake Assessment (Stueven and Bren 2000) determined a 20 percent reduction in phosphorus loads could be realized by constructing a central sewer collection system. If this system is not constructed, the estimated 20 percent reductions in phosphorus loads will not be realized. This should be completed as soon as possible since even the construction of a central collection system will not remove the phosphorus that is currently in the ground due to existing on-site drain fields. In areas where sand and gravel dominate the subsoil, phosphorus will continue to leach into the lake because of the low phosphorus holding capacity of these soils.

- Internal nutrient loadings

To this point, all discussion has focused on external sources of phosphorus loadings. Internal loadings of phosphorus can also contribute to algal blooms. If conditions are favorable, intense blooms can occur that may be an order of magnitude greater than "normal" for a particular lake.

Increased phosphorus loadings from any source may cause sediment anoxia in Enemy Swim Lake and trigger the extensive release of phosphorus and ammonia from the lakes sediments. Water quality data (Table 5) shows that both dissolved phosphorus and ammonia concentrations are sometimes elevated in bottom samples. This indicates that there is the potential for significant internal loadings to occur if anoxic conditions are created at the sediment surface.

Internal loadings can cause rapid declines in water quality. For example, Clear Lake exhibited a chlorophyll concentration of 119.9 mg/m3 during 1992 compared to the median value of 10.02 mg/m3 over the five year study period from 1991 to 1995 (German 1997). This represents a bloom over 10 times greater than what would be considered normal for Clear Lake because of phosphorus release from sediment.

During the drought year of 1988, the Oakwood Lakes produced algae blooms approximately 4 times higher than normal even though essentially zero loadings from the watershed occurred (German, 1992). The amount of phosphorus in the water column during mid-summer 1988 was approximately the same as was available from the sediments based on a sediment incubation study by Price (1990). This indicates how phosphorus stored in the sediments can support large algal blooms under the right conditions.

Phosphorus held in lake sediments represents historical watershed loadings of phosphorus much like savings in a bank. This phosphorus "bank" serves as a buffer absorbing excess phosphorus from the water column. Under certain conditions (low dissolved oxygen at the sediment surface) the sediment releases phosphorus into the water column where it is available to support algae blooms. Low DO concentrations near the sediment surface can be caused by the decay of animal waste, human waste, or plant material washed into the lake. Most often however, low DO levels are related to the decay of over-growths or blooms of algae and plants grown in the lake due to excess nutrients.

In the future it will be important to restrict phosphorus loadings to prevent filling of the sediment bank with phosphorus and to prevent the conditions of over-production and decay that lead to low DO that releases nutrients from the sediment. The cycle of over-production leading to release of nutrients from the sediment which in turn supports more production must be avoided since it is very difficult to reverse.

Conclusion

Water quality in lakes is a reflection of the watersheds that discharge water to them. The activities and practices of people living in the watershed and along the lakeshore may have a significant impact on the water quality of a lake. The greatest challenge of a non-point source pollution control project is to inform people of the impact their activities have on water quality and then move them to install practices that protect and/or restore a lake. This will continue to be a challenge as efforts move forward to protect the water quality of Enemy Swim Lake.

COORDINATION EFFORTS

The Day County Conservation District was the project sponsor. Several state, federal and local agencies and organizations contributed grant funds, technical services, cash and in-kind match to attain the project goal. Participating agencies and their contributions to the project are summarized below.

Enemy Swim Sanitary Sewer District

The Enemy Swim Sanitary Sewer District funded in-lake water quality monitoring during the implementation project. The sewer district has started the process of planning a Septic Tank Effluent Collection System and will utilize the Wastewater Feasibility Study funded by this project to determine the most economical alternative. The Enemy Swim Sanitary Sewer District has been placed on the State Water Plan, the first step in applying for public funds to construct a sewer system. The Project Coordinator attended seven sewer district meetings to disseminate project information and inform the districts board of directors about the progress of the implementation project and wastewater feasibility study.

Sisseton Wahpeton Sioux Tribe

The tribe received cost share for implementing best management practices on tribal land located within the Enemy Swim Lake watershed. The project coordinator worked with the Natural Resources Conservation Service's Tribal Liaison stationed in Sisseton South Dakota, and tribal land managers to locate sites and plan best management practices.

Roberts County Conservation District

Roberts County supported the project with a cash contribution and allowed the Project Coordinator to disseminate information through their office in Sisseton, and at the January 12, 2001 Sisseton Farm and Home Show. The Roberts County Conservation District Board of Supervisors participated on the project planning committee and EQIP work groups.

South Dakota Department of Agriculture, Division of Resource Conservation and Forestry

The Day County Conservation District obtained a Coordinated Soil and Water Conservation Grant to cost share BMP installation. Coordinated grant funds were only available during the first two years of this project, from 22 March 2001 to 31 December 2002.

South Dakota Department of Environment and Natural Resources (DENR)

DENR administered the project grant and provided oversight of all project activities through on-site office visits and watershed tours by DENR personnel, review of reports, and approval of payment requests. DENR also conducted yearly 319 Project Coordinator meetings attended by the Project Coordinator to review programs, policies, and procedures.

United State Department of Agriculture - Natural Resources Conservation Service (NRCS)

The agency provided technical assistance for designing and surveying BMPs (Figure 23) from its tribal liaison, soil scientist, range and soil conservationists, and district conservations from Webster and Sisseton, South Dakota Field Offices. In addition to personnel, NRCS provided software and hardware to generate conservation plans, contracts, and maps. The project utilized one NRCS program for cost share, the Environmental Quality Incentive Program (EQIP), and the Conservation Reserve Program (CRP) administered by the Farm Service Agency (FSA).

Figure 23. NRCS Personnel Surveying BMP Locations and Construction.

PUBLIC PARTICIPATION

The public was notified of opportunities to participate in the project through press releases, newsletters, and facts sheets distributed through the mail, meetings and other public forums. Examples of media used to inform the public are included in Appendix A. Several different audiences were informed about the project. These included watershed landowners and producers, lake shore property owners, sportsmen and other recreational lake users.

Figure 24. Information about the project was distributed at the 2002 Webster Farm and Home Show booth sponsored by the project.

Watershed Landowners and Producers

A fact sheet listing best management practices that would be cost shared was mailed to 200 watershed landowners and producers at the start of the project. A newsletter was specifically written for this audience describing new agricultural technologies including nose pumps. Watershed landowners and producers were also invited to participate in the Environmental Quality Incentive Program (EQIP) work groups convened to set conservation priorities in the watershed in 2002. Information about the project was also distributed at the 2001 Day County Fair; 2002, 2003, and 2004 Webster Farm, Home and Sports Show (Figure 24); and 2001 Sisseton Farm and Home Show.

Nine watershed landowners participated in the project by implementing best management practices funded by project grants on their land, including the Sisseton Wahpeton Sioux Tribe which manages three project sites held in trust for tribal members.

Lake Shore Property Owners

Although no cost share programs for lake shore property owners were included in the project workplan, several fact sheets were written specifically for this audience to promote best management practices they could voluntarily implement on their property. Fact sheets and other information pertinent to the watershed implementation project were distributed to property owners at lake association meetings, Enemy Swim Lake Sanitary Sewer District meetings, and the Webster and Sisseton - Farm, Home, and Sports Shows. Two newsletters describing project activities were mailed to 227 lake property owners.

PROJECT GOALS AND MILESTONES NOT MET

The goal of designing and implementing one Animal Nutrient Management Systems and six Clean Water Diversions in Enemy Swims Watershed was not met. The high cost of these systems and the uncertainty many older producers have in the future of their cattle operations are two reasons many would not commit to these BMPS. During the project two of the targeted systems went out of business and one reduced its herd size, all of which contributed to load reductions to the lake. These funds were reverted back to the SD Dept. of Environment and Natural Resources.

Due to the popularity and payment structure of the Conservation Reserve Program (CRP), this federal program replaced several BMPS that were to be cost shared by this project. Cost share funds and milestones for grass waterways, pasture renovation, critical area planting, and grass buffer strips were omitted or quantities reduced in a revised project PIP due to the CRP program. These funds were reverted back to the SD Dept. of Environment and Natural Resources. During the project period several new continuous CRP programs were also initiated by the Natural Resources Conservation Service. The use of CRP allowed the project to successfully address identified resource concerns on 480 acres of watershed cropland.

Two EQIP contracts written for watershed producers will not be completed during the project period. Producers typically have five years to complete these contracts and many times BMPS are not implemented until the final years of the contract. Best management practices funded by EQIP for this project that will not be implemented until after April 1, 2005, will result in a loss of in-kind and cash match, and reportable accomplishments.

Midway through the project both Day and Roberts Counties initiated a 911 address system eliminating rural route addresses. The project coordinator was never able to collect all the new watershed landowner and lake property owner address changes. The project utilized bulk mailing rates for newsletters and other project mailings. Mail sent by bulk rate is not forwarded to a new address or returned to the sender; instead it is destroyed by the U.S. Postal Service. No further newsletters or bulk mailings were completed.

PROJECT BUDGET

The Enemy Swim Lake Watershed Implementation Project was funded by an EPA Section 319 Clean Water Grant provided through the South Dakota Dept. of Environment and Natural Resources, a South Dakota Coordinated Soil and Water Conservation Commission Grant administered by the South Dakota Dept. of Agriculture's Division of Resource Conservation and Forestry, and the Natural Resources Conservation Service's Environmental Quality Incentive Program (EQIP).

<u>EPA Section 319 Clean Water Grant</u>

The original project budget had a total of $184,542.00 in 319 grant funds to provide wages and benefits for a Project Coordinator and District Business Manager, cost share for BMPS, and funds for information and education activities. The project budget was revised during 2004 because several 319 grant funded activities were not being installed by producers. Many of the omitted tasks were for installing BMPS that were replaced by the Conservation Reserve Program or due to a lack of interest by producers. Total 319 grant funds for the project were reduced to $74,070.35 in a revised budget submitted during 2004. Total 319 grant dollars expended during the project where $62,152.35, forty-two percent of the total project cost.

<u>South Dakota Coordinated Soil and Water Conservation Commission Grant</u>

The original project budget included a total of $29,261.00 in Commission Grant funds to cost share implementation of BMPS. The majority of this grant was utilized to fund grazing improvements including fencing and water development. Funds were available from this grant to construct grassed waterways; however there was no interest by producers to implement this BMP. Commission Grant funds were available only during the first two years of the 319 project. The revised project budget removed Commission Grant funds from the project since they were no longer available. A total of $17,768.64 in Commission grant funds were expended during the project, twelve percent of the total project cost.

<u>Environmental Quality Incentive Program (EQIP)</u>

The Project Coordinator applied for EQIP Priority Area funding the first two years of the project. Priority Area EQIP funds were dedicated for use in watersheds implementing 319 grant projects and had their own funds and budget, sign-up period, and ranking sheet separate of the general EQIP sign-up. However, after 2002 the Natural Resources Conservation Service, which administered the program, eliminated priority area funding. After 2002 EQIP applicants in the Enemy Swim Lake watershed had to be ranked along with all other applicants in the State which greatly reduced the chance of EQIP contracts in the project area being accepted. Because of the loss of EQIP priority funds, 319 grant funds were used to cost share installation of some practices not funded by EQIP. A total of $16,028.00 in EQIP dollars were expended during the project, eleven percent of the total project cost.

Table 7 shows the original project budget compared to the revised project budget, and total expenditures for each funding source. A copy of the revised budget was provided to DENR for posting on GRTS.

Table 7. Planned Versus Actual Budget Expenditures

Source of Funds	Original Budget	Revised Budget	Expended
EPA 319 Clean Water Grant	$184,542.00	$74,070.35	$62,152.35
SD Coordinated Soil & Water Grant	$29,261.00	$17,768.64	$17,768.64
Federal EQIP Funds	$106,140.00	$23,656.00	$16,028.00
Local Match	$115,308.00	$55,756.74	$52,461.31
Total	$435,251.00	$171,251.73	$148,410.30

<u>Local Match</u>

The project sponsor, the Day County Conservation District, contributed $1,731.44 in cash match and $3,186.57 in-kind match. The Enemy Swim Sanitary Sewer District contributed $957.00 in cash match for in-lake sampling costs. Local school districts contributed $1,272.47 in cash match for “Lakes Are Cool” field trips. Operator match for implementing best management practices was $45,313.83. A total of $52,461.31 in local cash and in-kind contributions were received during the project, thirty-five percent of the total project cost.

A complete account of original and amended project budgets and actual expenditures is given in Table 8.

Table 8. Enemy Swim Lake Watershed Improvement Project Original-Amended Project Budget and Actual Expenditures

	EPA 19			SD Soil & Water		NRCS EQIP			Local Match		
Personnel/Support	Original	Amended	Actual	Original	Amended/Actual	Original	Amended	Actual	Original	Amended	Actual
Project Coordinator	$ 39,351.98	$ 39,351.98	$ 30,575.79	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
District Business Mgr.	$ 4,704.25	$ 6,500.00	$ 8,430.54	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
District Board of Supervisors	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 500.00	$ 500.00	$ 338.53
Administrative											
Office Supplies	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,395.00	$ 1,395.00	$ 186.98
Mileage	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,169.64
Objective 1: Reduce Phosphorus Loading from Animal Feeding Operations											
Animal Waste Nutrient Mgt. Systems	$ 30,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 10,000.00	$ -	$ -
Clean Water Diversion Systems	$ 67,500.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 22,500.00	$ -	$ -
Nutrient Testing	$ 2,500.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Objective 2: Reduce Nutrient and Sediment Loading from Watershed Pasture, Rangeland, and Cropland											
Cattle Stream Crossings	$ -	$ -	$ -	$ -	$ -	$ 10,688.00	$ 3,825.00	$ 3,825.00	$ 3,562.00	$ 1,317.61	$ 1,317.61
Grassed Waterways	$ -	$ -	$ -	$ 11,664.00	$ -	$ -	$ -	$ -	$ 3,889.00	$ -	$ -
Pasture Renovation	$ -	$ 2,400.00	$ 2,400.00	$ -	$ -	$ 19,106.00	$ -	$ -	$ 6,368.00	$ 800.00	$ -
Critical Area Planting	$ 6,412.00	$ 832.00	$ 832.00	$ -	$ -	$ -	$ 278.00	$ 278.00	$ 2,138.00	$ 2,156.02	$ 2,156.02
Grass Buffer Strips	$ 4,275.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,425.00	$ -	$ -
Well Decommissioning	$ -	$ -	$ -	$ -	$ -	$ 5,400.00	$ -	$ -	$ 1,800.00	$ -	$ -
Grazing System-Fence	$ -	$ 5,750.00	$ 4,277.00	$ 10,472.00	$ 15,893.64	$ 30,184.00	$ 13,000.00	$ 10,032.00	$ 38,808.00	$ 37,751.00	$ 38,508.46
Pasture Watering Systems	$ -	$ 4,663.50	$ 3,876.50	$ 7,125.00	$ 1,875.00	$ 40,762.00	$ 6,553.00	$ 1,893.00	$ 15,960.00	$ 5,147.74	$ 3,331.74
Solar Pump Demonstration Project	$ 6,000.00	$ 2,208.27	$ 2,208.27	$ -	$ -	$ -	$ -	$ -	$ 2,000.00	$ 1,982.12	$ 1,982.12
Objective 3: Implement an Information and Education Program											
Lakes are Cool Field Trips	$ 9,474.00	$ 3,789.60	$ 2,041.61	$ -	$ -	$ -	$ -	$ -	$ 3,158.00	$ 2,526.40	$ 1,272.47
Demonstration Project Sign	$ 300.00	$ 300.00	$ 300.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 30.85	$ 30.85
Lake Friendly Farmer Program	$ 250.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Newsletters	$ 1,275.00	$ 1,275.00	$ 460.64	$ -	$ -	$ -	$ -	$ -	$ 425.00	$ 425.00	$ 131.55
Fact Sheets	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 180.00	$ -	$ -
In-Lake Sampling	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,725.00	$ 1,232.00
Mapping Software	$ 2,500.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
I & E Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 729.13
Objective 4: Waste Treatment Feasibility Study											
Feasibility Study	$ 10,000.00	$ 7,000.00	$ 6,750.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Monitoring Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 74.21
Total:	$ 184,542.23	$ 74,070.35	**$ 62,152.35**	$ 29,261.00	**$ 17,768.64**	$ 106,140.00	$ 23,656.00	**$ 16,028.00**	$ 114,108.00	$ 55,756.74	**$ 52,461.31**
			42%		12%			11%			35%

FUTURE RECOMMENDATIONS

The Conservation Reserve Program probably had the greatest effect on improving the lakes water quality. Efforts should be made by all resource agencies to maintain the CRP program in this watershed at or above the current acreage. If another general CRP sign-up is offered, resource personnel should concentrate on those areas identified by AGNPS as critical.

Much of Enemy Swim shoreline remains undeveloped. However, there has been new development around the lake (Figure 25). In recent years, many lakeshore property owners have torn down the smaller traditional one season cabins and built larger four season homes on these sites. These larger homes tend to have multiple bathrooms, laundry facilities and dishwashers requiring owners to connect to rural water systems. The increased water usage from new and rebuilt lake homes creates a larger volume of effluent flowing into lakeshore septic systems, and a greater potential for septic leachate reaching the lake. Resource agencies should strongly support the construction of a septic tank effluent collection system for Enemy Swim Lake.

Figure 25. New Housing Development on East Enemy Swim Lake

In-lake water quality monitoring should be continued by the Enemy Swim Lake Sanitary Sewer District and Water Resource Institute to document any changes in Enemy Swim's water quality. This continued monitoring will detect any changes brought about by the construction of a septic tank effluent collection system or any changes in watershed land use, especially if CRP acres are converted back to cropland.

The North Big Sioux Coteau Hydrological Unit, of which the Enemy Swim Lake watershed is part, was recently named one of two hydrological units to be eligible for USDA's Conservation Security Program (CSP). This program, administered by the Natural Resources Conservation Service, rewards agricultural operators who are currently utilizing best management practices to improve soil health and water quality on their lands. Several producers who participated in the Enemy Swim Watershed Improvement Project may be rewarded through the CSP program for BMPS funded by this project. If the CSP program is a success and is funded in the future, this program could be an incentive for producers in future watershed implementation projects to participate and implement best management practices offered by these implementation projects.

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APPENDIX A

Lakes Are Cool!!

Sponsored by the
Day County Conservation District
and
NeSoDak Environmental Learning Center
Enemy Swim Lake
September 8–10, 13-17 & 20–22, 2004

Lakes Are Cool Program

Lakes are an important resource worth preserving and learning about! The Day Conservation District is pleased to sponsor the "Lakes Are Cool" program, a one day field trip to NeSoDak Environmental Learning Center located on beautiful Enemy Swim Lake.

The "Lakes Are Cool" program offers 6th grade students a chance to experience hands-on testing and assessment of a lake environment, and an opportunity to learn a basic water based recreational skill on one of South Dakota's cleanest lakes.

Program activities include testing lake water for pH and dissolved oxygen, collecting and observing freshwater invertebrates and fish, basic canoeing, fishing skills and ethics, games and much more.

The cost is $8.00 per student, however, the Day Conservation District through a grant from the Environmental Protection Agency will reimburse your school 60% of the field trips cost. This includes student fees plus any costs incurred for buses and bus drivers. Call program coordinator Dennis Skadsen at 605/345-4661 ext. 124 to schedule a trip or for more information on the "Lakes Are Cool" program.

Students play the lake game, just one of the many activities offered during a "Lakes Are Cool" field trip.

Where:
NeSoDak Environmental Learning Center. Located on Enemy Swim Lake, six miles north of Waubay, SD on Day Co. Hwy 1.

When:
September 8-10, 13-17 & 20-22, 2004.

Who:
The program is available to 6th grade students in districts located in or near the Upper Waubay Watershed project area. These include the following districts; Bristol, Enemy Swim Day School, Roslyn, Sisseton, Summit, Tiospa Zina Tribal School, Waubay, Webster, and Wilmot.

Why:
To foster an interest in preserving and protecting one of our major resources, water.

What to Bring:
Students should wear clothing appropriate for early fall weather conditions including light jackets or sweatshirts that can be removed as the temperature rises, shoes or boots that can get wet or muddy, shorts for canoeing, and sack lunches. We request schools bring adult chaperones that can assist with program activities.

What to Expect:
Students typically arrive at the NeSoDak campus at 9:15 AM and begin activities around 9:30. Morning sessions will include water testing and assessment activities and will conclude at noon. A half hour will be allowed for lunch. The two-hour afternoon session will include your schools choice of several water based recreational skills including fishing, basic canoeing or paddleboats. Note, activities may vary according to group size. Schools typically depart by 2:30 pm to return to town in time for students to board buses and depart for home.

The futures in their hands!!

The Day Conservation District has sponsored special watershed protection and improvement projects since 1992. The Day and Roberts' Conservation Districts are currently co-sponsoring the Upper Waubay Watershed Protection Project which includes Blue Dog, Enemy Swim, and Pickerel Lakes. The project is funded by two grants from the Environmental Protection Agency, and the South Dakota Dept. of Agricultures Coordinated Soil and Water Conservation Grant fund. Further funding is provided by the Natural Resources Conservation Service's Environmental Quality Incentive Program.

The NeSoDak Environmental Learning Center, a program of Lutherans Outdoors of South Dakota, is an environmental education field school which offers programs year-round for youth and adults. These programs fulfill an essential role in the partnership between indoor and outdoor classrooms by offering interdisciplinary learner-focused hands-on experiences and a unique opportunity to study the basic concepts and principles of ecology. The center provides day and residential education programs to public and private school districts in South Dakota.

For information on further indoor and outdoor learning opportunities offered by the Day Conservation District and the NeSoDak Environmental Learning Center contact:

Day Conservation District
600 East Hwy 12 Suite 1
Webster, SD 57274
(605)345-4661

NeSoDak Environmental Learning Center
3285 Camp Dakota Drive
Waubay, SD 57273-5322
(605)947-4440

Watershed

Newsletter of the Upper Waubay Watershed Improvement Project

Number 3 Day/Roberts Conservation District May 2002

In This Issue

Two Lakes to Receive Health Check-ups!!

Enemy Swim Lake and Pickerel Lake will receive check-ups when water quality testing resumes this summer. It's been several years since tests have been conducted on either of these northeast South Dakota lakes. The Pickerel Lake and Enemy Swim Lake Sanitary Sewer Districts have agreed to fund water quality testing by the Water Resources Institute located on the campus of South Dakota State University. The sanitary districts will pay for water quality testing while the Day Conservation District and Water Resources Institute will provide testing equipment, personnel, and water quality analysis.

Pickerel Lake will be tested during the months of May through September. 1995 was the last year comprehensive water quality testing was conducted on this lake. Since that time several projects to improve Pickerel Lake's water quality, including the lakes central sewer collection system, have been completed.

Enemy Swim Lake will be tested during the months of June through August. Water quality testing has not been conducted on this lake since an EPA 319 water quality assessment project was completed in 1998.

The new study will determine the effect water quality projects have had on Pickerel lake's water quality, and alert resource agencies to any lingering or new water quality threats on both lakes. Testing procedures and sites on both Pickerel Lake and Enemy Swim Lake will duplicate those of previous studies. The goal of all the agencies involved is to continue testing well into the future to provide long term data that will help resource agencies learn how changing agricultural practices, shoreline development, and weather changes affect two of South Dakota's cleanest water bodies.

Lakes Are Cool !

Area students get their feet wet seining fish on Enemy Swim Lake during a "Lakes Are Cool" field trip!!

Area 6th grade students had a chance to get their feet wet last fall, as the "Lakes Are Cool" program began its first year at the NeSoDak Environmental Learning Center located on Enemy Swim Lake. Nine area elementary schools located in or near the Upper Waubay Watershed area were invited to participate including; Bristol, Enemy Swim Day School, Roslyn, Sisseton, Summit, Tiospa Zina Tribal School, Waubay, Webster, and Wilmot schools.

Students arrived at the NeSoDak Environmental Learning Center around 9:30 am to begin a day of exploration and fun. Morning activities included testing lake water for pH, dissolved oxygen, and temperature; and collecting, identifying,

Basic Canoeing 101!

and studying fish, aquatic plants, zooplankton, insects and other aquatic invertebrates. Morning activities are designed to teach students how to identify non point source pollution through water quality testing and bio assessment, and the importance of a healthy lake ecosystem. During the afternoon session students enjoyed the lake while canoeing, paddle boating, or learning basic fishing skills and ethics. Students departed for home around 2:30 pm, often with damp shoes and wet shorts!. Activities were led by Dennis Skadsen Watershed Coordinator for the Day Conservation District; Dave German, Water Resources Institute; and NeSoDak staff. 2001 participants included Bristol, Waubay, Webster, and Wilmot 6th grade students.

The "Lakes Are Cool" program was developed by the Day Conservation District as part of the Enemy Swim Lake Watershed Improvement Project funded by an Environmental Protection Agency 319 Clean Water Grant. The EPA 319 grant will cover sixty percent of the schools cost to participate in the program.

The NeSoDak Environmental Learning Center is owned and operated by Lutheran Outdoors of South Dakota. The learning center provides both day and residential year-round environmental outdoor education camps to private and public school districts in South Dakota.

Students observe plankton and aquatic insects collected from the lake.

Aquatic Ecosystems to be Surveyed

A grant from the United States Geological Survey will fund a study of Pickerel and Enemy Swim Lake's aquatic plant and invertebrate communities. The two-year project will be the first to inventory aquatic invertebrates including mollusks, insects, crustaceans, and worms occurring in these two lakes. The study will also describe in detail the aquatic plant communities of Pickerel and Enemy Swim Lakes.

Aquatic plants are an important part of a lake's ecosystem. The larger plants called macrophytes provide spawning habitat for many species of fish and provide protection for developing fry and fingerlings. These plants also provide habitat for insects which are an important part of the aquatic food chain. Plants also recycle important nutrients back into the lake ecosystem and produce oxygen essential for the survival of all aquatic organisms. The survey will also identify any exotic plant species like Eurasian water milfoil that could negatively impact these lake's ecosystems if present.

Aquatic insects are ideal bio-monitors of water quality and this study will provide baseline data for future bio-assessments of Pickerel and Enemy Swim Lake. These lakes are two of the state's cleanest and this information could provide resource agencies with a benchmark for restoration of insect and plant communities in lakes severely impacted by non point source pollution.

A preliminary survey of Enemy Swim Lake was completed during the summer of 2001. A total of twenty-two species of aquatic plants were found along with a healthy population of two species of freshwater mussels.

The Water Resources Institute located on the campus of South Dakota State University applied for the grant and will be the lead organization for this study.

Dave German, Water Resources Institute, prepares to drop a dredge into Enemy Swim Lake to collect insect larvae from the lakes bottom.

Enemy Swim Lake Feasibility Study Underway

A study to determine the feasibility and cost of a central sewer collection system for Enemy Swim Lake is underway. Clark Engineering of Aberdeen will be conducting the study this summer. The study is part of the Enemy Swim Lake Watershed Improvement Project funded by an EPA 319 Clean Water Act grant. The project is sponsored by the Day County Conservation District.

The feasibility study will look at two options for the lake; **(cont. on page 4)**

(Enemy Swim Feasibility Study cont.)

Option 1:
Construct a single septic tank effluent collection system for the entire lake. This system would collect effluent from all lake property through a single sewer main and connect to the Enemy Swim Village sewer main and lagoons operated by the Sisseton Wahpeton Sioux Tribe.

Option 2:
Construct three separate septic tank effluent collection systems utilizing existing infrastructures as follows;

- Connect the developments known as Block's Bay, Camp Dakota, South Enemy Swim Addition, Dinkel's 1st Subdivision, Synder's Resort, and tribal housing located along Enemy Swim's south shore, and Marguerite Park located on Campbell Slough, to the existing sewer main connecting Ne-So-Dak Bible Camp to Enemy Swim Village's wastewater collection system.
- Connect the developments known as Pleasure Park Subdivision, Block's Resort, Middle Beach, Bolsey's Pebble Bay, and tenants of leased property along the northwest shore of Church Bay, to the existing Pickerel Lake Sanitary Sewer Districts lagoon located north of Enemy Swim Lake.
- Construct a separate septic tank effluent system for existing lake homes/cabins and future developments on Government Lots 6 & 7 in the area known as East Enemy Swim Lake.

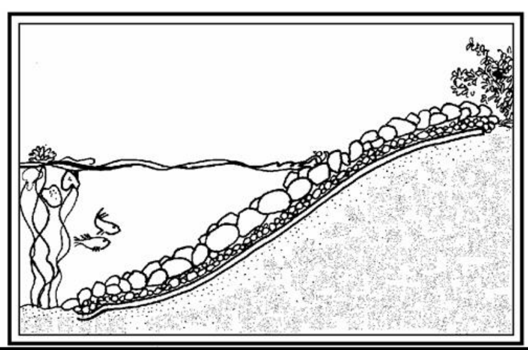
Lake property owners are asked to cooperate with surveyors who will be collecting information on lot sizes, wells, and existing septic tanks and drain fields around the lake. A public meeting will be held early this summer to further explain the feasibility study, and update lake property owners on watershed activities.

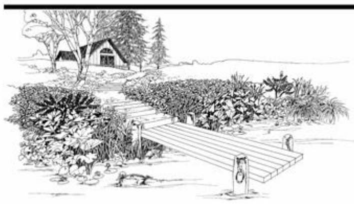
No Funding for Blue Dog Lake Shoreline Restoration

Funds to cost share restoration of eroding shoreline along Blue Dog Lake will not be forthcoming. The Day Conservation District has contacted FEMA, EPA, and State agencies for funding, however, none are available to private individuals at this time. Agencies state the high-cost of shoreline restoration compared to relatively low benefits to water quality as reason they no longer fund this practice. FEMA had made funds available on Lake Kampeska after a disaster declaration in 1997, however, few property owners were willing to follow FEMA guidelines for shoreline restoration. FEMA requires the use of fractured quarry rock, and improvements to the shoreline must remain unchanged and in place for twenty-five years. FEMA has not declared any disaster relief for Blue Dog Lake property owners.

Blue Dog Lake property owners interested in shoreline restoration, can contact the Day Conservation District for technical assistance. The District has published a fact sheet explaining several methods of shoreline restoration. You can also download information on shoreline restoration from the South Dakota Department of Environment and Natural Resources web site at;

www.state.sd.us/denr/DFTA/WatershedProtection/Brochure%20Shoreline%20Guidelines.ppt





N, P, Or K?
What Does Your Lake Lawn Require!

Do you fertilize your lake lawn every spring and fall? Do you know how much Nitrogen (N), Phosphate (P) or Potassium (K) your lawn requires? Improper applications of lawn fertilizer along a lake can be as detrimental to water quality as agricultural runoff. An excellent fact sheet "Managing Lawns to Protect Water Quality" lists several best management practices for lawn fertilizing, watering, and pesticide use that will help keep your lawn healthy and your lake clean!

Lawn fertilizer management near lakes should always be based on the type and variety of grass, soil type, and results of a soil test. For instance, a slow-release form of nitrogen fertilizer should be used on a high-maintenance, cool-season grass lawn growing on porous sandy soil. Nitrogen should be applied at a rate no higher than one pound per 1000 square feet of lawn per application. Phosphorus is another essential nutrient for your lawn, however, this nutrient causes the most problems if it reaches the lake. Never spread fertilizers containing phosphorus on driveways, sidewalks, or other hard surfaces where it could wash into the lake. Phosphorus and potassium applications should always be based on soil tests.

The application of phosphorus fertilizer on a lawn or garden located near a shoreline should always be based on a current soil test.—SDSU Extension Extra ExEx 1016 "Managing Lawns to Protect Water Quality"

Contact the Day Conservation District to receive your copy of "Managing Lawns to Protect Water Quality" or to sign-up for a free soil test of your lake lawn. Call: 605/345-4661 ext. 124 , e-mail: dennis-skadsen@sd.nacdnet.org or write to the return address given on the last page of this newsletter.

911 Address Update Request

We'd like to keep you informed!! If you're a resident of Day County and have received your new 911 street address, please fill out the form below with your new mailing address, detach with the old mailing label attached to the back of this form and return to the Day Conservation District. If you live outside of Day County and have a new mailing address please send us your new address also.

Street Address:______________________________________

City:________________________ State:________________

ZIP:________________________

Enemy Swim shoreline showing signs of damage from overgrazing.

Parting shots..............

An Environmental Quality Incentive Program (EQIP) contract has been signed to implement conservation practices on a pasture adjacent to Enemy Swim Lake's northeast shoreline. The conservation plan includes cross fencing for a rotational grazing system, exclusion fencing along the lake's shore to prevent livestock from reaching the lake, construction of a dugout for an alternate watering source, and deferred grazing for two years to allow pasture re-growth. The Natural Resources Conservation Service's EQIP program will pay 75% of the cost of materials for fences and construction of the dugout. The Enemy Swim Lake Sanitary Sewer District will provide the remaining 25% of the cost for the exclusion fence. The Enemy Swim Lake Watershed Improvement Projects EPA 319 grant will pay for deferred grazing. In-kind services will be provided by the Sisseton Wahpeton Sioux Tribe which manages this land. The Enemy Swim Lake Watershed Improvement Project is sponsored by the Day and Roberts County Conservation Districts.

600 East Hwy 12, Suite 1
Webster, SD 57274
Phone: 605/345-4661

Day Conservation District

Day Conservation District
600 East Hwy 12, Suite 1
Webster, SD 57274

Upper Waubay Watershed Improvement Project

Cost-share Programs for Watershed Landowners and Operators

The Upper Waubay Watershed Improvement Project includes land located within the watersheds of Blue Dog Lake, Enemy Swim Lake, and Pickerel Lake. The project's goals are to improve land use and water quality in these watersheds through the implementation of best management practices beneficial to farmers. The Day and Roberts Conservation District have obtained special funds from the SD Department of Agriculture's Coordinated Soil and Water Conservation Grant Program, Natural Resources Conservation Service's Environmental Quality Incentive Program (EQIP), and the U.S. Environmental Protection Service's Section 319 Nonpoint Source Grant Program.

Who's Eligible?

Any farmer operating land located within the watersheds of Blue Dog, Enemy Swim, and Pickerel Lakes. A map of each lake's watershed is provided on the back page. Priority will be given to certain areas of these watersheds.

Priority areas include:

- Animal feeding operations located adjacent to lakeshores or tributaries.
- Cropland or pastures bordering lakeshores.
- Cropland or pastures bordering tributaries or drainage's.
- Cropland or pastures identified by water quality assessment as potentially contributing nonpoint source pollution to surface waters. (These areas will be confirmed by on-site visits with the operator)

What Practices will be cost-shared?

Funds have been obtained to pay the operator a maximum of seventy-five percent (75%) of the total cost to implement the following conservation practices.

- Animal Waste Management Systems
- Clean Water Diversion Systems
- Feedlot Relocation
- Nutrient Management Planning
- Grassed Waterways
- Grass/Riparian Buffer Strips
- Critical Area Plantings
- Cattle Stream Crossings
- Cross fencing for prescribed grazing systems
- Pasture water development (including wells, dugouts, tanks and troughs, nose pumps, windmills)
- Pasture Renovation and Planting

How do I sign-up for these programs?

Sign-up for this program is continuous, contact either the Roberts or Day Conservation Districts for more information. Applicants will be ranked according to priority areas, water quality and environmental benefits, and cost-share buy down.

Lake Conservation Notes

Day Conservation District
600 East Hwy 12, Suite 1
Webster, SD 57274
Phone: 605/345-4661

Reducing Nonpoint Source Pollution—Protection Tips for Lake Property Owners

Nonpoint source pollution can come from agricultural land in a lakes watershed or from developed property along its shoreline. How you manage your lake property directly affects the lakes water quality. Listed below are several best management practices (BMPs) that lake property owners can implement to protect and improve your lake's water quality.

1. **Do not wash boats, pets, or other objects in the lake.**

2. **Use non-phosphate detergents when washing clothes and dishes at your lake home or cabin.**

3. **Do not wash cars, lawnmowers or tractors where wash water can drain into the lake.**

Wash water can contain gasoline, oil, and grease removed by cleaning products. Even though some products say "biodegradable", they may contain chemicals harmful to a lakes fragile ecosystem. Grass clippings cleaned from lawnmowers can also place unwanted nutrients like phosphate into the lake. Never place used motor oil on gravel roads or dirt paths to hold down dust. These can enter and pollute both surface and ground water.

4. **Before fertilizing your lawn or garden, have the soil tested!**

Have your soil tested for both nitrates and phosphates. Apply only the type of nutrient needed at the recommended amount and rate using a calibrated spreader. Never apply fertilizer to hard surfaces such as concrete, asphalt, brick, rock or dirt paths. Fertilizer applied to these surfaces will easily wash away and could enter the lake where it is not needed! Consider placing buffer zones between the lake and your groomed lawn.

5. Do not burn leaves, brush, or grass clippings along your shoreline!

The remaining ash contains nutrients detrimental to your lake. Try composting this material in an area where drainage to the lake is minimal. This compost makes an excellent mulch when worked into gardens and flower beds.

6. If you remove aquatic plants from the lake by raking or cutting, move them from the shoreline to a compost pile or area where drainage to the lake is minimal.

Aquatic plants left to decompose on shore will only provide nutrients for further plant growth including algae.

7. Leave a 20 foot buffer strip of natural vegetation between your yard and the shoreline.

When natural vegetation, especially trees, is removed from a shoreline, banks weaken and erosion usually follows. Rather than a well-manicured lawn, leave a 20 foot strip of natural vegetation along your shoreline where native trees, shrubs, grasses and herbaceous plants can grow. Buffer strips can retain excess nutrients and trap sediments from yard run-off before reaching the lake. Careful pruning of shoreline trees and shrubs can leave open areas to view the lake. Instead of a dirt path, build wooden steps down to the lakes shoreline to prevent erosion from human traffic. If you have already removed the natural vegetation along your shoreline, consider replanting a buffer strip using native vegetation, or leave an undisturbed strip of grass as a buffer strip between your manicured lawn and the shoreline.

8. Avoid dumping sand to create or replenish beaches on your lake front property.

Sandy beaches are nice, however dumping sand along your shoreline can create water quality problems. Adding sand to beaches or shorelines increases the rate of sedimentation to the lake. Dumping sand along your shore can damage or destroy natural spawning and nesting sites for fish, and smother bottom dwelling plants and invertebrates that young fish depend upon for food. Sand from gravel pits may contain contaminants like iron, phosphorus, or clay which increases the waters turbidity. If your property has a natural beach, consider yourself lucky!

9. Reduce the speed of motorboats and jet skis near shorelines!

The wakes of these crafts can cause shoreline erosion. A speed that produces no wake should be observed when water-skiing or operating your boat or jet ski within 150 feet of the shoreline.

APPENDIX B

Enemy Swim Lake
Wastewater Collection and Treatment Feasibility Study

A Report to the Day County Conservation District

Prepared by:

Clark Engineering Corporation 1011 1st Ave SE
PO Box 20
Aberdeen, SD 57402

2004

Enemy Swim Lake Wastewater Collection and Treatment Feasibility Study

A Report to the Day County Conservation District

I hereby certify that this Feasibility Report was prepared by me or under my direct supervision. I am a duly Registered Professional Engineer under the laws of the State of South Dakota.

Date

Reg.No.

TABLE OF CONTENTS

INTRODUCTION

Enemy Swim Lake is a 2,150-acre lake located in the Glacial Lakes region of Northeast South Dakota in Day County. Because of its high water quality and clarity, Enemy Swim Lake is a popular recreation destination in the Glacial Lakes area. More recent water quality assessments indicate increased nutrient loadings from cropland runoff, animal feeding operations, and leaching septic systems are resulting in a decrease in water quality and clarity in the lake.

There are approximately 260 homes, resort cabins, and recreational facilities located along the shores of the lake. Figure 1 shows the location of Enemy Swim Lake in Day County, SD. Wastewater generated by users of these homes and cabins, is presently collected, and treated or disposed of by individual septic tank and drain field systems, holding tanks or pit privies (outhouses). Many of these existing systems are likely not in compliance with the South Dakota Department of Environment and Natural Resources (DENR) Administrative Rules, Chapter *74:53:01, Individual and Small On-Site Wastewater Systems.* These rules establish the criteria for location and construction of individual wastewater collection and treatment systems such as those in existence at Enemy Swim Lake.

This study will provide an evaluation of and Opinions of Probable Cost for the construction of a Septic Tank Effluent Collection System at Enemy Swim Lake. This type of system utilizes small diameter pressure sewers, and septic tank effluent pumping units (S.T.E.P.) for collection and transport of domestic wastewater from individual homes and cabins. A sketch of a typical Septic Tank Effluent Pumping System is shown in Figure 2. This is the type of collection system constructed in 1997-1998 for the NeSoDak Bible Camp on Enemy Swim Lake. The NeSoDak system carries wastewater to a Duplex Submersible Pump Lift Station located near the SD Game, Fish, and Parks Lake Access area on Church Bay of Enemy Swim Lake. From there, wastewater is carried to the gravity sanitary sewer system in the Enemy Swim housing community located immediately south of the lake. Wastewater from NeSoDak enters the Enemy Swim housing sewer system and is carried to the Two-Cell Stabilization Pond located south of the Enemy Swim Housing community. Lutheran Outdoors who manages NeSoDak has an agreement with the Sisseton Wahpeton Sioux Tribe providing for the discharge of wastewater from the NeSoDak System to the Enemy Swim Housing system.

This Feasibility Study will evaluate additional Septic Tank Effluent Collection Systems for areas on the north, west, and south sides of Enemy Swim Lake. This study will evaluate the ability of the treatment facility for the Enemy Swim Housing community to handle additional flows from these areas.

A Septic Tank Effluent Collection System constructed to serve users on the east side of the lake, -- East Lake Developments, would likely discharge to a new total retention stabilization pond constructed in that area.

Septic Tank Effluent Collection Systems are evaluated and Opinions of Probable Cost are provided for the following:

Project A:	Wastewater Collection for all areas of the lake.
Project B:	Wastewater Collection and Treatment for the users in the Camp Dakota, South Enemy Swim Addition, and Block's Bay areas.
Project C:	Wastewater Collection for users in the Pleasure Park and Pebble Beach area with wastewater being routed to the Pickerel Lake Stabilization Ponds
Project D:	Wastewater Collection and Treatment for the users in the East Lake Development.

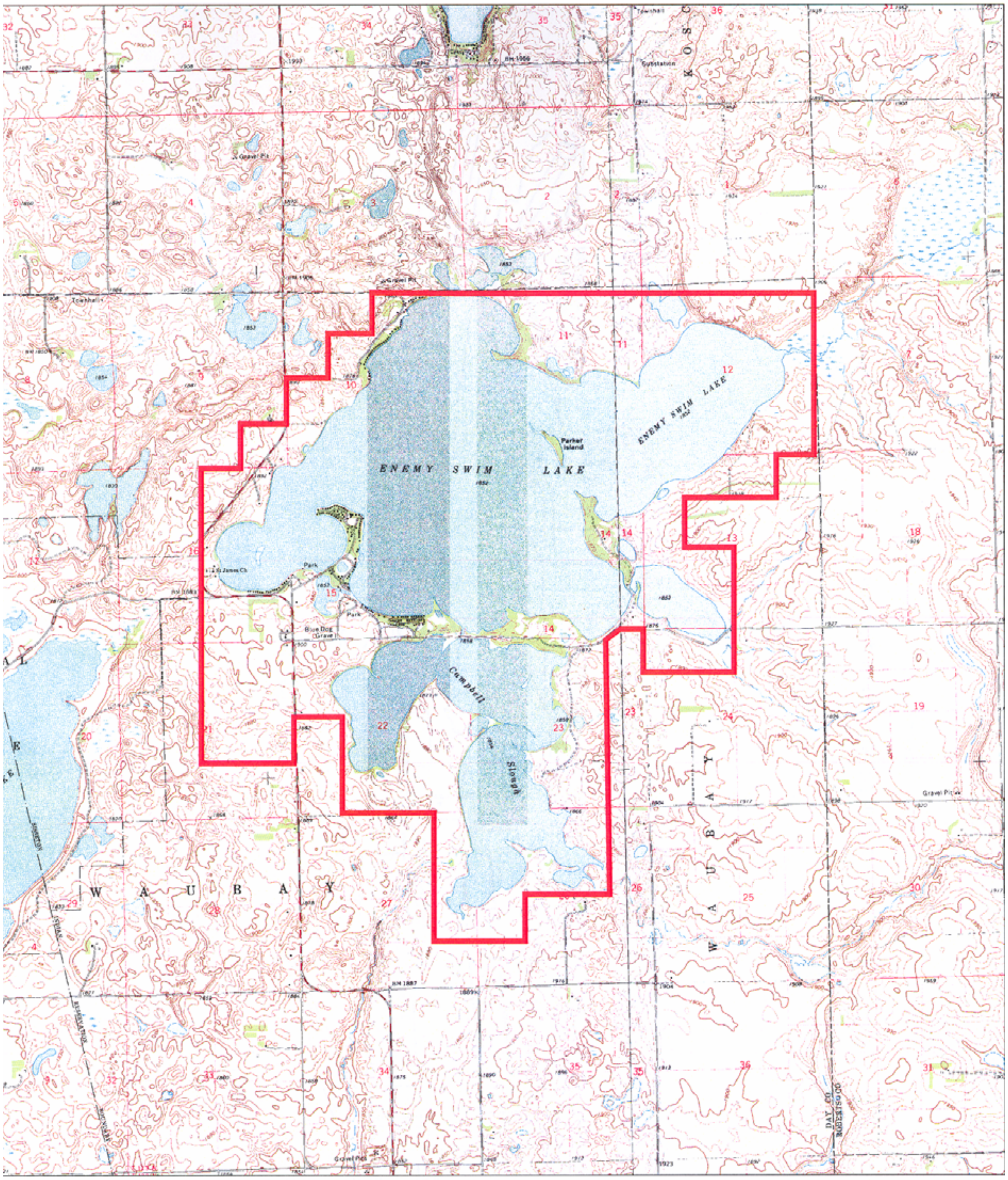
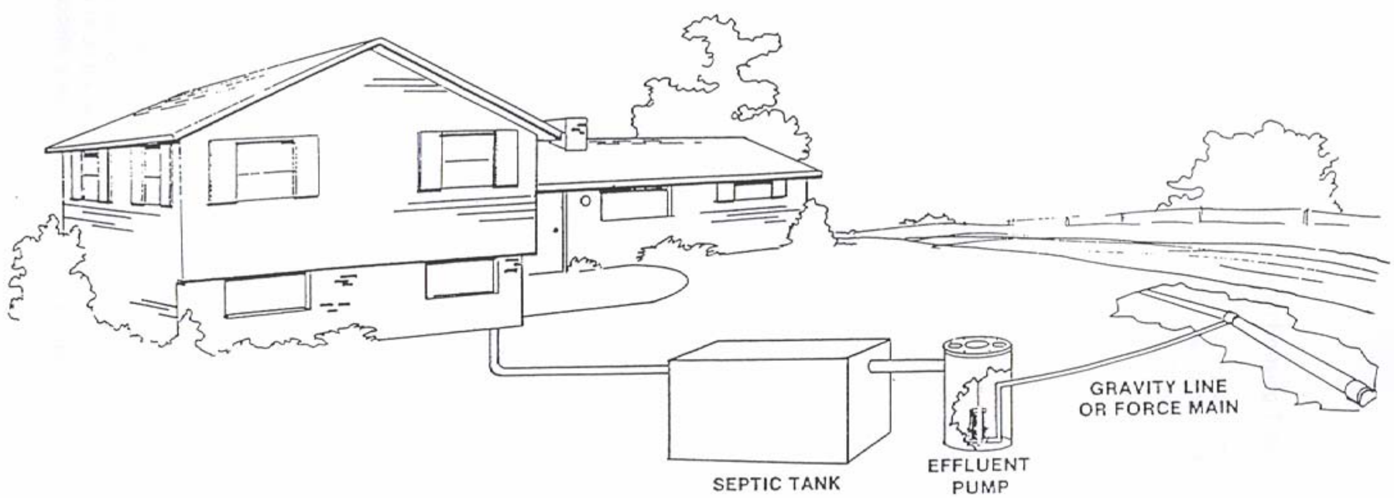

ENEMY SWIM LAKE
ENEMY SWIM LAKE
Parker Island
Campbell
Slough
W A U B A Y
Park
Blue Dog Grave
Gravel Pit
Substation
Townhall

FIGURE 1



Septic Tank Effluent Pumping System

Figure 2

Use of the NeSoDak System and the Enemy Swim Housing Treatment Facility.

As stated, a Septic Tank Effluent Collection System is in place to serve the NeSoDak Bible Camp on Enemy Swim Lake. The system was designed and constructed to accommodate additional users on the peninsula as well as the Sandy Beach Resort area. The system can also accommodate users along the south side of Church Bay (the Block's Bay area).

Challenging construction conditions and limited space for yet another buried utility line in the road leading to NeSoDak all but dictates those users on the peninsula connect to the existing NeSoDak system.

Users along the south side of Church Bay can also be readily served by connection to the existing lift Station at the Game, Fish, & Parks, access area on Church Bay.

An evaluation of the capacity of the treatment facility that serves the Enemy Swim Housing Community is provided in Appendix A. A projection of the volume of wastewater to be collected and treated from the various project areas is provided in Appendix B.

Project Descriptions

Project A

This System provides collection to all users on Enemy Swim Lake except those in the East Lake Developments. The distance separating the East Lake Developments from a central collection system for other areas makes the connection of the East Lake area to the central system cost prohibitive. This situation is discussed in more detail in the description for Project D.

The Project A system routes all wastewater to the southwest corner of Enemy Swim Lake. The arrangement of the system is shown in Figure 3.

As indicated by the information provided in Appendices A and B, the existing treatment facility for the Enemy Swim Housing Community is not large enough to accept the additional wastewater flows that this system will create.

Therefore, this system will require either a 4.5 Acre addition to the Enemy Swim Housing treatment facility, or a newly constructed treatment facility located on the west or southwest side of Enemy Swim Lake.

Project B

This system provides collection of wastewater for the users on the Camp Dakota Peninsula, South Enemy Swim Addition, along the south side of Church Bay, and the Marguerite Park development on Campbell Slough. Camp Dakota users will be connected to the existing NeSoDak system. The users in South Enemy Swim Addition, and Marguerite Park, will be connected to a new Lift Station on the north side of Campbell Slough. This lift station will carry wastewater to the Enemy Swim Housing Community gravity system. As indicated in Appendices A and B, this project will require a 3.0 acre addition to the Enemy Swim Housing Community treatment facility. The system for the users on the south side of Church Bay will be routed to the existing lift station at the Game, Fish, and Parks access area on Church Bay. The arrangement of this system is shown in Figure 4.

Project C

Project C provides a Septic Tank Effluent Collection System for the users on the north side of the lake in the Pleasure Park and Pebble Beach areas. This system will carry wastewater to the existing Pickerel Lake Stabilization Ponds. This system is shown in Figure 5.

Project D

This project provides wastewater collection and treatment to the users in the East Lake Development. This is a separate system from the other systems on the lake. The system is a Septic Tank Effluent Collection System and a Single-Cell Total Retention Stabilization Pond. This system is shown in Figure 6.

The distance between the East Lake area and the other areas makes connection of the East Lake area to other areas cost prohibitive. The length of line (force main} required to bring wastewater from the East Lake area is shown in Figure 7. A route that followed the existing road to reach a collection system on the south side of Enemy Swim Lake would be 21,000 plus feet in length. This is shown as Route 1 on Figure 7. A possible shorter route is shown on Figure 7 as Route 2. However, construction along this route may be difficult or impossible in the areas between Enemy Swim Lake and the adjacent bodies of water. This route would also require easements for construction of the line on private property.

The pipe installation costs for a 21,000 ft force main will be $257,250.00. This does not include appurtenances such as air relief valves and manholes, etc. This cost far exceeds the cost of constructing a small total retention pond to serve the users on East Lake.

FIGURE 3
PROJECT "A"

FIGURE 4
PROJECT "B"

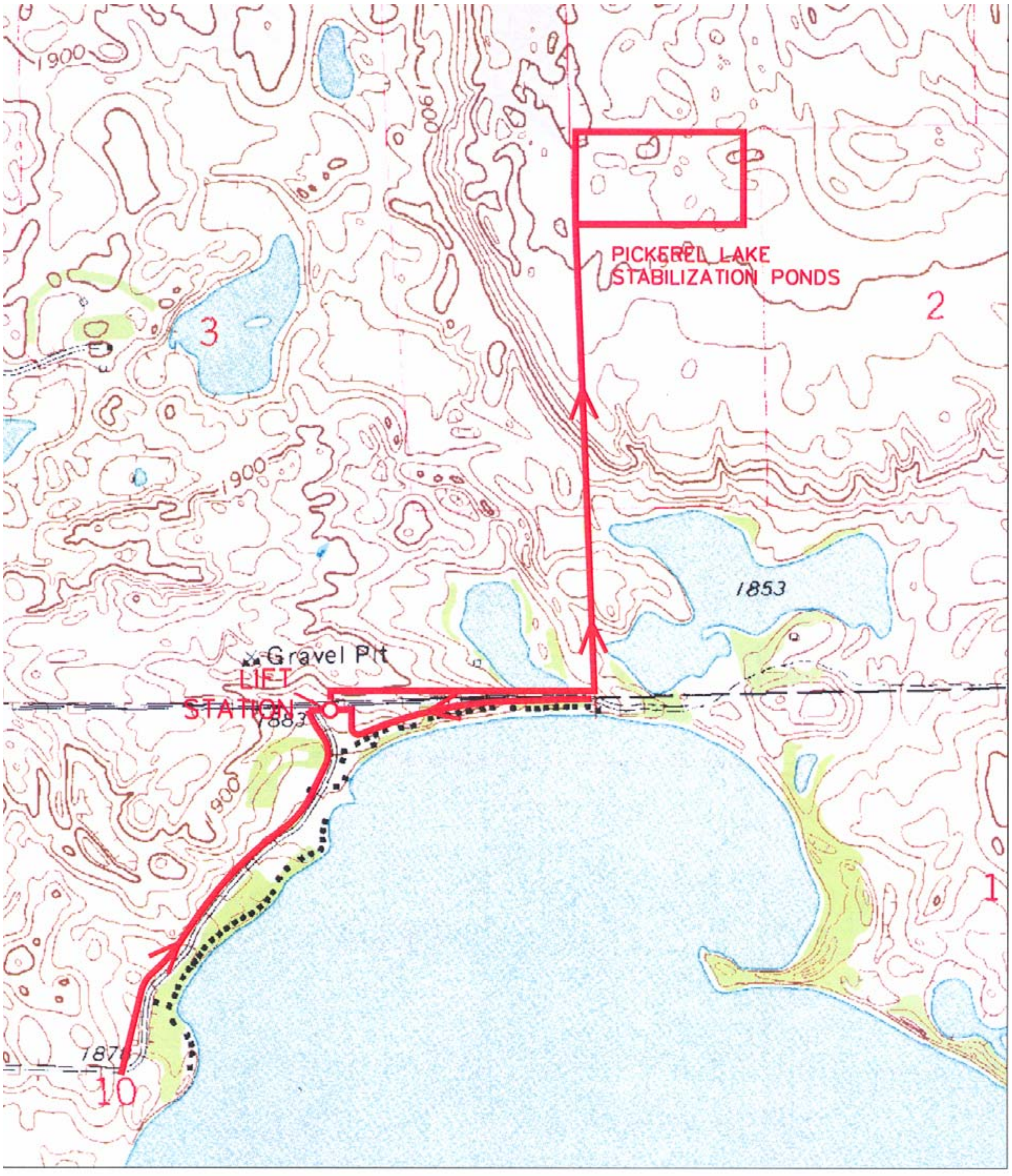


FIGURE 5
PROJECT "C"

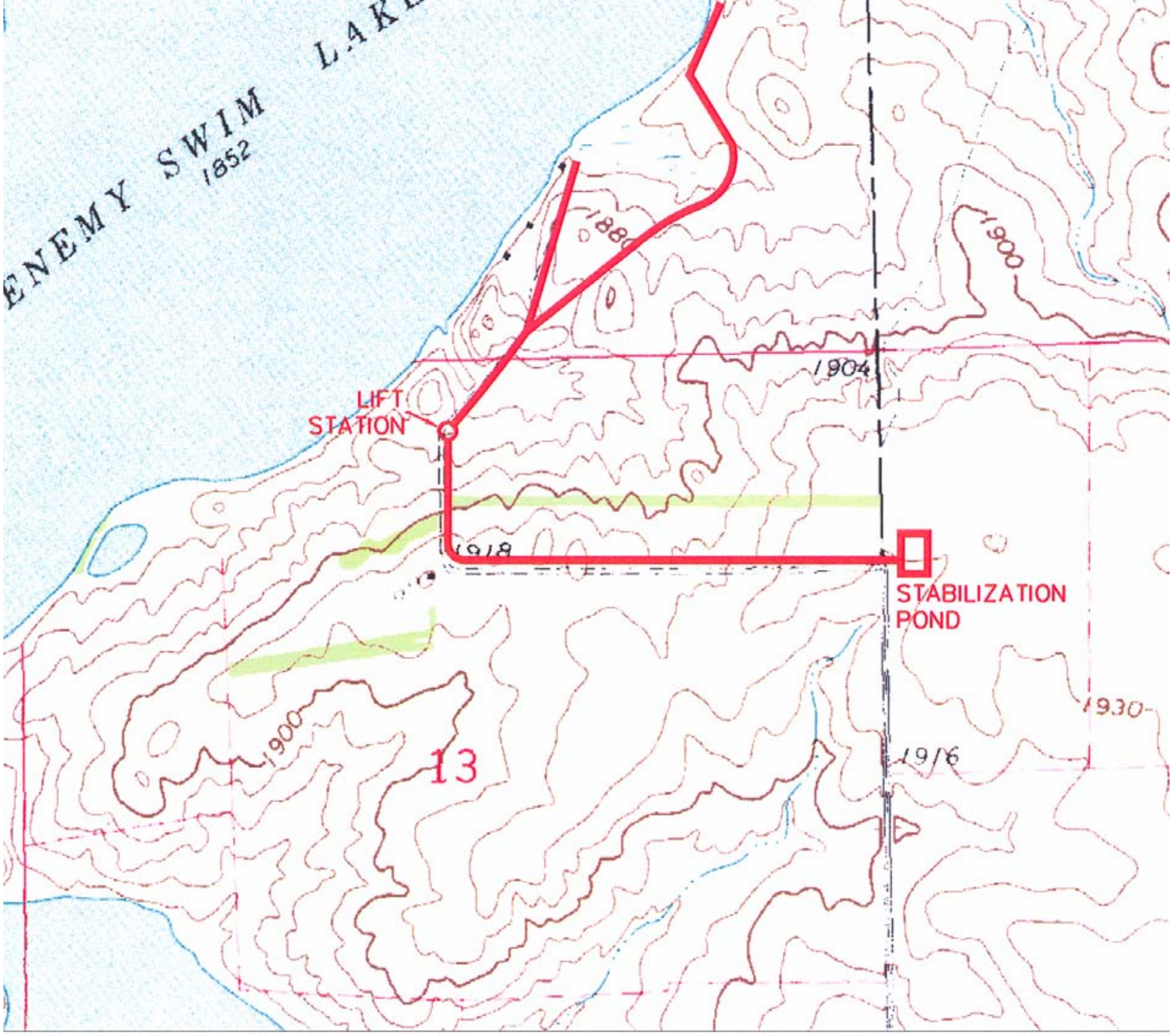


FIGURE 6
PROJECT "D"


Gravel Pit
Parker Island
ENEMY SWIM LAKE
ENEMY SWIM LAKE
Campbell
ROUTE #2
ROUTE #1
ROUTE #2
ROUTE #1
Park

FIGURE 7

OPINION OF PROBABLE COST –PROJECT A

Project A -- Wastewater Collection for All Areas of Enemy Swim Lake

This Opinion of Probable Cost is prepared based on estimated construction quantities and projected construction costs for years up to the 2006 construction season. Construction costs may increase significantly for periods beyond that time.

PLEASURE PARK & PEBBLE BEACH

NO.	ITEM	QUANTITY	UNIT PRICE	COST
1	1 .5" PVC	4000 LF	11.00	$44,000.00
2	2"PVC	900 LF	11.25	$10,125.00
3	2.5" PVC	3110 LF	11.75	$36,542.50
4	3"PVC	2120 LF	12.25	$25,970.00
5	4" PVC SERVICE LATERAL	4000 LF	12.25	$49,000.00
6	EFFLUENT PUMP STATION	43 EA	7500.00	$322,500.00
7	1.5" GATE VALVE & BOX	43 EA	450.00	$19,350.00
8	REPLACE SEPTIC TANK	40 EA	2250.00	$90,000.00
10	DUPLEX LIFT STATION	1 LS	100000.00	$100,000.00
11	4" PVC FORCE MAIN	4500 LF	12.25	$55,125.00
12	AIR RELEASE MANHOLE	6 EA	5000.00	$30,000.00
13	CLEAN OUT	6 EA	800.00	$4,800.00
14	RESTORATION	1 LS	8500.00	$8,500.00
15	GRAVEL RESTORATION	2000 T	8.00	$16,000.00
		CONSTRUCTION SUBTOTAL		***$811,912.50***

WOODLAND PARK (leased land)

1	1.5" PVC	1500 LF	11.00	$16,500.00
2	2"PVC	LF	11.25	$0.00
3	2.5" PVC	LF	11.75	$0.00
4	3"PVC	5700 LF	12.25	$69,825.00
5	4" PVC SERVICE LATERAL	1800 LF	12.25	$22,050.00
6	EFFLUENT PUMP STATION	14 EA	7500.00	$105,000.00
7	1.5" GATE VALVE & BOX	14 EA	450.00	$6,300.00
8	REPLACE SEPTIC TANK	12 EA	2250.00	$27,000.00
10	DUPLEX LIFT STATION	1 LS	100000.00	$100,000.00
11	4" PVC FORCE MAIN	7200 LF	12.25	$88,200.00
12	AIR RELEASE MANHOLE	4 EA	5000.00	$20,000.00
13	CLEAN OUT	4 EA	800.00	$3,200.00
14	RESTORATION	1 LS	4500.00	$4,500.00
15	GRAVEL RESTORATION	600 T	8.00	$4,800.00
		CONSTRUCTION SUBTOTAL		***$467,375.00***

CAMP DAKOTA (peninsula)

NO.	ITEM	QUANTITY	UNIT PRICE	COST
1	1.5" PVC	2000 LF	13.00	$26,000.00
2	2"PVC	930 LF	13.25	$12,322.50
3	2.5" PVC	1270 LF	13.50	$17,145.00
4	3"PVC	0 LF	14.00	$0.00
5	4" PVC SERVICE LATERAL	2000 LF	14.00	$28,000.00
6	EFFLUENT PUMP STATION	22 EA	7500.00	$165,000.00
7	1.5" GATE VALVE & BOX	22 EA	450.00	$9,900.00
8	REPLACE SEPTIC TANK	20 EA	2250.00	$45,000.00
12	AIR RELEASE MANHOLE	2 EA	5000.00	$10,000.00
13	CLEAN OUT	4 EA	800.00	$3,200.00
14	RESTORATION	1 LS	5000.00	$5,000.00
15	GRAVEL RESTORATION	600 T	8.00	$4,800.00
		CONSTRUCTION SUBTOTAL		***$326,367.50***

SANDY BEACH RESORT AREA

1	1.5" PVC	2000 LF	13.00	$26,000.00
2	2"PVC	1100 LF	13.25	$14,575.00
3	2.5" PVC	1350 LF	13.50	$18,225.00
4	3"PVC	0 LF	14.00	$0.00
5	4" PVC SERVICE LATERAL	2000 LF	14.00	$28,000.00
6	EFFLUENT PUMP STATION	24 EA	7500.00	$180,000.00
7	1.5" GATE VALVE & BOX	24 EA	450.00	$10,800.00
8	REPLACE SEPTIC TANK	24 EA	2250.00	$54,000.00
12	AIR RELEASE MANHOLE	3 EA	5000.00	$15,000.00
13	CLEAN OUT	4 EA	800.00	$3,200.00
14	RESTORATION	1 LS	5000.00	$5,000.00
15	GRAVEL RESTORATION	600 T	8.00	$4,800.00
		CONSTRUCTION SUBTOTAL		***$359,600.00***

SOUTH ENEMY SWIM ADDITION

NO.	ITEM	QUANTITY	UNIT PRICE	COST
1	1.5" PVC	3500 LF	13.00	$45,500.00
2	2"PVC	LF	13.25	$0.00
3	2.5" PVC	3800 LF	13.50	$51,300.00
4	3"PVC	820 LF	14.00	$11,480.00
5	4" PVC SERVICE LATERAL	3000 LF	14.00	$42,000.00
6	EFFLUENT PUMP STATION	35 EA	7500.00	$262,500.00
7	1.5" GATE VALVE & BOX	35 EA	450.00	$15,750.00
8	REPLACE SEPTIC TANK	35 EA	2250.00	$78,750.00
10	DUPLEX LIFT STATION	1 LS	100000.00	$100,000.00
11	4" PVC FORCE MAIN	3000 LF	12.25	$36,750.00
12	AIR RELEASE MANHOLE	4 EA	5000.00	$20,000.00
13	CLEAN OUT	4 EA	800.00	$3,200.00
14	RESTORATION	1 LS	7000.00	$7,000.00
15	GRAVEL RESTORATION	1500 T	8.00	$12,000.00
		CONSTRUCTION SUBTOTAL		***$686,230.00***

BLOCK"S BAY AREA

1	1.5" PVC	1200 LF	12.00	$14,400.00
2	2"PVC	0 LF	12.25	$0.00
3	2.5" PVC	1700 LF	12.50	$21,250.00
4	3"PVC	1 000 LF	13.00	$13,000.00
5	4" PVC SERVICE LATERAL	1500 LF	13.00	$19,500.00
6	EFFLUENT PUMP STATION	18 EA	7500.00	$135,000.00
7	1.5" GATE VALVE & BOX	18 EA	450.00	$8,100.00
8	REPLACE SEPTIC TANK	14 EA	2250.00	$31,500.00
12	AIR RELEASE MANHOLE	2 EA	5000.00	$10,000.00
13	CLEAN OUT	2 EA	800.00	$1,600.00
14	RESTORATION	1 LS	5500.00	$5,500.00
15	GRAVEL RESTORATION	700 T	8.00	$5,600.00
		CONSTRUCTION SUBTOTAL		$265,450.00
16	4.5 Acre Stabilization Pond Addition to Enemy Swim Facility	1 LS	120000.00	$120,000.00
		CONSTRUCTION SUBTOTAL		***$385,450.00***

EAST LAKE DEVELOPMENT

NO.	ITEM	QUANTITY	UNIT PRICE	COST
1	1.5" PVC	3500 LF	11.00	$38,500.00
2	2" PVC	LF	11.25	$0.00
3	2.5" PVC	800 LF	11.75	$9,400.00
4	3" PVC	3500 LF	12.25	$42,875.00
5	4" PVC SERVICE LATERAL	650 LF	12.25	$7,962.50
6	EFFLUENT PUMP STATION	6 EA	7500.00	$45,000.00
7	1.5" GATE VALVE & BOX	6 EA	450.00	$2,700.00
8	REPLACE SEPTIC TANK	6 EA	2250.00	$13,500.00
10	DUPLEX LIFT STATION	1 LS	100000.00	$100,000.00
11	4" PVC FORCE MAIN	3350 LF	12.25	$41,037.50
12	AIR RELEASE MANHOLE	2 EA	5000.00	$10,000.00
13	CLEAN OUT	3 EA	800.00	$2,400.00
14	RESTORATION	1 LS	15000.00	$15,000.00
15	GRAVEL RESTORATION	1000 T	8.00	$8,000.00
16	STABILIZATION POND	1 EA	40000.00	$40,000.00
	EASEMENTS FOR FORCE MAIN	4000 LF	5.00	$20,000.00
	LAND PURCHASE	1 LS	10000.00	$10,000.00
			CONSTRUCTION SUBTOTAL	***$406,375.00***
	CONSTRUCTION SUBTOTAL - ALL AREAS			$3,443,310.00
	CONTINGENCIES (15%)			$516,496.50
	GEOTECHNICAL ENGINEERING G			$8,000.00
	DESIGN SURVEY			$75,000.00
	DESIGN ENGINEERING			$150,000.00
	CONSTRUCTION ENGINEERING & ADMINISTRATION			$275,000.00
	LEGAL/ADMINISTRATION			$50,000.00
			TOTAL PROJECT COST	**$4,517,806.50**

OPINION OF PROBABLE COST – PROJECT B

Project B -- Wastewater Collection for Users on the Camp Dakota Peninsula, Sandy Beach Resort Area, South Enemy Swim Addition, and Block's Bay Areas

This Opinion of Probable Cost is prepared based on estimated construction quantities and projected construction costs for years up to the 2006 construction season. Construction costs may increase significantly for periods beyond that time.

CAMP DAKOTA PENINSULA

NO.	ITEM	QUANTITY	UNIT PRICE	COST
1	1.5" PVC	2000 LF	13.00	$26,000.00
2	2" PVC	930 LF	13.25	$12,322.50
3	2.5" PVC	1270 LF	13.50	$17,145.00
4	3" PVC	0 LF	14.00	$0.00
5	4" PVC SERVICE LATERAL	2000 LF	14.00	$28,000.00
6	EFFLUENT PUMP STATION	22 EA	7500.00	$165,000.00
7	1.5" GATE VALVE & BOX	22 EA	450.00	$9,900.00
8	REPLACE SEPTIC TANK	20 EA	2250.00	$45,000.00
12	AIR RELEASE MANHOLE	2 EA	5000.00	$10,000.00
13	CLEAN OUT	4 EA	800.00	$3,200.00
14	RESTORATION	1 LS	5000.00	$5,000.00
15	GRAVEL RESTORATION	600 T	8.00	$4,800.00
			CONSTRUCTION SUBTOTAL	***$326,367.50***

SANDY BEACH RESORT AREA

NO.	ITEM	QUANTITY	UNIT PRICE	COST
1	1.5" PVC	2000 LF	13.00	$26,000.00
2	2" PVC	1100 LF	13.25	$14,575.00
3	2.5" PVC	1350 LF	13.50	$18,225.00
4	3" PVC	0 LF	14.00	$0.00
5	4" PVC SERVICE LATERAL	2000 LF	14.00	$28,000.00
6	EFFLUENT PUMP STATION	24 EA	7500.00	$180,000.00
7	1.5" GATE VALVE & BOX	24 EA	450.00	$10,800.00
8	REPLACE SEPTIC TANK	24 EA	2250.00	$54,000.00
12	AIR RELEASE MANHOLE	3 EA	5000.00	$15,000.00
13	CLEAN OUT	4 EA	800.00	$3,200.00
14	RESTORATION	1 LS	5000.00	$5,000.00
15	GRAVEL RESTORATION	600 T	8.00	$4,800.00
			CONSTRUCTION SUBTOTAL	***$359,600.00***

SOUTH ENEMY SWIM ADDITION

NO.	ITEM	QUANTITY	UNIT PRICE	COST
1	1.5" PVC	3500 LF	13.00	$45,500.00
2	2" PVC	LF	13.25	$0.00
3	2.5" PVC	3800 LF	13.50	$51,300.00
4	3" PVC	820 LF	14.00	$11,480.00
5	4" PVC SERVICE LATERAL	3000 LF	14.00	$42,000.00
6	EFFLUENT PUMP STATION	35 EA	7500.00	$262,500.00
7	1.5" GATE VALVE & BOX	35 EA	450.00	$15,750.00
8	REPLACE SEPTIC TANK	35 EA	2250.00	$78,750.00
10	DUPLEX LIFT STATION	1 LS	100000.00	$100,000.00
11	4" PVC FORCE MAIN	3000 LF	12.25	$36,750.00
12	AIR RELEASE MANHOLE	4 EA	5000.00	$20,000.00
13	CLEAN OUT	4 EA	800.00	$3,200.00
14	RESTORATION	1 LS	7000.00	$7,000.00
15	GRAVEL RESTORATION	1500 T	8.00	$12,000.00
			CONSTRUCTION SUBTOTAL	***$686,230.00***

BLOCK'S BAY

NO.	ITEM	QUANTITY	UNIT PRICE	COST
1	1.5" PVC	1200 LF	12.00	$14,400.00
2	2" PVC	LF	12.25	$0.00
3	2.5" PVC	1700 LF	12.50	$21,250.00
4	3" PVC	1000 LF	13.00	$13,000.00
5	4" PVC SERVICE LATERAL	1500 LF	13.00	$19,500.00
6	EFFLUENT PUMP STATION	18 EA	7500.00	$135,000.00
7	1.5" GATE VALVE & BOX	18 EA	450.00	$8,100.00
8	REPLACE SEPTIC TANK	14 EA	2250.00	$31,500.00
12	AIR RELEASE MANHOLE	2 EA	5000.00	$10,000.00
13	CLEAN OUT	2 EA	800.00	$1,600.00
14	RESTORATION	1 LS	5500.00	$5,500.00
15	GRAVEL RESTORATION	700 T	8.00	$5,600.00
16	3.0 Acre Addition to Enemy Swim Facility	1 LS	80000.00	$80,000.00
			CONSTRUCTION SUBTOTAL	***$345,450.00***
	CONSTRUCTION SUBTOTAL - ALL AREAS			$1,717,647.50
	CONTINGENCIES (15%)			$257,647.13
	GEOTECHNICAL ENGINEERING			$6,000.00
	DESIGN SURVEY			$12,500.00
	DESIGN ENGINEERING			$90,000.00
	CONSTRUCTION ENGINEERING & ADMINISTRATION			$130,000.00
	LEGAL/ADMINISTRATION			$20,000.00
			TOTAL PROJECT COST	**$2,233,794.63**

OPINION OF PROBABLE COST – PROJECT C

Project C -- Wastewater Collection for Users in the Pleasure Park - Pebble Beach areas. Wastewater routed to Pickerel lake Stabilization Ponds

This Opinion of Probable Cost is prepared based on estimated construction quantities and projected construction costs for years up to the 2006 construction season. Construction costs may increase significantly for periods beyond that time.

NO.	ITEM	QUANTITY	UNIT PRICE	COST
1	1.5" PVC	4000 LF	11.00	$44,000.00
2	2" PVC	900 LF	11.25	$10,125.00
3	2.5" PVC	3110 LF	11.75	$36,542.50
4	3" PVC	2120 LF	12.25	$25,970.00
5	4" PVC SERVICE LATERAL	4000 LF	12.25	$49,000.00
6	EFFLUENT PUMP STATION	43 EA	7500.00	$322,500.00
7	1.5" GATE VALVE & BOX	43 EA	450.00	$19,350.00
8	REPLACE SEPTIC TANK	40 EA	2250.00	$90,000.00
10	DUPLEX LIFT STATION	1 LS	100000.00	$100,000.00
11	4" PVC FORCE MAIN	6000 LF	12.25	$73,500.00
12	AIR RELEASE MANHOLE	6 EA	5000.00	$30,000.00
13	CLEAN OUT	6 EA	800.00	$4,800.00
14	RESTORATION	1 LS	8500.00	$8,500.00
15	GRAVEL RESTORATION	2000 T	8.00	$16,000.00
	CONSTRUCTION SUBTOTAL			$830,287.50
	CONTINGENCIES (15%)			$124,543.13
	GEOTECHNICAL ENGINEERING			$4,000.00
	DESIGN SURVEY			$22,000.00
	DESIGN ENGINEERING			$40,000.00
	CONSTRUCTION ENGINEERING & ADMINISTRATION			$80,000.00
	LEGAL/ADMINISTRATION			$15,000.00
			TOTAL PROJECT COST	**$1,115,830.63**

OPINION OF PROBABLE COST – PROJECT D

Project D -- Wastewater Collection and Treatment for the East Lake Development

This Opinion of Probable Cost is prepared based on estimated construction quantities and projected construction costs for years up to the 2006 construction season. Construction costs may increase significantly for periods beyond that time.

NO.	ITEM	QUANTITY	UNIT PRICE	COST
1	1.5" PVC	3500 LF	11.00	$38,500.00
2	2" PVC	0 LF	11.25	$0.00
3	2.5" PVC	800 LF	11.75	$9,400.00
4	3" PVC	3500 LF	12.25	$42,875.00
5	4" PVC SERVICE LATERAL	650 LF	12.25	$7,962.50
6	EFFLUENT PUMP STATION	6 EA	7500.00	$45,000.00
7	1.5" GATE VALVE & BOX	6 EA	450.00	$2,700.00
8	REPLACE SEPTIC TANK	6 EA	2250.00	$13,500.00
10	DUPLEX LIFT STATION	1 LS	100000.00	$100,000.00
11	4" PVC FORCE MAIN	3350 LF	12.25	$41,037.50
12	AIR RELEASE MANHOLE	2 EA	5000.00	$10,000.00
13	CLEAN OUT	3 EA	800.00	$2,400.00
14	RESTORATION	1 LS	15000.00	$15,000.00
15	GRAVEL RESTORATION	1000 T	8.00	$8,000.00
16	STABILIZATION POND (0.75 Acre)	1 EA	35000.00	$35,000.00
	EASEMENTS FOR FORCE MAIN	4000 LF	5.00	$20,000.00
	LAND PURCHASE	1 LS	5000.00	$5,000.00
	CONSTRUCTION SUBTOTAL			$396,375.00
	CONTINGENCIES (15%)			$59,456.25
	GEOTECHNICAL ENGINEERING			$4,000.00
	DESIGN SURVEY			$10,000.00
	DESIGN ENGINEERING			$20,000.00
	CONSTRUCTION ENGINEERING & ADMINISTRATION			$44,000.00
	LEGAL/ADMINISTRATION			$30,000.00
			TOTAL PROJECT COST	**$563,831.25**

PROJECT FUNDING

Funding for construction of a project or projects to provide wastewater collection and treatment for Enemy Swim Lake will most likely come from a combination of loans, grants, and user's "connection" fees.

Competition for grant funds from the State of South Dakota or the USDA Rural Development Service to be used for projects such as wastewater collection and treatment at Enemy Swim Lake is high, and the amount of grant funding available annually is limited.

It is most likely that the majority of project funding will come from the State of South Dakota Revolving Loan Fund (SRF) and/or the USDA Rural Development Loan program (RD).

Slightly lower interest rates are available from the SRF program but the maximum length of term for the loan is 20 years. In September 2004, a 20 year SRF loan is available at 3.5%. Shorter term loans offer lower interest rates. RD Loans are available with a 40 year term. In 2004, interest rates for RD Loan ranged from 4.5% to 5.0%. For purposes of this report, a 5.0% rate will be used to evaluate costs to users.

Costs to users of a collection and treatment system at Enemy Swim Lake will include debt retirement costs and annual operating and maintenance (O&M) costs. The common practice is that costs be charged to all that the service is made available. In other words, all property owners are assessed the costs whether they elect to connect to the system or not. The basis of this principal is that the cost of installing the collection lines, running and maintaining the system, and administering the business of a sanitary district is the same whether or not certain property owners along the system choose to connect to the system. Some sanitary districts set a minimum O & M charge that all users (property owners) pay, and charge additional fees based on usage, either water usage or classification as seasonal or year-round user. The debt retirement costs are normally distributed uniformly to the property owners regardless of the amount of usage or the seasonal or year-round classification.

Some sanitary districts establish classifications for business and commercial connections to the system. This could be considered at Enemy Swim Lake.

It is also a common practice to set an initial "connection" fee to all users. This fee generates early or additional project funding that is used to reduce the amount the sanitary district must finance to construct the project. Users or property owners often have a choice to pay the "connection" fee in full or to finance all or part of the fee over a period of 5, 10, or more years. Financing is sometimes available through the sanitary district at a rate determined by the district, usually slightly higher than the rate at which the district can borrow funds.

Often a Sanitary District sets a higher "connection" fee for those wanting to connect to the system after construction is complete. This provides an incentive for all property owners to connect to the system during construction, and covers the added costs to accommodate the connection after the system connection is complete.

Estimate of a Monthly User Fee.

The following estimate of a monthly user fee is presented for general information and as a possible example of the costs that could be expected with one of the projects outlined in this report.

It is likely that a collection and treatment system at Enemy Swim lake will be constructed in phases. A project to provide collection and treatment to one area of the lake would be planned and constructed, and other projects to serve other areas of the lake planned and constructed as additional funding can be secured.

For this example, assume that the Project C as outlined in this report is completed. Project C provides a collection system for the Pleasure Park and Pebble Beach areas on the lake. The wastewater collected from these areas would be pumped to the Pickerel lake treatment facility located to the north of Enemy Swim.

The Estimated Total Cost for Project C is $1,115,830.00.

> There are approximately 10 year round homes and 40 seasonal homes in these two areas, or a total of 50 system users.
> The Sanitary District could set a connection fee of $1500/user.
> 50 users @ $2000.00/user = $100,000.00
> Assume 10% Grant Funding $111,583.00
> Balance of $904,247.00 to be financed
> $904,247.00 @ 5.0% for 40 years creates a monthly debt retirement cost of $4,358.47.
> $4,358.47/50users = $87.17/user for debt retirement.

This system will pump water to the Pickerel lake treatment facility. The Pickerel lake Sanitary District will likely charge a fee for the use of their facility. Assume a $3.00/month/user charge from the Pickerel lake District.

0& M costs are estimated to be $20 to $25 per user per month.

The total monthly user cost would be:

$87.17 Debt Retirement
$ 3.00 Pickerel lake Treatment Facility
<u>$25.00 0 & M Costs</u>
$115.17

Several factors could cause this fee to increase or decrease.

Increased Grant Funding could serve to decrease the monthly user cost.

Reduced amounts of Grant Funding will increase the fee unless offset by higher connection fees or some other source of funding.

Decreased or Increased Project costs could cause the monthly user cost to increase or decrease.

Increased or decreased O&M costs could cause the fee to increase or decrease.

A similar estimate can be calculated for Project B as described in the report. Project B would serve the south and southwest corner of Enemy Swim Lake.

Total Project Cost --- $2,233,794.00
115 Users
2 Resorts (Consider the two resorts equal to 5 users)
120 Total users
120 @ $ 2000.00 = $240,000.00 in connection fees
10% Grant = $223,379.00
$1,770,415.00 to finance @ 5.0%, 40 years.
Monthly debt retirement cost equals $8,533.40 or $71.11/user/month
O&M Costs = $25.00/user/month
Monthly Fee to SWS Tribe for use of Enemy Swim treatment facility = $3.00/user/month (estimate)
Total Monthly User Cost = $99.11

The examples presented above are estimates only. Before setting any fees the sanitary district must establish agreements with the Pickerel Lake Sanitary Sewer District and/or the Sisseton Wahpeton Sioux Tribe for the use of their treatment facilities. Those fees, along with the actual costs for construction and Operation and Maintenance (including administration costs) will determine the actual user fees to be paid.

APPENDIX A - Capacity of Enemy Swim Housing Treatment Facility

The Wastewater Treatment Facility for the Enemy Swim Housing Community consists of a 3.0 acre primary cell and a 1.5 acre second cell. The facility is design to provide total retention of wastewater.

Primary Cell -- 3.0 Acres

Water Loss

Evaporation
37 inches/year (1ft/12inches)(3.0 acres)(43,560sq. ft./acre) = 402,930 cubic feet

Percolation
1/16 inches/day (365 days/yr)(1ft/12inches)(3.0 acres)(43,560 sq. ft./acre) = 248,428 cubic feet

Total Water Loss in Primary Cell = 651,358 cubic feet

Second Cell -- 1.5 Acres

Water Loss

Evaporation
37 inches/year (1ft/12inches)(1.5 acres)(43,560sq. ft./acre) = 201,465 cubic feet

Percolation
1/8 inches/day (365 days/yr)(1ft/12inches)(1.5 acres)(43,560 sq. ft./acre) = 248,428 cubic feet

Total Water Loss In Second Cell = 449,893 cubic feet

Total Water Loss:
651,358 cubic feet + 449,893 cubic feet = 1,101,251 cubic feet or 8,237,357 gallons

Total Retention

For Total Retention

Influent + Precipitation - Evaporation- Percolation = 0
Or
Influent + Precipitation = Water Loss

The Enemy Swim Village facility serves a population of approximately 250 people.

250 people x 65 gallons/person/day x 365 days = 5,931,250 gallons

Influent = 5,931,250 gallons

Precipitation

21 inches/year
21 inches/12inches = 1.75 ft/ year
1.75 ft (3.0 Acres + 1.5 Acres)(43,560 ft/acre) = 343,035 cubic feet
343,035 cubic feet = 2,565,902 gallons

Influent (5,931,250 gallons) + Precipitation (2,565,902) - Water Loss (8,237,357gallons) = 259,795 gallons

The values used in the above calculations are typical values. Increased amounts of evaporation, percolation rates, or reduced wastewater contributions from users can all affect the ability of the facility to provide total retention of wastewater.

The treatment facility at the Enemy Swim Housing Community has seen greater rates of percolation through the floor of the two cells of the treatment facility. This likely adds to the ability of the facility to accommodate the added flows from the NeSoDak Camp system that pumps to the facility.

However, the existing Enemy Swim Housing Community system cannot likely accept added flows from other areas of Enemy Swim Lake without an addition to the facility.

APPENDIX B - Estimate of Wastewater Flows and Estimate of Area Required for Total Retention Facility

Project A -- All areas except East Lake Development

26 Permanent Homes
175 Seasonal Homes
NeSoDak Bible Camp
Bur Oak Resort
Sandy Beach Resort

Summer Flows (June - August)

Permanent Homes

26 x 2.5 person/home x 65 Gallons/Capita/Day (GPCD) x 92 Days = 388,700 Gallons

Seasonal Homes

175 x 3 persons/home x 40 GPCD x 35% Occupancy x 92 Days = 676,200 Gallons

NeSoDak Bible Camp

Design Flow for existing system = 11,500 Gal/Day (GPO)

11, 500 GPO x 92 Days = 1,058,000 Gallons

Bur Oak

Store/Cafe 300 GPD
7 Cabins x 2.5 person/cabin x 40 GPCD x 35% Occupancy = 245 GPD

(300 GPD + 245 GPD) x 92 Days = 50,140 Gallons

Sandy Beach

Store/Cafe 300 GPD
10 Cabins x 2.5 person/cabin x 40 GPCD x 35% Occupancy = 350 GPD

(300 GPD + 350 GPD) 92 Days = 59,800 Gallons

TOTAL SUMMER FLOWS:

388,700
676,200
1,058,000
50,140
59.800
2,232,840 Gallons

May, September, October Flows

Permanent Homes

26 x 2.5 person/home x 65 Gallons/Capita/Day (GPCD) x 92 Days = 388,700 Gallons

Seasonal Homes

175 x 3 persons/home x 40 GPCD x 10% Occupancy x 92 Days = 193,200 Gallons

NeSoDak Camp

11, 500 GPO x 20% x 92 Days = 211,600 Gallons

Bur Oak

Store/Cafe 150 GPD

7 Cabins x 2.5 person/cabin x 40 GPCD x 10% Occupancy = 70 GPO

(150 GPO + 70 GPD) x 92 Days = 20,240 Gallons

Sandy Beach

Store/Cafe 150 GPD

10 Cabins x 2.5 person/cabin x 40 GPCD x 10% Occupancy = 100 GPD

(150 GPO + 100 GPO) 92 Days = 23,000 Gallons

TOTAL MAY, SEPTEMBER, OCTOBER FLOWS

388,700
193,200
211,600
20,240
23,000
836,740 Gallons

Winter Flows

Permanent Homes

26 x 2.5 person/home x 65 Gallons/Capita/Day (GPCD) x 181 Days = 764,725 Gallons

NeSoDak Camp

11,500 GPO x 10% x 181 Days = 208,150 Gallons

Bur Oak

Store/Cafe 125 GPD

125 GPD x 181 Days = 22,625 Gallons

Sandy Beach

Store/Cafe 125 GPD

125 GPD x 181 Days = 22,625 Gallons

TOTAL WINTER FLOWS	764,725
	208,150
	22,625
	22,625
	1,018,125

TOTAL FLOWS 2,232,840 + 836,740 + 1,018,125 = 4,087,705 Gallons

Required Area for Total Retention

For Total Retention of Wastewater

Inflow + Precipitation - Evaporation - Percolation = 0

Average Annual Precipitation = 21 inches/year = 1.75 ft/yr
Average Annual Evaporation = 33 inches/year = 2.75 ft/yr
Percolation = 1/16 inch/day = 1.90 ft/yr

For an Inflow of 4,087,705 Gallons (546,485 Cubic Feet)

546,485 CF + [1.75ft. -- 2.75ft -1.90] (Area) = 0

546,485 CF = 2.90 Ft (Area)

188,443 Sq Ft = Area

Area Required = 4.33 Acres

USE 4.5 ACRES

Therefore, a 4.5 Acre Stabilization Pond is required to provide treatment to the areas of Enemy Swim included in Project A.

Project B - Camp Dakota Peninsula, Sandy Beach Resort Area, South Enemy Swim Addition, Block's Bay, and Marguerite Park

15 Permanent Homes
100 Seasonal Homes
NeSoDak Bible Camp
Bur Oak Resort
Sandy Beach Resort

Wastewater Flows were calculated by the same method used to estimate flow for Project A

TOTAL FLOWS	15 Permanent Homes	821,250 Gallons
	100 Seasonal Homes	110,400 Gallons {NO Winter Flows)
	NeSoDak Camp	1,477,750 Gallons
	Bur Oak Resort	93,005 Gallons
	Sandy Beach	105,065 Gallons
		2,607,470 Gallons

Required Area for Total Retention

For Total Retention of Wastewater

Inflow + Precipitation - Evaporation - Percolation = 0

Average Annual Precipitation = 21 inches/year = 1.75 ft/yr
Average Annual Evaporation = 33 inches/year = 2.75 ft/yr
Percolation = 1/16 inch/day = 1.90 ft/yr

For an Inflow of 2,607,470 Gallons (348,592 Cubic Feet)

348,592 CF + [1. 75ft. -- 2.75ft - 1.90] (Area) = 0

348,592 CF = 2.90 Ft (Area)
120,204 Sq Ft = Area

Area Required = 2.7 Acres

USE 3.0 ACRES

Therefore a 3.0 acre pond is required to provide Total Retention for these Areas.

This could be provided by a 3.0 acre addition to the existing Enemy Swim Housing Community facility.

Project C - Wastewater from the Pleasure Park and Pebble Beach Areas carried to the Pickerel Lake treatment facility

10 Permanent Homes
40 Seasonal Homes

Wastewater Flows were calculated by the same method used to estimate flow for Project A

TOTAL FLOWS	10 Permanent Homes	593,125 Gallons
	40 Seasonal Homes	<u>198,720 Gallons (NO Winter Flows)</u>
		791,845 Gallons

791,845 Gallons/yr = 2169 Gallons/day

The design flow for the Pickerel Lake Treatment Facility is 32,800 GPD.

2169 GPD/32,800 GPD = 0.066 or 6.61%

Therefore, the wastewater from the Pleasure Park and Pebble Beach areas would represent a volume = 6.61% of the Design Flow for the Pickerel Lake Treatment Facility. The Pickerel Lake Facility should be capable of accepting the additional flows from Pleasure Park and Pebble Beach.

Can the Woodland Park Area also be carried to the Pickerel Lake facility?

Woodland Park

7 Permanent Homes
10 Seasonal Homes

Wastewater Flows were calculated by the same method used to estimate flow for Project A

TOTAL FLOWS	7 Permanent Homes	415,187 Gallons
	10 Seasonal Homes	<u>49,680 Gallons (NO Winter Flows)</u>
		464,867 Gallons

464,867 Gallons + 791,845 (Pleasure Park & Pebble Beach) = 1,256,712 Gallons

1,256,712 Gallons/y =3443 Gallons/day

The Design Flow for the Pickerel Lake Facility is 32,800 GPD

3,443 GPD / 32,800 GPD = 0.105 or 10.5%

Therefore, adding the flow from Woodland Park to the flows from Pleasure Park and Pebble Beach would represent a volume = to 10.5% of the design flow for the Pickerel Lake facility. The Pickerel Lake Facility would likely be able to accept the additional flows, but this will need to be confirmed with the Pickerel Lake Sanitary District Officials before proceeding with this option.

Project D - East Lake Development

3 Permanent Homes
8 Seasonal Homes

Wastewater Flows were calculated by the same method used to estimate flow for Project A

TOTAL FLOWS	3 Permanent Homes	164,250 Gallons
	8 Seasonal Homes	39,744 Gallons (NO winter flows)
		203,994 Gallons

Assume additional development in this area could increase flows by the equivalent of 3 additional permanent homes.

203,994 Gallons + 164, 250 Gallons = 368,244 Gallons

Required Area for Total Retention

For Total Retention of Wastewater

Inflow + Precipitation - Evaporation - Percolation = 0

Average Annual Precipitation = 21 inches/year = 1.75 ft/yr Average
Annual Evaporation = 33 inches/year = 2.75 ft/yr
Percolation = 1/16 inch/day = 1.90 ft/yr

For an Inflow of 368,244 Gallons (49,230 Cubic Feet)

49,230 CF + [1.75ft. -- 2.75ft - 1.90] (Area) = 0

49,230 CF = 2.90 Ft (Area)
16,976 Sq Ft = Area

Area Required = 0.39 Acres
Use 0.5 Acres

Therefore a 0.5 acre pond is required to provide Total Retention for the East Lake Areas.