

OFFICE FILE COPY
DO NOT REMOVE

CANYON LAKE AND RAPID CREEK DIAGNOSTIC FEASIBILITY STUDY

PREPARED BY

WILLIAM C. STEWART
DR. WAYNE HOUTCOOPER
KEITH DELANGE

WATER RESOURCES MANAGEMENT DIVISION
SOUTH DAKOTA DEPT. OF WATER AND NATURAL RESOURCES

AUGUST 1980

EXECUTIVE SUMMARY

In July of 1987, the South Dakota Department of Water and Natural Resources (SDDWNR) and the City of Rapid City, South Dakota entered into a contract to conduct a Diagnostic Feasibility Study on Canyon Lake and Rapid Creek. Canyon Lake is a small man-made lake which has experienced nuisance growth of macrophytes. This vegetation has impaired recreational use in the lake.

The purpose of this study was to provide a general assessment of the water quality of Rapid Creek and Canyon Lake from Lake Pactola to the City and to identify pollution sources and potential pollution sources. The city had experienced taste and odor problems with their drinking water supply and requested that the SD DWR investigate the problem.

Sampling commenced on December 16, 1987 and was completed on November 16, 1988. A total of 9 individual sites were sampled with a total of 300 water quality samples collected. Sample analysis was performed by Travis Laboratories in Rapid City, South Dakota. Discharge data was provided by U.S. Geological Survey.

The study determined that the lake is acting as a nutrient sink. The load of nutrient load entering the lake is higher than the load leaving the lake. This report identifies sources of pollution and provides alternatives for restoration.

CANYON LAKE AND RAPID CREEK DIAGNOSTIC FEASIBILITY STUDY

Prepared by:

William C. Stewart
Dr. Wayne Houtcooper
Kleth DeLange

DIVISION OF WATER RESOURCES MANAGEMENT
DEPARTMENT OF WATER AND NATURAL RESOURCES

August 1989

TABLE OF CONTENTS

		<u>PAGE</u>
I.	INTRODUCTION	1
	A. Site Description	1
	B. Water Quality Standards	4
II.	METHODS AND MATERIALS	5
III.	RESULTS AND DISCUSSION	8
	A. Sediment and Nutrient Concentrations	8
	B. Temperature	12
	C. pH	19
	D. Fecal Coliform Bacteria	19
	E. Phosphorus	19
	F. Biological Oxygen Demand	19
IV.	NUTRIENT LOADINGS	20
V.	CONCLUSIONS	20
VI.	ALTERNATIVES FOR RESTORATION	27
VII.	RECOMMENDATIONS	30
VIII.	REFERENCES	32
		<u>PAGE</u>
Figure 1	Canyon Lake Watershed	2
Figure 2	Canyon Lake and Rapid City	3
Figure 3	Location of Sampling Site	6
Figure 4	Canyon Lake Bottom Contours	10
Figure 5	Canyon Lake Sediment Contours	11
Figure 6	Tributary Nutrient Concentrations	15
Figure 7	Tributary Solids Concentrations	16
Figure 8	In-lake Nutrient Concentrations	17
Figure 9	In-lake Solids Concentrations	18
Figure 10	Tributary Nutrient Loads	22
Figure 11	Tributary Solids Loads	23
Figure 12	Nutrient Loads at Inlet vs. Outlet	24
Figure 13	Fecal Coliform Bacteria - All Sites	26

Table 1.	Elutriate Test Results	Page 9
Table 2.	Minimum, Maximum, and Mean of Sample Concentrations.	13-14
Table 3.	Minimum, Maximum, and Mean of Daily Loads	21

APPENDIX A WATER QUALITY PARAMETERS

APPENDIX B CLEGHORN FISH HATCHERY
N.P.D.E.S. PERMIT

INTRODUCTION

In the spring of 1987, drinking water taste and odor problems were reported by Rapid City residents. During the summer of 1987, the City of Rapid City requested the South Dakota Department of Water and Natural Resources (SDDWNR) to conduct a Diagnostic Feasibility Study. The purpose of this study was to investigate the source of taste and odor problems, to provide a general assessment of the water quality status of Canyon Lake, and to propose restoration alternatives to improve water quality in the lake. A contract between the SDDWNR and the City was completed on July 7, 1987, and the study commenced in November of 1987.

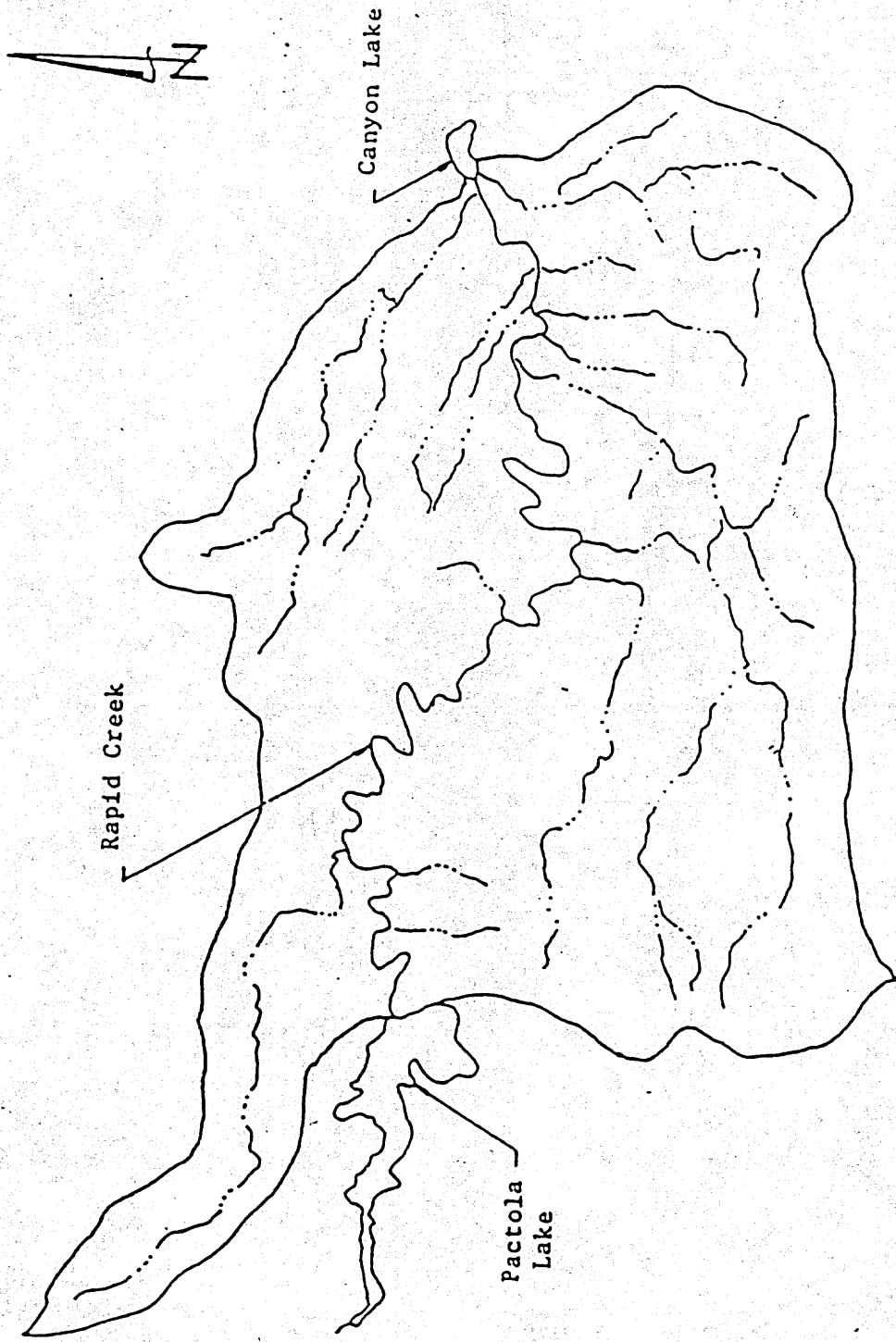
This report presents water quality information collected for the Diagnostic Feasibility Study of Canyon Lake/Rapid Creek and presents alternatives for the restoration of the lake and stream.

Site Description:

Canyon Lake is a 27-acre impoundment on lower Rapid Creek near Rapid City, South Dakota. The watershed which drains into Canyon Lake is approximately 42,000 acres. Rapid Creek is the largest stream draining the Black Hills. The average flow in Rapid Creek at Rapid City from November of 1987 through December of 1988 was 46.0 cfs and the flow is regulated by releases from Pactola Reservoir. Near the city's limit, the creek gains 10-20 cfs of flow from Cleghorn Springs. The South Dakota Department of Game, Fish and Parks utilizes about 8 cfs of this spring flow to operate the Cleghorn Springs Fish Hatchery which discharges to Rapid Creek about 1/5 mile upstream of Canyon Lake. There are several housing developments upstream of Canyon Lake with individual septic systems. The watershed area is primarily composed of conifer forest. Rapid Creek, below Canyon Lake, is the primary source of municipal water for Rapid City. Figure 1 on page 2 shows a diagrammatic view of the Canyon Lake watershed. Figure 2 on page 3 shows the Rapid City area with Rapid Creek and Canyon Lake.

The state of South Dakota has assigned the following beneficial uses to that section of Rapid Creek from Canyon Lake to the confluence with the north fork of Rapid Creek:

- (1) Domestic Water Supply Waters.



Scale 1 : 48,000

Figure 1. Watershed for Canyon Lake.

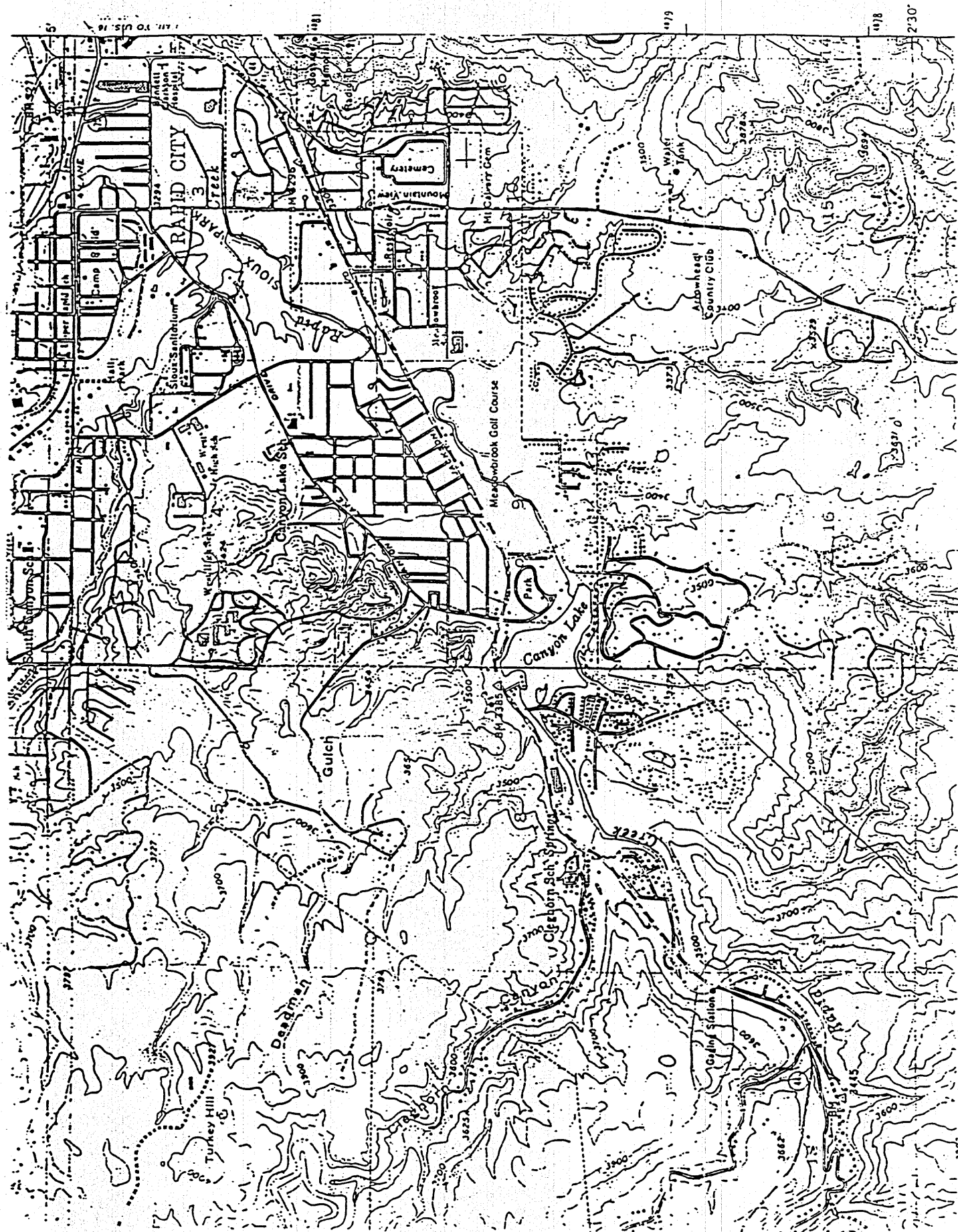


Figure 2. Canyon Lake and Rapid City.

- (2) Cold Water Permanent Fish Life Propagation Waters.
- (7) Immersion Recreation Waters.
- (8) Limited Contact Recreation Waters.
- (9) Wildlife Propagation and Stock Watering.
- (10) Irrigation Waters.

The assigned beneficial uses for Canyon Lake include the following:

- (1) Domestic Water Supply Waters.
- (2) Cold Water Permanent Fish Life Propagation Waters.
- (7) Immersion Recreation Waters.
- (8) Limited Contact Recreation Waters.

Water Quality Standards:

The water quality standards are based on the highest ranking beneficial use assigned to a particular water body. The highest ranking beneficial use assigned to both Rapid Creek and Canyon Lake is (1) Domestic Water Supply Waters. The applicable criteria are to be maintained at all times based upon the results of a 24 hour representative composited sample. The numerical value of a parameter found in any one grab sample collected during the period may not exceed 1.75 times the applicable criterion.

Based on these criteria, the water quality standards for the parameters tested for this study are the following for Rapid Creek:

- 1. Total Dissolved Solids - 1000 mg/l
- 2. Nitrates - 10 mg/l
- 3. pH greater than 6.5 and less than 8.6
- 4. Coliform organisms may not exceed a Most Probable Number of 200 per 100 ml sample based on a minimum of 5 samples obtained during separate 24-hour periods for any 30-day period from May 1 through September 30, and they may not exceed this value in more than 20 percent of the samples examined in this 30-day period. They may not exceed 400 per 100 milliliters in any one sample from May 1 to September 30.
- 5. Dissolved Oxygen - >6.0 mg/l
- 6. Un-ionized Ammonia - <.02 mg/l
- 7. Suspended Solids - <30 mg/l
- 8. Sulfate - <500 mg/l
- 9. Temperature - < 65.0 degrees F

The water quality standards for Canyon Lake are the following:

1. Total Dissolved Solids - 1000 mg/l
2. Nitrates - 10 mg/l
3. pH greater than 6.5 and less than 8.6
4. Coliform organisms may not exceed a Most Probable Number of 200 per 100 ml sample based on a minimum of 5 samples obtained during separate 24-hour periods for any 30-day period from May 1 through September 30, and they may not exceed this value in more than 20 percent of the samples examined in this 30-day period. They may not exceed 400 per 100 milliliters in any one sample from May 1 to September 30.
5. Dissolved Oxygen - > 6.0 mg/l
6. Un-ionized Ammonia - < .02 mg/l
7. Suspended Solids - < 30 mg/l
8. Sulfate - < 500 mg/l
9. Temperature - < 65.0 degrees F

METHODS AND MATERIALS

Samples were collected at 9 individual sampling sites in the study area (Figure 3, page 6). Four stations were tributary sites located at intervals on Rapid Creek from the Pactola Reservoir discharge to the Canyon Lake Inlet (sites 1-4). Site 3A was located at Cleghorn Springs. Site 4A was the Cleghorn Springs Fish Hatchery discharge. Two sites (sites 5 and 6) were in-lake sites, and the remaining site (site 7) monitored the Canyon Lake discharge. The location of each site is as follows:

- Site #1. Gaging station downstream of Pactola Reservoir Spillway. T1N R5E Sec. 2 Latitude 44 deg. 04 min. 36 sec. Longitude 103 deg. 28 min. 54 sec.
- Site #2. Gaging station downstream of Deer Creek confluence with Rapid Creek. T1N R6E Sec. 8 Latitude 44 deg. 03 min. 42 sec. Longitude 103 deg. 25 min. 04 sec.
- Site #3. Gaging station approximately 2.8 miles downstream of Victoria Creek confluence. T1N R7E Sec. 18 Latitude 44 deg. 03 min. 04 sec. Longitude 103 deg. 18 min. 47 sec.

SAMPLING SITES FOR RAPID CREEK AND CANYON LAKE DIAGNOSTIC FEASIBILITY STUDY

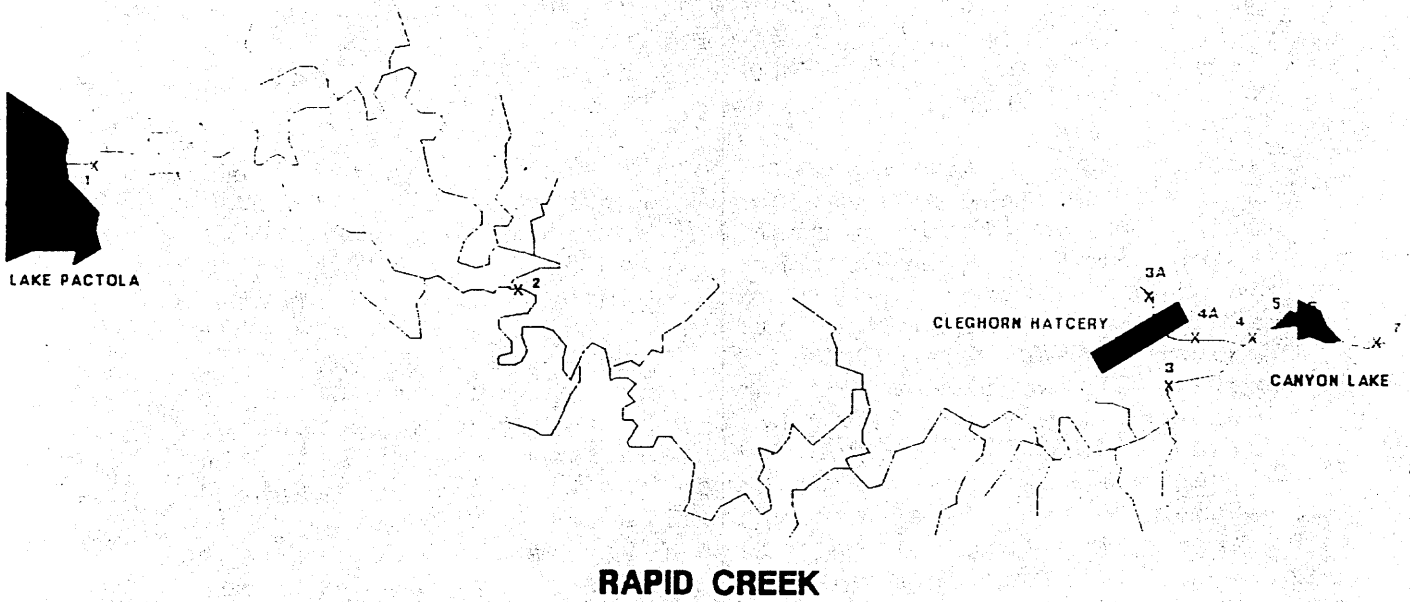


FIGURE 3. SAMPLING SITES

- Site #3a. Cleghorn Springs above fish hatchery.
- Site #4. Confluence of Cleghorn Springs Fish Hatchery effluent and Rapid Creek. T1N R7E Sec. 8 Latitude 44 deg. 03 min. 31 sec. Longitude 103 deg. 17 min. 48 sec.
- Site #4a. Discharge channel from Cleghorn Springs Fish Hatchery. Latitude 44 deg. 30 min. 32 sec. Longitude 103 deg. 17 min. 54 sec.
- Site #5. Located east of section line between sections 8 and 9, T1N R7E Latitude 44 deg. 30 min. 05 sec. Longitude 103 deg. 17 min. 30 sec.
- Site #6. Located west of the residential road T1N R7E Sec. 9 Latitude 44 deg. 03 min. 33 sec. Longitude 103 deg. 17 min. 22 sec.
- Site #7. Located on the outlet structure at the spillway of the Canyon Lake Dam. T1N R7E Sec. 9 Latitude 44 deg. 30 min. 02 sec. Longitude 103 deg. 17 min. 11sec.

Sites 1,2 and 3 were selected to provide loading information from Rapid Creek upstream from Canyon Lake. Sites 3a, 4, and 4a were monitored to quantify possible loads from the Cleghorn Springs Fish Hatchery. Site 3a was sampled to determine the water quality of Cleghorn Springs, upstream of the Hatchery. Site 4a was the main discharge from the Cleghorn Springs Fish Hatchery. Site 4 was selected to sample the mixing zone for the discharge from the Cleghorn Springs Hatchery and Rapid Creek. Site 5 was selected to provide information on the water quality in the mixing zone between the lake and the tributary inlet. Site 6 was selected to provide a representative in-lake location for water quality information. Site 7 was selected to estimate the nutrient load from the lake to Rapid Creek. The site number, sampling duration, and number of samples collected per site are shown in the following chart:

SITE #	SAMPLE TIME PERIOD		# OF SAMPLES
	FROM:	TO:	
1	1/19/88	5/12/88	18
2	12/16/87	5/12/88	20
3	12/16/87	11/16/88	42
3A	5/17/88	11/16/88	16
4A	3/22/88	11/16/88	32
4	12/16/87	11/16/88	43
5	12/16/87	11/16/88	43
6	12/16/87	11/16/88	43
7	12/16/87	11/16/88	43

Sampling at sites 1 and 2 was discontinued in May, 1988 because concentrations of nutrients and sediment were low and site 3 was available to monitor upstream water quality. Sites 3A and 4A were added to the study in an attempt to assess nutrient loadings from the fish hatchery.

All samples taken were grab samples collected approximately 6 inches below the surface of the water. The laboratory analyses were conducted by Travis Labs in Rapid City, South Dakota. Field sample collection and analyses were done by employees of the City of Rapid City. A mean daily discharge for each monitoring site for the study period was provided by the U.S. Geological Survey Office in Rapid City, South Dakota. The mean daily discharge data and the sample concentrations were used to calculate estimated daily and total loads for each site.

A complete sediment survey was completed for the lake during June of 1989. Elutriate samples were analyzed from the bottom sediments for metals and toxic contaminants. Results of the elutriate samples are found in table 1, page 9. Figure 4, page 10, shows a contour map of the lake basin. Figure 5, page 11, shows a map of sediment thickness.

RESULTS and DISCUSSION

Sediment and Nutrient Concentrations:

The abbreviations used on the figures are shown on the following table:

TABLE 1. SUMMARY OF RESULTS - CANYON LAKE PROJECT.
CANYON LAKE ELUTRIATE TEST RESULTS

PARAMETER	SEDIMENT	RECEIVING WATER	ELUTRIATE WATER
AMMONIA, NH ₃		0.08 ppm	2.14 ppm
CHEMICAL OXYGEN DEMAND		13.6 ppm	23.1 ppm
CYANIDE, TOTAL (AS Cn)	1.1 mg/kg	<0.02 ppm	<0.02 ppm
NITRATE, TOTAL (AS N)		<0.02 ppm	<0.02 ppm
PHOSPHORUS, TOTAL (AS P)		<0.01 ppm	0.03 ppm
TOTAL KJELDAHL NITROGEN (AS N)		0.64 ppm	2.46 ppm
OIL AND GREASE	0.28 mg/kg	<0.2 ppm	<0.2 ppm
ANTIMONY, TOTAL (AS Sb)	0.5 mg/kg	<0.1 ppb	<0.1 ppb
ARSENIC, TOTAL (AS As)	3.3 mg/kg	2.3 ppb	42.6 ppb
BARIUM, TOTAL (AS Ba)	63.4 mg/kg	55 ppb	143 ppb
BERYLLIUM, TOTAL (AS Be)	2 mg/kg	<5 ppb	<5 ppb
CADMIUM, TOTAL (AS Cd)	0.3 mg/kg	<1 ppb	<1 ppb
CHROMIUM, TOTAL (AS Cr)	2.4 mg/kg	<1 ppb	<1 ppb
COPPER, TOTAL (AS Cu)	3.5 mg/kg	<5 ppb	<5 ppb
IRON, TOTAL (AS Fe)	6438 mg/kg	167 ppb	1063 ppb
LEAD, TOTAL (AS Pb)	2 mg/kg	<2 ppb	<2 ppb
MAGNESIUM, TOTAL (AS Mg)	3.3 mg/kg	23.8 ppm	22.3 ppm
MANGANESE, TOTAL (AS Mn)	123 mg/kg	10 ppb	206 ppb
MERCURY, TOTAL (AS Hg)	<0.1 mg/kg	0.2 ppb	0.2 ppb
SELENIUM, TOTAL (AS Se)	0.3 mg/kg	1.3 ppb	2.1 ppb
ZINC, TOTAL (AS Zn)	35.5 mg/kg	8 ppb	<5 ppb
NICKEL, TOTAL (AS Ni)	4.5 mg/kg	<5 ppb	<5 ppb
ALUMINUM, TOTAL (AS Al)	4445 mg/kg	34 ppb	317 ppb
CALCIUM, TOTAL (AS Ca)	15.7 mg/kg	45 ppm	54.5 ppm
SODIUM, TOTAL (AS Na)	0.1 mg/kg	5.1 ppm	5.2 ppm
POTASSIUM, TOTAL (AS K)	1 mg/kg	2.8 ppm	4.6 ppm
SILVER, TOTAL (AS Ag)	<0.1 mg/kg	<0.1 ppb	<0.1 ppb
CHLORINATED PESTICIDES	<0.5 mg/kg	<0.5 ppb	<0.5 ppb
PCB	<50 ug/kg	<50 ppb	<50 ppb

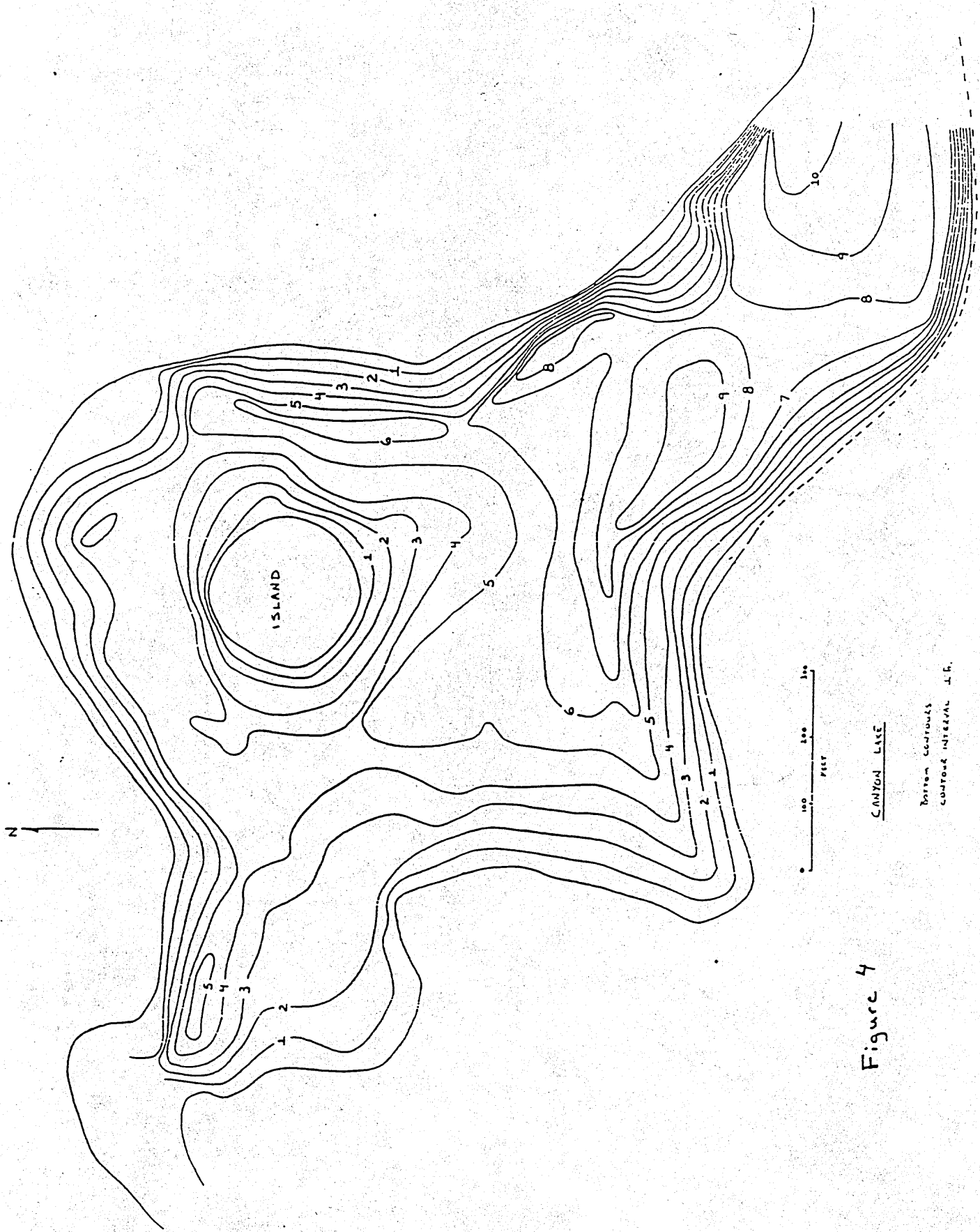


Figure 4

CANYON LAKE

Bottom contours
Course interval 1 ft.

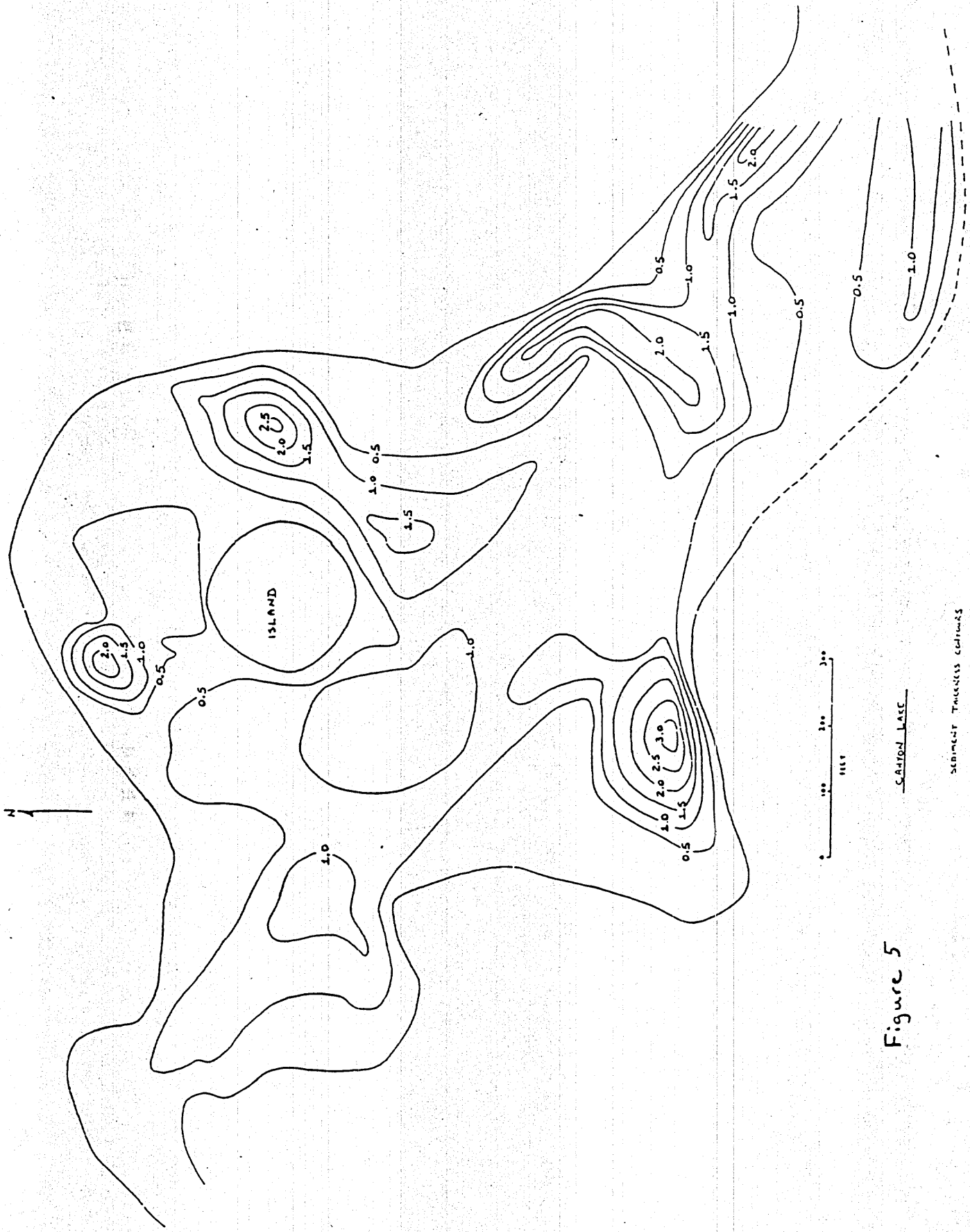


Figure 5

SEDIMENT THICKNESS CONTOURS
 CONTOUR INTERVAL 0.5 M.

<u>Abbreviation</u>	<u>Parameter</u>
Water Temp	Water Temperature
Air temp	Air Temperature
D.O.	Dissolved Oxygen
FPH	Field pH
Fecal	Fecal Coliform Bacteria
Conduct.	Specific Conductivity
LPH	Laboratory pH
Talka	Total Alkalinity
Tsol	Total Solids
Tssol	Total Suspended Solids
Tdsol	Total Dissolved Solids
Ammon	Total Ammonia
NO3+N02	Nitrate + Nitrite Nitrogen
TKN	Total Kjeldahl Nitrogen
TP04P	Total Phosphorus
OP04P	Orthophosphate
S04	Sulfate
UNAIM	Un-ionized Ammonia

Table 2, page 13 and 14, is a summary of the maximum, minimum, and mean concentrations of water quality data collected from each sampling site. Figure 6, page 15, shows the relationships between the concentrations of selected parameters and the locations of the tributary sites. For each of the nutrients shown in Figure 6, site 4a, the discharge from the Cleghorn Fish Hatchery, has the highest concentration with the exception of nitrates. Sites 1, 2, and 3 are consistently the lowest concentrations in each of the nutrient parameters. Site 4, the tributary site immediately upstream of Canyon Lake, has the second highest nutrient concentrations with the exception of nitrates. The concentrations for solids are essentially the same for all sites and this relationship may be seen on Figure 7, page 16. The in-lake concentrations are shown graphically in Figure 8, page 17 and Figure 9, page 18. The purpose for analyzing each individual parameter is described in Appendix A.

Most of the sample parameters were within the concentration limits set by State standards. Concentrations of the following parameters indicate that they may exist in sufficient quantities to cause problems.

Temperature:

The maximum water temperature recorded for a tributary was 72 degrees F, and the minimum was 32 degrees F. The mean temperature for all tributary sites was 45 degrees F. Four consecutive samples exceeded the maximum allowable standard

TABLE 2 (CONTINUED)

SITE 5 - CANYON LAKE CIN-LAKE
 SAMPLE DATA 1988
 CONCENTRATIONS

# OF SAMPLES	SAMPLE PERIOD FROM TO	WATER TEMP		D.O.		FPH FECAL		CONDUCT.		LPH TALKA		TSOL TDSOL		TSSOL AMMON		TKN TPO-AP		S04 UNATH					
		MAXIMUM	MINIMUM	MEAN	70	97	15.20	8.10	490	415	8.50	203	239	292	22	0.18	0.39	0.74	0.663	6.0	44	0.002508	
43	16-Dec-87 16-Nov-88				53	58	11.22	7.84	34	384	7.94	172	221	217	4	0.05	0.17	0.34	0.040	0.014	2.3	35	0.000750

SITE 6 - CANYON LAKE CIN-LAKE
 SAMPLE DATA 1988
 CONCENTRATIONS

# OF SAMPLES	SAMPLE PERIOD FROM TO	WATER TEMP		D.O.		FPH FECAL		CONDUCT.		LPH TALKA		TSOL TDSOL		TSSOL AMMON		TKN TPO-AP		S04 UNATH					
		MAXIMUM	MINIMUM	MEAN	70	97	15.00	8.10	5300	400	8.50	198	288	282	23	0.08	0.29	0.68	0.054	14.0	57	0.001629	
43	16-Dec-87 16-Nov-88				53	60	11.19	7.91	206	375	8.01	169	214	209	5	0.04	0.13	0.36	0.025	0.015	2.9	34	0.000736

SITE 7 - RAPID CREEK-CANYON LAKE DISCHARGE
 SAMPLE DATA 1988
 CONCENTRATIONS

# OF SAMPLES	SAMPLE PERIOD FROM TO	WATER TEMP		D.O.		FPH FECAL		CONDUCT.		LPH TALKA		TSOL TDSOL		TSSOL AMMON		TKN TPO-AP		S04 UNATH				
		MAXIMUM	MINIMUM	MEAN	72	98	14.30	8.90	420	405	8.70	202	300	292	14	0.14	1.45	0.67	0.250	0.044	47	0.008114
43	16-Dec-87 16-Nov-88				54	60	11.03	8.01	24	373	8.11	168	216	212	4	0.04	0.18	0.31	0.028	0.013	35	0.001045

CANYON LAKE D/F - TRIBUTARY SITE RESULTS

MEAN NUTRIENT CONCENTRATIONS - 1988

MILLIGRAMS PER LITER

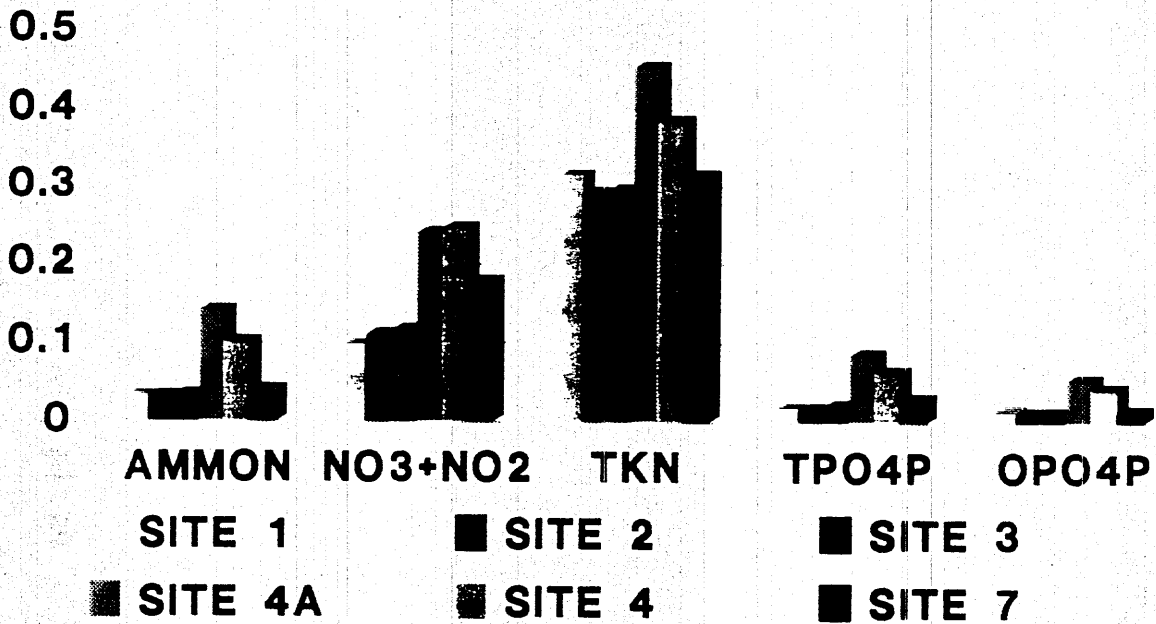


FIGURE 6. TRIBUTARY SITE NUTRIENT CONCENTRATIONS.

CANYON LAKE - TRIBUTARY SITE RESULTS

MEAN SOLIDS CONCENTRATIONS - 1988

MILLIGRAMS PER LITER

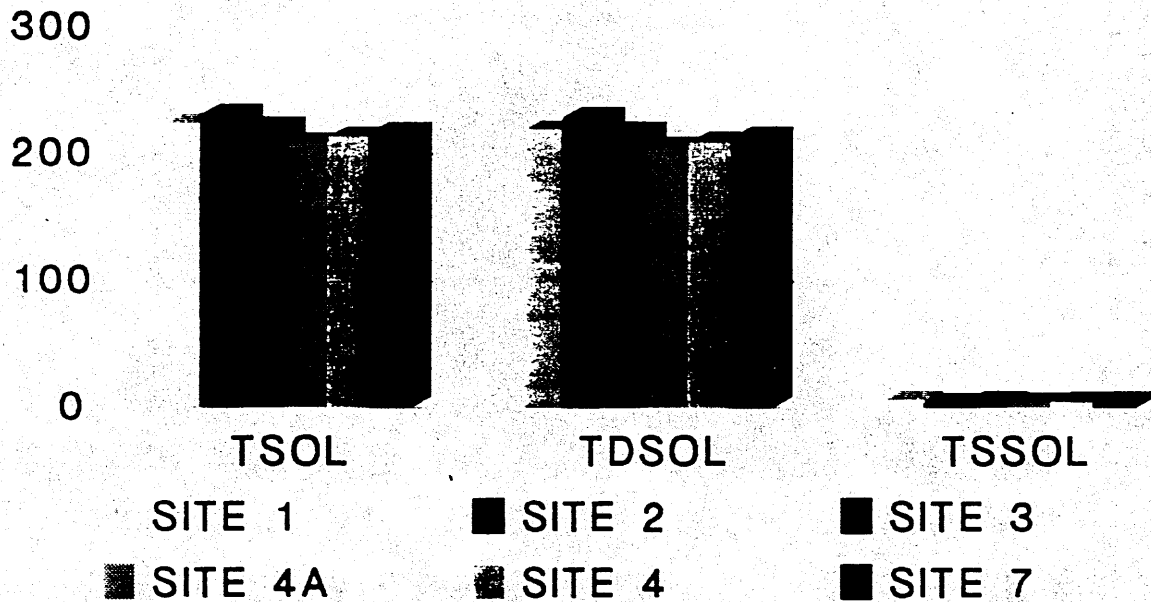


FIGURE 7. TRIBUTARY SITE SOLID CONCENTRATIONS

CANYON LAKE D/F IN-LAKE RESULTS

MEAN NUTRIENT CONCENTRATIONS - IN-LAKE 1988

MILIGRAMS PER LITER

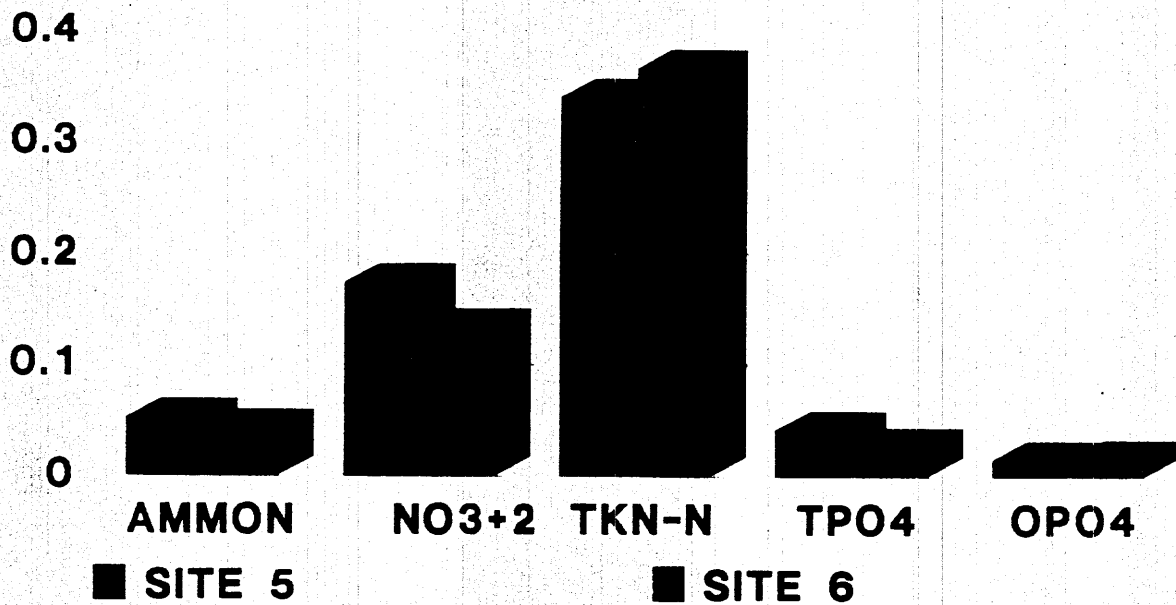


FIGURE 8. IN-LAKE NUTRIENT CONCENTRATIONS.

CANYON LAKE D/F IN-LAKE RESULTS

MEAN SOLID CONCENTRATIONS - IN-LAKE 1988

MILIGRAMS PER LITER

300

200

100

0



TSOL



TDSOL



TSSOL

■ SITE 5

■ SITE 6

FIGURE 9. IN-LAKE SOLIDS CONCENTRATIONS.

of 65 degrees F at sites 5 and 6 from may 26 to July 5, 1988. Site 7 had three consecutive samples which exceeded the standard from June 7 to July 5, 1988. This indicated a potential problem for the cold water permanent fish life propagation beneficial use designation.

pH:

The maximum and minimum pH measurements during the study was 8.9 and 7.2. This indicates that the water in the study area is slightly alkaline. Most of these measurements are considered normal and not an impairment to the fish populations in the area. The only sample which exceeded the standard for the cold water permanent fish life propagation criteria was collected on June 7, 1988 at site 7.

Fecal Coliform:

The mean count of fecal coliform bacteria for the tributary sites was 14.5 colonies per 100 milliliters. Fecal coliform counts were high for in-lake site 6 with a maximum count of 5,300 colonies per 100 ml. The mean count for site 6 was 205 colonies per 100 ml with 18.6% of the samples above the maximum allowable standard. The South Dakota standard for fecal coliforms in Rapid Creek and Canyon lake is 200 colonies per 100 ml. During the course of the study, site 4 and site 7 each had 1 sample that exceeded the standard. In-lake site 5 had 1 sample and site 6 had 9 samples which exceeded the standard.

Phosphorus:

The maximum concentration for total phosphorus for all samples was 0.66 mg/l found at in-lake site 5. The second highest concentration was found at site 3 and was 0.28 mg/l. The mean concentration of total phosphorus for all sites was .04 mg/l. The high concentration found at site 5 may be the result of sampling error.

The maximum concentration for orthophosphate was 0.17 mg/l and the minimum concentration was 0.01 mg/l. There is no state standard for phosphorus in South Dakota. Consequently, although literature values indicate a problem may exist at the levels experienced, state standards were not affected.

Biological Oxygen Demand:

The BOD concentrations were measured at in-lake sites 5 and

6 only. The maximum BOD concentration measured was 14 mg/l and the minimum was 1 mg/l. The mean concentration found in Canyon Lake was 2.55. These concentrations are probably due to the large amount of macrophyte growth and fecal material from waterfowl in the lake.

NUTRIENT LOADING

In order to quantify the nutrient budget of Canyon Lake, it was necessary to convert the concentration data to mean daily loads. This was accomplished by calculating a mean daily concentration based on the sample data. The mean daily concentrations were combined with mean daily discharge in liters per day. The result is an estimated daily load for each site in kilograms per day.

There are several nutrient sources in the Rapid Creek watershed. Forest land can contribute to the nutrient and sediment load as a result of natural decay cycles, fire, and logging activities. Septic systems from housing developments increase nutrient concentrations in groundwaters. Livestock operations may cause increased nutrient loads in lakes and streams. Other possible sources of nutrient and sediment include urban runoff, roads, and construction.

Table 3, page 21, contains a summary of the maximum, minimum, and mean of all loadings data. Figure 10, page 22, and Figure 11, page 23, show the relationships of selected parameters for the tributary sites. The largest loads for nutrients and sediments are consistently found at site 4, the tributary site directly upstream of Canyon Lake. There is an increase in the mean daily loads between site 2 and site 3 and a larger increase in mean daily loads between sites 3 and 4. This trend is apparent for all selected parameters on Figures 10 and 11. The mean daily load at the discharge of Canyon lake (site 7) is consistently lower for each parameter than site 4.

CONCLUSIONS:

The estimated total load from Rapid Creek (site 4) versus the discharge from Canyon Lake (site 7) indicates that Canyon Lake is acting as a nutrient sink for Rapid Creek because a greater load of nutrients enter Canyon Lake than are discharged (Figure 12, page 24). The result is an increase in available nitrogen and phosphorus to nourish submergent macrophytes. The shallow basin, very transparent water, and

TABLE 3 SUMMARY OF RESULTS - CANYON LAKE PROJECT
ESTIMATED DAILY TRIBUTARY LOADS
ALL LOADS IN KILOGRAMS PER DAY - DISCHARGE IN LITERS PER DAY

SITE	SAMPLE PERIOD	FROM	TO	LITERS/DRY				TALKAL	TSOL	TDSOL	TSSOL	AMMON	NO3+	TKM-N	TP04	OP04	S04	UNIAN
				MAXIMUM	MINIMUM	MEAN												
SITE 1 - RAPID CREEK SAMPLE DATA 1988 DAILY LOADS	SAMPLE PERIOD	FROM	TO	18	19-Jan-88	12-May-88	141,901,415	22,420	31,942	31,588	636	4.26	14.19	35.56	1.50	5.463	0.047826	
							31,805,490	4,918	4,771	4,551	37	0.95	0.37	5.87	0.34	0.34	1,302	0.004544
							50,165,448	8,044	11,177	10,970	206	1.54	4.92	16.83	0.71	0.62	2,076	0.013378
SITE 2 - RAPID CREEK SAMPLE DATA 1988 DAILY LOADS	SAMPLE PERIOD	FROM	TO	20	16-Dec-87	12-May-88	141,901,415	22,846	32,130	31,568	617	4.97	14.19	58.18	1.56	6,052	0.069666	
							31,805,490	5,064	6,373	6,899	34	0.95	3.34	1.10	0.34	0.34	993	.000000
							46,534,206	7,798	10,674	10,544	129	1.49	5.35	16.67	0.70	0.56	1,878	0.012597
SITE 3 - RAPID CREEK SAMPLE DATA 1988 DAILY LOADS	SAMPLE PERIOD	FROM	TO	42	16-Dec-87	16-Nov-88	296,035,711	52,250	64,343	62,887	4,536	9.59	32.20	128.10	70.06	5.04	16,282	0.279459
							4,893,152	876	1,003	998	5	0.15	0.49	1.37	0.05	0.05	152	.000000
							88,075,288	14,907	18,768	18,244	523	2.88	9.70	24.39	1.85	0.92	3,767	0.066225
SITE 4A - CLEGGHORN HATCHERY DISCHARGE SAMPLE DATA 1988 DAILY LOADS	SAMPLE PERIOD	FROM	TO	32	22-Mar-88	16-Nov-88	31,805,490	6,107	7,509	7,374	296	6.04	8.07	16.95	5.46	4.26	1023	0.066672
							21,285,212	3,450	2,714	2,622	24	0.68	2.25	4.65	1.05	0.23	468	0.005797
							25,828,708	4,568	5,242	5,174	68	3.18	6.11	10.77	1.82	1.15	676	0.021635
SITE 4 - RAPID CREEK - HATCHERY DISCHARGE MIXING ZONE SAMPLE DATA 1988 DAILY LOADS	SAMPLE PERIOD	FROM	TO	43	16-Dec-87	16-Nov-88	352,306,962	66,938	67,995	67,643	3,562	41.71	101.29	137.79	20.67	17.22	12,311	0.383180
							34,252,066	6,097	6,388	6,320	54	1.57	7.88	9.30	1.46	0.83	839	.000000
							125,443,290	22,083	26,099	25,483	616	9.67	29.66	45.03	6.16	3.99	3,732	0.089520
SITE 7 - RAPID CREEK-CANYON LAKE DISCHARGE SAMPLE DATA 1988 DAILY LOADS	SAMPLE PERIOD	FROM	TO	43	16-Dec-87	16-Nov-88	330,287,777	57,470	74,645	73,984	1,638	26.03	170.28	106.55	39.76	3.30	13,542	1.508744
							34,252,066	6,496	6,611	6,559	49	1.05	3.43	4.62	0.61	0.37	1,028	.000000
							117,907,545	19,947	24,875	24,412	463	5.02	16.18	35.66	2.93	1.31	4,095	0.186166

CANYON LAKE D/F LOADS-TRIBUTARY SITES

ESTIMATED MEAN DAILY NUTRIENT LOADS 1988

KILOGRAMS PER DAY

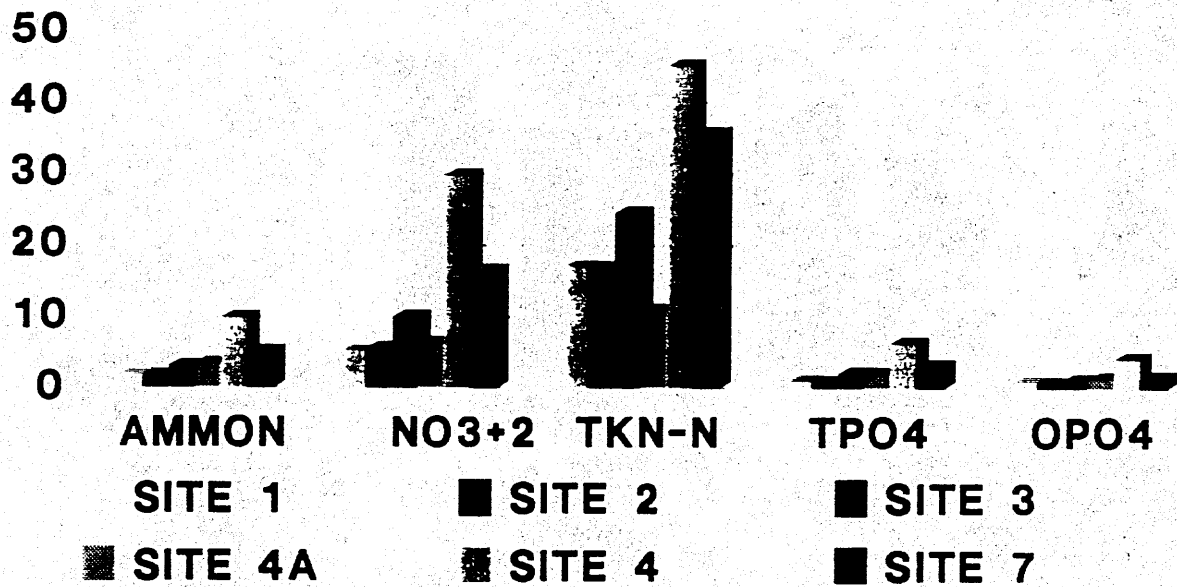


FIGURE 10. NUTRIENT LOADS FOR TRIBUTARY SITES.

CANYON LAKE D/F LOADS - TRIBUTARY SITES

ESTIMATED MEAN DAILY SOLID LOADS 1988

KILOGRAMS PER DAY

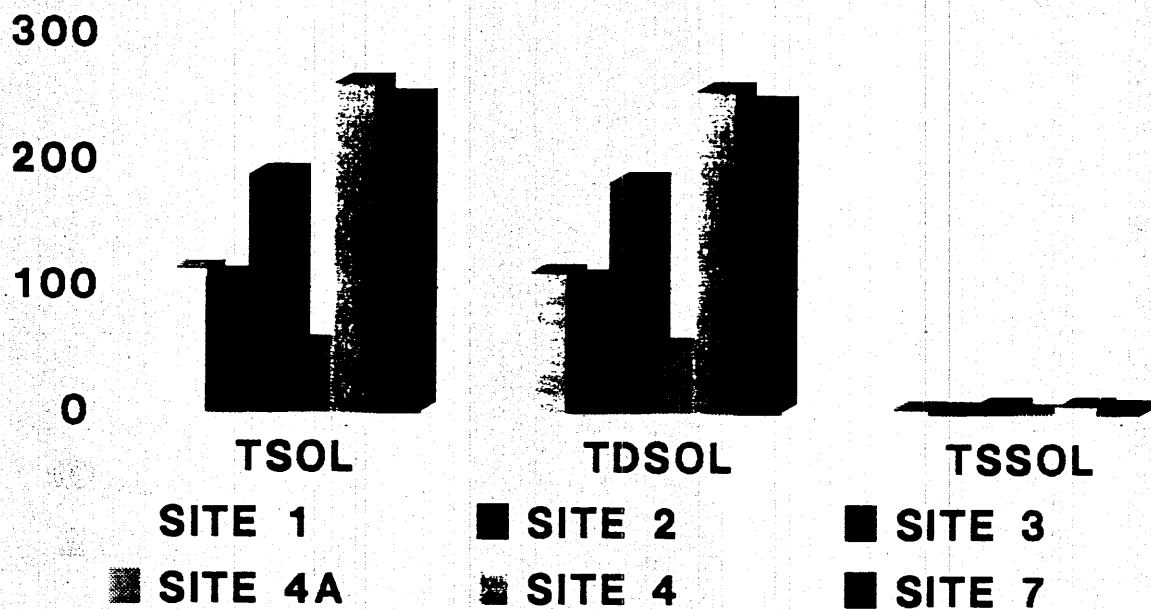


FIGURE 11. SOLID LOADS FOR TRIBUTARY SITES.

CANYON LAKE D/F NUTRIENT LOAD COMPARISON

LOADS AT INLET VS. OUTLET - 1988

LOADS IN TONS FOR 1988

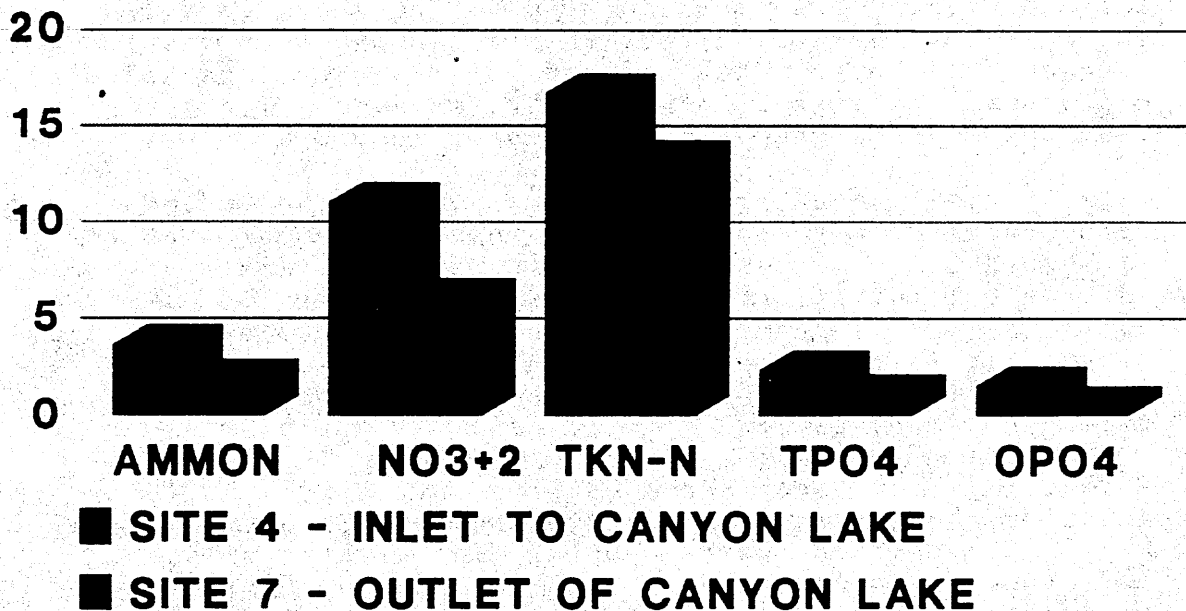


FIGURE 12. LOADS AT INLET VS. OUTLET.

nutrients combine to cause a nuisance growth of weeds in the lake. Even though the concentrations seemed to be acceptable at face value, because of the volume of flow and the impact of the Canyon Lake Reservoir on the flow of Rapid Creek, the total annual load is a significant factor.

A number of sources may be contributing nutrients and sediment to Canyon Lake. Probable nonpoint sources include the forest land, septic systems, in housing developments along the two creeks and large numbers of waterfowl which reside on the lake and increase in number during migration. The latter situation is the most probable cause of the high in-lake fecal coliform bacteria counts (Figure 13, page 26).

The primary point source of nutrients is the Cleghorn Fish Hatchery. The total nutrient load increased between sites 2 and 3 and then increased dramatically between sites 3 and 4. The main source located between sites 3 and 4 is the Cleghorn Hatchery. The Statement of Basis and the National Pollutant Discharge Elimination System Permit for the Cleghorn Fish Hatchery is included as Appendix B.

Based on in-lake and tributary monitoring, the sediment load into Canyon Lake does not appear to be a serious problem. It should be noted that the sample data for this study does not reflect the effect of the Westberry Trails forest fire due to a lack of runoff events during the last part of the study. It is possible that the fire may have greatly increased the nutrient and sediment load into Rapid Creek after the study period.

A total of 7 bacterial samples were collected in attempts to identify the source of the taste and odor problems in the Rapid City drinking water supply. The results of this testing were inconclusive. Small numbers of Actinomyces bacteria were found in the water samples. While we have no substantial evidence to support the idea, the metabolites Geosmin and MIB of Actinomyces bacteria are suspect. It is possible that the taste and odor problems may be directly influenced by the nutrient buildup and eutrophication of Canyon Lake.

CANYON LAKE FECAL COLIFORMS MEAN CONCENTRATIONS FOR ALL SITES 1988

COLONIES PER HUNDRED ML.

300

200

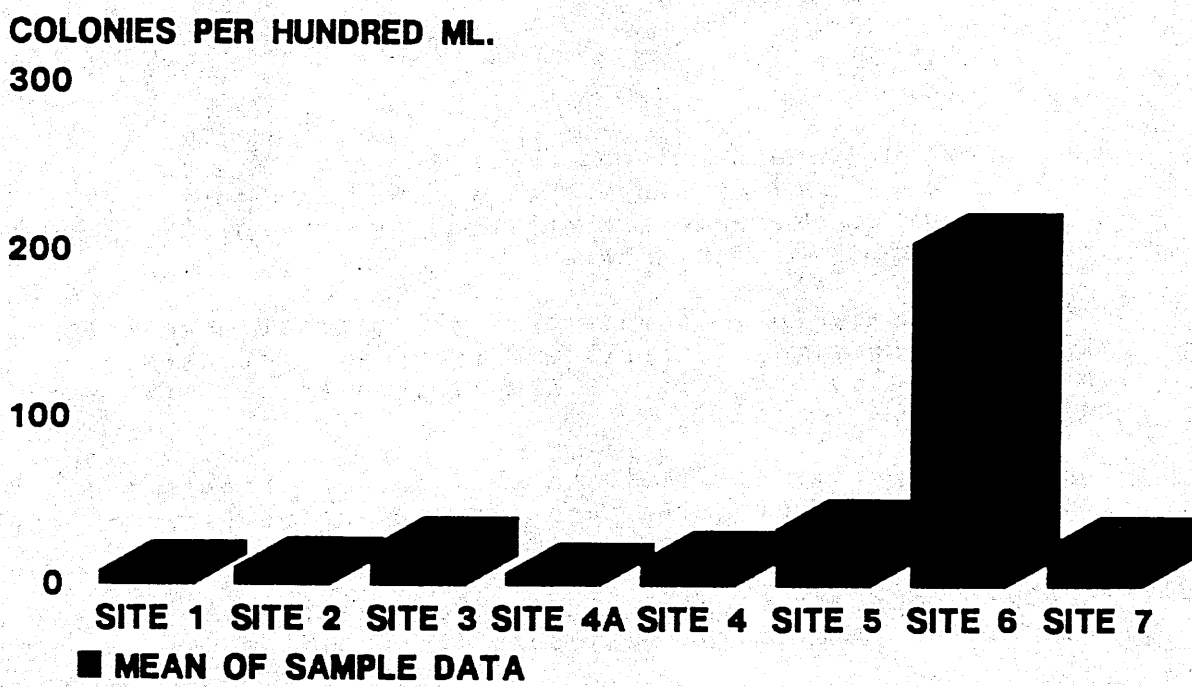
100

0

SITE 1 SITE 2 SITE 3 SITE 4A SITE 4 SITE 5 SITE 6 SITE 7

■ MEAN OF SAMPLE DATA

FIGURE 13. FECAL COLIFORM CONCENTRATIONS



ALTERNATIVES FOR RESTORATION

The data collected during the Diagnostic Feasibility study indicates that the majority of the pollutants are carried into Canyon Lake by Rapid Creek. Pollution may be attributed to the Cleghorn Springs Hatchery and various non-point sources including runoff from the land, possible septic contamination from housing developments upstream, and new construction sites. The result of this pollution is the rapid eutrophication of Canyon Lake and the excess growth of submerged aquatic plants.

Alternatives for the restoration of Canyon Lake were selected based on four criteria.

- (1) Environmental
- (2) Technical
- (3) Social
- (4) Economic

Environmental considerations indicate that the restoration effort should minimize damage to the environment of the area and enhance the natural characteristics of the area.

Technical criteria stipulate that the planned alternatives must be technically feasible and provide a reduction in the nutrient pollution and sedimentation of the lake and creek.

Social criteria state that the plan should enhance the recreational opportunities and improve the quality of life for the people of the Rapid City area.

Economic considerations indicate that the planned alternative provide the most benefit for the money.

The restoration alternatives which have been identified are outlined as follows:

1. Waterfowl control or removal from Canyon Lake.
 - a. Elimination of nesting sites.
 - b. Prohibit feeding of waterfowl.
 - c. Temporary hazing program during migration.
 - d. Removal of domestic waterfowl.

2. Rerouting or treatment of the discharge from the Cleghorn Hatchery.
 - a. Onsite treatment of the discharge.
 - b. Route the discharge around the lake and drinking water intakes.
 - c. Route discharge around lake and above the drinking water intakes.
3. Increase the volume of the Canyon Lake.
 - a. Raise the dam elevation.
 - b. Removal of bottom material.
 - (1) Extensive dredging of Canyon Lake.
 - (2) Drawdown of the lake and removal by land based equipment.
4. Land treatment measures in the watershed.
 - a. Sediment control structures.
 - b. Septic system evaluation to locate possible discharges to Rapid Creek.
5. Weed control in Canyon Lake.
 - a. Chemical treatment of the lake.
 - b. Mechanical weed harvesting.
6. Runoff control for construction sites and access roads.
 - a. Sediment control structures.
 - b. Filter strips or filter material.
 - c. Contour or terrace constructions.
7. Removal of the island from Canyon Lake.
8. No action.

DISCUSSION OF ALTERNATIVES

Waterfowl Removal From Canyon Lake:

While waterfowl on Canyon Lake are popular with the general public, it is questionable if the large numbers of waterfowl are compatible with the drinking water beneficial use designation of the lake. The state recommends a plan be developed to remove the resident population of waterfowl from the lake. The first step would be for the City to establish an ordinance against feeding waterfowl in Canyon Lake. An intensive public relations campaign would need to be developed explaining the reason for the feeding ban to the public. All domestic waterfowl should be removed from

the lake and the city may wish to consider a temporary hazing procedure for wild waterfowl during migration. The South Dakota Department of Game, Fish, and Parks should be consulted before any hazing procedure is implemented.

Rerouting or Treatment of Discharge From Cleghorn Springs Fish Hatchery:

The data indicates that approximately 75% of the phosphorus load to Canyon Lake comes from Rapid Creek, upstream of the Cleghorn Springs Main Channel. Total load calculations for the period 3/22/88 to 11/16/88 indicate that approximately 25% of the total phosphorus and 24% of the orthophosphorus loadings to Canyon Lake are contributed by the water from the Cleghorn Springs Main Channel. Total loads of total phosphorus for the period were 3,841 lbs. at Canyon Lake and 959 lbs. at Cleghorn Springs Main Channel. Total loads for orthophosphate for the period were 2,552 lbs. at Canyon Lake and 607 lbs. at the Cleghorn Springs Main Channel. Cleghorn Springs Fish Hatchery contributes nutrients to Rapid Creek and Canyon Lake. The rerouting or treatment of this source of nutrient would benefit the lake. Because of the small area where the hatchery discharges, a treatment facility is probably not feasible. It is recommended that the discharge from the Cleghorn Springs Fish Hatchery be piped to a point downstream of Canyon Lake. This action would eliminate a large portion of the nutrient load to the lake.

Increasing the Volume of Canyon Lake:

Increasing the volume of Canyon Lake would increase the recreation value and water storage capabilities for the lake. Regulations set forth by the US Army Corps of Engineers prohibit the raising of the lake by increasing the elevation of the control structure. Because the layer of soft sediment in the lake averages less than 1 foot, the effectiveness of dredging the lake is doubtful. The concept of drawing down the lake and removing bottom material by land based equipment is possible. However, the cost of such an operation would possibly not justify the benefits gained by the action. For the reasons stated above, the SD DWR recommends that increasing the volume of the lake not be considered a practical alternative.

Land Treatment Measures In the Watershed:

Sediment control structures in burn areas and around new construction sites can be constructed in a cost effective manner. Construction of terraces, reseeding of burned areas, and management of access roads are relatively low

cost measures. These structures can serve to reduce the sediment load to Rapid Creek and Canyon Lake. The SD DWR recommends the use of this alternative in the Canyon Lake Watershed.

Weed Control In Canyon Lake:

The SD DWR feels that the weed control in Canyon Lake could be best accomplished by the use of a mechanical weed harvester. The weed harvester currently in use at Canyon Lake is rather inefficient. The State believes a more efficient model would be beneficial. This is an effective management tool if used with other management techniques which limit the inflow of nutrients to the lake.

Removal of the Island From Canyon Lake:

Several improvements could be made by removing the existing man-made island. Flow characteristics could be improved and areas of "dead" water may be eliminated. The depth of the area around the island could be increased to aesthetically improve the area by reducing weed growth. The island is currently intensively used by waterfowl as nesting habitat. Removal of the island would eliminate a major nesting area. Removal of the island may be accomplished by temporary drawdown of the lake and removal by land based equipment. This alternative could be very expensive and the cost - benefit ratio is questionable. The state recommends that the alternative be given consideration.

No Action:

If this alternative is selected the lake will continue to degrade and weed problems may be expected to become worse over time.

RECOMMENDATIONS

Based on the results of this study including the fact that Canyon Lake is acting as a nutrient and sediment sink for Rapid Creek, the DWR recommends the following alternatives for restoration:

1. Elimination of all domestic waterfowl on Canyon Lake and take steps to discourage use by wild ducks and geese.
2. Implementation of Best Management Practices in the watershed.

3. Rerouting or treatment of the discharge from the Cleghorn Springs Fish Hatchery.
4. In conjunction with the other recommended alternatives, increase weed harvesting efforts on Canyon Lake.
5. Removal of the island in Canyon Lake.

These recommendations should serve to provide a basis for the development of a complete lake restoration workplan and subsequent implementation. The recommendations listed above are provided for review only. They are not to be considered the only possible methods of restoration. Given the dynamic status of the science of lake restoration, new methodologies could become available at any time.

REFERENCES

1. Cole, G. A. 1983. Textbook of Limnology. C. V. Mosby CO. St. Louis. 344 pp.
2. Wetzel, R. G. 1983. Limnology. W. B. Saunders Co. Philadelphia. 750 pp.
3. Vollenweider, R. A. 1976. Advances In Defining Critical Loading Levels For Phosphorus In Lake Eutrophication. Mem Ist Ital Idrobiol.
3. Ried, G. K. 1963. Ecology of Inland Waters and Estuaries. Reinhold Publishing Co. New York. 340 pp.

APPENDIX A

WATER QUALITY PARAMETERS

1. Laboratory analysis

- a. Fecal coliform (organisms/100ml) to indicate fecal contamination and thus potential human health hazards. Fecal coliform bacteria are bacteria which live in the digestive tract of warm-blooded animals. These bacteria are considered to be an indicator of sewage pollution or livestock manure. Fecal coliform bacteria are not found in the digestive tract of cold-blooded animals such as fish, amphibians or reptiles. Some fecal coliform will exist in nature from the fecal material of wild animals or birds.
- b. Biochemical oxygen demand (BOD) (mg/l) to measure the organic content in polluted waters. BOD is a measurement of the potential for oxygen removal from the water and an indicator of organic pollution. As organisms die, the process of decomposition by bacteria removes dissolved oxygen from the water. The more nutrient rich the environment, the more potential for growth of aquatic organisms: hence, there will be more bacterial decomposition.
- c. Lab pH (su) for measuring the hydrogen ion activity which directly affects the toxicity (solubility) of heavy metals in water, among other items. The pH scale is a number range between 1 and 14 with 7 being neutral. Any value less than 7 is considered acidic, any value greater than 7 is considered basic.
- d. Suspended solids (mg/l) to indicate the sediment load into a body of water and possible problems to the biological community. Suspended solids does not include a measure of larger particles that are moved along the stream bed during high flows.
- e. Total solids (mg/l) to determine dissolved solids by subtracting suspended solids from total solids. Dissolved solids may have a detrimental affect on the biological community.
- f. Ammonia-nitrogen (mg/l) is a product of the first oxidative step in degrading organic material. It is directly available to plants as a nutrient for growth. Ammonia can be used as evidence of organic pollution and the unionized fraction of ammonia is toxic to fish.
- g. Nitrite-nitrogen (mg/l) constitutes the inorganic nitrogen fraction which is used by phytoplankton. Nitrate-nitrogen (mg/l) also indicates pollution from animal wastes, fertilizers or nitrogenous organic matter which is used by algae. It gives an indication as to what may be causing pollution in a lake (i.e., fertilizers, animal wastes, nitrogenous organic matter).

- h. Total Kjeldahl Nitrogen (mg/l) to measure both ammonia and organic nitrogen. Ammonia is subtracted from TKN and results in the organic nitrogen fraction which can be broken down to nitrogen compounds which are utilized by phytoplankton.
- i. Total phosphorus (mg/l) represents all of the phosphorus found in the water sample. Not all of the phosphorus is immediately available to aquatic plants and algae. Phosphorus is an element which is essential to all life and is the least available to living organisms. For this reason, phosphorus is commonly the limiting factor for biological productivity. When phosphorus concentrations are too high, nuisance growth of aquatic plants or algae may result.
- j. Ortho-phosphorus (mg/l) is analyzed because it is phosphorus which is immediately available to algae.

Field Analysis

- a. Water temperature (F or C) is taken since it has considerable effect on the chemical processes in a lake. Also, temperature is important to fish life and other aquatic species.
- b. Field pH (su) measures the hydrogen ion activity which can affect the toxicity of heavy metals in the water, as well as other factors.
- c. Dissolved oxygen (mg/l) because it is an indicator of the overall health of the lake and it is needed to sustain most aquatic animal life.
- d. Climatic conditions - wind, precipitation, air temperature (F or C).
- e. Visual observations - septic conditions, odor, water color, turbidity or anything unusual (e.g. dead fish).
- f. Tributary flow depth (ft.) to calculate flows entering the lake.
- g. The following additional measurements are taken for in-lake analysis: water depth, oxygen profiles, composite sampling at various lake depths (surface, mid-depth and bottom), chlorophyll a, Secchi Disc (visibility) and phytoplankton identification.

In-lake sediment sampling

- a. Corps of Engineers Elutriate Test for some of the above mentioned parameters plus selected pesticides; such as Endrin, DDT, parathion, Etc., is used to determine what is in the sediments.

- b. Sediment depth measurements are used to determine sediment volumes in the lake.

APPENDIX B



Department of Water & Natural Resources

Joe Foss Building
23 East Capitol
Pierre, South Dakota 57501-3181

M E M O R A N D U M

August 10, 1989

TO: Bill Stewart

FROM: Joe Bowar

RE: South Dakota Department of Game, Fish and Parks - Cleghorn Springs State Trout Hatchery NPDES Permit SD-0000060

The NPDES permit for Cleghorn Springs expired June 30, 1989, and is currently in the renewal process. DWRN drafted the permit, and since we are not a delegated state, the EPA must issue the final permit. I have attached a copy of the existing permit which is still in effect until the new one is issued.

Fish hatcheries are regulated under the NPDES program as categorical industries (aquaculture) and have effluent limitations based upon the average amount of food used during the maximum production month. The effluent limitation is specified in pounds per day and also as a concentration (mg/L). The South Dakota Surface Water Quality Standards (ARSD 74:03:02:45) specify that effluent from water pollution control facilities discharging to coldwater fisheries must meet a total suspended solids and BOD5 limitation of 10 mg/L based on composites. In addition, a grab sample must be taken during raceway cleaning and analyzed for total suspended solids. The pH must also be in the range of 6.6 to 8.3. The new permit will contain additional monitoring for ammonia on a weekly basis and during raceway cleaning. Past grab samples of the discharge indicate no ammonia standard violations but more data will help insure protection of the instream standard of 0.02 mg/L unionized ammonia.



RECEIVED

JAN 10 1985

SOUTH DAKOTA DEPARTMENT OF
WATER AND NATURAL RESOURCES
OFFICE OF WATER QUALITY

BHRO

Permit No. SD-0000060

Effective Date: Date of Issuance*

Expiration Date: June 30, 1989

AUTHORIZATION TO DISCHARGE UNDER THE
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Clean Water Act, as amended
(33 U.S.C. 1251 et. seq.) (hereinafter referred to as "the Act"),

the South Dakota Department of Game, Fish, and Parks - Cleghorn Springs State
Trout Hatchery,

is authorized by the United States Environmental Protection Agency,

to discharge from their hatchery operation,

to Rapid Creek,

in accordance with effluent limitations, monitoring requirements and other
conditions set forth in Parts I, II, and III, hereof.

Samuel C. Berwa
Authorized Permitting Official

12-28-84
Date

Max H. Dodson
Director
Water Management Division
Title

*Thirty (30) days after the date of receipt of this permit by the Applicant.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

- Effective immediately, the permittee is authorized to discharge from their outfall to Rapid Creek. Such discharges shall be limited and monitored by the permittee as specified below:

<u>Effluent Characteristics</u>	<u>Discharge Limitations</u>		<u>Monitoring Requirements</u>			
	kg/day (lbs/day) Daily Avg.	Daily Max.	Concentration mg/L 24-Hour Comp.	Instantaneous mg/L Instantaneous	Measurement Frequency	Sample Type
Total Suspended Solids	190(418)	284(625)	10	17.5	Quarterly	Composite
Flow	--	--	--	--	Quarterly	Instantaneous

The pH shall not be less than 6.6 standard units nor greater than 8.3 standard units and shall be monitored quarterly by composite.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): At the point of discharge to Rapid Creek but prior to mixing with any other waters.

Raceway Cleaning

In addition to the composite sample, a quarterly grab sample shall be taken during raceway cleaning and analyzed for Total Suspended Solids. Frequency and duration of cleaning operations and related flows shall be reported.

B. MONITORING AND REPORTING**1. Representative Sampling**

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge. All samples shall be taken at the monitoring points specified in this permit and, unless otherwise specified, before the effluent joins or is diluted by any other wastestream, body of water, or substance. Monitoring points shall not be changed without notification to and approval by, the permit issuing authority.

2. Reporting

Monitoring results obtained during the previous 6 months shall be summarized and reported on a Discharge Monitoring Report Form (EPA No. 3320-1), postmarked no later than the 28th day of the month following the completed reporting period. The first report is due on July 28, 1985. If no discharge occurs during the reporting period, "no discharge" shall be reported. Duplicate signed copies of these, and all other reports required herein, shall be submitted to the Regional Administrator and the State at the following addresses:

U.S. Environmental Protection Agency	South Dakota Department of Water
Suite 280, 1860 Lincoln Street	and Natural Resources
Denver, Colorado 80295	Division of Water Management
Attention: Water Management Division	Office of Water Quality
Compliance Branch (8WM-C)	Joe Foss Building
	Pierre, South Dakota 57501

3. Definitions

- a. The "daily average" discharge means the total discharge by weight during a calendar month divided by the number of days in the month that the production or commercial facility was operating. Where less than daily sampling is required by this permit, the daily average discharge shall be determined by the summation of all the measured daily discharges by weight divided by the number of days during the calendar month when the measurements were made.
- b. The "daily maximum" discharge means the total discharge by weight during any calendar day. This limitation shall be determined by the analyses of a properly preserved sample and the flow at the time of sampling. If a composite sample is collected, it shall be composited in proportion to flow at the time of sampling.
- c. A "composite" sample, for monitoring requirements, is defined as a minimum of four grab samples taken at 2 hour intervals over an 8 hour period and composited in proportion to flow at the time of sampling.

B. MONITORING AND REPORTING (Continued)

3. Definitions (Continued)

- d. A "grab" sample, for monitoring requirements, is defined as a single "dip and take" sample at a representative location in the waste stream.
- e. A "24 hour" composite is defined as a minimum of 12 grab samples taken at 2 hour intervals and composited in proportion to Flow at the time of sampling.

4. Test Procedures

Test procedures for the analysis of pollutants shall conform to regulations published pursuant to Section 304(h) of the Act, under which such procedures may be required.

5. Recording of Results

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:

- a. The exact place, date, and time of sampling;
- b. The dates the analyses were performed;
- c. The person(s) who performed the analyses;
- d. The analytical techniques or methods used; and,
- e. The results of all required analyses.

6. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Discharge Monitoring Report Form (EPA No. 3320-1). Such increased frequency shall also be indicated.

7. Records Retention

All records and information resulting from the monitoring activities required by this permit, including all records of analyses performed and calibration and maintenance of instrumentation and recordings from continuous monitoring instrumentation, shall be retained for a minimum of three (3) years, or longer, if requested by the Regional Administrator or the State Water Pollution Control Agency.

A. MANAGEMENT REQUIREMENTS

1. Change in Discharge

All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit more frequently than or at a level in excess of that authorized shall constitute a violation of the permit. Any anticipated facility expansions, production increases, or process modifications which will result in new, different, or increased discharges of pollutants must be reported by submission of a new NPDES application or, if such changes will not violate the effluent limitations specified in this permit, by notice to the permit issuing authority of such changes. Following such notice, the permit may be modified to specify and limit any pollutants not previously limited.

2. Noncompliance Notification

If, for any reason, the permittee does not comply with or will be unable to comply with any daily maximum effluent limitation specified in this permit, the permittee shall provide the Regional Administrator and the State with the following information, in writing, within five (5) days of becoming aware of such condition:

- a. A description of the discharge and cause of noncompliance; and,
- b. The period of noncompliance, including exact dates and times; or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate and prevent recurrence of the noncomplying discharge.

3. Facilities Operation

The permittee shall at all times maintain in good working order and operate as efficiently as possible all treatment or control facilities or systems installed or used by the permittee to achieve compliance with the terms and conditions of this permit.

4. Adverse Impact

The permittee shall take all reasonable steps to minimize or correct any adverse impact on the environment resulting from noncompliance with any effluent limitations specified in this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

A. MANAGEMENT REQUIREMENTS (Continued)

5. Bypassing (See Additional Requirements Under PART III)

Any diversion from or bypass of facilities necessary to maintain compliance with the terms and conditions of this permit is prohibited, except (i) where unavoidable to prevent loss of life or severe property damage, or (ii) where excessive storm drainage or runoff would damage any facilities necessary for compliance with the effluent limitations and prohibitions of this permit. The permittee shall promptly notify the Regional Administrator and the State in writing of each such diversion or bypass.

6. Removed Substances

Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of waste waters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering navigable waters.

7. Power Failures

In order to maintain compliance with the effluent limitations and prohibitions of this permit, the permittee shall either:

a. In accordance with the Schedule of Compliance contained in Part I, provide an alternative power source sufficient to operate the waste water control facilities;

or, if such alternative power source is not in existence, and no date for its implementation appears in Part I,

b. Take such precautions as are necessary to maintain and operate the facility under his control in a manner that will minimize upsets and insure stable operation until power is restored.

B. RESPONSIBILITIES

1. Right of Entry

The permittee shall allow the head of the State Water Pollution Control Agency, the Regional Administrator, and/or their authorized representative, upon the presentation of credentials:

- a. To enter upon the permittee's premises where an effluent source is located or in which any records are required to be kept under the terms and conditions of this permit; and
- b. At reasonable times to have access to and copy any records required to be kept under the terms and conditions of this permit; to inspect any monitoring equipment or monitoring method required in this permit; and to sample any discharge of pollutants.

2. Transfer of Ownership or Control

In the event of any change in control or ownership of facilities from which the authorized discharges emanate, the permittee shall notify the succeeding owner or controller of the existence of this permit by letter, a copy of which shall be forwarded to the Regional Administrator and the State Water Pollution Control Agency.

3. Availability of Reports

Except for data determined to be confidential under Section 308 of the Act, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the State Water Pollution Control Agency and the Regional Administrator. As required by the Act, effluent data shall not be considered confidential. Knowingly making any false statement on any such report may result in the imposition of criminal penalties as provided for in Section 309 of the Act.

4. Permit Modification

After notice and opportunity for a hearing, this permit may be modified, suspended, or revoked in whole or in part during its term for cause including, but not limited to, the following:

- a. Violation of any terms or conditions of this permit;
- b. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or,
- c. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.

B. RESPONSIBILITIES (Continued)

5. Toxic Pollutants

Notwithstanding Part II, B.4. above, if a toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307(a) of the Act for a toxic pollutant which is present in the discharge and such standard or prohibition is more stringent than any limitation for such pollutant in this permit, this permit shall be revised or modified in accordance with the toxic effluent standard or prohibition and the permittee so notified.

6. Civil and Criminal Liability

Nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

7. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Act.

8. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Act.

9. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

10. Severability

The provisions of this permit are severable and, if any provision of this permit or the application of any provision of this permit to any circumstance is held invalid, the application of such provision to other circumstances and the remainder of this permit shall not be affected thereby.

OTHER REQUIREMENTS

Bypass of Treatment Facilities

1. Definitions

- a. "Bypass" means the diversion of waste streams from any portion of a treatment facility.
- b. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

2. Prohibition of Bypass

Any bypass is prohibited and the permit issuing authority may take enforcement action against a permittee for bypassing, unless:

- a. The bypass was unavoidable to prevent loss of life, personal injury, or severe property damage; and,
- b. There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if the permittee could have installed adequate backup equipment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance.

3. Authorized Bypass

- a. If, for any reasons, a partial or complete bypass is considered necessary, a request for such bypass shall be submitted to the State of South Dakota and to the United States Environmental Protection Agency at least sixty (60) days prior to the proposed bypass. If the proposed bypass is judged acceptable to the State of South Dakota and by the United States Environmental Protection Agency, the bypass will be allowed subject to limitations imposed by the State and the United States Environmental Protection Agency.
- b. If, after review and consideration, the proposed bypass is determined to be unacceptable by the State and by the United States Environmental Protection Agency, or if limitations imposed on the approved bypass are violated, such bypass shall be considered a violation of this permit; and the fact that application was made, or that a partial bypass was approved, shall not be a defense to any action brought thereunder.

OTHER REQUIREMENTS (Continued)

Bypass of Treatment Facilities (Continued)

3. Authorized Bypass (Continued)

- c. The sixty (60) day period referred to in subparagraph a. may be reduced or waived at the discretion of the permit issuing authority.

4. Notification for Unauthorized Bypasses

- a. The permittee shall provide immediate (within 24 hours) oral notification of any bypass which may endanger health or the environment.
- b. All bypasses not specifically authorized under Paragraph 3. of this Section are subject to the notification requirements of Part II, Section A.2., Noncompliance Notification, of this permit.

Reapplication

If the permittee desires to continue to discharge, he shall reapply, at least one hundred eighty (180) days before this permit expires, using the application forms then in use. The permittee should also reapply if he desires to maintain a permit, even though there was not a discharge from the treatment facilities during the duration of this permit.

Statement of Basis

Applicant: South Dakota Department of Game, Fish, and Parks -
Cleghorn Springs Fish Hatchery
Permit Number: SD-0000060
Contact Person: Ms. Laurie Root, Hatchery Biologist
Phone: (605) 394-2397
Permit Type: Minor Industrial (Fish Hatchery) Facility - Renewal

Description

The Cleghorn Springs Fish Hatchery is located on the southwest edge of Rapid City, South Dakota (SE 1/4, Section 9, T1N, R7E). This facility is a cold water hatchery owned and operated by the South Dakota Department of Game, Fish, and Parks which produces roughly 128,000 pounds of fish per year.

The facility consists of a hatchery building with 44 raceways, 8 broodstock raceways, and 50 production raceways. The treatment facility built in 1973 consists of two 30 by 100 foot settling basins 3 feet deep. The basins have sloped bottoms and collection troughs for solids handling. Four times per year the sludge collected is scraped into the troughs and flushed to a 1,000 gallon manhole which discharges to the Rapid City sanitary sewer. The sludge is produced from fish waste and uneaten food. The clarified effluent is released by a discharge structure.

Approximately 75% of the clarified water from the settling ponds is discharged to an unnamed tributary of Rapid Creek which flows approximately 700 feet to Rapid Creek. The remaining 25% is recirculated through the production raceways along with fresh water from an infiltration gallery. Continuous flows through the facility may reach a maximum of 9.0 mgd, but average about 7.2 mgd.

Receiving Water

Any discharge from this facility would enter an unnamed tributary of Rapid Creek flowing approximately 700 feet to Rapid Creek. The unnamed tributary of Rapid Creek is classified by South Dakota Surface Water Quality Standards (SDSWQS) for the following beneficial uses:

- (9) Wildlife propagation and stock watering waters; and
- (10) Irrigation waters.

Rapid Creek is classified by SDSWQS for the following beneficial uses:

- (1) Domestic water supply waters;
- (2) Coldwater permanent fish life propagation waters;
- (7) Immersion recreation waters;
- (8) Limited contact recreation waters;
- (9) Wildlife propagation and stock watering waters; and
- (10) Irrigation waters.

Monitoring Data

Monitoring data is from Discharge Monitoring Reports (DMRs) received by this program from the Cleghorn Springs Fish Hatchery. DMRs signed by the principal executive officer or authorized agent must be submitted to EPA and this Program every 6 months. If no discharge occurs it shall be stated as such on the DMR.

DATE	TSS (mg/l)	TSS * (mg/l)	FLOW (MGD) ^c	pH
7-12-88	1.9	3.5	7.4	7.5-7.6
1-6/88	1.0	1.6	7.0	7.4-7.6
1-6/87	1.6	4.2	7.724	7.5-7.6
12/85-6/86	2.8	3.9	7.26	7.6-7.7
7-12/85	1.0	1.8	7.43	7.6-7.7

* During raceway cleaning

Results of monitoring data indicate that the facility is in compliance with their permit limitations.

Inspections

The most recent "Compliance" inspections conducted by Department of Water and Natural Resources (DWR) personnel occurred on January 22, 1987 and February 22, 1989. The facility was found to be in compliance with their permit.

Effluent Limitations

The facility must meet the following effluent limitations which are based on both South Dakota Surface Water Quality Standards (SDSWQS) and Regional policy for calculating Total Suspended Solids for fish hatcheries:

Regional Policy Calculations

Average amount of food used during the maximum month = 620 pounds/day

Pollutant production: $0.75 \text{ lbs TSS/lbs/food} \times 620 \text{ lbs/food/day}$
 $= 465 \text{ lbs TSS/day}$

Discharge limitation with 20% solids removal:

$0.80 \times 465 \text{ lbs TSS/day} = 372 \text{ lbs TSS/day}$

1. Total Suspended Solids shall not exceed 372 lbs/day (Daily Average), or 558 lbs/day (Daily Maximum), nor shall the concentration exceed 10 mg/l in any 24-hour composite or 17.5 mg/l in any single analysis and/or measurement.
2. The pH shall not be greater than 6.6 or less than 8.3 units in any single analysis and/or measurement.
3. No sanitary wastes shall be introduced into this discharge.
4. In addition, a quarterly grab sample shall be taken during raceway cleaning and analyzed for Total Suspended Solids. Frequency and duration of cleaning operations shall be reported.
5. Only commercially processed fish feed shall be used (No unprocessed offal or other animal by-products).
6. There shall also be no discharge of floating solids or visible foam in other than trace amounts.

Any excess over any limitation defined in this permit shall be considered a violation of the permit unless the permittee can demonstrate that the excess is caused by the presence in the intake water of that parameter in violation.

A "composite" sample, for monitoring requirements, is defined as a minimum of four grab samples taken at 2 hour intervals over an 8 hour period and composited in proportion to flow at the time of sampling.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the point of discharge to the unnamed tributary of Rapid Creek.

The permittee shall send the U.S. Environmental Protection Agency production data on a yearly basis. This data is to include: annual production of fish in pounds; amount of food fed in maximum month in pounds; and daily food usage during maximum month in pounds. Additionally, the mean water flow through the hatchery shall be included. This information can be attached to the DMR form which is submitted in the last quarter of the calendar year.