

Considered: 1

WATER PERMIT NO. 5180-3

MAP No. same 487-7645

Name of Applicant City of Lake Andes

Post Office Address PO Box 783, Lake Andes SD 57356

Amount of Water Claimed 4.6 cfs (1800 ac-ft annually) Total Acres NA

Source of Water Supply Missouri River (stored water - see F.U. Permit No. 1688-3)

Water to be used for REC, FWP County Charles Mix

About adjacent miles to of Lake Andes.

PROOF OF PUBLICATION: Received ✓ Not Received

APPLICATION: Approved Subject to

F.F. & C.L. Adopted Not Approved Deferred

PRIORITY Date Received Dec. 30, 1987 Fee 550⁰⁰ Remarks appropria-
12/30/87 tion from Future Use Permit No. 1688-3

Corrected Application Received Feb. 5, 1988 Period of Annual Use Jan 1 - Dec 31

WATER QUALITY APPROVAL RECEIVED NA APPROVED/CONDITIONAL (Circle one)

WI-1 Description same as Application YES NO REMARKS

Diversion Point Missouri River: E $\frac{1}{2}$ E $\frac{1}{2}$

section 5 - T95N - R65W

Land to be Irrigated water is to be used to

stabilize the water level in the south unit

of Lake Andes (South Lake)

Well Log: Driller NA Licensed YES NO

Depth of Well REMARKS

Type of Map aerial photo + topo PREPARED BY Lyle Laberee Reviewed and the Number
assigned on February 10, 1988 By Ron Derrall

FORM 2 Application for uses other than irrigation (type in print)

Copy

Mail to: Water Rights Div
523 E. Capitol
Pierre, SD 57501
(605) 778-3832

leave
blank

No. _____ Hydrologic Unit _____
Map No. _____ Basin _____
Newspaper _____

Application For Permit To Appropriate Water Within The State Of South Dakota

Check use of water Industrial ☐ Commercial ☐ Municipal ☒ Other Common Distribution System ☐
Rural Water System ☐ Suburban Housing ☐ Geothermal Heat ☐ Institutional ☐ Recreational ☒
Domestic ☐ (above 18gpm) Other ☒ Fish + Wildlife Propagation, Municipal + Recreational.

Type of Application: Check one or more of the following

New ☐ Vested Right ☐ Future Use ☐ Change Use ☐
☒ Amend Permit No. 5180-2 with old priority date retained

Change diversion point(s) ☐ Add diversion point(s) ☐ Other ☐
☐ Application to Change diversion point(s) ☐ Diversion point(s) ☐ on Permit No. _____

☐ Construction to use water reserved by _____

1. Name of Applicant City of Lake Andes

Post Office Address P.O. Box 783 Lake Andes SD State 57254
(Street, RR or Box) (City)

2. Amount of water claimed (cfs) 46 cfs (1800 acre-feet annually)

3. Source of water supply Missouri River

4. Location of point of diversion Intake: E 1/2 E 1/2 Section 5 T95N-R45E
Lake Andes pipeline to a point near the treatment plant and then through
private pipeline across the N 1/2 Section 9 T96N-R65W to Lake Andes (Box 783)
County Lincoln

5. County water commissioner Charles M. M.

6. Period of diversion, which water is to be used January 1 - December 31

7. Description of proposed project. When available include any preliminary engineering
drawings and all data relating to the project. (Attach sheet if more space is needed)
For extension of time for one fifth of work
by September 1, 1991 due cooperation of law began
City of Lake Andes (see attached letter) (letter from
city) in accordance with SDCL 45-25

8. Name of applicant City of Lake Andes

9. Name of applicant City of Lake Andes

10. Name of applicant City of Lake Andes

11. Name of applicant City of Lake Andes

12. Name of applicant City of Lake Andes

13. Name of applicant City of Lake Andes

14. Name of applicant City of Lake Andes

Mail to: Water Rights Div.
DWNR, Foss Bldg.
Pierre, SD 57501
(605) 773-3352

No. 5180-3 Hydrologic Unit 10140101
Map No. same Basin Missouri River
Newspaper The Lake Andes Wave, Box 216 (wed)

Application For Permit To Appropriate Water Within The State Of South Dakota

Check use of water: Industrial ☐ Commercial ☐ Municipal ☒ Other Common Distribution System ☐
Rural Water System ☐ Suburban Housing ☐ Geothermal Heat ☐ Institutional ☐ Recreational ☒
Domestic ☐ (above 18gpm) Other ☒ Fish & Wildlife Propagation

Type of Application: Check one or more of the following

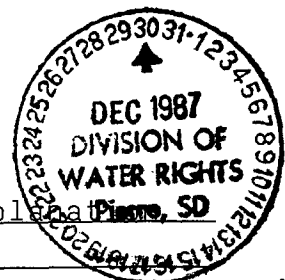
New ☒ Vested Right ☐ Future Use ☐ Change Use ☐

☐ Amend Permit No. _____ with old priority date retained

Change diversion point(s) ☐ Add diversion point(s) ☐ Other ☒ See attached explanation at Pierre, SD

☐ Application to: Change diversion point(s) ☐ Add diversion point(s) ☐ on Permit No. _____

☒ Construction to use water reserved by Future Use Permit No. 1688-3



- Name of Applicant City of Lake Andes Phone No. 487-7645
Post Office Address P.O. Box 783 Lake Andes State SD 57356
(Street, RR or Box) (City) Zip Code
- Amount of water claimed (c.f.s.) 4.6 (1800 acre-feet annually)
- Source of water supply Missouri River — Lake Francis Case
Intake: E $\frac{1}{2}$ E $\frac{1}{2}$ Section 5-T95N-R65W; Divert from city water line:
- Location of point of diversion Northwest Quarter of the Northwest Quarter of the Northwest Quarter (NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$), Section 9, Township 96 North, Range 65 West of the 5th P.M.
From existing twelve (12) inch raw water line _____ County Charles Mix
- Counties where water will be used Charles Mix
- Annual period during which water is to be used Throughout year when dry January 1-December 31
- Give a brief description of proposed project. When available include any preliminary engineering report or other reports or information that will help explain the project. (Attach sheet if more space is needed)

See attached explanation

Attachments: Attach Form 2A if diversion from a well or dugout, or if storage of water, is proposed. Attach map (see instruction)

STATE OF SOUTH DAKOTA)
County of CHARLES MIX

I, Dwight D. Herrrold, Mayor of the City of Lake Andes, SD the applicant, certify that I have read this application, have examined the attached map and that the matters stated are true and that I intend, and am able to complete the necessary construction.

Signed

Dwight D. Herrrold

Subscribed and sworn to before me this 28th day of December 1987

Notary Public

MCC 4/7/91



**SOUTH DAKOTA
WATER PERMIT**

Date of first receipt of application December 30, 1987

Date of return to applicant for correction, amendments or changes required January 7, 1988

Date of receipt of corrected application February 5, 1988

The Water Management Board approved Water Permit Application No. 5180-3

on May 11, 1988 for the City of Lake Andes
(Applicant)

PO Box 783 Lake Andes SD 57356
(Street, RR or Box) (City) (State) (Zip Code)

authorizing the construction of the water use system and the placing of water to beneficial use subject to the following limitations, conditions and qualifications:

1. Water Permit No. 5180-3 appropriates 4.6 cubic feet of water per second
(1800 acre-feet annually) from the Missouri River. Diversions from
the Missouri River are to be made from the E $\frac{1}{2}$ E $\frac{1}{2}$ section 5-T95N-R65W
via the City of Lake Andes pipeline to a point near the treatment plant and
then through a proposed pipeline across the N $\frac{1}{2}$ section 9-T96N-R65W to
Lake Andes (South Lake).
2. The water appropriated shall be used for the purpose of stabilizing the South Lake water
level and for municipal uses
and may not exceed the amount of water needed for beneficial use for municipal, recreational fish &
wildlife propagation.
3. The water is to be used during the following described annual period: Jan 1 - Dec 31
4. The date from which applicant may claim the right is December 30, 1987
5. One-fifth of the construction is to be completed on or before November 11, 1990
6. All construction is to be completed on or before May 11, 1993
7. Water is to be put to beneficial use on or before May 11, 1997
8. Water rights obtained in compliance with the laws of the State of South Dakota may not be unlawfully impaired by this appropriation.

QUALIFICATIONS

That pursuant to the "Lake Andes Diversion Project Operational Plan" submitted to the Water Management Board May 11, 1988:

1. Missouri River water may only be pumped into "The South Lake" of Lake Andes if "The South Lake" pool elevation is below 1436.75 feet above mean sea level.
2. All pumping operations shall cease when the "The South Lake" pool elevation is at or below 1434.75 feet above mean sea level.
3. Subject to the above qualifications, when pumping will begin and end will be decided by a representative from the South Dakota Department of Game, Fish and Parks, a representative from the United States Fish and Wildlife Service, and the City of Lake Andes.

WATER MANAGEMENT BOARD

By: John Hatch
Chief Engineer

Division of Water Rights
Dept. of Water and Natural Resources

NOV 30 1988

LAKE ANDES DIVERSION PROJECT

PROGRAM NARRATIVE

- A. **Project Description:** The Applicant City of Lake Andes ("the City") presently obtains water for domestic use purposes from Lake Francis Case via a 12 inch pipeline constructed in the late 1960s. When designed, the plastic pipeline was deliberately oversized in anticipation of supplementing the Lake of Lake Andes ("the Lake") at some point in the future. That point in time has arrived.

The Lake is situated in Charles Mix County, South Dakota, and has been determined to be an important wildlife refuge and public recreational area. In the 1930s the main body of the Lake was divided into three units by the construction of two cross dikes. These dikes are elevated section line roads maintained by the County with some assistance from the U.S. Fish and Wildlife Service. This Diversion Project is concerned with the south portion of the Lake, referred to locally as "The South Lake."

The South Lake borders a twenty-two (22) acre city park on the eastern limits of the city. Preliminary reports by the Corps of Engineers determined the annual evaporation loss to vary from 1.16 feet in a typical year to 2.49 feet in a drought year. It is the intention of this project to help offset such evaporation losses in the South Lake by means of an underground supplemental source pipeline running eight tenths (.8) of a mile from the City Water Treatment Plant to

the intended outlet point on South Lake.

As the existing pipeline is adequate to convey the necessary supplemental water supply, the applicant seeks only to increase its intake pump size and construct the supplemental source pipeline above-mentioned. The lift or head requirements are low as a result of reasonably flat terrain lying between the treatment facility and the outlet point.

The operation of the turn out valve for diversion would be wholly located upon City property and under the control of the applicant. Flood control of the South Lake takes place by use of a subterranean canal running south and west of the City to an open canal ultimately leading to Lake Francis Case.

The Lake is presently at ideal and optimal level for wildlife and recreational purposes. However, maintenance of this level is essential to the continued use and benefit of this resource.

South Lake consists of a body of water covering approximately one thousand six hundred fifty (1,650) acres of lake bed. Its depth during normal years (22 inches of precipitation) is about ten (10) feet. This south unit of Lake Andes includes a U.S. Fish and Wildlife refuge known locally as "Owen's Bay." South Lake is considered the most significant unit of the Lake for fish and wildlife purposes.

CHOTEAU CREEK BASIN

143

06453255 CHOTEAU CREEK NEAR AVON, SD

LOCATION.--Lat 42°55'24", long 98°06'21", in NW¼NW¼NW¼ sec.31, T.94 N., R.61 W., Bon Homme County, Hydrologic Unit 10170101, on left bank at downstream side of highway bridge, 6.3 mi southwest of Avon, 0.7 mi downstream from Dry Choteau Creek, and 12.7 mi upstream from mouth.

DRAINAGE AREA.--602 mi².

PERIOD OF RECORD.--Oct. 1, 1982, to Sept. 30, 1983.

GAGE.--Water-stage recorder. Altitude of gage is 1,290 ft, from topographic map.

REMARKS.--Records good except those for winter period and/or backwater from beaver dam, Oct. 1 to Mar. 31, which are poor. Several observations of water temperature and specific conductance were made during the year.

EXTREMES FOR CURRENT YEAR.--Peak discharges above base of 100 ft³/s and maximum (*):

Date	Time	Discharge (ft ³ /s)	Gage height (ft)	Date	Time	Discharge (ft ³ /s)	Gage height (ft)
Feb. 24	0300	422	5.19	May 2	1945	427	5.21
Mar. 7	1500	388	5.04	May 5	1830	629	5.99
Mar. 10	1100	316	4.71	July 1	1315	186	4.09
Apr. 1	1100	*703	*6.24	July 8	1730	178	4.05
Apr. 13	1730	376	4.99	Aug. 1	1715	101	3.45
Apr. 17	0545	500	5.51				

Minimum daily discharge, 0.83 ft³/s Oct. 1.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1982 TO SEPTEMBER 1983
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.83	2.6	6.6	3.0	3.3	138	617	96	23	175	61	4.4
2	.90	3.4	6.6	3.0	3.3	127	582	254	22	175	76	4.1
3	.93	3.1	6.5	2.9	3.1	119	669	347	21	141	60	3.8
4	.92	3.1	6.4	2.9	3.0	108	597	276	19	122	46	3.5
5	1.0	3.2	6.2	2.9	3.0	114	429	550	19	116	34	3.3
6	1.0	3.6	6.2	2.9	2.9	199	320	540	17	126	26	3.1
7	1.0	3.4	6.0	3.1	2.9	373	263	400	17	152	23	2.8
8	1.0	4.0	5.8	3.1	2.8	146	210	302	15	172	19	3.0
9	1.3	4.4	5.7	3.2	2.8	94	179	183	14	177	17	1.9
10	1.2	4.6	5.9	3.3	2.8	191	179	129	14	167	14	1.8
11	1.2	5.0	5.4	3.3	2.8	160	176	114	13	152	13	2.0
12	1.2	5.1	5.1	3.6	2.7	168	163	121	13	138	12	2.0
13	1.2	5.2	5.1	3.6	2.6	159	327	113	14	126	11	2.1
14	1.2	5.3	5.1	3.5	2.7	150	280	101	15	114	10	2.2
15	1.2	5.4	5.0	3.4	3.7	128	241	88	13	104	9.7	2.6
16	1.2	5.4	4.7	3.4	23	119	434	78	12	96	8.6	2.3
17	1.2	6.4	4.6	3.3	168	123	468	73	16	95	8.3	2.4
18	1.2	6.6	4.6	3.2	281	128	370	72	20	92	8.1	2.1
19	1.4	6.6	4.5	3.2	254	144	420	73	19	89	7.8	2.2
20	1.0	6.6	4.4	3.2	316	141	415	73	17	83	7.6	2.1
21	1.2	7.3	4.4	3.2	194	120	374	72	18	75	7.2	2.1
22	.95	6.8	4.4	3.3	211	100	289	64	20	66	7.0	2.1
23	1.4	6.8	4.4	3.4	356	92	229	59	24	66	6.9	2.1
24	1.7	7.4	4.4	3.4	388	85	192	52	31	61	6.5	2.2
25	2.0	7.7	3.9	3.6	215	81	159	45	29	56	6.5	2.3
26	2.2	6.8	3.4	3.7	153	78	132	39	23	51	5.8	2.6
27	2.3	6.7	3.6	3.7	144	68	123	34	22	47	5.6	2.9
28	2.5	6.8	3.3	3.7	147	78	113	29	26	43	5.3	2.4
29	2.6	6.5	3.3	3.6	---	86	103	25	34	44	5.2	3.1
30	2.8	6.6	3.1	3.5	---	178	98	24	99	39	4.8	2.6
31	2.8	---	3.0	3.3	---	503	---	24	---	37	4.5	---
TOTAL	44.53	162.4	151.6	102.4	2894.4	4498	9151	4450	659	3197	537.4	78.1
MEAN	1.44	5.41	4.89	3.30	103	145	305	144	22.0	103	17.3	2.60
MAX	2.8	7.7	6.6	3.7	388	503	669	550	99	177	76	4.4
MIN	.83	2.6	3.0	2.9	2.6	68	98	24	12	37	4.5	1.8
AC-FT	88	322	301	203	5740	8920	18150	8830	1310	6340	1070	155

WTR YR 1983 TOTAL 25925.83 MEAN 71.0 MAX 669 MIN .83 AC-FT 51420

CHOTEAU CREEK BASIN

06453255 CHOTEAU CREEK NEAR AVON, SD

LOCATION.--Lat 42°55'24", long 98°06'21", in NW¼NW¼NW¼ sec.31, T.94 N., R.61 W., Bon Homme County, Hydrologic Unit 10170101, on left bank at downstream side of highway bridge, 6.3 mi southwest of Avon, 0.7 mi downstream from Dry Choteau Creek, and 12.7 mi upstream from mouth.

DRAINAGE AREA.--602 mi².

PERIOD OF RECORD.--Oct. 1, 1982, to current year.

GAGE.--Water-stage recorder. Altitude of gage is 1,290 ft, from topographic map.

REMARKS.--Records good. Several observations of water temperature and specific conductance were made during the year.

EXTREMES FOR CURRENT YEAR.--Peak discharges above base of 100 ft³/s and maximum (*):

Date	Time	Discharge (ft ³ /s)	Gage height (ft)	Date	Time	Discharge (ft ³ /s)	Gage height (ft)
Mar. 28	0115	528	5.34	May 28	2345	219	4.41
Apr. 3	1915	827	6.58	June 12	0130	*4350	*13.93
Apr. 8	1245	587	5.77	June 23	0800	3710	13.04
Apr. 15	1230	2400	10.97	July 10	0500	1380	8.19
Apr. 22	2100	392	5.29	July 10	1645	1140	7.80
May 1	0645	968	7.39				

Minimum daily discharge, 1.5 ft³/s Oct. 17.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1983 TO SEPTEMBER 1984
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1.9	2.6	3.6	2.7	6.5	16	184	823	59	336	20	6.8
2	1.7	2.5	3.5	2.7	6.5	15	158	597	56	273	19	6.9
3	2.2	2.7	3.2	3.1	7.0	15	560	650	50	224	18	7.2
4	2.0	2.9	3.2	3.2	7.0	14	662	606	48	187	22	7.2
5	1.7	2.9	3.2	3.2	4.8	12	428	473	52	156	19	6.9
6	1.6	3.0	3.2	3.2	4.6	11	410	396	66	130	17	7.1
7	1.9	3.0	3.2	3.2	4.6	9.0	566	420	74	112	18	6.6
8	1.7	3.1	3.2	3.2	6.2	6.4	580	364	131	107	18	6.4
9	1.8	3.3	3.2	3.2	9.4	7.5	465	282	117	114	15	6.2
10	1.8	3.1	3.2	3.0	9.4	8.0	312	222	262	756	15	6.1
11	1.8	3.1	3.4	3.0	9.4	8.2	320	228	416	564	14	6.1
12	1.7	3.0	3.5	3.0	9.4	8.5	914	229	3030	229	12	6.1
13	1.6	3.2	3.5	2.7	7.8	8.9	1290	186	1510	144	11	6.0
14	1.6	3.2	3.5	2.6	7.7	15	1470	161	1220	114	9.5	5.5
15	1.8	3.0	3.5	2.6	9.0	44	2280	133	877	98	10	5.4
16	1.7	2.9	3.6	2.7	11	32	1910	113	823	86	11	5.4
17	1.5	2.9	3.6	2.7	9.9	23	1210	92	800	77	11	5.4
18	1.8	2.9	3.4	2.6	10	23	763	87	644	68	10	5.4
19	2.3	4.6	3.2	2.6	5.7	20	475	85	459	61	9.0	5.4
20	2.2	5.0	3.2	2.3	7.2	35	334	74	697	52	9.0	5.3
21	2.2	4.3	3.2	2.3	7.1	85	278	67	913	46	9.8	5.1
22	2.1	4.6	3.2	2.2	7.1	155	346	59	1740	41	9.0	4.9
23	2.6	3.9	3.1	2.2	8.5	221	343	51	3590	35	8.5	5.0
24	2.2	3.6	3.0	2.2	9.9	274	253	43	2950	32	10	5.2
25	2.2	3.5	2.8	2.4	9.5	284	217	38	2070	30	11	5.2
26	2.7	3.5	2.5	2.6	11	241	198	34	1500	67	9.1	5.2
27	2.2	3.8	2.6	2.6	10	454	244	92	1150	41	8.5	5.2
28	2.7	3.6	2.7	3.7	12	490	248	177	883	33	8.3	5.2
29	2.7	3.2	2.7	4.5	15	377	245	169	659	28	7.3	5.2
30	2.2	3.6	2.7	5.0	---	275	591	99	466	24	7.3	5.2
31	2.6	---	2.7	6.0	---	219	---	78	---	21	7.6	---
TOTAL	62.7	100.5	98.3	93.2	243.2	3406.5	18254	7128	27312	4286	383.9	174.8
MEAN	2.02	3.35	3.17	3.01	8.39	110	608	230	910	138	12.4	5.83
MAX	2.7	5.0	3.6	6.0	15	490	2280	823	3590	756	22	7.2
MIN	1.5	2.5	2.5	2.2	4.6	6.4	158	34	48	21	7.3	4.9
AC-FT	124	199	195	185	482	6760	36210	14140	54170	8500	761	347
CAL YR 1983	TOTAL	25828.8		MEAN	70.8	MAX	669	MIN	1.5	AC-FT	51230	
WTR YR 1984	TOTAL	61543.1		MEAN	168	MAX	3590	MIN	1.5	AC-FT	122100	

06453255 CHOTEAU CREEK NEAR AVON, SD

LOCATION.--Lat 42°55'24", long 98°06'21", in NW¼NW¼NW¼ sec.31, T.94 N., R.61 W., Bon Homme County, Hydrologic Unit 10170101, on left bank at downstream side of highway bridge, 6.3 mi southwest of Avon, 0.7 mi downstream from Dry Choteau Creek, and 12.7 mi upstream from mouth.

DRAINAGE AREA.--602 mi².

PERIOD OF RECORD.--October 1982 to current year.

GAGE.--Water-stage recorder. Elevation of gage is 1,290 ft above National Geodetic Vertical Datum of 1929, from topographic map.

REMARKS.--Records good except those for Aug. 28 to Sept. 25, which are poor. Several observations of water temperature and specific conductance were made during the year.

EXTREMES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 100 ft³/s and maximum (*):

Date	Time	Discharge (ft ³ /s)	Gage height (ft)	Date	Time	Discharge (ft ³ /s)	Gage height (ft)
Mar. 9	1430	243	4.54	Apr. 24	0215	146	3.92
Mar. 13	1300	*287	*4.78	May 12	2000	228	4.45

Minimum daily discharge, 1.7 ft³/s Sept. 27.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1984 TO SEPTEMBER 1985
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	5.5	8.2	7.0	5.0	4.6	29	31	55	12	4.2	2.6	4.0
2	6.1	7.4	7.0	5.1	4.4	28	29	44	11	4.2	2.5	5.0
3	6.1	7.2	7.0	5.8	4.2	37	27	35	11	3.9	2.5	4.0
4	6.1	7.2	7.0	5.7	4.0	25	26	29	12	4.0	2.4	4.0
5	6.5	6.9	7.0	5.4	4.0	20	27	26	11	3.8	2.2	4.0
6	8.3	6.8	6.7	5.5	4.0	26	29	22	10	3.8	2.2	4.0
7	8.6	6.8	6.5	5.5	4.1	44	29	21	14	3.7	2.1	4.0
8	7.7	6.5	6.8	5.5	4.2	130	28	19	15	3.5	2.1	4.0
9	8.1	6.6	7.0	5.5	4.2	185	26	18	15	3.5	1.9	4.0
10	8.8	6.8	7.2	5.5	4.2	169	23	16	15	3.4	2.0	4.0
11	8.9	7.3	7.2	5.3	4.2	124	21	20	15	3.2	2.1	4.0
12	8.9	7.2	7.0	5.2	4.2	180	21	103	13	3.2	3.1	3.0
13	9.1	7.2	6.2	5.3	4.3	275	19	117	13	3.1	2.4	4.0
14	9.5	7.2	6.4	5.4	4.4	267	18	50	12	2.9	2.3	3.0
15	12	6.8	6.7	5.4	4.4	220	17	41	10	3.2	2.2	3.0
16	17	6.4	7.5	5.4	7.5	184	15	39	9.2	3.5	4.0	2.5
17	14	6.4	7.2	5.3	15	163	14	37	7.2	3.8	7.7	2.0
18	13	6.4	6.5	5.0	27	157	13	37	6.6	3.8	7.1	2.0
19	22	6.7	6.4	5.0	30	157	12	37	6.1	3.5	4.1	2.0
20	20	6.7	6.2	5.0	39	144	13	35	5.9	3.1	2.9	2.0
21	16	6.8	6.1	5.0	51	126	16	35	5.5	3.2	2.8	2.0
22	14	7.0	6.1	5.0	29	99	18	31	4.6	3.0	5.1	2.0
23	15	7.2	6.1	5.1	27	77	79	28	4.2	2.9	11	2.0
24	13	7.6	5.6	5.2	18	59	117	24	4.1	2.7	22	2.0
25	12	7.8	5.5	4.8	17	45	65	21	4.2	2.8	9.1	2.0
26	11	9.0	5.5	4.8	24	36	53	20	7.4	2.8	3.9	2.1
27	12	8.5	5.5	4.8	34	34	66	18	7.2	3.0	3.3	1.7
28	10	8.4	6.0	4.8	39	33	65	16	5.8	2.6	3.0	1.8
29	10	8.0	5.6	4.8	---	31	53	16	5.0	2.4	3.0	1.8
30	9.4	8.0	5.5	4.6	---	32	49	17	4.5	2.6	3.0	1.9
31	8.5	---	5.3	4.6	---	32	---	14	---	2.6	3.0	---
TOTAL	337.1	217.0	199.3	160.3	420.9	3168	1019	1041	276.5	101.9	129.6	87.8
MEAN	10.9	7.23	6.43	5.17	15.0	102	34.0	33.6	9.22	3.29	4.18	2.93
MAX	22	9.0	7.5	5.8	51	275	117	117	15	4.2	22	5.0
MIN	5.5	6.4	5.3	4.6	4.0	20	12	14	4.1	2.4	1.9	1.7
AC-FT	669	430	395	318	835	6280	2020	2060	548	202	257	174
CAL YR 1984	TOTAL	62035.0		MEAN	169	MAX	3590	MIN	2.2	AC-FT	123000	
WTR YR 1985	TOTAL	7158.4		MEAN	19.6	MAX	275	MIN	1.7	AC-FT	14200	

06453255 CHOTEAU CREEK NEAR AVON, SD

LOCATION.--Lat 42°55'24", long 98°06'21", in NW¼NW¼ sec.31, T.94 N., R.61 W., Bon Homme County, Hydrologic Unit 10170101, on left bank at downstream side of highway bridge, 6.3 mi southwest of Avon, 0.7 mi downstream from Dry Choteau Creek, and 12.7 mi upstream from mouth.

DRAINAGE AREA.--602 mi².

PERIOD OF RECORD.--October 1982 to current year.

GAGE.--Water-stage recorder. Elevation of gage is 1,290 ft above National Geodetic Vertical Datum of 1929, from topographic map.

REMARKS.--Records good except for periods of estimated record, which are poor. Estimated daily discharges during water year: Dec. 1, 2, Jan. 4, 21, 22, 26, Feb. 4-8, 20, 25-28, Mar. 19-21, and Apr. 14-18. Several observations of water temperature and specific conductance were made during the year.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 7,280 ft³/s, June 12, 1984, gage height, 13.93 ft; minimum daily discharge, 0.83 ft³/s, Oct. 1, 1982.

EXTREMES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 100 ft³/s and maximum (*):

Date	Time	Discharge (ft ³ /s)	Gage height (ft)	Date	Time	Discharge (ft ³ /s)	Gage height (ft)
Mar. 4	2330	406	5.27	June 22	0215	2,530	11.02
Mar. 22	0700	794	6.59	June 29	1930	239	4.14
Apr. 8	2145	497	5.46	July 8	0230	130	3.49
Apr. 19	2000	2,440	10.85	Sept. 16	1400	105	3.34
Apr. 28	0030	1,200	7.75	Sept. 19	0600	159	3.70
May 8	0815	3,050	11.89	Sept. 20	0945	1,950	9.75
May 11	1345	785	6.43	Sept. 24	1815	358	4.78
June 13	0930	*3,200	*12.02				

Minimum daily discharge, 1.9 ft³/s, Oct. 1.

REVISIONS.--The maximum discharge for water year 1984 has been revised to 7,280 ft³/s, June 12, 1984, gage height, 13.93 ft.

CORRECTIONS.--Published acre-feet for October of 1984 and 1985 water years is in error. Correct figures are as follows: October 1983, 124; October 1984, 669.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1985 TO SEPTEMBER 1986
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1.9	2.4	3.0	2.9	2.9	69	118	891	50	149	27	4.8
2	2.2	2.3	3.0	2.9	2.7	73	118	628	42	134	23	5.1
3	2.6	2.3	3.0	2.6	2.9	97	148	475	35	116	19	5.3
4	2.9	2.3	2.9	2.4	3.0	254	216	369	35	101	17	5.2
5	2.9	2.3	2.9	2.3	3.0	338	249	292	34	90	15	5.1
6	2.8	2.3	3.1	2.3	3.0	302	247	241	30	112	15	5.0
7	2.7	2.5	3.1	2.2	3.0	284	332	279	69	128	13	4.7
8	2.5	2.5	3.3	2.3	3.0	201	454	1730	53	126	12	5.3
9	2.3	2.5	3.3	2.3	3.0	275	460	693	49	113	10	4.9
10	2.4	2.5	3.3	2.3	3.0	241	367	524	75	103	7.9	5.0
11	2.6	2.5	3.3	2.3	2.9	216	275	749	106	98	6.9	3.8
12	2.9	2.5	3.4	2.3	3.0	202	210	660	677	89	6.5	3.7
13	2.6	2.7	3.4	2.4	2.9	200	186	486	2880	82	6.0	3.6
14	3.2	2.7	3.3	2.3	2.9	173	350	355	2240	70	5.9	3.3
15	2.4	2.7	3.6	2.3	2.9	152	550	276	1600	72	5.4	4.0
16	2.1	2.7	3.6	2.5	2.8	148	600	251	1220	75	5.3	36
17	2.0	2.7	3.7	3.3	3.0	170	800	226	966	68	4.7	27
18	2.4	2.7	3.6	3.8	4.0	415	1000	193	739	64	4.5	34
19	2.2	2.7	3.6	3.3	4.2	450	1760	159	586	66	4.7	126
20	2.9	2.7	3.6	3.6	4.1	350	2180	136	513	59	4.7	669
21	2.6	2.5	3.5	3.5	3.3	650	1630	115	405	59	4.1	194
22	2.6	2.5	3.3	3.5	3.2	773	1120	99	1310	59	4.1	112
23	2.8	2.5	3.3	3.3	3.1	607	734	93	443	57	4.1	229
24	2.5	2.9	3.3	3.1	3.2	407	561	86	323	55	4.3	339
25	2.5	3.1	3.3	3.1	5.0	293	530	74	232	49	4.4	312
26	2.4	3.0	3.1	3.0	40	270	519	76	167	43	5.5	234
27	2.5	3.1	3.1	3.1	150	228	946	73	155	39	5.2	181
28	2.7	2.9	3.1	3.1	80	184	1120	80	157	37	5.3	152
29	2.5	2.9	3.3	3.1	---	164	876	71	171	34	5.0	126
30	2.5	2.9	2.9	3.0	---	142	942	64	165	31	5.0	107
31	2.5	---	2.9	2.9	---	127	---	61	---	29	4.9	---
TOTAL	78.6	78.8	101.1	87.3	350.0	8455	19598	10505	15527	2407	265.4	2946.8
MEAN	2.54	2.63	3.26	2.82	12.5	273	653	339	518	77.6	8.56	98.2
MAX	3.2	3.1	3.7	3.8	150	773	2180	1730	2880	149	27	669
MIN	1.9	2.3	2.9	2.2	2.7	69	118	61	30	29	4.1	3.3
AC-FT	156	156	201	173	694	16770	38870	20840	30800	4770	526	5840

CAL YR 1985	TOTAL	6663.5	MEAN	18.3	MAX	275	MIN	1.7	AC-FT	13220
WTR YR 1986	TOTAL	60400.0	MEAN	165	MAX	2880	MIN	1.9	AC-FT	119800

1987 WY

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

05453255

CHOTEAU CR NR AVON SD

PROCESS DATE: 17-MAR-89 10:01 EBN

LAT 425524

LONG 9930621

STATE 45

COUNTY 039

DATUM OF BASE:

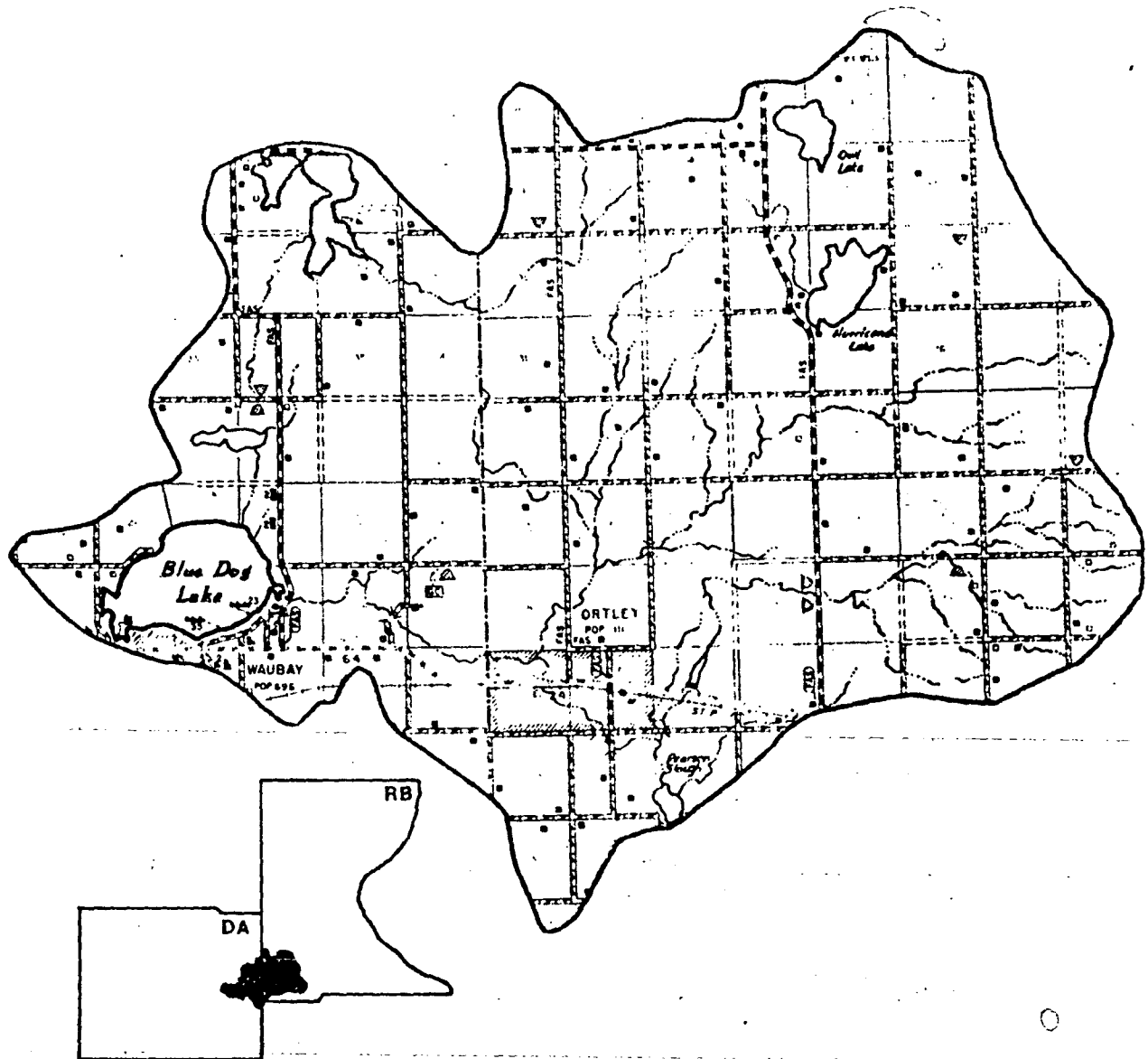
DRAINAGE AREA: 502

PROVISIONAL DATA DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	95	20	16	8.5	7.7	26	1550	65	16	5.7	7.3	4.1
2	81	19	17	8.0	8.0	29	1180	65	14	6.1	6.5	4.0
3	69	20	7.6	8.2	7.7	22	860	64	14	5.5	6.2	3.8
4	61	17	9.5	8.2	6.6	21	668	53	12	6.2	6.1	3.6
5	54	14	15	8.1	6.8	20	574	44	10	5.5	5.2	4.0
6	47	14	16	8.0	6.8	21	491	33	8.7	5.0	6.4	4.2
7	42	16	14	7.6	7.2	22	420	32	7.9	4.3	5.6	3.9
8	34	17	14	7.2	7.2	23	371	26	9.3	6.1	5.5	3.6
9	33	14	14	6.4	7.6	21	332	25	8.3	5.2	5.2	3.6
10	47	14	13	6.4	8.0	21	315	24	11	7.7	4.8	3.7
11	55	12	11	6.7	8.1	21	304	22	10	5.2	4.7	3.2
12	57	10	11	7.4	7.9	20	266	15	7.7	5.2	5.1	3.2
13	55	11	9.5	8.3	8.0	20	253	18	6.5	16	5.2	3.3
14	47	11	9.0	8.2	7.5	15	260	18	5.8	11	4.7	3.2
15	47	12	9.0	7.6	7.6	12	250	15	5.4	9.2	5.5	7.7
16	49	12	9.7	6.9	7.5	11	238	16	4.8	8.3	27	155
17	47	12	9.3	7.1	7.9	152	231	20	8.5	6.4	29	55
18	44	11	9.5	5.5	7.7	690	229	17	6.2	6.6	9.9	18
19	39	10	9.5	5.9	9.1	722	212	14	5.6	6.3	5.5	8.7
20	34	11	9.3	5.6	8.2	1020	193	26	5.3	6.2	4.1	6.8
21	29	12	8.5	6.4	8.0	1670	178	22	5.0	6.3	4.1	5.6
22	27	14	8.6	5.6	8.0	1540	152	14	5.0	5.5	4.1	4.9
23	25	14	8.5	5.1	7.3	1330	139	13	4.0	5.2	4.0	4.3
24	24	14	8.0	5.0	7.7	1440	134	11	4.0	41	4.5	4.2
25	23	15	7.2	5.2	9.0	2220	127	51	4.0	350	4.7	4.6
26	23	15	7.2	5.3	8.8	3820	107	61	3.9	90	4.6	4.6
27	24	16	7.6	5.6	11	5020	90	33	4.2	29	4.5	3.9
28	24	19	8.0	5.5	29	3600	94	19	4.8	18	4.4	3.7
29	22	21	8.5	5.1	---	1560	90	21	5.1	13	4.3	3.7
30	21	18	8.5	7.2	---	1370	79	40	4.8	10	4.2	3.3
31	21	---	8.5	7.6	---	1840	---	20	---	7.7	4.1	---
TOTAL	1301	436	323.2	210.4	240.9	26325	10392	911	221.9	207.0	207.1	345.8
MEAN	42.0	14.5	10.4	6.79	8.60	914	345	29.4	7.40	26.0	6.68	11.5
MAX	95	21	17	8.5	29	5020	1550	65	15	350	29	155
MIN	21	10	7.2	5.0	6.6	11	79	11	3.9	4.3	4.0	3.2
AC-FT	2580	865	641	417	476	56190	20610	1810	440	1600	411	686

CAL YR 1986 TOTAL 62201.7 MEAN 170 MAX 2880 MIN 2.2 AC-FT 123400
WTR YR 1987 TOTAL 43725.3 MEAN 120 MAX 5020 MIN 3.2 AC-FT 86730

SOUTH DAKOTA LAKES SURVEY



1981

Steffen

10/24/81

South Dakota Lakes Classification and Inventory
Final Report

prepared by
Ronald M. Koth

South Dakota Department of Water and Natural Resources
Office of Water Quality
Joe Foss Building
Pierre, South Dakota 57501

July 1, 1981

The preparation of this report has been funded through a grant to the South Dakota Department of Water and Natural Resources from the United States Environmental Protection Agency.

Lake Andes

LOCATION

County: Charles Mix Latitude: 43 Deg. 10 Min. 42 Sec. N
Longitude: 98 Deg. 26 Min. 36 Sec. W

Township 96, 97N, Range 64, 65W, Section(s) 5, 6; 1, 2, 3, 10, 11; 20,
21, 28, 29, 30, 31, 32; 10,
15, 16

LAKE USE

Beneficial Use Classification

- (6) Warm water marginal fish life propagation.
- (7) Immersion recreation.
- (8) Limited contact recreation.
- (9) Wildlife propagation and stock watering.

Estimated population within 65 mile radius of lake: 103,884

Ownership status: State owned.

Public Interest: Restore Lake Andes Association

LAKE MORPHOMETRY

Area: 4,616 A (1868.1 ha)
Shoreline length: N/A
Maximum depth: 10 ft. (3.0 m)
Mean depth: 3.2 ft. (1.0 m)
Volume: 14771.2 acre-feet (1.822 x 10⁷m³)
Watershed/lake surface area ratio: 27
Origin of lake basin: natural (glacial)
Thermal stratification: No

Major Inflows (named or permanent streams): Andes Creek
Outlet: unnamed

CHEMICAL PARAMETERS

The following data is from a lake survey conducted during summer 1979.
Samples were composited from 3 in-lake sites on each of two dates.
Averages are for samples in the upper mixed zone of the lake.

	<u>Sample Size</u>	<u>Mean</u>
Secchi disk depth (inches)	1	24
Chlorophyll a (mg/m ³)	2	29.8
Total phosphorus (mg/l)	2	1.26
Ortho phosphate as P (mg/l)	2	1.11
Total Kjeldahl nitrogen (mg/l)	2	3.45
Ammonia nitrogen (mg/l)	2	.52

Nitrate nitrogen (mg/l)	2	.1
Nitrite nitrogen (mg/l)	2	.01
pH	2	8.2
Total solids (mg/l)	2	2209
Suspended solids (mg/l)	2	5.5
Dissolved solids (mg/l)	2	2204
Total alkalinity (mg/l)	1	236
Chloride (mg/l)	2	90.1
Sulfate (mg/l)	2	1128
Conductivity (cond/°C)	1	2810/22
Total hardness (mg/l)	2	1213

TSI Values	5-29-79	7-25-79	Mean Value
SD	57.14	67.14	62.1
Chla	37.37	70.32	53.9
TP	111.29	101.19	106.2

Vertical profile for the date (5-29-79) with the most pronounced stratification (if any), (Figure 17).

Depth (ft.)	Temp (°C)	D. Oxygen (mg/l)	pH
1	24.3	13.1	8.5
3	23.3	13.7	-

This lake was not included in the National Eutrophication Survey.

AQUATIC PLANTS AND ALGAE

One-hundred percent of the shoreline length was covered with cattail and bullrush. Nearly 100% of the lake surface was covered by dead stems of emergent plants. Floating leaved and submergent plant species identified were: Potamogeton pectinatus and Ceratophyllum demersum.

Algal Species and Volumes from Lake Andes, Charles Mix County, 1979.

Lake Andes, Charles Mix County

Taxa	5/29/79		7/25/79	
	Cells/ml1	Volume2	Cells/ml	Volume
Ankistrodesmus falcatus	24	1,200	249	12,450
Chlamydomonas globosa	246	46,740	16,242	3,085,980
Chlorella vulgaris	18	3,240		
Cosmarium depressum			11	107,800
Cryptomonas ovata			260	273,000
Euglena gracilis			87	262,305

Lakes Andes, 5-29-79 Dissolved Oxygen & Temperature Profile

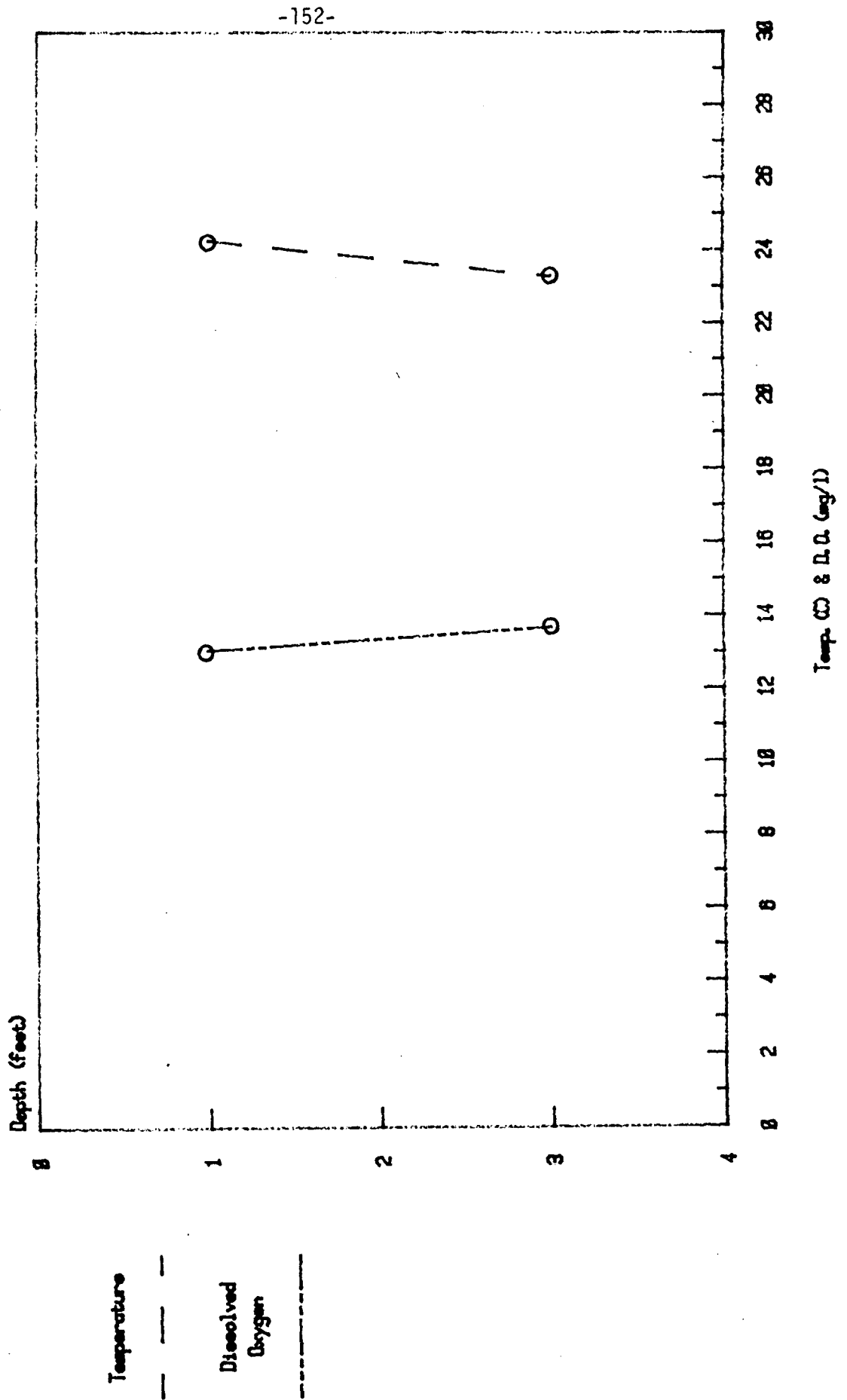


Figure 14

Oscillatoria tenuis	3,898	62,368
Rhopalodia gibba	11	57,595
Scenedesmus incrassulatus	390	74,100

Total	288	51,180	21,148	3,935,598
-------	-----	--------	--------	-----------

d (Species diversity)	0.74	1.05
J (Equitability)	0.47	0.35
V (Variety)	0.35	0.70

1Calculated total number of cells/species/ml original lake water.

2Total wet cell volume per species units - μm^3

WATERSHED DESCRIPTION

Watershed area (excluding lake surface) 122,342 acres (49,511 hectares).

Soil associations within watershed:

Association	Area A	% of Total
EA-H3-EU	62,394	51
H3-EA	55,053	45
CY-EU	2,446	2
HG-WL	2,446	2

EA-H3-EU - Eakin-Highmore-Ethan: Gently undulating well-drained soils.

H3-EA - Highmore-Eakin: Nearly level to sloping, well-drained silty soils that formed in glacial drift.

CY-EU - Clarno-Ethan: Gently undulating to rolling, well-drained soils.

HG-WL - Highmore-Walker: Well-drained and moderately well drained, nearly level and gently undulating, silty soils on uplands.

POLLUTION PROBLEMS

Non-Point Pollution Sources

Shoreline erosion: Estimated to be low by field observers in 1979.

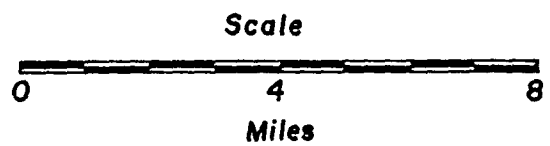
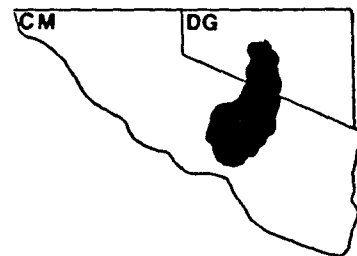
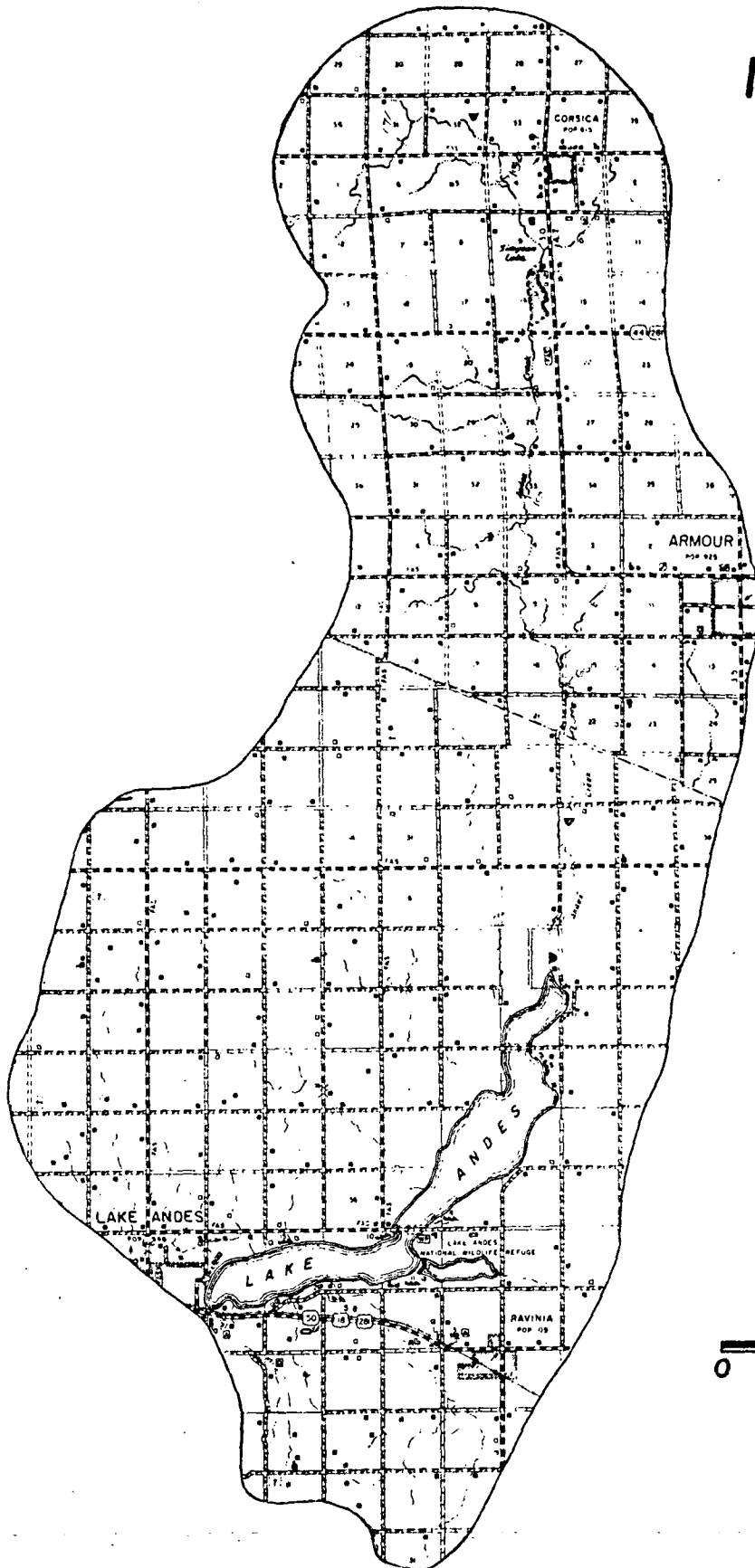
Watershed erosion: Estimated erosion rate in watershed = 4.9 tons/acre/year. Land use in watershed is estimated to be 80% crop, 20% rangeland or pasture. Weighted average slope for the entire watershed is 5.1%.

Point Source Pollution Sources

No point source pollution sources were identified.

Lake Andes

122,342 acres



IMPAIRMENTS

Emergent aquatic vegetation almost totally restricts any type of boating or fishing activity. This lake is primarily a wetland area for waterfowl production, not water recreation.

208 AGENCIES

S.D. DWR
Office of Water Quality
Joe Foss Building
Pierre, South Dakota 57501

Charles Mix County Conservation District
Lake Andes, South Dakota 57356

LCRLA27



App. No. 5180-3

signature:
Sgt. M. Lefner

RECEIPT

Division of Water Rights

South Dakota Department of Water and Natural Resources

411142

Pierre, February 5, 19 88

RECEIVED OF Southern Missouri Water Development District, PO Box 43, Armour, SD 57313
the following amount in fees for services rendered as provided for by law:

Fee for Application for Permit No. _____ to Appropriate Water, to construct works and to put water to beneficial use <u>from Future Use 1688-3</u>	550 00
Fee for Application for Permit No. _____ to Appropriate Water for Future Use _____	
Fee to retain Future Use Permit No. _____ after period of seven years.	
Fee for Inspecting Constructed Works, confirming beneficial use and issuing Water License No. _____	
Fee for Filing Transfer Form _____	
Fee for Filing Extension Request _____	
Fee for Certified Copy of _____	
Fee for Print Copy of Map _____	
Fee for Certifying _____	
Fee for _____	
(Any Other Work Provided by Law)	
Total	550 00

By John Hatch
Chief Engineer JOHN HATCH (ms)

SOUTH Dakota Department of
Water & Natural Resources

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

April 13, 1987

Bill Wilson
United States Department of Interior
Fish and Wildlife Service
Lake Andes National Wildlife Refuge office
Lake Andes, SD 57356

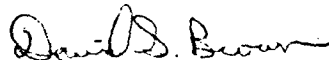
Dear Bill:

I am returning the manuscript entitled "History of Lake Andes" compiled by John Decker, Assistant Refuge Manager, May, 1982. A copy of the manuscript was made and is on file with this office.

Also enclosed is a copy of the water permit application report of the City of Lake Andes proposed lake maintenance project.

Please contact me if you have any questions concerning the City of Lake Andes proposed project.

Very truly yours,



David S. Brown
Natural Resources Engineer
605 773-3352

enclosures

PS Form 3811, Dec. 1980

RETURN RECEIPT, REGISTERED, INSURED AND CERTIFIED MAIL

● SENDER: Complete items 1, 2, 3, and 4. Add your address in the "RETURN TO" space on reverse.	
(CONSULT POSTMASTER FOR FEES)	
1. The following service is requested (check one).	
☒ Show to whom and date delivered —¢	
☐ Show to whom, date, and address of delivery.. —¢	
2. ☐ RESTRICTED DELIVERY —¢	
(The restricted delivery fee is charged in addition to the return receipt fee.)	
TOTAL \$ _____	
3. ARTICLE ADDRESSED TO: Bill Wilson U.S. Dept. of Interior Lake Andes Natl Wildlife Refuge Lake Andes SD 57356	
4. TYPE OF SERVICE:	ARTICLE NUMBER
☐ REGISTERED ☐ INSURED	P 404 786 488
☐ CERTIFIED ☐ COD	
☐ EXPRESS MAIL	
(Always obtain signature of addressee or agent)	
I have received the article described above.	
SIGNATURE ☐ Addressee ☒ Authorized agent	
5. DATE OF DELIVERY 4-14-88	POSTMARK
6. ADDRESSEE'S ADDRESS (Only if required) Pam Nagel	
7. UNABLE TO DELIVER BECAUSE:	7a. EMPLOYEE'S INITIALS

CITY OF LAKE ANDES

BOX 783

SOUTH DAKOTA 57356

HUB OF THE RANDALL-LAKE AREA



FAMOUS FOR HUNTING
FISHING & CAMPING



December 29, 1987

Water Rights Division
DWR, Foss Bldg.
Pierre, SD 57501

RE: Lake Andes Diversion Project

Dear Sir:

Enclosed please find the Application For Permit To Appropriate
Water Within The State of South Dakota for the City of Lake
Andes.

Sincerely,

A stylized, handwritten signature in dark ink, appearing to read "Michael J. Whalen".

MICHAEL J. WHALEN
CITY ATTORNEY

cc

Enclosures

SOUTH DAKOTA
Department of
Water & Natural Resources

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

January 7, 1988

Lyle Laberee, Manager
Southern Missouri Water Development District
P.O. Box 670
Lake Andes, South Dakota 57356

Dear Mr. Laberee:

This letter is in response to our phone conversation on January 6, 1988 and the permit application submitted by Lake Andes received on December 30, 1987. The following information is needed to complete the application:

1. The application fee to appropriate 4.6 cfs (1800 acre-feet annually) is \$550.00.
2. The enclosed map needs to have the diversion point from the Missouri River marked with an "x" and also be signed.
3. A proposed operating plan and the elevation in feet mean sea level at which the lake will be maintained.

The application can not be processed until the application fee, map and additional information are returned. Please contact me if you have any questions.

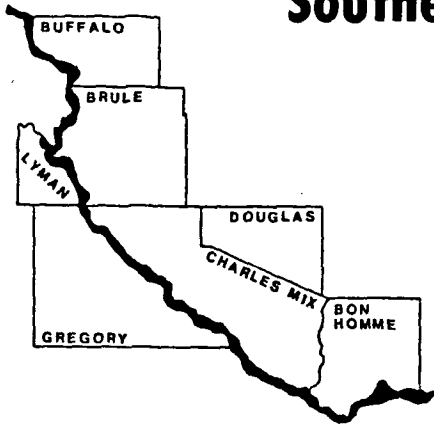
Sincerely,



Ron Duvall
Natural Resources Engineer

RD:ms
Enc.

Southern Missouri Water Development District



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P.O. BOX 43
DOUGLAS COUNTY COURTHOUSE
ARMOUR, SOUTH DAKOTA 57313

(605) 724-2624

January 28, 1988

South Dakota Department of
Water and Natural Resources
Joe Foss Building
Pierre, SD 57501



Dear Mr. Duvall:

This letter is in response to your letter of January 7, 1988. Sorry I am slow in responding but I have been gone too much.

A check for \$ 550.00 for the application fee is attached. I have marked the location of the diversion point, which is the same as the City of Lake Andes intake for their water supply.

The south unit of Lake Andes will be maintained as close as possible to 1437.25 MSL, this is the elevation of the outlet. The proposed operating plan is to monitor the lake elevation and when it starts to drop from the 1437.25 water will be directed from the City Water Treatment Plant. The City of Lake Andes will have adequate domestic water by pumping ten (10) to sixteen (16) hours per day at peak use. The remaining time (eight hours or more) untreated water would be diverted into Lake Andes during dry periods. With this type of operation the lake should be maintained near the 1437.25 MSL except in extreme dry cycles.

Sincerely,

Lyle M. Laberee
LYLE LABEREE

cc

Enclosures

Lake Andes Data

Lake is divided into three (3) parts due to two (2) county roads across the lake bed, however the three parts are connected via uncontrolled culverts.

Surface Area Lake - Taken from USGS Topo, Denmark, S. Dak. 1964

<u>cell Number</u>	<u>at Elevation (FT msl)</u>	<u>Surface Area (Acres)</u>
1 - "The South Lake"	1437	1815
2 - The middle lake	1437	2335
3 - The north lake	1437	625

Total = 4,775 acres

Lake Andes Middle Fringe (Owe - Bay)

- Surface Area at elevation 1441 is 279 acres (USGS Topo, 1964)

The purpose of the proposed water permit is to maintain "the South Lake" as close as possible to the outlet elevation of 1437.25 FT msl. with the City of Lake Andes operating the diversion system. Permit allows 1800 AC-FT annually to be used to maintain the lake (which is 0.94 Feet spread over 1800 acres and 0.38 Feet spread over 4775 acres)

Evaporation losses

assumptions: - "The South Lake" is isolated / not connected with the middle and north lakes at elevation 1437 FT msl

- evap. losses from lake in a typical year 12.49 Feet in a day (taken from info. submitted to Division for "Lake Andes Diversion Project, Program Narrative")

South Lake Evap. losses

$$\text{Volume lost to Evap. typical year} = (\text{Surface Area}) \times (\text{Evap. rate}) = (1815 \text{ Acres}) (12.49 \text{ Feet}) = 2,105 \text{ AC-FT}$$

$$\text{Volume lost to Evap. } = (\quad) \times (\quad) = (10 \text{ Acres}) (2.49 \text{ Feet}) = 24,519 \text{ AC-FT}$$

2nd Evap. losses about the project

$$\text{Loss Typical year} = \left[\frac{\text{Volume Inflow}}{\text{Volume Evap.}} \right] \times 100 = \left[\frac{(1800 \text{ AC-FT})}{(2,105 \text{ AC-FT})} \right] \times 100 = 86\%$$

$$\text{Loss a Decadal year} = \left[\frac{(1800 \text{ AC-FT})}{(24,519 \text{ AC-FT})} \right] \times 100 = 40\%$$

Water Permit # 5180-3Evaporation losses continued

Assumptions: - "The South Lake" is connected with the middle and north lake at Elevation 1437 FT MSL

- evap. losses vary from 1.16 feet in a typical year to 2.49 feet in a drought year

Total Lake evap losses

$$\text{Volume lost to evap. typical year} = (\text{Surface Area}) \times (\text{Evap. rate}) = (4775 \text{ acres}) (1.16 \text{ feet}) = 5,539 \text{ AC-FT}$$

$$\text{Volume lost to evap. drought year} = (4775 \text{ acres}) (2.49 \text{ feet}) = 11,890 \text{ AC-FT}$$

% of evap. losses offset by product

$$\% \text{ on a typical year} = [\text{Volume of Inflows} / \text{Volume of Evap.}] \times 100 = [(17,775 \text{ AC-FT}) / (5,539 \text{ AC-FT})] \times 100 = 32\%$$

$$\% \text{ on a drought year} = [(17,775 \text{ AC-FT}) / (11,890 \text{ AC-FT})] \times 100 = 15\%$$

Lake Andrus (Sillville Refuge) (Owens Bay)

Surface Area = 279 acres at elevation 1441 FT MSL

Average Annual precip = 23 inches (Climate of SD, Bulletin 582, January 1971, P. 19)

Average Annual Lake Evaporation (Period 1946-1955) = 38.5 inches (Climate of SD, Bulletin 582, November 1971, P. 29)

Average net loss of lake water level = (Aver. Annual precip) - (Average Annual Lake evap)

$$\text{Average net loss of lake water level} = (23 \text{ inches}) - (38.5 \text{ inches}) = -15.5 \text{ inches} = -1.29 \text{ FT} = \text{NL}$$

$$\text{Average Annual Volume of water lost to evap.} = (\text{Lake Surface Area}) \times (\text{NL}) = (279 \text{ acres}) \times (-1.29 \text{ FT}) = -360 \text{ AC-FT}$$

Volume of water supplied to lake

Well flow into lake at a constant discharge of 1000 gpm = 1,613 AC-FT/year

Since flow into well can supply ≈ 4.5 times more water than what is needed, maintaining Owens Bay water levels should not be a problem

Annual Pumping Costs (*Estimate)

Pump diversion rate is 4.6 cfs = 9.126 Ac-Ft/day

Total Annual allowed diversion = 1800 Ac-Ft

$$\begin{aligned}\# \text{ of days pump run per year} &= (\text{Total Annual Diversion}) / (\text{diversion rate}) \\ &= (1800 \text{ Ac-Ft}) / (9.126 \text{ Ac-Ft/day}) \\ &= 197.23 \text{ days} \quad \leftarrow (24 \text{ hours per day}) \\ &= (197.23 \text{ days}) / (365 \text{ days}) \times 100 = 54\% \text{ of the year}\end{aligned}$$

Cost of electricity to run pump

$$\text{Total Head needed} = H_e + H_L$$

H_e = Head due to elevation difference
 H_L = Friction losses

$$H_e = 126 \text{ FT}$$

$$H_L = \frac{f L V^2}{d \cdot 2g}$$

where: f = friction factor
 L = length (FT)
 d = diameter (FT)

Known Diameter = 12 inches, Area = $\pi r^2 = \pi (0.5)^2 = 0.785 \text{ ft}^2$ $\frac{V^2}{2g}$ = velocity head (FT)

Known $Q = 4.6 \text{ cfs}$

Known $L = 33,000 \text{ FT}$

Assume Turbulent Flow; Average Velocity squared = $V^2 = (Q/A)^2$
 $= (4.6 \text{ cfs} / 0.785 \text{ ft}^2)^2$
 $= 34.34 \text{ ft}^2/\text{sec}^2$

$$V = \sqrt{34.34} = 5.86 \text{ FT/s}$$

$$\frac{V^2}{2g} = \frac{(34.34)}{64.4} = 0.5 \text{ FT}$$

$$\text{Reynolds Number} = \frac{Vd}{\nu}$$

$$= \frac{(5.86)(1.0)}{1.217 \times 10^{-5}} = 4.8 \times 10^5$$

assume: H₂O at 60°F so $\nu = 1.217 \text{ ft}^2/\text{sec}$
assume: ϵ for cast iron, conventional pipe of 0.000008

$$\epsilon/d = 0.000008/1.0 = 0.000008$$

From Moody diagram $f = 0.013$

$$H_L = \frac{f L V^2}{d \cdot 2g} = \frac{0.013 (33,000) (0.5)}{1.0} = 215 \text{ Feet}$$

$$\text{Total Head needed} = H_e + H_L = 126 \text{ FT} + 215 \text{ FT} = 341 \text{ Feet}$$

$$BHP = \frac{Q H_T}{3960 E_p}$$

BHP = Brake horse power
where Q = discharge in gpm

H_T = Head in Feet = 341 feet

E_p = efficiency of pump

Assume: $E_p = 65\%$

Given $Q = 4.6 \text{ cfs} = 2065 \text{ gpm}$

$$BHP = \frac{(2065 \text{ gpm})(341 \text{ FT})}{3960 (.65)} = 274 \text{ HP}$$

$$\therefore BHP = 0.746 \text{ kW}$$

$$326.5 \text{ BHP} = 204 \text{ kW}$$

pump needs to run 24 hours per day for 197 days to supply 1800 AC-FT

$$\text{Kilowatt hours} = \frac{(24 \text{ hours})(197 \text{ days})}{(1 \text{ day})} (204 \text{ kW}) = 965,638 \text{ kW hours on a yearly basis}$$

Assume: cost of 3¢ per kilowatt hour

$$\text{Cost of project per year} = 965,638 \text{ kW hours} \times (0.035 \text{ \$/kWhr}) = \$33,800$$

Neglecting maintenance & installation costs of pump and pipe

Evaporation and Precip. Data

Reference: NOAA Climatological Data, Annual Summary, South Dakota, years of 1951-1986. at Pierre, Charles Mix County

Year	Annual Precipitation (inches)	Annual evaporation (inches)	Average Annual Temperature °F
1986	32.07	42.91	49.7
1985	21.16	36.06	46.5
1984	34.27	34.29	47.9
1983	22.12	43.71	48.0
1982	26.30	29.82	46.9
1981	19.38	39.25	47.1
1980	16.22	40.14	49.9
1979	Not Available	not available	not available
1978	20.76	37.88	45.8
1977	30.85	35.85	49.4
1976	14.23 ← Drought year →	53.34	49.7
1975	18.97	43.84	48.2
1974	12.27 ← Drought year →	49.39	49.9
1973	29.07	40.30	47.5
1972	26.84	33.15	46.6
1971	25.76	42.57	48.3
1970	20.28	42.95	48.1
1969	20.21	42.95	47.7
1968	20.41	45.72	48.8
1967	21.63	37.40	48.6
1966	16.69	47.50	47.9
1965	21.94	42.54	48.1
1964	19.02	47.67	49.4
1963	16.57	45.20	51.0
1962	34.08	37.01	48.2
1961	22.36	39.34	48.4
1960	24.89	42.53	47.2
1959	21.11	48.52	48.6
1958	15.35 ← Drought year →	45.94	49.2
1957	22.79	37.67	48.5
1956	12.45 ← Drought year →	39.27	49.2
1955	21.60	42.62	49.3
1954	22.40		50.5
1953	21.78		51.5
1952	16.37		50.9
1951			46.6
1950			45.4

Precip.
Average = $744.22/34 = 21.89$
Median = 21.71

Evap.
Average = $1275.17/31 = 41.14$
Median = 40.9

Average Temp.
Average = 47.5

Average year net loss = $(41.14 \text{ inches}) - (21.89 \text{ inches}) = 19.25 \text{ inches} = \underline{\underline{1.60 \text{ Feet}}}$

Drought years = (1976, 1974, 1958, 1956)

Average precip = $(14.23 + 12.27 + 15.35 + 12.45)/4 = 13.58 \text{ inches}$

Average evap. = $(53.34 + 49.39 + 45.97 + 39.27)/4 = 46.99 \text{ inches}$

Net loss = $33.41 \text{ inches} = \underline{\underline{2.78 \text{ Feet}}}$

Determine Amount of Runoff entering lake during an average and drought year

Reference: Lake Andes Diversion Project Program Narrative

Given: Corps of Engineers determined the annual evaporation loss of Lake Andes of 1.16 Feet in a typical year to 2.49 Feet in a drought year.

$$\text{Average Evap loss} = 5,539 \text{ AC-FT (COE)}$$

$$\text{Average precip} = +21.89 \text{ inches (DSB)}$$

$$\text{Average evap} = -41.14 \text{ inches (DSB)}$$

$$\text{Net loss} = 19.25 \text{ inches} = 1.60 \text{ Foot (DSB)}$$

$$\text{Net loss} = 1.16 \text{ Foot (COE)}$$

$$\text{Runoff on and Average year} = (\text{Net loss}_{\text{DSB}} - \text{Net loss}_{\text{COE}}) \times (\text{Lake Surface Area})$$

$$= (1.60 - 1.16) \times (4775 \text{ AC}) = \underline{\underline{2,101 \text{ AC-FT}}}$$

Given:

$$\text{Drought year Evap loss} = 11,890 \text{ AC-FT (COE)}$$

$$\text{Drought " Precip} = +13.58 \text{ in (DSB)}$$

$$\text{Drought " evap} = -46.99 \text{ in (DSB)}$$

$$\text{Net loss} = -33.41 \text{ inches} = 2.78 \text{ Foot (DSB)}$$

$$\text{Net loss} = 2.49 \text{ Foot (COE)}$$

$$\text{Runoff on drought year} = (\text{Net loss}_{\text{DSB}} - \text{Net loss}_{\text{COE}}) \times (\text{Lake Surface Area})$$

$$= (2.78 - 2.49) \times (4775 \text{ AC}) = \underline{\underline{1385 \text{ AC-FT}}}$$

Is this a valid approach?

Runoff Calculations For Lake Andes Watershed

Drainage Basin Characteristics

Reference: Koth, Ronald M., July 1981, South Dakota Lakes Survey,
SD DWR, Office of Water Quality, P. 153-154.

(1) Total watershed area = 122,342 acres (191.159 miles²)

(2) Soil Associations within watershed:

- 51% (62,394 acres) Eakin-Highmore-Ethan: Gently undulating well-drained soils
- 45% (55,053 acres) Highmore-Eakin: Mostly level to sloping, well-drained
silty soils that formed in glacial drift
- 2% (2,446 acres) Clarvo-Ethan: Gently undulating to rolling, well
drained soils.
- 2% (2,446 acres) Highmore-Walkers: well drained and moderately
well drained, nearly level and gently undulating,
silty soils on uplands.

(3) Land use in watershed

- 80% crop, 20% rangeland or pasture
- weighted average slope for entire watershed is 5.1%

Soil Group Classification

Reference: Speare, M. J., January, 1971, South Dakota
Engineering Field Manual for Conservation Practices,
U.S. Department of Agriculture, Soil Conservation
Service, Huron, SD, P. 2-11 - 2-29.

(4) Soil Group

Eakin-Highmore-Ethan
Highmore-Eakin
Clarvo-Ethan
Highmore-Walkers

Classification

B-B-B

B-B

B-B

B-?

not listed
CC, from SCS
phone
communications

overall classification = B

(5) 24-hour South Dakota Rainfall (inches) (From charts)

Frequency	Depth
100 year	5.6
50 year	5.1
25 year	4.5
10 year	3.8
5 year	3.3
2 year	2.1

Soil Cover complexes in Lake Arlos Drainage

Reference: Telephone conversations with Leslie Labadie (District Conservationist)
Lake Arlos Field office

(6) Pasture land and rangeland in fair conditions

Cropland = 25% Alfalfa } all straight row farming
30% small grains
45% Corn and Milo

Weighted CN Value (Average Conditions, for watershed conditions II, $I_a = 0.25$)

Reference: Chow, Ven TE, 1944, Handbook of Applied Hydrology,
P 21-27 - 21-32.

(7) Given: Total Drainage Area = 122,342 acres
- 80% of Drainage (97,874 acres) is cropland (straight row)
- 20% of Drainage (24,468 acres) is rangeland or pasture (fair condition)

From Table 21-12 (P. 21-27)

Land Use	Treatment or practice	Hydrologic Condition	Hydrologic Soil group	Runoff Curve Number (CN)
Pasture or range	- - - -	Fair	B	69
25% Small grain	straight row	Good	B	75
30% Row Crops (Corn, Milo)	straight row	Good	B	78
45% Closed-seeded legumes or rotation meadow (Alfalfa)	straight row	Good	B	72

Weighted CN values in Percent of Total Drainage

Pasture or range $CN = (0.20) \times CN = (0.20) \times (69) = 13.8$

Small grain $CN = (0.80) \times (0.25) \times CN = (0.80) \times (0.25) \times (75) = 15.0$

Row Crops $CN = (0.80) \times (0.30) \times CN = (0.80) \times (0.30) \times (78) = 18.7$

Closed-seeded legumes $CN = (0.80) \times (0.45) \times CN = (0.80) \times (0.45) \times (72) = 25.9$

weighted $CN = 73.4$ use 73

Estimate of Direct Runoff

Given: $CN = 73$, 24-hour Rainfall values, Average Antecedent Conditions, using Fig. 21-6, Drainage basin is 122,342 ACRES

Storm Frequency	Rainfall Depth (inches)	Direct Runoff (inches)	Volume of Runoff (AC-in)	Volume of Runoff (AC-Ft)
100 year	5.6	2.8	342,558	28,547.1
50 year	5.1	2.3	281,387	23,449.0
25 year	4.5	1.9	232,450	19,371.1
10 year	3.8	1.2	146,810	12,234.5
5 year	3.3	1.1	134,976	11,215.1
2 year	2.4	0.5	61,171	5,098.2

This analysis does not take into account storage "loss" due to dams, ditches or Simpson Lake
- A climatic runoff reduction factor has not been applied

(9) Climatic Index

Reference: Engineering Manual, 1982, National Engineering Handbook, Hydrology, Section 4, P. 21.3.

$$C_c = \frac{100 P_a}{(T_a)^2}$$

where: C_c = climatic index
 P_a = average annual precipitation
 T_a = average annual Temperature in degree Fahrenheit

Given: $P_a = 21.9$ in.
 $T_a = 48.5^\circ F$

$$C_c = \frac{100 (21.9)}{(48.5)^2} = 0.93$$

(10) Estimate of net runoff (Table 21.3 - Channel-loss factor for Reduction of Direct Runoff P. 21.6)

$$\text{Channel Loss Factor} = 0.92$$

$$\begin{aligned} P_{100} &= 2.8 \times 0.92 = 2.58 \text{ in.} \\ P_{50} &= 2.3 \times 0.92 = 2.12 \text{ in.} \\ P_{25} &= 1.9 \times 0.92 = 1.75 \text{ in.} \\ P_{10} &= 1.3 \times 0.92 = 1.10 \text{ in.} \\ P_5 &= 1.1 \times 0.92 = 1.01 \text{ in.} \\ P_2 &= 0.5 \times 0.92 = 0.46 \text{ in.} \end{aligned}$$

NOTE: Drainage Area of Lake
 Acres as determined by
 SCS in 1958 was 4,800
 Acres, not 122,342 that
 was used in this Analysis

(11) Volume of Runoff (Storm Independent Conditions)

$$\begin{aligned} V_{100} &= (2.58 \text{ in.}) \times (122,342 \text{ acres}) = 315,642 \text{ acre-in.} = 10,460 \text{ ac-ft} \\ V_{50} &= (2.12 \text{ in.}) \times (122,342 \text{ acres}) = 259,365 \text{ acre-in.} = 8,410 \text{ ac-ft} \\ V_{25} &= (1.75 \text{ in.}) \times (122,342 \text{ acres}) = 214,099 \text{ acre-in.} = 7,030 \text{ ac-ft} \\ V_{10} &= (1.10 \text{ in.}) \times (122,342 \text{ acres}) = 134,576 \text{ acre-in.} = 4,480 \text{ ac-ft} \\ V_5 &= (1.01 \text{ in.}) \times (122,342 \text{ acres}) = 123,565 \text{ acre-in.} = 4,110 \text{ ac-ft} \\ V_2 &= (0.46 \text{ in.}) \times (122,342 \text{ acres}) = 56,257 \text{ acre-in.} = 1,870 \text{ ac-ft} \end{aligned}$$

Runoff For Antecedent Moisture Condition I (Chow, 21-29-31-30) Table 21-14

(1)	CN for Condition II	CN for AMC I	S
	73	54	8.5
			$S = \frac{1,000}{CN} - 10 = \frac{1,000}{54} - 10 = 8.5 \text{ in.}$

$$Q = \frac{(P - 0.2)^2}{P + 0.8S}$$

where: P is total storm rainfall in inches

Direct Runoff

$$(2) Q_{100} = \frac{(5.6 - 0.2(8.5))^2}{5.6 + 0.8(8.5)} = 1.23 \text{ in.}$$

$$Q_{10} = \frac{(3.8 - 0.2(8.5))^2}{3.8 + 0.8(8.5)} = 0.42 \text{ in.}$$

$$Q_{50} = \frac{(3.1 - 0.2(8.5))^2}{3.1 + 0.8(8.5)} = 0.97 \text{ in.}$$

$$Q_5 = \frac{(3.3 - 0.2(8.5))^2}{3.3 + 0.8(8.5)} = 0.25 \text{ in.}$$

$$Q_{25} = \frac{(4.5 - 0.2(8.5))^2}{4.5 + 0.8(8.5)} = 0.69 \text{ in.}$$

$$Q_2 = \frac{(2.4 - 0.2(8.5))^2}{2.4 + 0.8(8.5)} = 0.05 \text{ in.}$$

(3) Climatic Index = $C_i = 0.93$ (assumed, no frequency reduction factor)

(4) Estimate Direct Storm runoff (Condition I)

$$Q = (\text{Direct runoff}) \times C_i$$

$$Q_{100} = (1.23 \text{ in}) \times 0.93 = 1.14 \text{ in}$$

$$Q_{50} = (0.97 \text{ in}) \times 0.93 = 0.90 \text{ in}$$

$$Q_{25} = (0.69 \text{ in}) \times 0.93 = 0.64 \text{ in}$$

$$Q_{10} = (0.40 \text{ in}) \times 0.93 = 0.39 \text{ in}$$

$$Q_5 = (0.25 \text{ in}) \times 0.93 = 0.23 \text{ in}$$

$$Q_2 = (0.05 \text{ in}) \times 0.93 = 0.05 \text{ in}$$

(5) Estimate of Peak Volume storm runoff (Condition I)

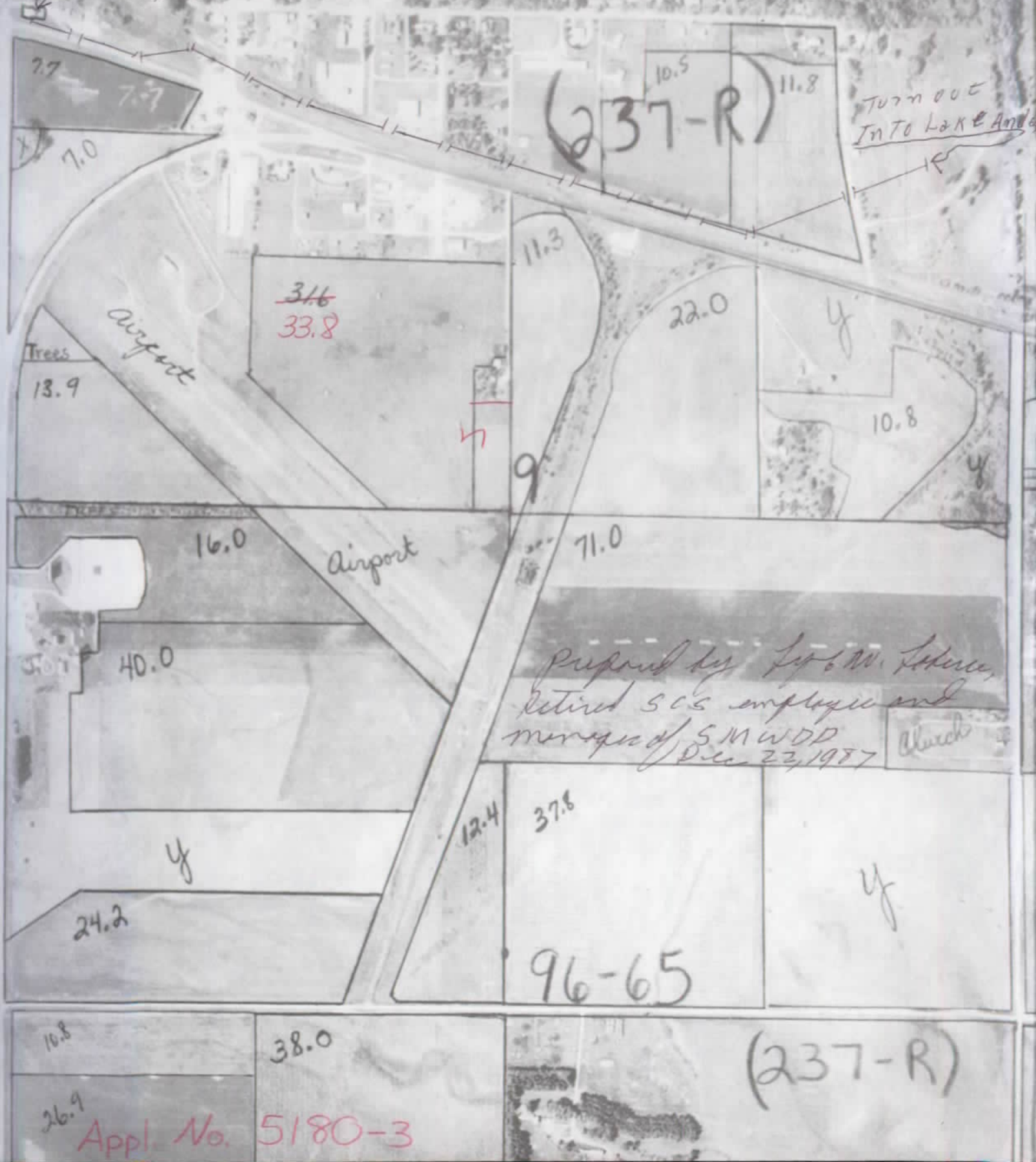
$V_{100} = (1.14 \text{ in}) \times (122,342 \text{ acres})$	$= 139,470 \text{ ac-in} = 11,623 \text{ ac-FT}$
$V_{50} = (0.90 \text{ in}) \times "$	$= 110,108 \text{ ac-in} = 9,176 \text{ ac-FT}$
$V_{25} = (0.64 \text{ in}) \times "$	$= 78,299 \text{ ac-in} = 6,525 \text{ ac-FT}$
$V_{10} = (0.39 \text{ in}) \times "$	$= 47,713 \text{ ac-in} = 3,976 \text{ ac-FT}$
$V_5 = (0.23 \text{ in}) \times "$	$= 28,139 \text{ ac-in} = 2,345 \text{ ac-FT}$
$V_2 = (0.05 \text{ in}) \times "$	$= 6,117 \text{ ac-in} = 510 \text{ ac-FT}$

$$V = (\text{Direct runoff}) \times (\text{Drainage Area})$$

NOTE: Drainage Area of Lake Ardes as determined by SCS in 1958 was 84,800 Acres, not 122,342 Acres that was used in this Analysis.

NOT TO SCALE

CITY OF LAKE ANDER
TREATMENT PLANT



Taken From United State Fish and Wildlife Service document
 entitled "HISTORY OF LAKE ANDES", Compiled by John Decker,
 Assistant Refuge Manager, May 1982, Lake Andes National
 Wildlife Refuge.

LAKE ANDES NATIONAL WILDLIFE REFUGE
 AREA-CAPACITY TABLE
 for
 NORTH UNIT (Unit 3)

<u>Elevation</u> <u>(msl)</u> <u>(assumed)</u>	<u>Capacity</u> <u>Acre-Feet</u>	<u>Difference</u> <u>in Capacity</u>	<u>Area</u> <u>Acres</u>	<u>Diff. in</u> <u>Area</u>
1429.25 92	0		0	
1430.25 93	21	21	42	42
1431.25 94	106	85	128	86
1432.25 95	300	194	260	132
1433.25 96	626	326	392	132
1434.25 97	1,055	429	466	74
1435.25 98	1,548	493	520	54
1436.25 99	2,093	545	570	50
1437.25 *100	2,683	590	611	41
1438.25 101	3,312	629	647	36
1439.25 102	3,975	663	680	33

*100.0 = Original Water Right Filing elevation.

Note: Current spillway crest (North-Center Units) = 1436.35 elev.

Planimetered from Solberg's contour map by RWD 6/15/43
 retyped 2/25/64 CMS

See Dwg. 3R-So.Dak.-173-6

LAKE ANDES NATIONAL WILDLIFE REFUGE
AREA-CAPACITY TABLE
for
MIDDLE UNIT (Unit 2)

<u>Elevation</u>	<u>Capacity Acre-Feet</u>	<u>Difference in Capacity</u>	<u>Area Acres</u>	<u>Diff. in Area</u>
1427.0	0		195	
1428.0	550	550	902	707
1429.0	1,670	1,120	1,338	436
1430.0	3,150	1,480	1,620	282
1435.0	12,620	9,470	2,170	550
1437.25	18,000	11,900	- 2359	420
1440.0	24,520		2,590	
1437.0				

Note: Current spillway crest (South-Center Units) = 1434.85 msl
Data obtained from (BA) curves, Wagner Unit - Letter incl. of 5/29/62.

LAKE ANDRES NATIONAL WILDLIFE REFUGE
AREA-CAPACITY TABLE
For
SOUTH UNIT (Unit 1)

<u>Elevation</u>	<u>Capacity Acres-Feet</u>	<u>Difference in Capacity</u>	<u>Area Acres</u>	<u>Diff. in Area</u>
1426.0	0		0	
		835		836
1428.0	835		836	
		2,325		654
1430.0	3,160		1,490	
		7,945		198
1435.0	11,105		1,688	
1437.25	<u>18,169</u>	8,755	-1760	162
1440.0	19,860		1,850	

Note: Current spillway crest (South-Center Unit) = 1434.85 msl

Data obtained from (BR) curves, Wagner Unit - Letter incl. of 5/29/62.

LAKE ANDES NATIONAL WILDLIFE REFUGE
AREA-CAPACITY TABLE
for
OWENS BAY UNIT

<u>Elevation</u>	<u>Capacity Acre-Feet</u>	<u>Difference in Capacity</u>	<u>Area Acres</u>	<u>Diff. in Area</u>
1436.52	0		0	
1437.52	11	11	22	22
1439.52	212	201	179	157
1441.52	633	421	242	63
1443.52	1,155	522	±280	38

* Water Right filing no. 220-3 based on 280 surface acres.

Note: Current spillway crest = 1441.52 elevation
= 96.0 (assumed) on Dwg. 3R-So.Dak.-173-2 =
6.0 on water gauge forms prior to September 1964
Planimetered from Dwg. M-So.Dak.-2.02 by RWD 4/3/59
retyped 2/25/64 GMS
Also see Dws. 3R-So.Dak.-173-1 & 2

LAKE ANDES NATIONAL WILDLIFE REFUGE
AREA-CAPACITY TABLE
for
SOUTH UNIT (Unit 1)

<u>Elevation</u> <u>(msl)</u> <u>(assumed)</u>	<u>Capacity</u> <u>Acres-Feet</u>	<u>Difference</u> <u>in Capacity</u>	<u>Area</u> <u>Acres</u>	<u>Diff. in</u> <u>Area</u>
1426.25 89	0		0	
1427.25 90	541	541	1,082	1082
1428.25 91	1,747	1,206	1,330	248
1429.25 92	3,142	1,395	1,460	130
1430.25 93	4,634	1,492	1,525	65
1431.25 94	6,181	1,547	1,570	45
1432.25 95	7,768	1,587	1,605	35
1433.25 96	9,389	1,621	1,638	33
1434.25 *97	11,038	1,649	1,660	22
1435.25 98	12,711	1,673	1,687	27
1436.25 99	14,415	1,704	1,722	35
1437.25 100	16,159	1,744	1,767	45
1438.25 101	17,948	1,789	1,812	45
1439.25 102	19,779	1,831	1,851	39

*97.0 = Original water right filing elevation.

Note: Current spillway crest (South-Center Units) = 1434.85 elev.

Planimetered from Solberg's contour map by RWD 6/15/45

retyped 2/25/64 GWS

See Dwg. SD-So.Dak.-173-4 & 173-5

Information received January 13, 1976 at 11:50 A.M.

21-1-76

Information provided by Paul Rist, Ass't State Conservationist, U. S. Soil Conservation Service, Huron, South Dakota

* STOCK DAM & DUGOUT INFLUENCE ON LAKE ANDES

<u>Unit</u>	<u>Total Drainage Area</u>	<u>Number of stock dams & dugouts</u>	<u>Total storage Acre feet</u>
South	20,000 acres	93	93 acre-feet (27 surface acres)
Center	11,800 acres	54	54 acre-feet (16 surface acres)
North	53,000 acres	72	72 acre feet (22 surface acres)
	16,000 acres Charles Mix Co.		174 acre feet (52 surface acres)
	37,000 acres Douglas County	174	

TOTAL ACRE FEET = 393

TOTAL NUMBER OF DAMS & DUGOUTS = 393

TOTAL DRAINAGE AREA = 84,800 acres

Data compiled by SCS office, Lake Andes

1969 Aerial photos used plus what has been done since 1969 ...Data is current.

If 4900 surface acres on Lake Andes, then stock dams & dugouts hold back .96 inches of water over entire lake surface area.

Taken from United States Fish and Wildlife
"HISTORY OF LAKE ANDES", compiled by John Becker,
Assistant Refuge Manager, May 1962, Lake Andes National
Wildlife Refuge.
-obtained from Bill Wilson, U.S. Fish & Wildlife
Manager at Lake Andes Refuge

COPY OF SCS RECONNAISSANCE REPORT, LAKE ANDES WATERSHED, 1958

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Huron, South Dakota

Reconnaissance Report
Lake Andes Watershed
July 7 & 8, 1958

Personnel participating:

Clarence Brehm, Conservation Engineer, SCS, Huron, S.D.
James P. Hughes, Work Unit Conservationist, SCS, Lake Andes, S.D.
LeRoy Shearer, Biologist, SCS, Huron, S. D.
Gordon Stroup, Agricultural Engineer, SCS, Lake Andes, S.D.
Ray Huxtable, Party Leader, Watershed Work Plan Party, SCS, Huron
Les Nelsen, Game Warden, Dept. of Game, Fish & Parks

A. Purpose and Objective of Report

This report is to supply additional information to the Dept.
of Game, Fish & Parks per their request dated May 27, 1958.

The objective of the report is to summarize data pertaining
to precipitation and runoff from the various watershed areas. From
this material some general observations and conclusions are presented.

B. References used during Reconnaissance

Available studies and surveys made in the past by various
agencies and groups were reviewed. This data was supplemented by making
a field tour and through interview with local technicians.

Reports reviewed were:

1. Study by Lake Committee of the Lake Andes Chamber of Commerce
with recommendations. July 1955.
2. Water Conditions and Gauge Readings in Lake Andes -
Dave McGlauchlin, U. S. Fish and Wildlife Service

C. Factors to be Considered

1. Precipitation and Evaporation

From information available in other reports, office data, etc.
and without the benefit of field surveys, estimates were made of

the drainage areas, water surface areas, depth, storage and evaporation volumes of each part of the lake area represented by the North, middle and south units. In considering the lake as a whole, there is not enough runoff from precipitation to supply the entire lake area.

It was estimated that Lake Andes has a contributing watershed of about 84,800 acres. Based on Soil Conservation Service procedures, we have estimated the following runoff by frequencies:

80% chance of occurrence (1 in 1.25 yrs)	- runoff - 1260 acre feet
50% chance of occurrence (1 in 2 yrs)	- runoff - 3300 a.f.
20% chance of occurrence (1 in 5 yrs)	- runoff - 9600 a.f.

When the entire lake is filled to the spillway (or outlet levels) it was estimated that the total storage is:

North unit	- 1700 acresfeet
Middle unit	- 8400 acre feet
South unit	- <u>7600</u> acre feet

Total - 17,700 acre feet

A ten year chance of occurrence, or ten year frequency, would produce a runoff of about 16,500 acre feet. In other words, a ten year frequency storm is needed to fill the entire lake area assuming the lake was dry at the time the runoff occurred.

Evaporation reduces the water stored in the lake to a considerable extent and must be considered in estimating the volume of water that is available. Using the most recent figure of 14 inches of evaporation per year, over and above normal precipitation, storage losses were determined.

Runoff from Present Contributing Areas

If the entire 84,800 acres of drainage above Lake Andes is broken down into contributing areas, the areas above each unit are approximately as follows:

North unit	- 53,000 acres
Middle unit	- 11,600 acres
South unit	- 20,000 acres

Since the average runoff is inadequate to make a good lake of all three units, consideration was given to determining the runoff to each area. The following table relates the runoff in inches, volume in acre feet and evaporation volume for the frequencies that are important to this study:

(See Table 1)

3. Sedimentation

Sedimentation has occurred in the lake area although it does not seem to be serious in reducing the water storage potential of the lake itself. The contributing areas have discharged silt in flat waterways where native vegetation and weeds have trapped most of the silt before it reaches the lake. No borings were made and it is not considered necessary to do so at this time.

4. Storage of Water in Dams or Dugouts Above the Lake

Additional dams and dugouts are continually being constructed in the upper reaches of the watershed. At the same time, new drainage work brings in additional water into the main waterways. It was assumed that for the present these practices are counter-balancing each other with regard to runoff water reaching Lake Andes.

ources of Additional Water

1. Wells

Numerous wells for additional water supplies have been dug along the shoreline of the lake in the past. These wells have been short-lived, generally less than 10 years. Only one well is functioning at present. This well is discharging into Owens Bay at an estimated rate of 1000 gallons per minute.

Assuming that a well would flow 1000 G.P.M., the expected volume per day would amount to 4 acre feet per day or 1460 acre feet per year.

2. Diversions

The possibility of diverting water from other watersheds exists in two locations. In the past a diversion was built west of the city bringing additional water into the South unit of the lake. The watershed behind this diversion is approximately 2560 acres. After the diversion was constructed a high intensity rain in this area caused some flooding. Because of this the diversion was blocked and the runoff waters allowed to return to the original channel. With a minimum expenditure and some improvements this diversion could be restored.

TABLE 1

Unit	Drainage area in acres	Total Storage in Acre feet	Inches of Runoff by % Chance or Occurrence			Runoff in Acre feet by % Chance or Occurrence			Evaporation in Acre Feet by % Chance or Occurrence			Net Volume of Water in Acre Feet by % Chance or Occurrence		
			80	50	20	80	50	20	80	50	20	80	50	20
North	53,000	1400	0.18"	0.47"	1.37"	796	2490	6050	430	580	580	366	1910	5470
Middle	11,600	8400	0.18"	0.47"	1.37"	174	455	1328	48	125	360	126	330	968
South	20,200	7600	0.18"	0.47"	1.37"	303	791	2308	84	220	640	219	571	1668
Totals	84,800	17,400				1273	3736	9686	562	925	1580	711	2811	8106

Another area constituting about 2000 acres could be diverted into the South unit from south of the lake. The diversion could follow the old railroad grade built during the construction stages of Fort Randall dam.

These two areas are steeply rolling to hilly. Better than 50 percent of the area is poor rangeland. The runoff from this area would be relatively high, both from snow melt and rainfall.

A summary of the potential from these two areas is as follows:

Diversion west of lake (2560 acres)

80% chance	100 acre feet
50% chance	220 acre feet
20% chance	515 acre feet

Diversion south of lake (2000 acres)

80% chance	75	75 acre feet
50% chance	167	acre feet
20% chance	400	acre feet

3. Drainage

A third area consisting of approximately 16,000 acres could be diverted into Lake Andes. This area lies in the north-eastern part of Douglas County. At the present time a large ditch drains a portion of the area into Platte and Choteau Creeks. The ditch, as it exists, does not give adequate drainage for the area.

The terrain is characterized by shallow depressions and sloughs and under normal conditions contribute little in the way of runoff.

Although inclement weather and poor roads prevented the party from viewing the area, a study of aerial photographs showed a possibility of diverting this 16,000 acre area into Lake Andes Creek and subsequently into the north unit of Lake Andes

It is felt that this area, because of its larger size, would be of considerable benefit in bringing additional water into the lake and at the same time provide an adequate outlet for the proper management of periodic yields of excess water on the cropland.

Div

4. Diversion from Fort Randall Reservoir

A study has been made by the U.S. Fish and Wildlife Service, the South Dakota Dept. of Game, Fish and Parks, the Corps of Engineers and local people on the possibility of pumping water from Fort Randall Reservoir into Lake Andes. The total estimated cost is \$430,000 with an annual operating and maintenance cost of \$16,000. The average annual benefits to wildlife is estimated at \$17,000. The final analysis by the Corps of Engineers was that the project was not economically feasible because of the high costs. The wildlife interests feel the project was feasible and the project should have been included as part of the Fort Randall project.

5. Diversion of Water as Part of Irrigation Projects or Collection of Irrigation Waste Waters

The Bureau of Reclamation is currently preparing a report on the feasibility of irrigating lands in the Lake Andes area. Some of the canals may come close to the lake. It would, therefore, be possible to divert waters from these canals into the lake, especially during periods when irrigation waters are not being used. Waste waters from the irrigated lands plus drainage of irrigable lands could contribute materially to the lake water supply.

At a minimum of cost Lake Andes could be materially benefited as an indirect benefit of irrigation in the area.

Conclusions or Recommendations

It is easily recognizable that there is insufficient precipitation and runoff to make all three units of the lake into areas capable of supporting fish on an average year. Neither is there enough water on a frequency of one in two years, or on a five year frequency. A ten-year storm or a buildup of rather wet years are the only situations where the lake will be full. It appears that an effort should be made to make good fishing areas of the north and south units leaving the middle unit dry, or only as a catch basin for the overflow from the two units.

Drilling and development of water producing artesian wells is costly but could serve as a supplemental measure. If wells are constructed, brass casing is necessary to prolong the life of the wells. It can also be expected that artesian flows will be reduced in future years as has been the case with many other similar wells throughout the state. It would be best to conserve the artesian basin for domestic uses.

Diverting water into the South Unit appears feasible. The

engineering would not be particularly difficult and cost should not be excessive. The yield in the South Unit for an 80% chance would be increased from 219 acre feet to 394 acre feet or 44%. For a 50% chance, the yield would increase from 571 acre feet to 958 acre feet or 40 percent. The yield from a 20 percent chance of once in five years would increase from 1668 acre feet to 2583 acre feet or 35 percent. Water yield from the area west of the South Unit will roughly correspond to the amount lost on an average by evaporation. Once the lake is at a maximum elevation, it could be expected that the extra water from the diversions would materially help maintain the lake surface at a constant level over extended periods. During drought periods or low runoff years, these areas would not sustain a constant lake level.

Draining extra water into the North Unit or diverting waters from other watersheds possibly has limited potential. A quick survey of the area in northwestern Douglas County might be profitable.

Direct pumping of water from the Fort Randall Reservoir could be the most positive solution. Because of the high installation costs, plus high operation and maintenance costs, it appears that this method cannot be considered at this time.

Extra water as a result of irrigation in the Lake Andes Watershed appears to be the most promising solution at some future date. Extra water drained from depressions in the irrigated area, plus waste waters and seepage waters could be a very dependable and economical source. This water would be obtained without any direct cost to the lake. There would be a possibility to pump water during the colder months with the pumps and canals used for irrigation. The operation and maintenance costs for this operation would be similar to that for a single purpose system.

From available weather data, it appears that under existing conditions, the lake can enjoy high water levels only 5 - 10 years out of each 20 years. For the immediate future it is our opinion that the North and Middle Unit will have to be operated as they are at present. Some definite improvement can be accomplished by diverting two additional areas into the South Unit.

The long range future for the lake seems to depend on irrigation waters that may be brought into the area. If these things can become reality, Lake Andes may again become known as "The World's Best Bass Lake."

Report on Water Permit Application
No. 5180-3 City of Lake Andes
"The South Lake" of Lake Andes

March 15, 1988

Water Right No. 1683-3 (priority date of March 31, 1970) authorizes the city of Lake Andes to divert 0.89 cubic feet of water per second (cfs) of Missouri River water for municipal purposes. The diversion point is located 2982 feet south and 867 feet west of the northeast corner of Section 5, T95N, R65W.

Water Permit Application No. 5180-3 proposes to use the existing municipal pipeline (Water Right No. 1683-3), increase its intake pump size from a capacity of 0.89 cfs (645 ac-ft annually) to 4.6 cfs (2445 ac-ft annually) and construct an additional pipeline from the city water treatment plant to "the south lake" of Lake Andes. The pipeline discharge location would be in the NE1/4 NE1/4 of Section 9 T96N R65W. The purpose of pumping water into the lake is to offset evaporation losses in "the south lake" and to maintain "the south lake" as close as possible to the outlet elevation.

Two county roads constructed across the lake bed divide the lake into three units. The southern most unit is locally called "the south lake". Stop logs currently regulate flows under the county road bridges and at the outlet.

Discussion

Lake Andes has a surface area of 4775 acres and a storage of approximately 20,080 ac-ft when the lake is filled to the outlet elevation. Lake Andes is a National Wildlife Refuge and is managed by the United States Fish and Wildlife Service and the South Dakota Department of Game, Fish and Parks.

"The south lake" has a surface area of 1815 acres when the lake is filled to the outlet elevation. Net evaporation losses (accounting for precipitation and runoff) on an average and during a drought year would be approximately 2,105 and 4,519 ac-ft respectively (Herrold, 1988). Pumping 1800 ac-ft of Missouri River water per year into Lake Andes would offset net evaporation losses during an average and drought year by approximately 86 and 40 percent respectively.

The lake bed of Lake Andes is owned by the State of South Dakota. The United States Fish and Wildlife Service has flood easements around the perimeter of Lake Andes. Information from the Department of Game, Fish and Parks indicate that the State of South Dakota has flood easements with private individuals along the entire discharge drainage which ends at the Missouri River.

A "south lake" operating plan agreement between the State of South Dakota, United States Fish and Wildlife Service, and the City of Lake Andes currently does not exist.

Review of Existing Water Permits

Water Right No. 220-3 (July 6, 1956 priority date) permits 2.22 cfs from a Dakota Formation well to flow into Owens Bay which is a manmade impoundment immediately adjacent to Lake Andes. The water is used to maintain the lake level in Owens Bay as a fish and wildlife management area.

Vested Water Right Claim No. 774-3 (1889 priority date) permits the Department of Game, Fish and Parks to divert 12,048 ac-ft annually of water from Andes Creek and dry draws into Lake Andes for public recreational purposes.

There is unappropriated water available from the Missouri River (Water Rights Division, 1988).

Conclusions

1. There is unappropriated water available for the applicant's proposed use.
2. The proposed diversion can be developed without unlawful impairment of existing water rights.

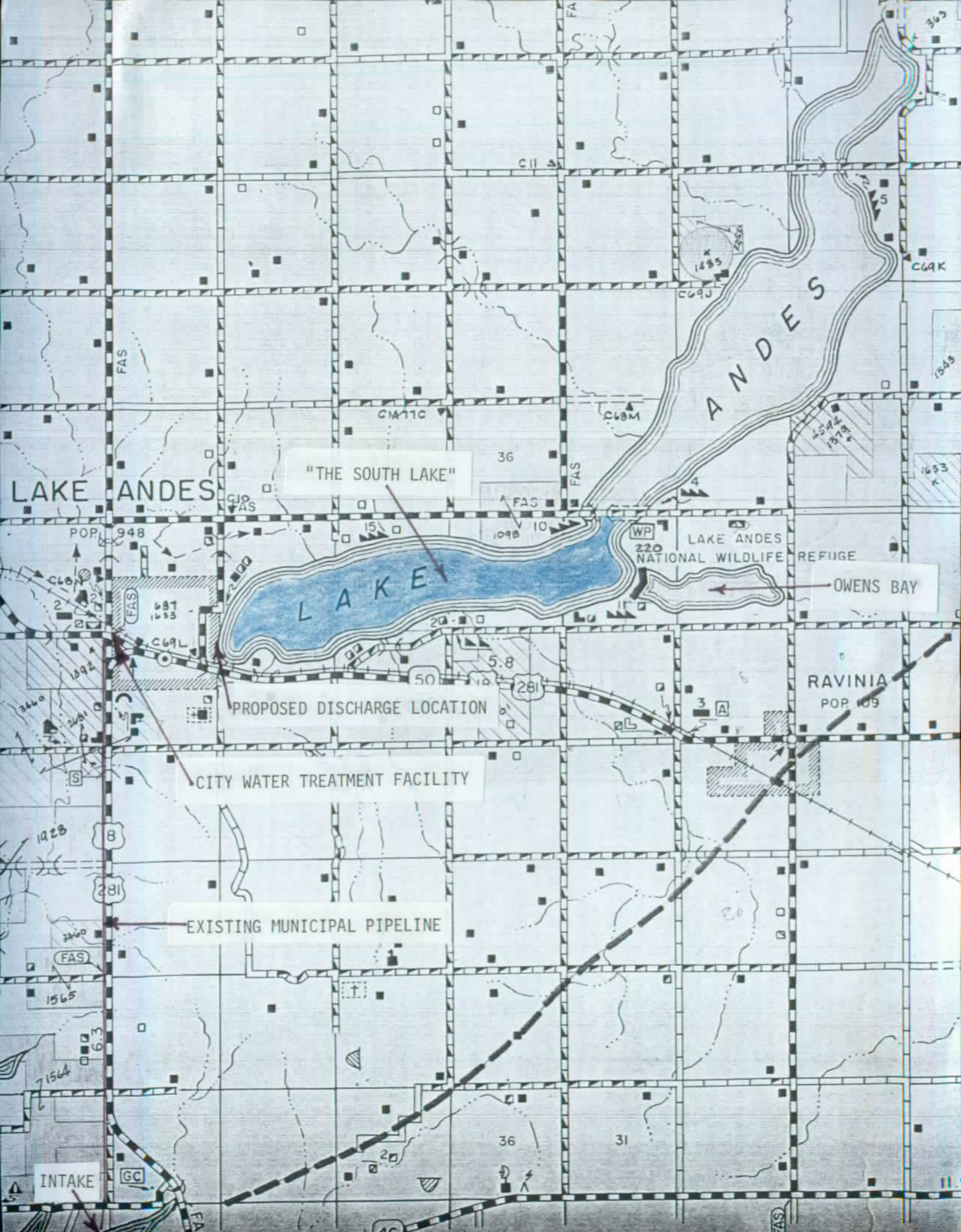
David S. Brown/ks

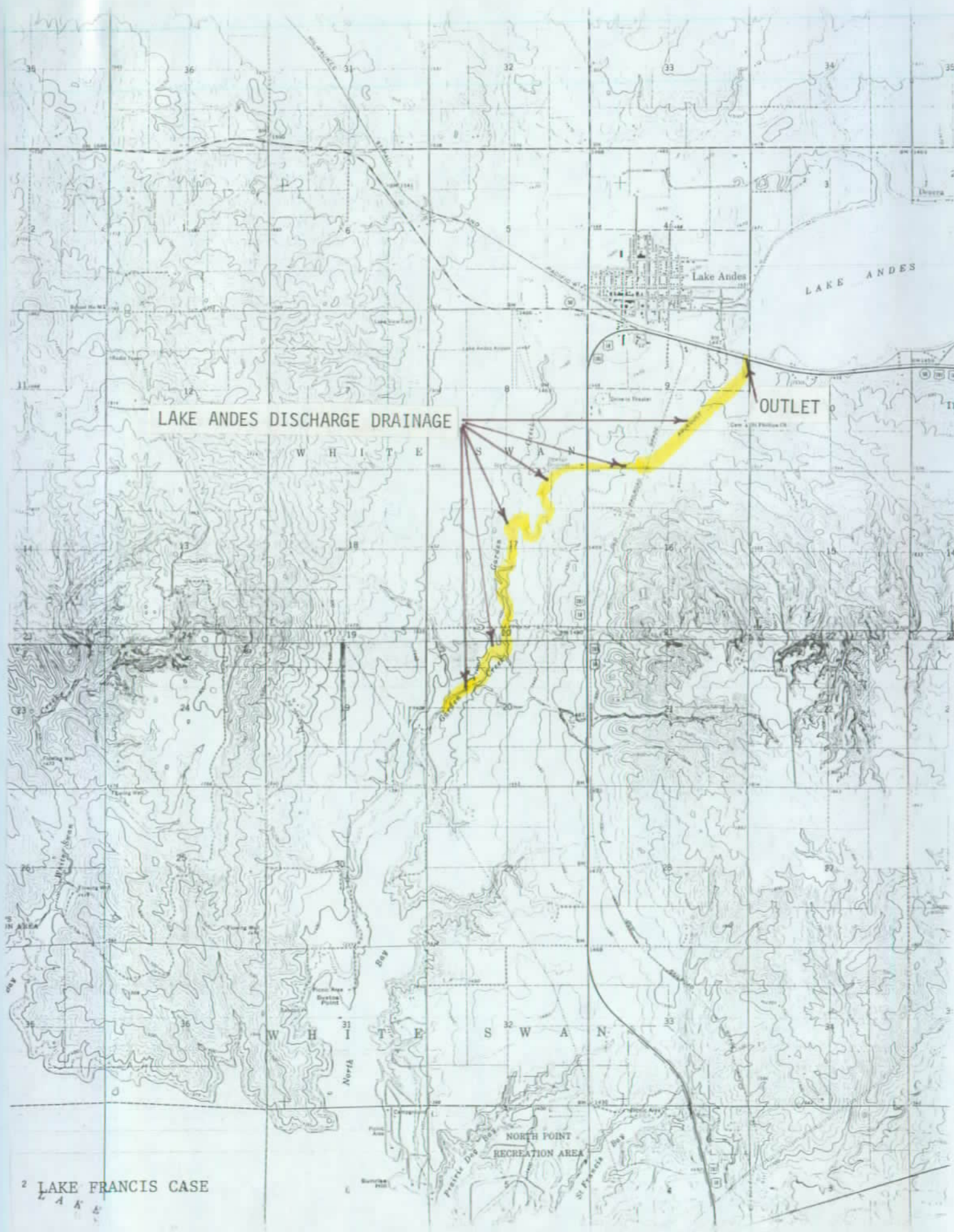
David S. Brown
Natural Resources Engineer

Bibliography

Herrold, Dwight D., 1988, Lake Andes Diversion Project Program Narrative, City of Lake Andes, Lake Andes, SD 57356.

Water Rights Division, 1988, Records Concerning Water Availability from the Missouri River, DWNRR, Division of Water Rights, Joe Foss Building, Pierre, SD 57701.



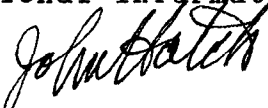


RECOMMENDATION OF CHIEF ENGINEER FOR WATER PERMIT
APPLICATION NO. 5180-3, City of Lake Andes

Pursuant to SDCL 46-2A-2, the following is the recommendation of the Chief Engineer, Water Rights Division, Department of Water and Natural Resources concerning Water Permit Application No. 5180-3, City of Lake Andes, PO Box 783, Lake Andes SD.

The Chief Engineer is recommending DEFERRAL of Application No. 5180-3 until a water level operating plan for the South Lake and Andes Lake is prepared, to determine if an Ordinary High Water Mark should be established for Andes Lake, and to determine if maintaining water levels in the South Lake by pumping water into South Lake will result in increased flooding around Andes Lake and the South Lake due to unexpected flood flows into Andes Lake.

See the attached report for additional information.


JOHN HATCH, Chief Engineer
April 1, 1988

Instruction to Newspaper - Publish first publication of the following Notice on or before April 13, 1988 with 2nd publication 7 days later. The applicant is responsible for payment.

NOTICE OF HEARING on Application No. 5180-3 to Appropriate Water

Notice is hereby given that the City of Lake Andes whose mailing address is PO Box 783, Lake Andes, South Dakota has filed an application for a permit to appropriate 4.6 cubic feet of water per second (1800 acre-feet annually) from the Missouri River. Water is to be diverted from the Missouri River in the E 1/2 E 1/2 Section 5, T95N, R65W via the City of Lake Andes Pipeline to a point near the treatment plant and then through a proposed pipeline across the N 1/2 Section 9, T96N, R65W to Lake Andes (South Lake). Water is to be used for municipal purposes and to stabilize the South Lake water level for recreation use and fish and wildlife propagation.

Pursuant to SDCL 46-2A-2 the Chief Engineer of the Water Rights Division recommends DEFERRAL of Application No. 5180-3 until a water level operating plan for the South Lake and Andes Lake is prepared, to determine if an Ordinary High Water Mark should be established for Andes Lake, and to determine if maintaining water levels in the South Lake by pumping water into South Lake will result in increased flooding around Andes Lake and the South Lake due to unexpected flood flows into Andes Lake.

The application will be considered by the Water Management Board in Room 216, Joe Foss Bldg, 523 E Capitol, Pierre SD, on May 11, 1988 at 10:00 am.

The recommendation of the Chief Engineer is not final or binding upon the Board and the Board is authorized to 1) approve, 2) approve with qualifications, 3) defer, or 4) deny the application after it reaches a conclusion based upon facts presented at the public hearing. Any interested person who may be affected by a Board decision and who intends to participate in the hearing before the Board and present evidence or cross-examine witnesses according to SDCL 1-26, must file a written petition with BOTH the applicant and the Chief Engineer by April 29, 1988. The petition may be informal, but it must include a statement describing the petitioner's interest in the application, the reasons for the petitioner's opposition to or support of the application, and the signature and mailing address of the petitioner or his legal counsel if legal counsel is obtained. The applicant need not file a petition.

This application is made pursuant to the provisions of SDCL 46-1-1 thru 46-1-9, 46-1-12 thru 46-1-15; 46-2-3.1, 46-2-9, 46-2-11, 46-2-13, 46-2-17; 46-2A-1 thru 46-2A-10, 46-2A-12, 46-2A-14, 46-2A-15, 46-5-1 thru 46-5-11, 46-5-13 thru 46-5-15, 46-5-24, 46-5-25, 46-5-30.2, 46-5-30.4, 46-5-31; and Board Rules ARSD 74:02:01:01 thru 74:02:01:15.

This hearing is an adversary proceeding. The applicant or any person, after filing a petition, has the right to be present or to be represented by a lawyer. These and other due process rights will be forfeited if they are not exercised. Decisions of the Board may be appealed to the Circuit Court and State Supreme Court as provided by law.

Any person wishing a copy of the Chief Engineer's recommendation, further information on this application or to assure access to the hearing by the handicapped can contact the Water Rights Division, Joe Foss Bldg, Pierre SD (605 773-3352) for assistance prior to the hearing date. The time of the hearing will be automatically extended for at least twenty days upon written request of the applicant or person who has filed a petition to oppose or support the application. The request for extension must be filed with the Chief Engineer by April 29, 1988.

No. 5180-3

PROOF OF PUBLICATION

STATE OF SOUTH DAKOTA)
County Charles Mix) ss.

I, Pam J. Wells hereby

certify that the annexed printed copy of Notice of Intent to Appropriate

Water was taken from the Lake Andes Water

A newspaper which during the whole time of publication of said notice
herein after stated, has been and is printed and published in the _____

City of Lake Andes

County of Charles Mix and State of South Dakota;
that the said notice was published in said newspaper on the following
two dates:

April 13, 1988

April 20, 1988

Pam J. Wells
(Signature)

Public Hearing
(Title)

4-20-88
(Date Signed)

Cost of Printing: \$40.86

Public Notice

NOTICE OF HEARING
on Application No. 5180-3 to Appropriate
Water

Notice is hereby given that the City of Lake Andes whose mailing address is PO Box 783, Lake Andes, South Dakota has filed an application for a permit to appropriate 4.6 cubic feet of water per second (1800 acre-feet annually) from the Missouri River. Water is to be diverted from the Missouri River in the E½ E½ Section 5, T95N, R65W via the City of Lake Andes Pipeline to a point near the treatment plant and then through a proposed pipeline across the N¼ Section 9, T96N, R65W to Lake Andes (South Lake). Water is to be used for municipal purposes and to stabilize the South Lake water level for recreation use and fish and wildlife propagation.

Pursuant to SDCL 46-2A-2 the Chief Engineer of the Water Rights Division recommends DEFERRAL of Application No. 5180-3 until a water level operating plan for the South Lake and Andes Lake is prepared, to determine if an Ordinary High Water Mark should be established for Andes Lake, and to determine if maintaining water levels in the South Lake by pumping water into South Lake will result in increased flooding around Andes Lake and the South Lake due to unexpected flood flows into Andes Lake.

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This application is made pursuant to the provisions of SDCL 46-1-1 thru 46-1-9, 46-1-12 thru 46-1-15; 46-2-3.1, 46-2-9, 46-2-11, 46-2-13, 46-2-17; 46-2A-1 thru 46-2A-10, 46-2A-12, 46-2A-14, 46-2A-15, 46-5-1 thru 46-5-11, 46-5-13 thru 46-5-15, 46-5-24, 46-5-25, 46-5-30.2, 46-5-30.4, 46-5-31; and Board Rules ARSD 74:02:01: 01 thru 74:02:01:15.



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A-13-20-93L

CITY OF LAKE ANDES

BOX 783

SOUTH DAKOTA 57356

HUB OF THE RANDALL-LAKE AREA



FAMOUS FOR HUNTING
FISHING & CAMPING



April 19, 1988

Water Management Board
Department of Water and Natural Resources
Joe Foss Building
523 East Capitol
Pierre, SD 57501

RE: Lake Andes Diversion Project

Dear Gentlemen:

As City Attorney for the City of Lake Andes, request is hereby made for a copy of board rules ARSD 74:02:01:01 through 74:02:01:15. Please insure that we have these rules at least two weeks prior to the hearing before the board scheduled for May 11, 1988. You are hereby advised that regarding that hearing, we intend to call several witnesses as the applicant. Our witnesses will include representatives of State and Local government together with interested parties. We are aware that an interested party not being called by the applicant as a witness would be required to file a petition in order to appear at the hearing. The City will be represented by Whalen Law Office, P.C. of Lake Andes, South Dakota.

Sincerely,

A handwritten signature in dark ink, appearing to read "Michael J. Whalen". The signature is fluid and cursive, with a large, stylized initial "M".

MICHAEL J. WHALEN
CITY ATTORNEY

cc



Department of Water & Natural Resources

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

April 21, 1988

5180-3

Michael J Whalen, City Attorney
City of Lake Andes
Box 783
Lake Andes SD 57356

Dear Mr. Whalen:

As requested, enclosed is a copy of Chapter 74:02:01, the General Rules. If we can be of further assistance, please contact us.

Very truly yours,

A handwritten signature in black ink, appearing to read "John Hatch". The signature is written in a cursive, flowing style.

JOHN HATCH, Chief Engineer
Water Rights Division
605 773-3352

enclosure

Michael J. Whalen
Timothy R. Whalen

WHALEN LAW OFFICE, P.C.

P.O. BOX 127
LAKE ANDES, SD 57356-0127

TELEPHONE
(605) 487-7645



May 10, 1988

Mr. John Hatch
Water Rights Division
Joe Foss Building
Pierre, SD 57501

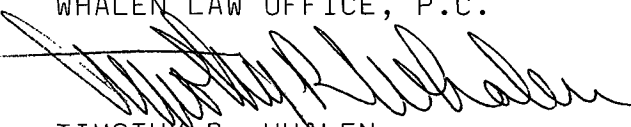
RE: Lake Andes Diversion Project

Dear Mr. Hatch:

Enclosed herewith please find the Operational Plan for the Lake Andes Diversion Project. Feel free to make copies of same for all members of the board.

Sincerely,

WHALEN LAW OFFICE, P.C.


TIMOTHY R. WHALEN
ASSISTANT CITY ATTORNEY
LAKE ANDES, SOUTH DAKOTA

cc

Enclosure



LAKE ANDES DIVERSION PROJECT
OPERATIONAL PLAN

The Applicant City of Lake Andes ("the City") presently obtains water for domestic use purposes from Lake Francis Case via a 12 inch pipeline constructed in the late 1960s. When designed, the transite pipeline was deliberately oversized in anticipation of supplementing the Lake of Lake Andes ("the Lake") at some point in the future. That point in time has arrived.

The Lake is situated in Charles Mix County, South Dakota, and has been determined to be an important wildlife refuge and public recreational area. In the 1930s the main body of the Lake was divided into three units by the construction of two cross dikes. The North unit consists of six hundred eleven (611) acres, the Middle unit consists of two thousand three hundred fifty-nine (2,359) acres, and the South unit consists of one thousand seven hundred sixty (1,760) acres. This Operational Plan is concerned with the south portion of the Lake, referred to locally as "The South Lake."

The South Lake borders a twenty-two (22) acre city park on the eastern limits of the city. Preliminary reports by the Corps of Engineers determined the annual evaporation loss to vary from 1.16 feet in a typical year to 2.49 feet in a drought year. It is the intention of this project to help offset such evaporation losses in the South Lake by means of an buried pipeline running eight tenths (.8) of a mile from the City Water Treatment Plant to the intended outlet point on South Lake. When pumping will

commence and end will be dictated by the water level of the lake. Presently, the South Lake is at the overflow level of 1437.25, which level was established after the high water levels experienced in 1924. The City contemplates maintaining the water at this level. Pumping will commence when the water level elevation drops to 1436.75 (six inches below overflow). In the event the water level should fall below 1435.25 level, the City shall cease all pumping operations. Consequently, pumping shall commence upon the level of the South Lake dropping six inches. All pumping shall cease if the water level in South Lake drops two feet or more at any point in the year. The specific dates of the commencement and ending of the pumping operations are impossible to predict. However, the most practical time of the year to start pumping will be in early to mid Spring (April to May), depending on the amount of runoff from snow, etc. It is anticipated that pumping would end in mid to late Fall (October to November).

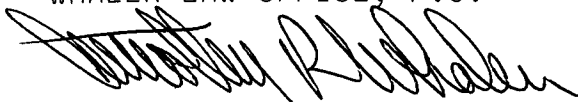
The operation of the turn out valve for diversion would be wholly located upon City property and under the control of the applicant. However, the determination as to when pumping shall commence and end will be made through a cooperative effort of a representative from the South Dakota Department of Game, Fish, and Parks, a representative from the Federal Fish and Wildlife, and the City of Lake Andes.

During normal years, the Charles Mix County area receives approximately twenty-two (22) inches of precipitation. However, the high water mark of the South Lake unit in 1986 was 1441.40,

and in 1987 it was 1441.09. In both years the Charles Mix County area received an unusual amount of moisture. Not since 1924 had water levels of the South Lake reached the levels recorded in 1986 and 1987. Clearly, these were years of an extraordinary nature and do not accurately reflect the typical moisture received in a year in this area. Moreover, according to an easement in favor of the United States of America, the high water mark of Lake Andes is identified at approximately the same levels reached in 1986 and 1987 (said easement is attached hereto as Exhibit A). Although these water levels caused overflow, the majority of that overflow was controlled by the overflow drainage canal that leads from South Lake to Lake Francis Case. The principle problem incurred by the residents of the City and surrounding area was from ground water seepage into basements rather than damage to property from overflow waters from South Lake. Moreover, practically all residents, whether adjacent to the Lake or not, experienced this problem.

Respectfully submitted,

WHALEN LAW OFFICE, P.C.

A handwritten signature in black ink, appearing to read "Timothy R. Whalen", written over the printed name.

TIMOTHY R. WHALEN
ASSISTANT CITY ATTORNEY
LAKE ANDES, SOUTH DAKOTA

Charles Mix County, a body politic of the State of South Dakota,

grantor, in consideration of \$1.00, acknowledged as received, and the benefits to other lands of grantors, convey and warrant to the United States of America by and through the Secretary of Agriculture of Washington, D. C., and their successors and assigns forever:

The exclusive and perpetual right and easement to flood with water, and to maintain and operate, and/or to raise the water level of Lake Andes to the permanent high water contour of that lake, and to maintain said level at or below 4 feet above the present Government meander line as found at the southeast corner of Section 4, in Township 96 North, of Range 65, West of the 5th P.M., in Charles Mix County, South Dakota, as provided by Act of Congress approved September 21, 1922 (42 Stat. 990), which high water elevation is now established by the top of the center pier of the outlet control works as now constructed, upon the lands hereinafter described, by means of dams, dikes, ditches, spillways, and other structures, for water conservation, drought relief, and for migratory bird and wildlife conservation purposes, and/or upon said lands and waters to operate and maintain a wildlife conservation demonstration unit and a closed refuge and reservation for migratory birds and other wildlife.

The land upon and over which said exclusive and permanent rights and easements are granted are described as follows:

A strip of land which lies below a line two feet in elevation above the aforesaid established high water line on the following described premises in Charles Mix County, South Dakota, to-wit: Lot numbered Six (6) of Section One (1), in Township Ninety-six (96) North, of Range Sixty-five (65), West of the 5th P.M. and Lot Numbered Five (5) of Section One (1), in Township Ninety-six (96) North, of Range Sixty-five (65), West of the 5th P.M.

And for said consideration it is expressly understood that the above specified sum, acknowledged as received, liquidates all damages whatsoever that have occurred or may occur on account of the construction, building or maintenance of said dams, dikes, ditches, spillways and other constructions, and in the filling and draining of said lake from time to time, to them, or to their successors in title forever; provided, Lake Andes being a legally meandered and navigable lake, nothing contained herein shall at any time be construed as to change or modify the riparian rights of the grantor, the freedom of boating by power or otherwise, and the right of fishing, now existing or which may hereafter exist under Federal or State Law, and any action taken by the grantee or its successors to nullify the above rights shall render this easement void; and provided further, that nothing contained herein shall at any future time be construed as including the rights to inundate by means of additional construction on any or all of the above described lands beyond the point and/or area flooded by the completed original structure and/or construction, nor shall anything contained herein be construed as to authorize the maintenance of the water level of the Lake at a higher elevation than that established by the aforesaid act of Congress.

Dated this 4th day of April, A.D. 1939

In the presence of:

ATTEST:

Sgd./ Mae A. Woods
County Auditor

(SEAL)

Charles Mix County, a body politic of (L.S.)
the State of South Dakota,

By Sgd./ Joseph Novak (L.S.)
Chairman of the Board of
County Commissioners. (L.S.)

STATE OF SOUTH DAKOTA)
) ss.
COUNTY OF CHARLES MIX)

On this 4th day of April, A.D. 1939, before me Paul A. Kern, a Notary Public in and for the County and State aforesaid, personally appeared Joseph Novak, and Mae A. Woods, known to me to be the Chairman of the Board of County Commissioner, and County Auditor, respectively, of the corporation and body politic that is described in and who executed the within instrument and acknowledged to me that said corporation executed the same.

(SEAL)

Sgd./ Paul A. Kern
Notary Public Charles Mix County,
State of South Dakota

STATE OF SOUTH DAKOTA)
County of Charles Mix) ss.
I certify the within instrument was filed of record
the 8 day of April 1940 at 4:00 o'clock P.M. and
recorded in book 15 of Misc. Record and pages 558-
560.
Ref. of Deeds.

Exhibit A



Department of Water & Natural Resources

Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501

Water Rights Division
605 773-3352

NOV 30 1988

City of Lake Andes
PO Box 783
Lake Andes, South Dakota 57356

Dear Sir:

Enclosed herewith is your Water Permit No. 5180-3 as approved by the Water Management Board authorizing you to construct your water diversion system and put the water to beneficial use, not exceeding the limits as specified in said Water Permit No. 5180-3.

Also enclosed is Form 10, Notice of Completion of Works and Application of Water to Beneficial Use, which you are to complete and submit to the Chief Engineer when you have completed the system and/or have put the water to beneficial use. An inspection can then be scheduled so that your Water License may be issued to you, thus completing your acquisition of a Water Right.

Very truly yours

JOHN HATCH, Chief Engineer
Water Rights Division

JH: ms

enclosure

PLEASE NOTE: Certain changes can be made in your permit within the five year construction period, usually without affecting the priority date provided an application to amend your permit is made within the five year period-i.e. changes in location or number of diversion points (wells) or location of land to be irrigated. Well locations for wells into the same aquifer can be moved up to 660 feet without application.

Applications to amend a permit after the five year construction period will be assigned a new priority date. Applications to change water sources, to add lands or increase original diversion rates, if approved will usually receive the date of the new application as a priority date regardless of the five year construction period.

WNR-809-5/83



**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3181
www.state.sd.us/denr

SEP 23 1998

5180A-3

City of Lake Andes
%Robin Smith, Finance Officer
P.O. Box 783
Lake Andes, SD 57356-0783

Dear Ms. Smith:

Enclosed is Water License No. 5180A-3 and Receipt No. 415864 for \$50.00 which was assessed for an investigation and issuance of the license. Water License No. 5180A-3 is the final document which completes the process of obtaining a water right.

As long as you use the water beneficially, as stated in the Water License, State Water Laws provide that you have a continuing right to use the water.

Very truly yours,

JOHN HATCH, Chief Engineer
Water Rights Program
(605) 773-3352

gm
enclosures

NOTE: The applicable portions of Water Permit No. 5180-3 have been incorporated into Water License No. 5180A-3.