

Considered: 1

Vested Right Claim
WATER PERMIT NO. 1399-1

MAP No. same

Name of Applicant Cook-Burns Ditch Company c/o James Jennings

Post Office Address RR1, Box 182C, Spearfish SD 57783

Amount of Water Claimed 33.0 cfs Total Acres 621.8

Source of Water Supply Spearfish Creek

Water to be used for irrigation County Lawrence & Butte

About 5 miles N of Spearfish.

PROOF OF PUBLICATION: Received Not Received

APPLICATION: Approved Subject to

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

PRIORITY Date Received December 30, 1987 Fee \$15.00 Remarks

Corrected Application Received Period of Annual Use Apr 1 - Nov 30

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

WI-1 Description same as Application YES NO REMARKS

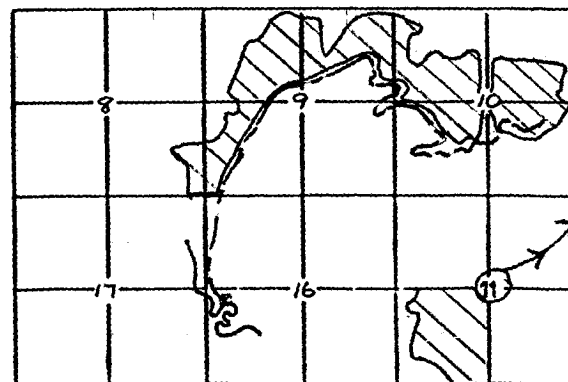
Diversion Point Spearfish Creek: NW 1/4 SW 1/4

section 16 - T7N - R2E

Land to be Irrigated E 1/2 SE 1/4 section 8; NE 1/4, NW 1/4, N 1/2 SW 1/4,

SW 1/4 SW 1/4 section 9; S 1/2 NE 1/4, N 1/2 SE 1/4, W 1/2 NW 1/4, SE 1/4 NW 1/4, N 1/2 SW 1/4

section 10; SW 1/4 section 11; all in T7N - R2E



Well Log: Driller NA Licensed YES NO

Depth of Well REMARKS

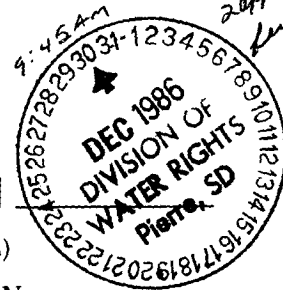
Type of Map aerial photo PREPARED BY Rassool Ahadi Reviewed and the Number

assigned on August 10, 1987 By Ron Duvall

No. 1399-1 Hydrologic Unit 10120203
 Map No. same Basin Belle Fourche R
 Newspaper Queen City Mail, Box 7, Spearfish (Wed)
Belle Fourche Daily Post, 1004 5th Ave

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

Type of Application: Check one or more of the following:

New ☐ Vested Right ☒ Future Use ☐☐ Application to amend Permit No. _____ with old priority date retained☐ Change diversion point(s) ☐ Add diversion point(s) ☐ Change acreage ☐ Other ☐☐ Application to: ☐ Change use ☐ Change diversion point(s) ☐ Add diversion point(s)☐ Add Acreage ☐ Increase diversion rate ☐ Other _____ See Permit No. _____☐ Application to: ☐ Use ☐ Transfer water reserved by Future Use Permit No. _____1. Name of Applicant Cook-Burns Ditch Company/James Jennings Phone No. 642-2146

Box 182 C
 Post Office Address RR 1, Spearfish, South Dakota State 57783
 (Street, RR or Box) Zip Code

2. Amount of water claimed (c.f.s.) 33 Total acres irrigated 621.83. Source of Water supply Spearfish Creek4. Location of point of diversion Approximately 2450 ft N, 400 ft E from SW Corner of Section 16,
T7N-R2ECounty Lawrence5. Counties where water will be used Lawrence and Butte6. Annual period during which water is to be used April 1 - November 30

7. List below each forty acre subdivision, or lot, or fraction thereof and show number of acres to be irrigated in each.

Land Description	No. Acres Irr.
<u>See attached sheet</u>	

Land Description	No. Acres Irr.

Attach sheet if more space is needed

8. 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)

This application is to file a vested right claim pursuant to SDCL 46-5-49

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 Butte)^{ss}I, James Jennings the applicant, certify that I have read the foregoing application, have examined the attached map and that the matters therein stated are true and that I intend, and am able to complete the necessary construction.Signed James JenningsSubscribed and sworn to before me this 23rd day of December 19 86KIM A. HABECK, Notary Public
My Commission Expires 11-1-92

Kim A. Habeck
 Notary Public (or other qualified officer)

SOUTH DAKOTA

VESTED WATER RIGHT NO. 1399-1 FOR IRRIGATION

Date of Receipt of Claim December 30, 1986.

Date of Validation February 27, 1991.

The Water Management Board validated Vested Water Right Claim No. 1399-1 for irrigation purposes for Cook-Burns Ditch Company, RR 1, Box 182C, Spearfish, SD 57783 with the following limitations, conditions and qualifications:

1. Vested Water Right No. 1399-1 validates a vested right claim appropriating 17.8 cubic feet of water per second from Spearfish Creek to irrigate 621.8 acres via the Cook-Burns Ditch. The Spearfish Creek diversion point for the Cook-Burns Ditch is located in the NW1/4 SW1/4 Section 16, T7N, R2E. The irrigated acreage is located in the E1/2 SE1/4 Section 8; NE1/4, NW1/4, N1/2 SW1/4, SW1/4 SW1/4 Section 9; S1/2 NE1/4, N1/2 SE1/4, W1/2 NW1/4, SE1/4 NW1/4, N1/2 SW1/4 Section 10; SW1/4 Section 11; all in T7N, R2E.
2. The appropriation may not exceed the amount of water needed for beneficial use for irrigation. The appropriation may not exceed 3 acre feet per irrigated acre per year. The water is to be used during the following annual period: April 1 - November 30.
3. The priority date of the Vested Water Right is June 15, 1881.
4. The water use system has been constructed and water has been applied to beneficial use.
5. Water rights obtained in compliance with the laws of the State of South Dakota may not be unlawfully impaired by this appropriation.

QUALIFICATIONS

1. That Vested Right No. 1399-1 is subject to domestic use rights. Diversion of water under Water Right No. 1399-1 is contingent upon supplies being available first to domestic users.
2. That the flow measuring device on Cook-Burns Ditch continue to be maintained and records of diversions be kept as directed by the Chief Engineer and reported to the Chief Engineer annually.

WATER MANAGEMENT BOARD

By: John H. Hatch
Chief Engineer

APR 25 1991

date

Division of Water Rights
Dept. of Water and Natural Resources

STATE OF SOUTH DAKOTA

VESTED RIGHT WATER LICENSE NO. 1399-1 FOR IRRIGATION

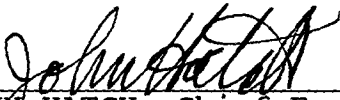
(1) Cook-Burns Ditch Company of RR 1 Box 182C, Spearfish, SD 57783 made Application No. 1399-1, December 30, 1986 for validation of a vested right claim to appropriate 33.0 cubic feet of water per second from Spearfish Creek, Lawrence County, South Dakota for irrigation purposes. Vested Water Right No. 1399-1 was validated February 27, 1991 with a priority date of June 15, 1881. Construction of the described water supply system and application of water to beneficial use has been completed and complies with applicable provisions of South Dakota State Law.

The applicable portions of Location Notice No. 31661 were incorporated into Vested Water Right No. 1399-1 with the abandoned portions of Location Notice No. 31661 cancelled.

(2) The applicant is entitled to divert 17.8 cubic feet of water per second for beneficial use. The Spearfish Creek diversion point for Cook-Burns Ditch is located approximately 2450' N and 400' E from the SW corner of Section 16, T7N, R2E (NW 1/4 SW 1/4).

The location of the irrigated acreage is: (see attached sheet)

(3) Pursuant to Section 46-5-30.1 Cook-Burns Ditch Company of RR 1 Box 182C, Spearfish, SD 57783 the holder(s) and/or owner(s) of Vested Water Right No. 1399-1 is issued a license to appropriate 17.8 cubic feet of water per second from Spearfish Ditch with a priority date of June 15, 1881 from the location specified in (2) of this license. The water is to be used for the purpose of irrigation. This license is subject to any limitations, conditions or qualifications listed in Vested Water Right No. 1399-1 and subject to South Dakota State Law.



JOHN HATCH, Chief Engineer
Water Rights Division
Department of Water and Natural
Resources

APR 25 1991

Cook-Burns Ditch

Section 8 T7N-R2E

NE $\frac{1}{4}$ SE $\frac{1}{4}$	3.0 Acres	
SE $\frac{1}{4}$ SE $\frac{1}{4}$	16.1 Acres	Subtotal 19.1 Acres

Section 9 T7N-R2E

SW $\frac{1}{4}$ NE $\frac{1}{4}$	15.5 Acres	
SE $\frac{1}{4}$ NE $\frac{1}{4}$	8.0 Acres	
NW $\frac{1}{4}$ NE $\frac{1}{4}$	30.0 Acres	
NE $\frac{1}{4}$ NE $\frac{1}{4}$	35.0 Acres	Subtotal 88.5 Acres

SE $\frac{1}{4}$ NW $\frac{1}{4}$	33.9 Acres	
SW $\frac{1}{4}$ NW $\frac{1}{4}$	15.1 Acres	
NE $\frac{1}{4}$ NW $\frac{1}{4}$	35.9 Acres	
NW $\frac{1}{4}$ NW $\frac{1}{4}$	5.0 Acres	Subtotal 89.9 Acres

NE $\frac{1}{4}$ SW $\frac{1}{4}$	6.0 Acres	
NW $\frac{1}{4}$ SW $\frac{1}{4}$	26.0 Acres	
SW $\frac{1}{4}$ SW $\frac{1}{4}$	15.0 Acres	Subtotal 47.0 Acres

Section 10 T7N-R2E

SW $\frac{1}{4}$ NE $\frac{1}{4}$	40.0 Acres	
SE $\frac{1}{4}$ NE $\frac{1}{4}$	39.0 Acres	Subtotal 79.0 Acres

NW $\frac{1}{4}$ SE $\frac{1}{4}$	30.1 Acres	
NE $\frac{1}{4}$ SE $\frac{1}{4}$	19.0 Acres	Subtotal 49.1 Acres

NW $\frac{1}{4}$ NW $\frac{1}{4}$	36.0 Acres	
SW $\frac{1}{4}$ NW $\frac{1}{4}$	33.5 Acres	
SE $\frac{1}{4}$ NW $\frac{1}{4}$	36.0 Acres	Subtotal 105.5 Acres

NE $\frac{1}{4}$ SW $\frac{1}{4}$	30.0 Acres	
NW $\frac{1}{4}$ SW $\frac{1}{4}$	12.7 Acres	Subtotal 42.7 Acres

Section 11 T7N-R2E

NE $\frac{1}{4}$ SW $\frac{1}{4}$	40.0 Acres	
SE $\frac{1}{4}$ SW $\frac{1}{4}$	29.0 Acres	
SW $\frac{1}{4}$ SW $\frac{1}{4}$	10.0 Acres	
NW $\frac{1}{4}$ SW $\frac{1}{4}$	22.0 Acres	Subtotal 101.0 Acres

TOTAL ACRES FOR COOK-BURNS DITCH 621.8 ACRES

Affidavit of Water Use

No. _____

(Type or Print in Ink)

Note: This Form is supplemental to Form 2 and is to be used when an affidavit pertaining to construction and water use already constructed is needed, primarily with vested right claims.

**Affidavit Of Construction Of Water Use System
And Application Of Water To Beneficial Use**

Name of Applicant (Same as Form 2) Cook-Burns Ditch/James Jennings

Post Office Address RR 1 Spearfish, South Dakota 57783
(Street, RR or Box) (State) (Zip Code)

A. Notice of Appropriation August 16, 1886 Date of Posting ?

Date of recording August 16, 1886 Recording date Lawrence County 38 574
Where Book Page

B. Date of start of construction of water supply system 1881C. Date that water was first applied to beneficial use June 15, 1881D. Name of owner of original water supply system William Cook and Samuel BurnsE. Amount of water originally applied to beneficial use 5000 MIF. Present Use of Water - Amount of water now being used 33 cfs for irrigation of cropsDate that this water was first used June 15, 1881

G. Chronological History of Water Use

I can attest to the continuous use of the Cook-Burns Ditch water for irrigation use since 1962. Neighbors who have lived a lifetime in this area claim the ditch has been used each year.

Attach to this Form 2B any copies of notices, postings, filings, publications, affidavits, or other records that apply. You may also attach any written statement by you, or by others, that you deem pertinent.

State of South Dakota)

SS

County of Butte)

I, James Jennings the applicant, certify that I have read the foregoing
(print or type)
 and that the matters therein stated are true.

Signed James JenningsSubscribed and sworn to before me December 23rd, 19 86

KIM A. HABECK, Notary Public
 My Commission Expires 11-1-92

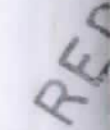
Kim A. Habeck
 Notary Public or other qualified officer

I, the undersigned do hereby certify that I know about the water use system described above, that I have read the foregoing, and that the matters therein stated are true.

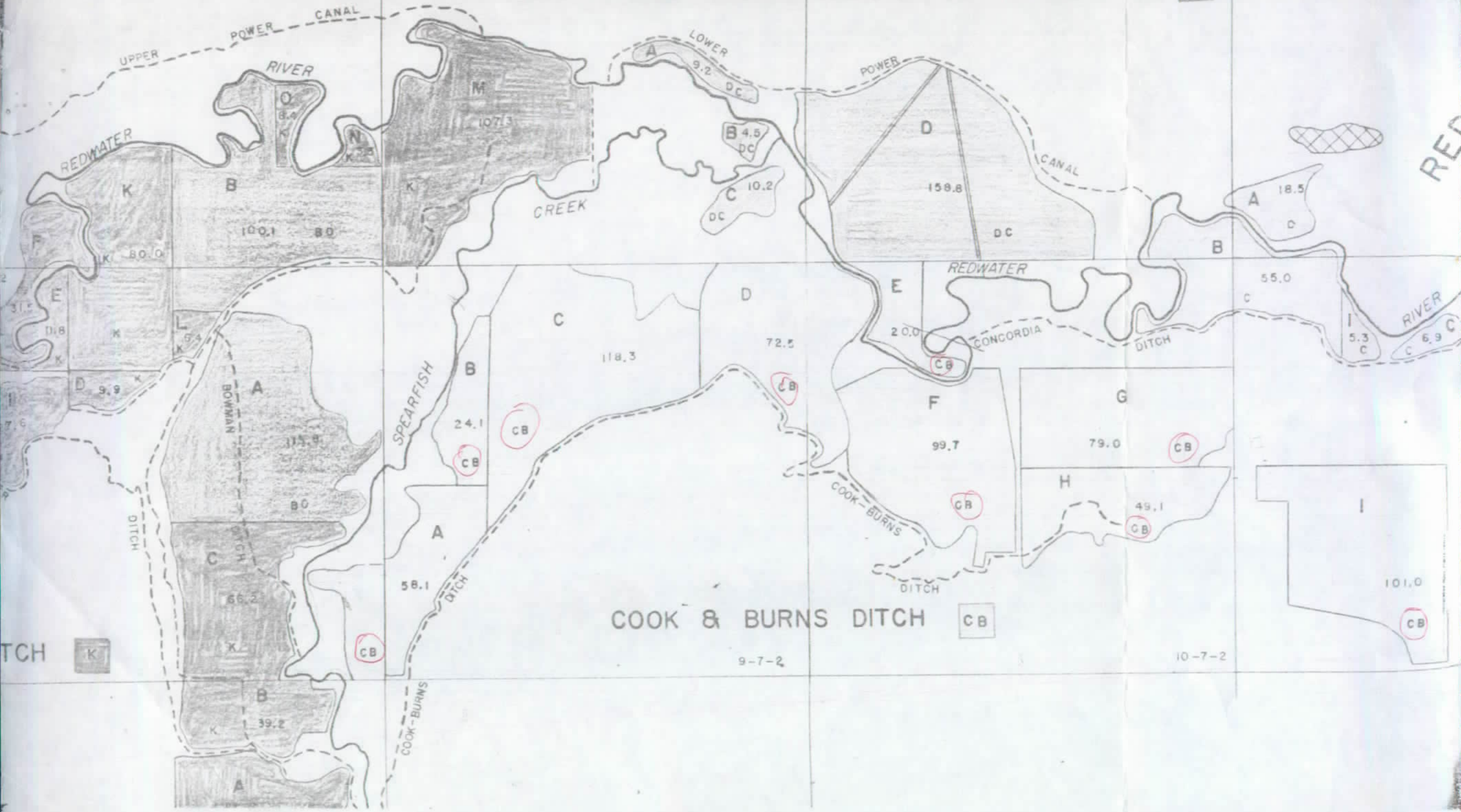
Donald J. Helmer 12-23 19 86
(Print name) DONALD HELMER
Vincent Crago 12-23 19 86
(Print name) VINCENT CRAGO

50

DC



V.R. Appl. No. 1399-1



COOK & BURNS DITCH

CB

9-7-2

10-7-2

RECEIPT

Division of Water Rights

South Dakota Department of Water and Natural Resources

410879

Pierre, December 30, 1986

Box 182 C

RECEIVED OF Cook-Burns Ditch Company/James Jennings, RR 1, Spearfish, SD 57783

the following amount in fees for services rendered as provided for by law:

Fee for Application for Permit No. <u>1399-1</u> to Appropriate Water, to construct works and to put water to beneficial use	15	00	VR
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	15	00

By John Hatch
Chief Engineer JOHN HATCH/mis

December 14, 1961

Mr. G. A. Williams
RFD 1
Spearfish, S. Dak.

Mr. Ole Moller
RFD 1
Spearfish, S. Dak.

Crago Brothers
RFD 1
Spearfish, S. Dak.

Re: Cook and Burns Ditch

The State Water Resources Commission has been making a study of water use pertaining to the surface flows of Redwater River and its tributaries in South Dakota.

As a part of this study, a search has been made for written records and documents which pertain to the diversions of the water. The Commission found the following pertaining to the Cook and Burns Ditch:

(1) A Water Right Location, filed August 16, 1886, claiming a location of water on June 15, 1881 and claiming 5000 miner's inches of the waters of Spearfish Creek. Signed by William Cook and Samuel Barnes. Filed in Book 38, page 574, Lawrence County.

(2) An Agreement, dated September 29, 1886 and filed May 28, 1888 in Book 51, page 414, between Cook and Burns and 8 (eight) other signers in which it is stipulated that the eight other signers shall have the right to enlarge and extend the Cook and Burns Ditch.

There being no court case of record that was found which interpreted, determined or established your water right, the record, as outlined above, indicates an appropriative water right claiming 5000 miner's inches with a priority of June 15, 1881 for the upper portion of the ditch and a priority of September 29, 1886 for the remainder of the ditch.

In an appropriative water right, the amount claimed, in your case 5000 miner's inches, is not necessarily the

Mr. G. A. Williams
Mr. Ole Moller
Crago Brothers

December 14, 1961

amount of water which you are entitled to divert. You are entitled to divert that amount of water put to beneficial use, not exceeding 5000 miner's inches, providing that amount is available after holders of prior water rights have obtained their allocation of the water.

It would be advisable for you to check to see if you can locate additional records that pertain to the Cook and Burns Ditch. The Water Resources Commission would appreciate being informed about any additional data you find that you deem applicable, in order to obtain as complete a record as possible, and would arrange to have a representative meet with you to discuss the information contained in this letter and such additional information as you might find, if you so desire.

A letter, dated January 16, 1961 was sent to you enclosing a map showing fields reported to be irrigated and the acreages of these fields. With your help these fields and acreages have been revised. Enclosed, for your information, is a copy of the revised map and the revised list of owners and acreages.

Sincerely,

J. W. GRIMES
Executive Officer and
Chief Engineer

Encls: Map and List

WATER RIGHTS DIVISION

(605) 773-3352

June 29, 1982

Crago Brothers
RFD#1
Spearfish, South Dakota 57783

RE: Cook & Burns Ditch

Gentlemen:

This office is currently updating the water rights records for Spearfish Creek and the Redwater River. Enclosed is a map that was compiled in 1961-62 showing lands served by the Cook & Burns Ditch. We would appreciate your review of this map noting any additions or corrections in lands or landowners and returning it to me in the enclosed envelope.

If you have any questions please contact me.

Thank you,

Kevin C. Larson
Water Resources Engineer

KCL:ms
Enc.

Book 38, Page 374

9.1.4

No. 31661

Water Right Location

William Cook et al. Locators

Filed August 16th, 1886, at
5:20 o'clock P.M.

John Baker, Register of Deeds.

By J. E. Baker, Deputy.

Notice of Water Right Location.

Know all men by these presents that we, William Cook and Samuel Barnes, claim by right of location and appropriation Five Thousand (5000) inches (Miners measurement) of the waters of this Spearfish Creek for Mining, Milling, Domestic or any other useful purpose, said water being diverted from said creek about One hundred and fifty yards Northeast from Reeds School House, at a point where this notice is posted, and conveyed by ditch to the ranches of the Locators. said water was located and claimed on or about the 15th day of June 1881. Date of this certificate August 16th, 1886, and a true copy of this notice was filed for record in the Office of the Register of Deeds of Lawrence County on the 16th day of August, 1886.

William Cook

Samuel Barnes

Locators.

STATE OF SOUTH DAKOTA

COUNTY OF LAWRENCE

) ss

)

I hereby certify that the within instrument is a true, correct and complete copy of the instrument as recorded in my office on the 16th day of August, 1886, at 5:20 o'clock P.M. in Book 38, at Page 374.

AND ON MICROFILM WHICH MEET THE RECOMMENDED REQUIREMENTS OF THE NATIONAL BUREAU OF STANDARDS FOR PERMANENT REPRODUCTIONS. REDUCTION 25 ROLL NO. 1 DATE MICROFILMED 5-4-83

DATE MICROFILMED

By [Signature] Clerk of

July 10, 1986

Dear Person-in-Charge,

11/19/86

I have a question. In the event that we place a circular sprinkler on the 101 acres plot in 11-7-2, what procedure is recommended? The circular system is actually set up for an 120acre space. At that time, would I apply for the additional acres to be licensed or what?

Please advise.

Yours truly,

Zola Crago
835 Harding
Belle Fourche, S.D. 57717

WATER RIGHTS DIVISION
(605) 773-3352

December 12, 1986

Bruce Jennings
DeWild, Grant, Reckert & Associates
315 1st Avenue
Rock Rapids, Iowa 51246

Dear Bruce:

Enclosed you will find the calculations for the flume and gate capacities for the Cook-Burns Ditch. As you see I used two different methods to calculate the flume capacity. Chosen was the higher capacity of 16.44 cfs.

Please let me know if you come up with other figures. If you have any questions, please do not hesitate to contact me.

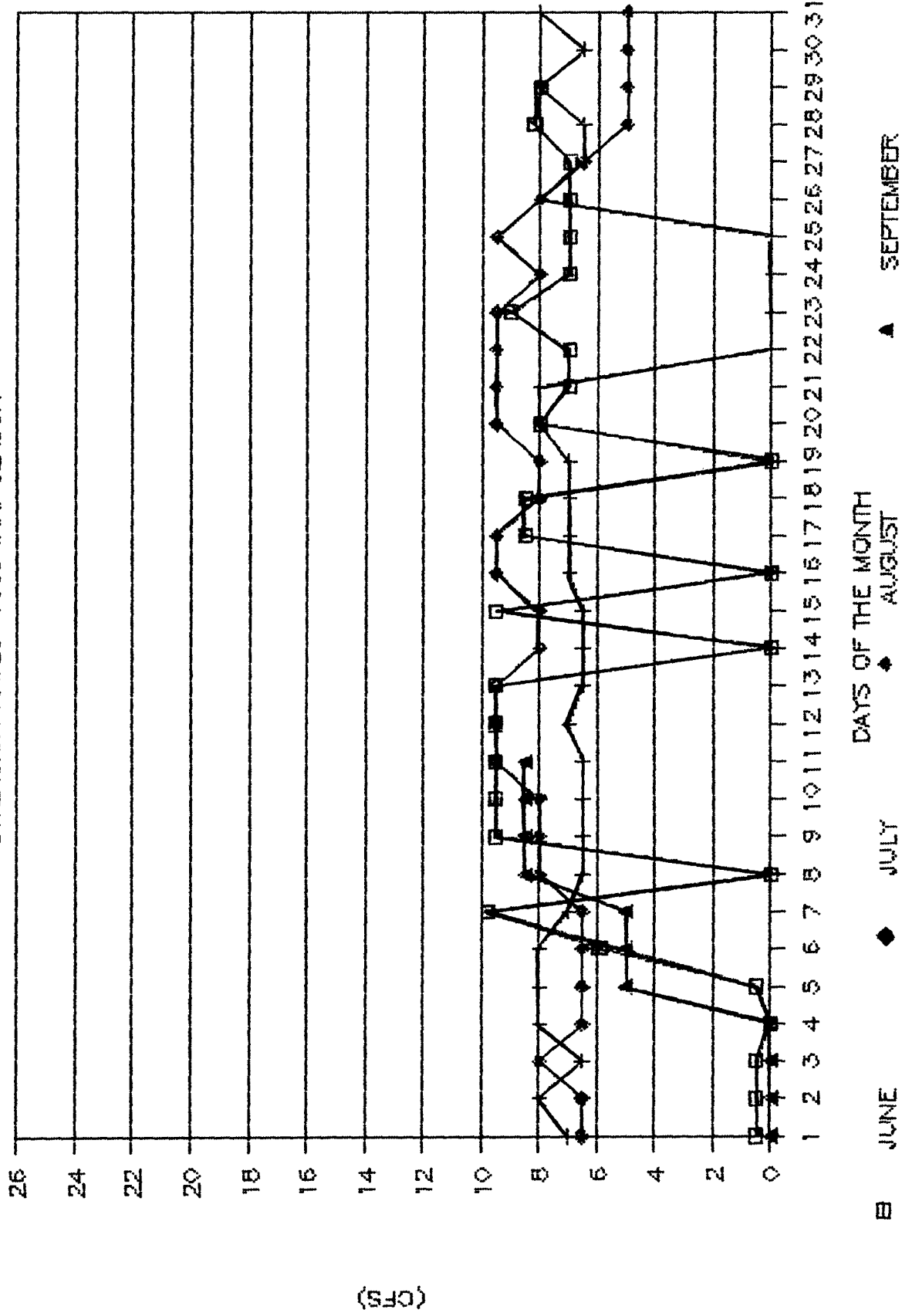
Sincerely,

RA
Rassool Ahadi
Natural Resources Engineer

RA:ms
Enc.

COOK-BURNS DITCH

DIVERSION RATES - 1988 IRR. SEASON



NRAdi 10/31/88

DIVERSION RATE RECORD

Ditch Company COOK-BURNS

Month JUNE

Ditch President _____

Year 1988

Type of Measuring Device?

☐ A) Parshall Flume: Throat Width _____ ft.

☐ B) Weir: Crest Length _____ ft. ☐ C) Other: _____



Date	Time - PM	Head (ft.)	No. of Acres Being Irrigated	Name of the Gauge Reader	Remarks
1	6:45	1"		JENNINGS	LIVESTOCK WATER
2	8:10	1"		JENNINGS	LIVESTOCK WATER
3	6:30	1 1/4"		JENNINGS	LIVESTOCK WATER
4					LIVESTOCK WATER
5	3:30	1 3/8"		JENNINGS	LIVESTOCK WATER
6	8:00	6 3/4		Jennings - 2	
7	8:53	9 1/8"		Jennings - 2	
8					
9	5:49	9"		Jennings - 2	
10	8:25	9"		Jennings 2	
11	6:02	9"		Jennings 2	
12	6:14	9"		Jennings 2	
13	5:37	9"		Jennings 2	
14					
15	6:16	9"		Jennings 2	
16					
17	6:21	8 1/2		"	
18	1:28	8 1/2		"	
19				"	
20	6:12	8		"	
21	6:14	7 1/2		"	
22	3:30	7 1/2		"	
23	6:15	8 1/4		"	Rained 1"
24	1:41	7 1/2		"	
25	6:46	7 1/2		"	
26	7:38	7 1/2		"	
27	4:34	7 1/2		"	
28	5:33	8 1/4		"	Rained 1/4"
29	5:57	8 1/4		"	
30	3:00	8"		"	Rained 1/2"
31					

DIVERSION RATE RECORD

Ditch Company Cook - Burns

Month June

Ditch President Jim Jennings

Year 1989

Type of Measuring Device?

☐ A) Parshall Flume: Throat Width _____ ft.

☐ B) Weir: Crest Length _____ ft. ☐ C) Other: _____



Date	Time	Head (ft.)	No. of Acres Being Irrigated	Name of the Gauge Reader	Remarks
1	6:37	5 1/8		Jennings	
2	6:37	5 1/8		Jennings	
3					Turned Ditch off
4					for maintenance
5	6:37	6 3/4		Jennings	
6	6:42	6		Jennings	
7	6:41	6 1/4		Jennings	
8	6:56	5 1/4		Jennings	
9					turned down ditch
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20	6:03 PM	4 1/4		Jennings	
21	6:27 PM	5 1/2		Jennings	
22	6:42 PM	5 1/4		Jennings	
23	7:08 PM	5 9/8		Jennings	
24	7:24 PM	6 1/2		Jennings	Rainy
25	3:35 PM	5 3/4		Jennings	
26	5:55 PM	2 3/8		Jennings	
27	5:25 PM	7		Jennings	
28	7:05 PM	6		Jennings	
29	5:17 PM	6		Jennings	
30	6:37 PM	10 5/8		Jennings	Cleaned out ditch head gate
31					

DIVERSION RATE RECORD

Ditch Company COOK-BURNS

Month July

Ditch President JIM JENNINGS

Year 1989

Type of Measuring Device?

☐ A) Parshall Flume: Throat Width _____ ft.

☐ B) Weir: Crest Length _____ ft. ☐ C) Other: _____



Date	Time	Head (ft.)	No. of Acres Being Irrigated	Name of the Gauge Reader	Remarks
1	10 19	10		Jennings	
2	7 am	10		Helmer	
3	8 am	10		"	
4	8 am	10			
5	8 am	9 1/2			
6	4 pm	9			
7	2 pm	9			
8	6 am	10			
9	10 am	10			
10	8 am	10			
11	2 pm	10			
12	8 am	10			
13	6 am	10			
14	7 am	10			
15	2 pm	9 1/2			
16	8 am	10			
17	6 am	10			
18	8 am	5			
19	8 am	5			
20	11:30 am	5			
21	8 am	5			
22	7 am	2			Turned gates down
23	9 am	2			
24					
25					
26	2 pm	7			
27	7 am	7			
28	11 am	9			
29	10 am	9			
30	7 am	9			
31	8 am	9			

DIVERSION RATE RECORD

Ditch Company Cook Burns

Month Aug

Ditch President Jim Jennings

Year 1989

Type of Measuring Device?

☐ A) Parshall Flume: Throat Width _____ ft.

☐ B) Weir: Crest Length _____ ft. ☐ C) Other: _____



Date	Time	Head (ft.)	No. of Acres Being Irrigated	Name of the Gauge Reader	Remarks
1	7:30	9		Chuck Crago	
2	7:30	9 1/2		"	
3	8:00	10		"	
4	"	9		"	
5	"	10		"	
6	"	9		"	
7	"	9		"	
8	"	9 1/2		"	
9	"	8 1/2		"	
10	"	9		"	
11	"	9		"	
12	"	9		"	
13	"	10		"	
14	"	9 1/2		"	
15	"	9		"	
16	"	9		"	
17	"	9		"	
18	"	9 1/2		"	
19	"	10		"	
20	"	9		"	
21	"	9		"	
22	"	8 1/2		"	
23	"	8 1/2		"	
24	"	9		"	
25	"	9		"	
26	"	9		"	
27	"	9 1/2		"	
28	"	9		"	
29	"	8 1/2		"	
30	"	9		"	
31	"	9		"	

DIVERSION RATE RECORD

Ditch Company Cook-Burns

Month SEP

Ditch President Jim Jennings

Year 1989

Type of Measuring Device?

☐ A) Parshall Flume: Throat Width _____ ft.

☐ B) Weir: Crest Length _____ ft. ☐ C) Other: _____



Date	Time	Head (ft.)	No. of Acres Being Irrigated	Name of the Gauge Reader	Remarks
1	8:00	8 1/2		Chuck CRAPO	
2	"	9		"	
3	"	9		"	
4	"	9		"	
5	"	8 1/2		"	
6		7 1/2		"	
7		7 1/2		"	
8		7 1/2		"	
9		7 1/2		"	
10		7 1/2		"	
11		7 1/2		"	
12		9		"	
13		9		"	
14		9		"	
15		9		"	
16		9		"	
17		8 1/2		"	
18		9		"	
19		9		"	
20		9		"	
21		9		"	
22		5		"	
23		5		"	
24		4 1/2		"	
25		5		"	
26		5		"	
27		0			TURNED Ditch off for
28		0			THE SEASON
29		0			
30		0			
31		0			

DIVERSION RATE RECORD

Ditch Company Cook-BURNS

Month JUNE

Ditch President Jim Jennings

Year 1990

Type of Measuring Device?

☐ A) Parshall Flume: Throat Width _____ ft.

☐ B) Weir: Crest Length _____ ft. ☐ C) Other: _____



Date	Time	Head (ft.)	No. of Acres Being Irrigated	Name of the Gauge Reader	Remarks
1		—			
2		—			
3		—			
4		—			
5		—			
6		—			
7	7pm	unmeasurable		DON HELMER	Stock water
8		"			"
9		"			"
10		"			"
11		"			"
12		"			"
13		"			"
14		"			"
15		"			"
16		"			"
17		"			"
18		"			"
19		"			"
20		"			"
21		"			"
22	7am	8		DON HELMER	IRRIGATION
23	"	8		"	"
24	8am	8		"	"
25	7:30	8		"	"
26	6am	8		"	"
27	"	8		"	"
28	7am	8		"	"
29	6am	8		"	"
30	6am	8		"	"
31	—	—		—	"

DIVERSION RATE RECORD

Ditch Company Cook-Burns

Ditch President Jim Jennings

Type of Measuring Device?

☐ A) Parshall Flume: Throat Width _____ ft.

☐ B) Weir: Crest Length _____ ft. ☐ C) Other: _____

Month July
Year 1990



Date	Time	Head (ft.)	No. of Acres Being Irrigated	Name of the Gauge Reader	Remarks
1	6 pm	7 1/2		Don Helmer	
2	7 am	8			
3	8 am	8			
4	3 pm	8			
5	1 pm	8			
6	5 pm	6 1/2			
7	8 pm	6 1/2			
8	3 pm	6			
9	1 pm	6			
10	4 pm	7			
11	8 pm	7			
12	8 pm	7			
13	5 pm	7			
14	11 am	7			
15	2 pm	7			
16	8 pm	6 1/2			
17	8 am	8 1/2			
18	9 am	8 1/2			
19	8 am	8 1/2			
20	9 am	8 1/2			
21	1 pm	10			Rained 2 to 3 in.
22	6 pm	10			
23	8 am	9 1/2			
24	7 am	9 1/2			
25	8 am	9			
26	7 pm	9			
27	7 am	9			
28	6 pm	9 1/2			
29	4 pm	8 1/2			
30	3 pm	8 1/2			
31	8:30	9			



DIVERSION RATE RECORD



Ditch Company Coak Burns

Month Aug

Ditch President JIM JENNINGS

Year 1990

Type of Measuring Device?

☐ A) Parshall Flume: Throat Width _____ ft.

☐ B) Weir: Crest Length _____ ft. ☐ C) Other: _____

Date	Time	Head (ft.)	No. of Acres Being Irrigated	Name of the Gauge Reader	Remarks
1	6 Pm	9		Don HEYMER	
2	7 Pm	9		"	
3	9am	9		"	
4	11am	9		"	
5	6am	9		"	
6	7am	9		"	
7	9am	9		"	
8	9am	9		"	
9	7am	9		"	
10	10am	8 1/2		"	
11	11am	8 1/2		"	
	9am	8 1/2		"	
13	10am	8 1/2		"	
14	8am	8 1/2		"	
15	1 Pm	8		"	
16	2 Pm	8		"	
17	4 Pm	8		"	
18	4 Pm	8		"	
19	2 Pm	8		"	
20	1 Pm	8		"	
21	4 Pm	8		"	
22	8am	8 1/2		"	
23	11am	9		"	
24	11am	9		"	
25	2 Pm	9		"	
26	11am	9		"	
27	1 Pm	9		"	
28	3 Pm	9		"	
29	10am	9		"	
30	6:30	9		"	
31	6:30	9		"	



DIVERSION RATE RECORD

Ditch Company COOK BURNS

Month Sept

Ditch President JIM JENNINGS

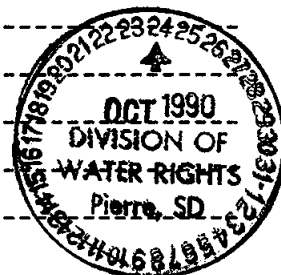
Year 1990

Type of Measuring Device?

☐ A) Parshall Flume: Throat Width _____ ft.

☐ B) Weir: Crest Length _____ ft. ☐ C) Other: _____

Date	Time	Head (ft.)	No. of Acres Being Irrigated	Name of the Gauge Reader	Remarks
1	839	10 1/2		Jennings	
2	940	10 3/8		↓	
3	657	10 1/4			
4	702	10 1/4			
5	610	10 1/2			
6	612	8 1/2			
7	628	8 3/4			
8	609	7 3/4			
9	610	3 1/2			
10	605	2 3/4			
11	555	2 1/8			
12	617	2 1/8			
13		2 1/8			
14		2 1/8			
15		2 1/8			
16		8			
17		8 1/8			
18		8 1/8			
19	642	8 1/8			
20	647	4			
21	651	4			
22	645	4			
23	632	4			
24	658	4			
25	621	4			
26	638	4			
27	637	4			
28	651	4			
29	650	4			
30	637	4			
24 Oct 1	810	4			



DIVERSION RATE RECORD

Ditch Company Cook-Burns

Month Aug

Ditch President _____

Year 1988

Type of Measuring Device?

☐ A) Parshall Flume: Throat Width _____ ft.

☐ B) Weir: Crest Length _____ ft. ☐ C) Other: _____



Date	Time	Head (ft.)	No. of Acres Being Irrigated	Name of the Gauge Reader	Remarks
1	7:30	7		Chuck Crago	
2	7:30	7		Chuck Crago	
3	7:30	8		"	
4	7:30	7		"	
5	8:00	7		"	
6	8:00	7		"	
7	7:30	7		"	
8	7:30	8		"	
9	8:00	8		"	
10	8:00	8		"	
11	8:00	9		"	
12	8:00	9		"	
13	8:00	9		"	
14	8:00	8		"	
15	8:00	8		"	
16	8:00	9		"	
17	8:00	9		"	
18	8:00	8		"	
19	8:00	8		"	
20	8:00	9		"	
21	7:30	9		"	
22	7:30	9		"	
23	7:30	9		"	
24	7:30	8		"	
25	7:30	9		"	
26	7:30	8		"	
27	7:30	7		"	
28	7:30	6		"	
29	8:00	6		"	
30	8:00	6		"	
31	8:00	6		"	

Cook Burns Ditch

RR 1 Box 182C

DIVERSION point SW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec 16 T7R-R2E

MAXIMUM DIVERSION RATE 125 CFS

	NAME	LOCATION	MEASURE	COMMENTS
1	JENNINGS Ranch Co	849 7-2	82.2	
2	Donald HILMER	9-7-2	118.3	
3	VINCENT CRAIG	9910-7-2	192.2	
4	ZOLA CRAIG	10811-7-2	229.1	

TOTAL 621.8

DIVERSION DITCH SERVICE

NAME OF THE DITCH: *Coat Road*

ADDRESS:

DIVERSION POINT: $\frac{1}{4}$ $\frac{1}{4}$ SEC. T N-R E; SOURCE:

MAXIMUM DIVERSION RATE: C.F.S.

ACREAGE SERVED: ACRES

LANDOWNER'S NAME	LOCATION OF LAND BEING IRRIG. BY THIS DITCH	ACREAGE	COMMENTS
<i>Donald H. Hines</i>			
<i>Zola Crago</i>	<i>10-7-2</i>	<i>128.1</i>	
<i>Donald Jennings</i>	<i>11-7-2</i>	<i>101.</i>	
<i>Vincent Crago</i>			

LANDOWNER'S
NAME

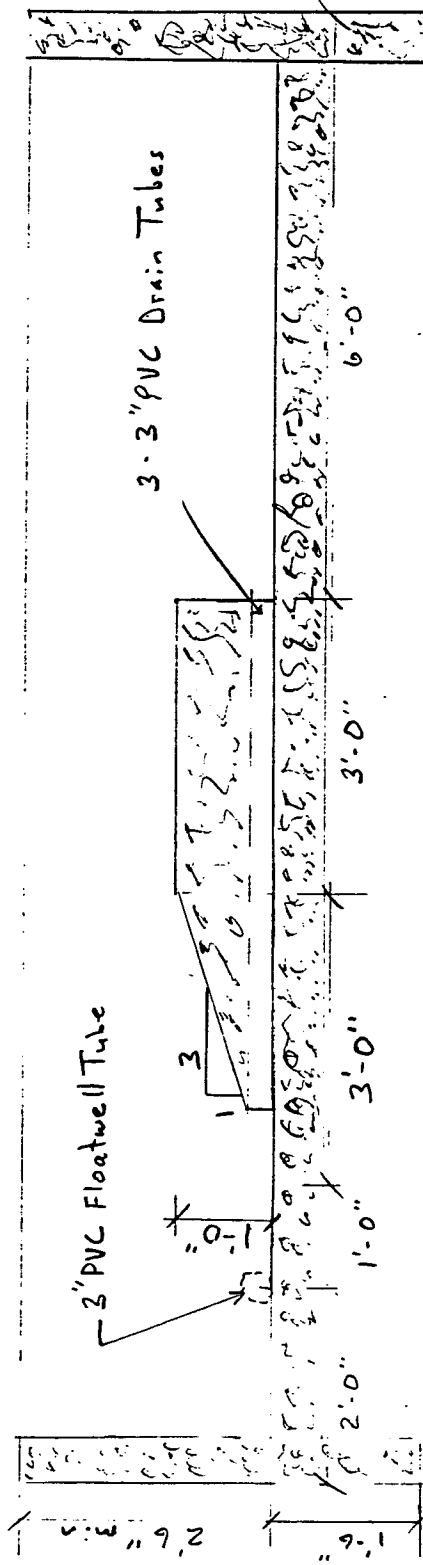
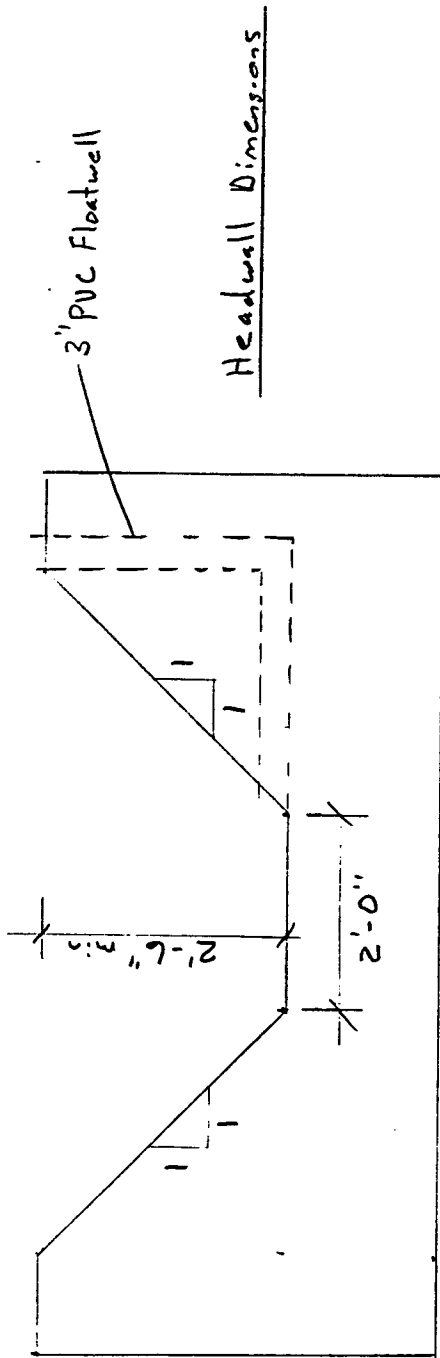
LOCATION OF LAND
BEING IRRIG. BY
THIS DITCH

ACREAGE

COMMENTS

--	--	--	--

CALCULATIONS FOR Flumes



Profile Flume Dimensions

Flume FB-1

Scale: 1/4" = 1'-0"

Constructing Simple Measuring Flumes For Irrigation Canals

Albert J. Clemmens and John A. Replogle¹

Introduction

Poor irrigation water management causes many serious water-supply and water-quality problems. Farmers and other water users are being encouraged to develop their own water management plans or improve existing ones. A major step in implementing any plan is measuring the amount of irrigation water applied. Correct application depends on accurate discharge rate information, both for the main irrigation stream entering the field and for runoff leaving the field.

Typical water-measuring devices—sharp- and broad-crested weirs and flumes such as the parshall, cutthroat, and short- and long-throated trapezoidal that are used in open channels or ditches—are cumbersome and expensive. Since most of these measuring devices require laboratory calibration, flumes used in the field are limited to the particular shapes and sizes for which these calibrations are available.

Issued March 1980

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

Stock No. 001-000-04119-3

¹Research hydraulic engineers. Science and Education Administration, Agricultural Research, U.S. Water Conservation Laboratory, Phoenix, Ariz. 85040.

Flume Design Criteria

The profile and cross section of the b-c-w flume are shown in figure 3. The important design dimensions are the sill height, S , and the sill length, L . The sill represents the floor of the throat section for these flumes. The sides of the throat section are the existing channel walls. The sill length is less important for design and need not be considered in selecting sizes for the new style measuring flume. There are certain conditions, however, under which the sill length limits the design. If it is too short, the flow lines will not be parallel enough in the throat section and the flume ratings may deviate by as much as percent from those presented in this publication (see p.9). When this condition exists, the rating tables are marked to indicate that a longer throat would be used.

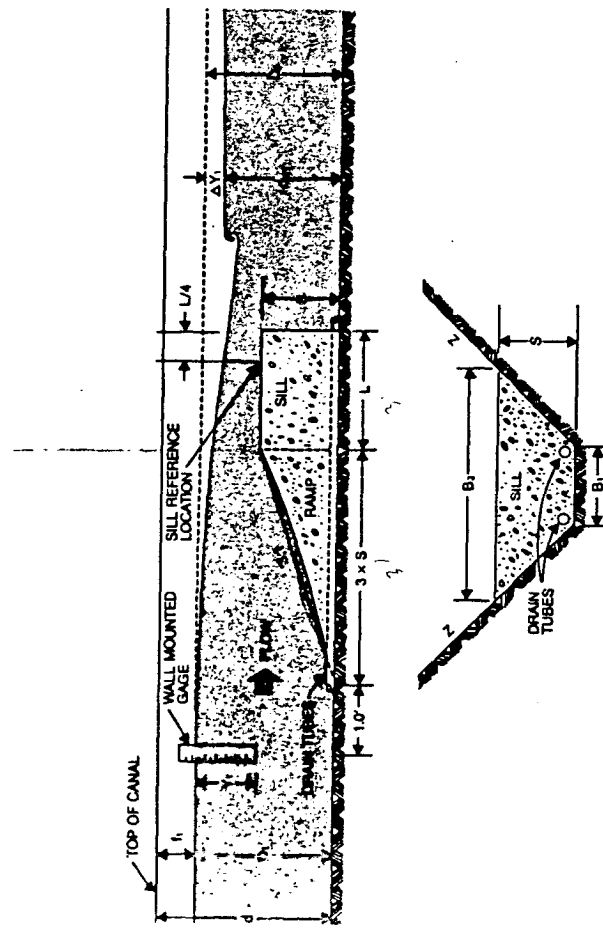


FIGURE 3.— Flume dimensions in profile (top) and cross section (bottom).
 Abbreviations used in the profile are as follows: d = constructed depth; D_1 = upstream water depth; t_1 = actual freeboard; Y_1 = sill-referenced flow depth; L = sill length; Y_1 = actual increase in water depth caused by the flume; S = sill height; d_m = flow depth; $3 \times S$ = three times the sill height (ramp length).
 Abbreviations used in the cross section (bottom) are as follows: B_3 = sill width; B_1 = canal bottom width; Z = sideslopes; S = sill height.

The sill height is the most important design dimension for controlling the water levels in the ditch. The sill must be high enough so that it obstructs the usual flow in the ditch, causing the water surface upstream from the flume to rise as shown in figure 3. Field and laboratory experience with this style of flume has shown that flumes will operate satisfactorily at 85 percent submergence. For example, the downstream water depth should be no more than 85 percent of the upstream water depth, both measured from the elevation of the top of the sill. Thus, one criterion for design is that the required minimum depth change caused by the flume at maximum flow should be 15 percent of the sill-reference depth, Y_1 .

Another criterion of sill height is that it not cause so much of an obstruction in flow that the ditch upstream from the flume is overtopped. The Soil Conservation Service recommends that the freeboard for stable subcritical flow in trapezoidal channels be 20 percent of the energy head at normal depth. (This is approximately 20 percent of the flow depth for canals with very slow-moving flow.) Because of the stable nature of the flow upstream from the b-c-w flumes, the free board requirement there can usually be reduced from 20 percent of D_1 to 20 percent of Y_1 , which is the sill reference depth (fig. 3). These two criteria must be met for the full range of expected flow conditions. The conditions for both criteria are most crucial at the maximum expected flow rate, Q_m , for these shapes of flumes. Thus, the design is based on the maximum expected discharge and the associated depth, d_m . Since this water depth is important to the design, some engineering assistance may be required to get accurate maximum depth-discharge relationships.

Three selected sill heights have been chosen to accommodate the usual range of flows for three standard-sized slipformed canals. Design and selection of a flume is a simple, straightforward procedure.

Flume Design Procedure

Table 1 can be used as a design aid for selecting the appropriate flume. The example shown in table 1 is for a 36-inch ditch with a 2-foot bottom and 1:1 slopes that is used to carry a maximum of 20 cubic feet per second (cfs). If the ditch flows about 25 inches deep at this discharge, what sill height should be selected? To use the table for this example, begin by using the basic information about the canal or ditch where the flume is to be located (lines 1-3). Line 1 is simply the vertical depth of the canal, d, line 2 is the width of the canal bottom, B₁, and line 3 is the canal wall side slope, Z, expressed as a ratio of horizontal to vertical distance. Line 4 is the maximum discharge rate. Line 5 is the flow depth. Line 6 is the existing freeboard in the ditch prior to flume construction (line 1 minus line 5).

Once this information is obtained, the selection procedure is straightforward. Table 2 gives flume calibrations for three sizes of flumes (sill heights) for each of three ditch shapes. To begin the selection procedure, find the ditch shape in table 2 (A, B, or C) that matches lines 2 and 3 in table 1. This example, the ditch shape corresponds to canal shape B. Choose any one of the three flume sizes from that group. For this example, FB1 was tried first. Record the information from table 2 for that flume size in the blanks provided for lines 7 through 12 on table 1. (The repetition of some information in table 1 assures that the appropriate flume group and size are chosen from table 2.)

The remaining section of table 1 is a check on the flow conditions that should exist if the trial flume size were installed. Figure 3 shows a profile of a flume and a typical water surface resulting from flume placement. From appropriate columns of table 2, find the sill-referenced flow depth, Y₁, for the design discharge, Q_m, and enter it under line 13 in table 1. For the example, Y₁ = 1.143, for Q_m = 20. Add lines 12 and 13 to obtain the total ditch depth, line 14, D₁ = 5 + Y₁. Subtract line 5 from line 14 to get the actual rise in water level caused by the flume, line 15, ΔY₁ = D₁ - d_m (fig. 3). Next, calculate the rise in water surface that the flume must cause so that it operate properly, line 16, ΔY₂ = 0.15 Y₁. If the actual increase in water depth, ΔY₁, is less than that required, ΔY₂ (ΔY₁ - ΔY₂ = ΔY₃ < 0) then the flume cannot be expected to operate properly (line 17), because it will be submerged, as for FB1 of the example.

This limit on the flume submergence assures that the water depth downstream from the flume will not affect the water depth reading upstream in the flume at the gage location. If ΔY₃ is negative, a higher sill must be used, so lines 7-17 are repeated for a higher sill height, as for FB2. For this example, ΔY₃ is positive and the design criteria have been met. Where the selection produces a ΔY₃ that is greater than about 3 inches, a lower and more economical sill should be tried.

Table 1. Broad-crested weir design and selection

Canal Data			
1. Constructed depth--d =	3	ft. =	36
2. Bottom width--B ₁ =	2	ft. =	24
3. Side slopes--Z =	1/1		
Weir Selection Using Tables			
7. Trial flume identification:			
8. Bottom width, B ₁ (matches line 2)			
9. Sill width, B ₂			
10. Side slopes, Z (matches line 3)			
11. Critical section (sill) length, L			
12. Trial sill height, S			
Submergence - Freeflow Check, Weir in Place			
S	=	1.00	
L	=	3.00	
Z	=	1/1	
B ₂	=	4.00	
B ₁	=	2.0	
FB1			
Trial 1			
S	=	1.25	
L	=	2.50	
Z	=	1/1	
B ₂	=	4.50	
B ₁	=	2.0	
FB2			
Trial 2			
S	=	1.50	
L	=	2.00	
Z	=	1/1	
B ₂	=	5.00	
B ₁	=	2.0	
FB3			
Trial 3			
Flow Data for Canal Without Weir in Place			
4. Maximum discharge rate - Q _m =	20	cfs	
5. Flow depth for Q _m - d _m =	2.08	ft. =	25
6. Freeboard - f _p =	0.92	ft. =	11
(line 1 minus line 5)			

1.04	1.09	1.14	ft.
2.54	2.94	2.14	ft.
0.46	0.26	0.06	ft.
0.16	0.16	0.17	ft.
0.30	0.09	-0.11	ft.
0.46	0.66	-	ft.
0.21	0.22	-	ft.
0.25	0.44	-	ft.

How were Q_m and d_m determined? estimated

Example Problem

Location

FB3

Flume selected

Comments

and f₃ are both fairly large, FB3 about the actual water depths. Since a Y₃

The actual freeboard with the flume in place, line 1 minus line 14, is entered in line 18. The required freeboard, 20 percent x line 13, is entered in line 19. If the actual freeboard, f_1 , is less than the required freeboard, f_2 , $-f_2 = f_3 < 0$ then the freeboard requirement has not been met (line 20). If the criteria outlined for lines 17 and 29 are both met ($\Delta Y_1 > 0$ and $f_3 > 0$), in the example for FB2, then the flume trial will work for that situation. If $\Delta Y_1 > 0$ and $f_3 > 0$, or the other is not met, a different flume size (sill height) should be tried. In the example, flume FB2 could have been selected; however, if FB3 had been tried first, as shown in trial 3 of table 1, it also would satisfy the criteria of line 19 and could be selected.

For individual situations, the selection may be based on the certainty of the values used for Q_m and d_m . Here, if d_m were actually 27 inches (2.25 ft), f_1 for flume FB2 would be $-0.073'$, and the flume would be submerged. In flume FB3 would probably be chosen, since there is still plenty of freeboard (line 20, table 1). If two trials work and neither is close to the two limits, then in general, select the lowest sill that satisfies the criteria; in this case FB2 would have been chosen. The reason for choosing the lower sill is that it will cause the least head loss in the canal if it works, and if it doesn't work, the sill can easily be raised by capping it with new concrete. If the lowest sill height had been used and the design flow rate had been too low, the canal might overtop and the sill height would be difficult to lower.

In some situations, more than one sill height will work. In other situations one of the flume sizes given here will work. If the highest sill is too low or lowest sill too high, try another location along the ditch where the flow conditions are different. If a suitable location cannot be found, a new flume can be computed that will be tailored to the particular site. If a flume sill is too low and the next largest sill is too high, either look for a location where lower sill can be used or use the larger sill and add additional sidewall height to the ditch upstream from the flume.

There are some limitations on these flumes that are related to the ratio between the throat or sill length, L , and the upstream depth, Y_1 , presented in discussion of parallel flow in the section on Flume Design Criteria (p. 4). Table 2, several columns have a horizontal dashed line near the bottom indicating the column (that is, for FA3, between 0.720 and 0.773). If flow depths corresponding discharges below these lines (higher values) are used, at 6 inches should be added to the throat length, L . This will not have a significant effect on the other discharge ratings as listed above the dashed

Table 2. Flume calibrations—water depth at gage location referenced to weir crest (in feet)

CANAL SHAPE A B = 1.0' Z = 1:1									
Flow rate (ft ³ /s)	FA1	FA2	FA3	FB1	FB2	FB3	FC1	FC2	FC3
	B ₁ =2.50' L=2.00' S=0.75'	B ₂ =3.50' L=1.50' S=1.00'	B ₃ =5.00' L=1.00' S=1.25'	B ₁ =2.50' L=2.00' S=0.75'	B ₂ =4.50' L=2.50' S=1.25'	B ₃ =5.00' L=2.00' S=1.50'	B ₁ =5.125' L=3.50' S=1.25'	B ₂ =5.75' L=3.50' S=1.50'	B ₃ =6.375' L=2.50' S=1.75'
0.5	0.160	0.143	0.130	0.160	0.175	0.164	0.252	0.234	0.217
0.6	0.179	0.161	0.146	0.179	0.194	0.183	0.287	0.267	0.249
0.7	0.197	0.177	0.161	0.197	0.211	0.200	0.312	0.291	0.272
0.8	0.214	0.192	0.175	0.214	0.226	0.215	0.337	0.315	0.296
0.9	0.230	0.207	0.189	0.230	0.241	0.230	0.362	0.339	0.320
1.0	0.246	0.221	0.202	0.246	0.256	0.245	0.387	0.364	0.345
1.2	0.275	0.248	0.226	0.275	0.286	0.275	0.437	0.414	0.395
1.4	0.302	0.273	0.249	0.302	0.312	0.301	0.487	0.464	0.445
1.6	0.327	0.296	0.271	0.327	0.337	0.326	0.537	0.514	0.495
1.8	0.351	0.318	0.292	0.351	0.362	0.351	0.587	0.564	0.545
2.0	0.374	0.340	0.312	0.374	0.387	0.376	0.637	0.614	0.595
2.5	0.427	0.389	0.358	0.427	0.441	0.430	0.737	0.714	0.695
3.0	0.476	0.434	0.400	0.476	0.491	0.480	0.837	0.814	0.795
3.5	0.520	0.477	0.440	0.520	0.535	0.524	0.937	0.914	0.895
4.0	0.562	0.516	0.477	0.562	0.577	0.566	1.037	1.014	0.995
4.5	0.601	0.553	0.512	0.601	0.617	0.606	1.137	1.114	1.095
5.0	0.638	0.588	0.546	0.638	0.653	0.642	1.237	1.214	1.195
6.0	0.707	0.654	0.608	0.707	0.723	0.712	1.387	1.364	1.345
7.0	0.771	0.715	0.666	0.771	0.787	0.776	1.487	1.464	1.445
8.0	0.829	0.772	0.720	0.829	0.845	0.834	1.587	1.564	1.545
9.0	0.885	0.825	0.773	0.885	0.901	0.890	1.687	1.664	1.645
10.0	0.937	0.875	0.821	0.937	0.953	0.942	1.787	1.764	1.745
11.0	0.986	0.923	0.867	0.986	1.001	0.990	1.887	1.864	1.845
12.0	1.033	0.968	0.911	1.033	1.049	1.038	1.987	1.964	1.945
13.0	1.078	1.014	0.954	1.078	1.095	1.084	2.087	2.064	2.045
14.0	1.121	1.056	0.994	1.121	1.137	1.126	2.187	2.164	2.145
15.0	1.162	1.096	1.034	1.162	1.177	1.166	2.287	2.264	2.245
16.0	1.200	1.135	1.071	1.200	1.215	1.204	2.387	2.364	2.345
17.0	1.240	1.173	1.108	1.240	1.255	1.244	2.487	2.464	2.445

Flume Construction

Once a satisfactory flume design has been chosen, flume construction is simple and straightforward. The flume has two sections—a ramp and a sill (throat section) (fig. 3). The sill should be level with no large irregularities. The width of the sill, B_s , should be as close to the value given in table 2 as the desired accuracy of measurement (that is, a 1 percent error in B_s will produce roughly a 1 percent error in discharge). With the wide sills used here, an error one-half inch in sill width would cause about a 1 percent error. Within limits, the sill length in the flow direction has very little effect on the discharge reading. Errors of 2 or 3 inches in length would cause virtually no change in discharge reading, especially if the error makes the throat longer. While the sill height is of prime importance to design because it controls the water surface elevation and submergence properties, precise vertical location of the sill is not critical to discharge rating, except when it causes the time width dimension to deviate significantly. For example, an error of one-half inch in sill height, which can be caused by irregularities in the channel bottom, would change the sill width by 1 inch for a channel with 1:1 slopes. This would cause only about a 2 percent error. The flume dimensional tolerances thus allow flumes to be placed in slipform ditches, which vary slightly in shape from the standard. These tolerances should not, however, be an excuse for sloppy or poor construction but can make construction quick and easy.

The upper edge of the ramp should join the sill edge such that it does not leave above the sill to cause unpredictable flow separation. Precision edge attaching of the two sections or slight rounding of the joint corner is desirable. When the ramp is hand-troweled into place avoid making large rumps or bumps. The ramp should be fairly uniform across with an approximate 3:1 slope. The ramp may be slightly concave as shown in figure 3. The ramp need not taper to zero thickness but can be ended abruptly when it comes 2 to 3 inches thick.

Drain tubes should be installed as shown in figure 3 to allow the ditch to drain for mosquito control. Flow through the drain tubes will usually be negligible compared with flow through the flume. If tubes 2 to 3 inches in diameter or larger are used, the upper ends can be plugged to stop the flow. Sediment, which tends to accumulate at the base of the ramp, may plug the drains and should be cleaned out periodically. Sediment will not significantly accumulate in the ditch behind the flume if it did not normally accumulate in the ditch previously. Special flumes can be designed for sediment-laden ditches where 6 inches or more of sediment is normally deposited between annual periods.

Cast-in-place construction is straightforward. Cut out two pieces of plywood, each matching the cross section of the sill as shown in figure 3, with the corners cut out for inserting the drain tubes (cutting out the corners is necessary anyway since few slipform ditches have distinct corners). Cut 2-by-

2-inch spacers to length, 4, for holding the two forms apart. With the spacers between the two plywood forms, wire tie the plywood forms together. This makes the form for pouring the sill. Next, clean out a section of the ditch and place the forms on the bottom of the ditch. Insert the drain tubes and shim the forms so that the tops are level in the cross-ditch direction and with respect to each other. It is easy to see whether the form closely matches the ditch. Small errors are not important. As the form is filled with concrete, remove the 2-by-2-inch spacers. The concrete will hold the plywood apart. Use the plywood forms as screed edges for screeding and troweling the sill to a smooth, level surface.

After the concrete in the sill has taken initial set, the upstream form can be removed and the ramp hand-troweled into place (fig. 4). Both the ramp and sill can be broom-finished.

For single-pour construction, the upstream form can be made of a metal frame constructed from angle iron. This frame provides the upstream screeding edge for finishing the sill and is left permanently in place within the flume structure. Thus, both the sill and the ramp can be constructed at the same time, without waiting or returning to the site.

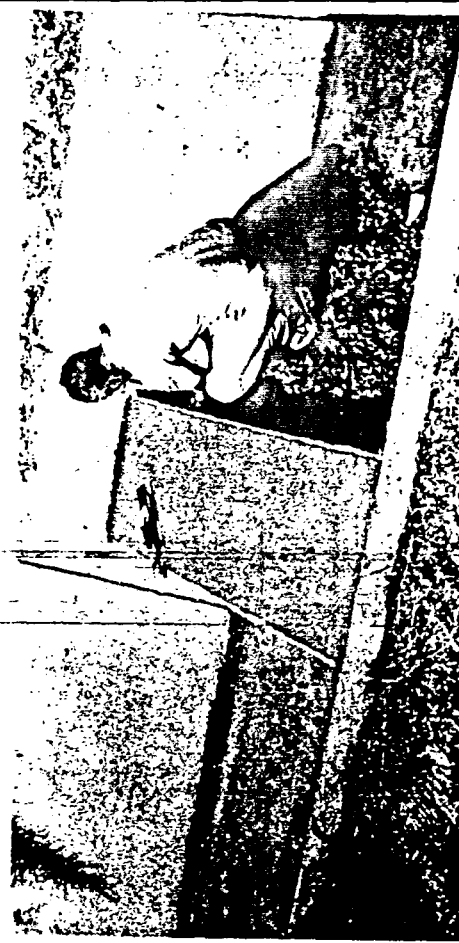


FIGURE 4.—Construction of b-c-w flume FB3 installed in a 30-in ditch near Tacna, Ariz. The sill (throat section) has been poured. The upstream form is being removed so that the ramp can be poured (flow will be from right to left).

PN-6553

Gage Construction and Placement

A convenient type of gage to use is one marked in discharge units and tached to the canal wall. Gages can be constructed of 0.125- by 1.5-inch unimum bar stock and stamped with a chisel, hammer, and a metal-amping die set. The gages must be cleaned with a wire brush periodically to 'move deposits. Since baked enamel gages are easier to read but must be ustom ordered, they are considerably more expensive (fig. 5). The gage is aced on the sidewall and the vertical depths given in table 2 must be ounted to sloping distances by multiplying the vertical depths by 1.414,

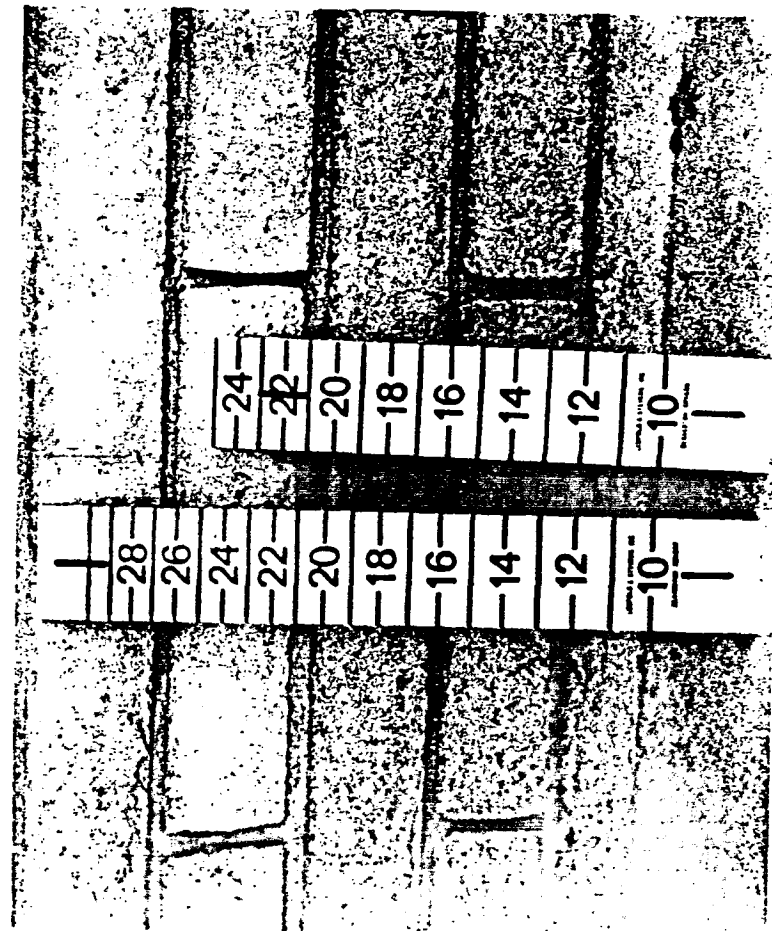


FIGURE 5.—Commercially available baked enamel, wall-mounted gages marked in 1/2 in. The slotted holes make gage placement easier.

1.414, and 1.601 for ditch shapes A, B, and C, respectively. The discharge values are then marked on the gage at these calculated distances from the gage zero (the zero point need not be marked on the gage).

To obtain accurate discharge ratings, the gage must be carefully surveyed into place with a surveyor's level and rod. The reference elevation for mounting the gage is along the centerline of the canal on top of the sill at about L/4 from the downstream end of the flume (fig. 3). This eliminates errors caused by a nonlevel sill. Often the ditch side slopes are not exactly as intended, thus a wall-mounted gage could be in error. To eliminate most of the error, the gage is referenced and mounted so that the gage is most accurate at the most commonly used discharge. The greatest errors will then occur at gage readings which are seldom used. Mount the gage so that the mark for the most commonly used discharge is at a vertical distance, Y_1 , above the sill reference location, corresponding to the same discharge in table 2.

The gage can be mounted on the wall with lead anchors and screws. A slotted hole can be used to adjust the gage to the proper elevation, or the holes can be drilled in the gage after the anchors are in place. Always check the gage after it has been fastened to make sure that it hasn't slipped. Because of the controlled error in the design and construction processes, which can hold the basic uncertainty of the device to less than ± 2 percent, most of the introduced error will be in the final gage reading. The wall-mounted gage is easily read to within ± 5 percent at most all flows, and for the midrange and higher flows ± 5 percent of the true discharge is easily accomplished. If the water surface is choppy, a skimmer can be placed upstream to reduce the surface waves. Use a stilling well and point gage if greater accuracy is desired.

PN-6554

COOK-BURNS DITCH-DIVERSION RATES (CFS)-1988 IRRIGATION SEASON

	JUNE	JULY	AUGUST	SEPTEMBER
1	0.5	7	6.5	0
2	0.5	8	6.5	0
3	0.5	6.5	8	0
4	0	8	6.5	0
5	0.5	8	6.5	5
6	5.9	8	6.5	5
7	9.8	7	6.5	5
8	0	6.5	8	8.5
9	9.5	6.5	8	8.5
10	9.5	6.5	8	8.5
11	9.5	6.5	9.5	8.5
12	9.5	7	9.5	
13	9.5	6.5	9.5	
14	0	6.5	8	
15	9.5	6.5	8	
16	0	7	9.5	
17	8.5	7	9.5	
18	8.5	7	8	
19	0	7	8	
20	8	8	9.5	
21	7	8	9.5	
22	7	0	9.5	
23	9	0	9.5	
24	7	0	8	
25	7	0	9.5	
26	7	8	8	
27	7	6.5	6.5	
28	8.2	6.5	5	
29	8	8	5	
30		6.5	5	
31		8	5	
MAX.	9.8	8	9.5	8.5

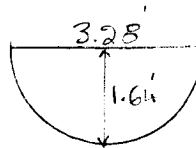
- Flume Capacity: $n = .012$

$$Q = \frac{1.49}{n} R^{2/3} S^{1/2} \cdot A \Rightarrow Q = 20.5 \text{ CFS}$$

- Flume Capacity: $n = .015$

$$Q = \frac{1.49}{n} R^{2/3} S^{1/2} \cdot A \quad n = .015$$

$$S = .002 \text{ ft/ft}$$



$$R = \frac{A}{W_p} = \frac{4.2248 \text{ ft}^2}{5.1522 \text{ ft}} \Rightarrow R = .82 \text{ ft}$$

$$Q = \underline{16.44 \text{ CFS}}$$

- Gate Capacity:

$$Q = C_d (b - 2b H_1) \sqrt{g H_1}^{3/2}$$

$$H_1 = b = 3'$$

$$n = .1$$

$$C_d = .587$$

$$g = 32.2 \text{ ft/s}^2$$

$$Q = 41.54 \text{ CFS For one gate}$$

$$Q_{\text{total}} = \underline{83.0 \text{ CFS}} \text{ for both gates}$$

$$\text{Vested: } \underline{125 \text{ CFS}}$$

Flume Capacity $n = .012$

$$Q = 20.5 \text{ CFS}$$

Flume Capacity, $n = .015$

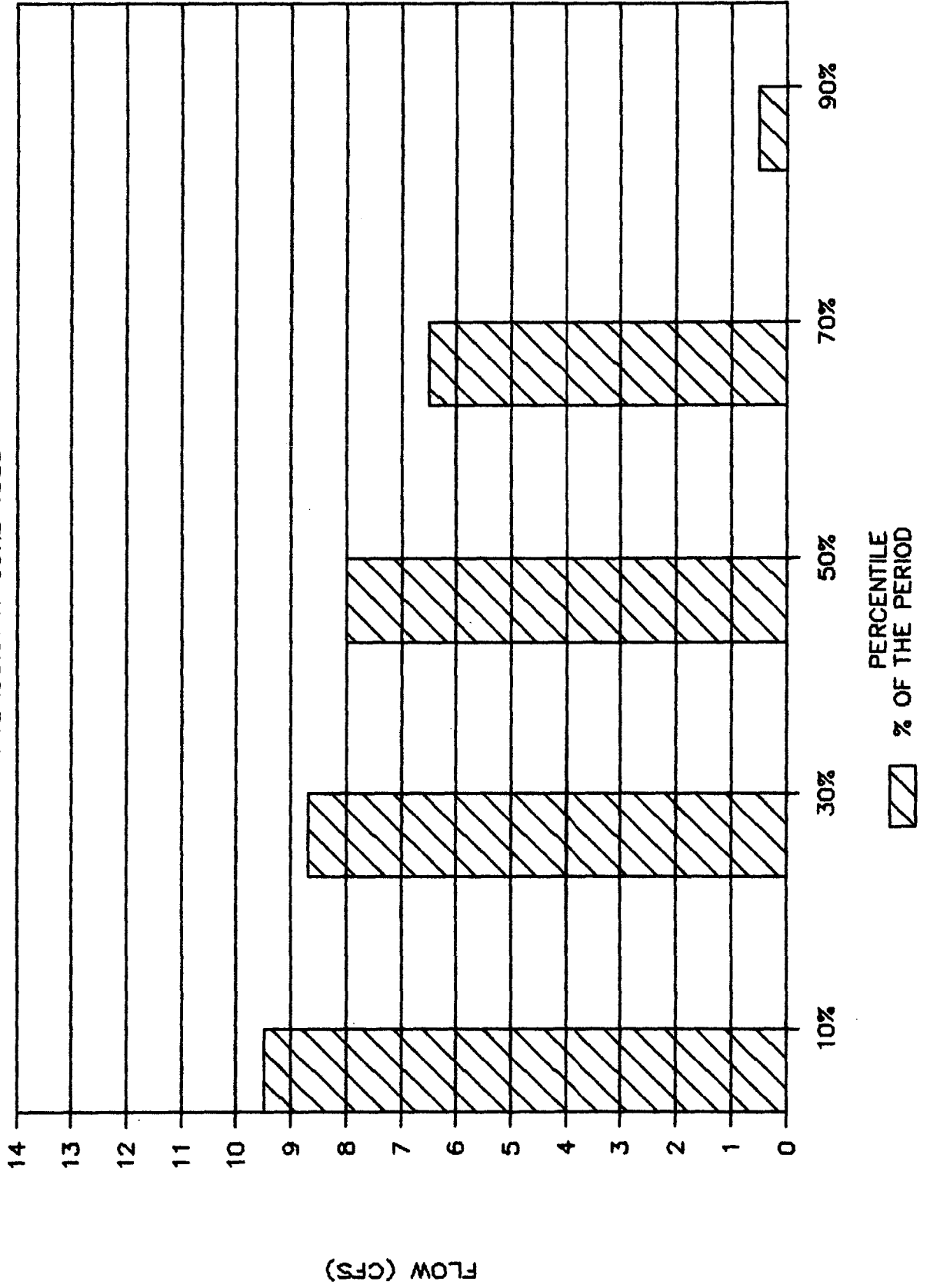
$$Q = 16.44 \text{ CFS}$$

$$Q_{\text{gates}} = 83.0 \text{ CFS}$$

$$Q_{\text{vested}} = 125 \text{ CFS}$$

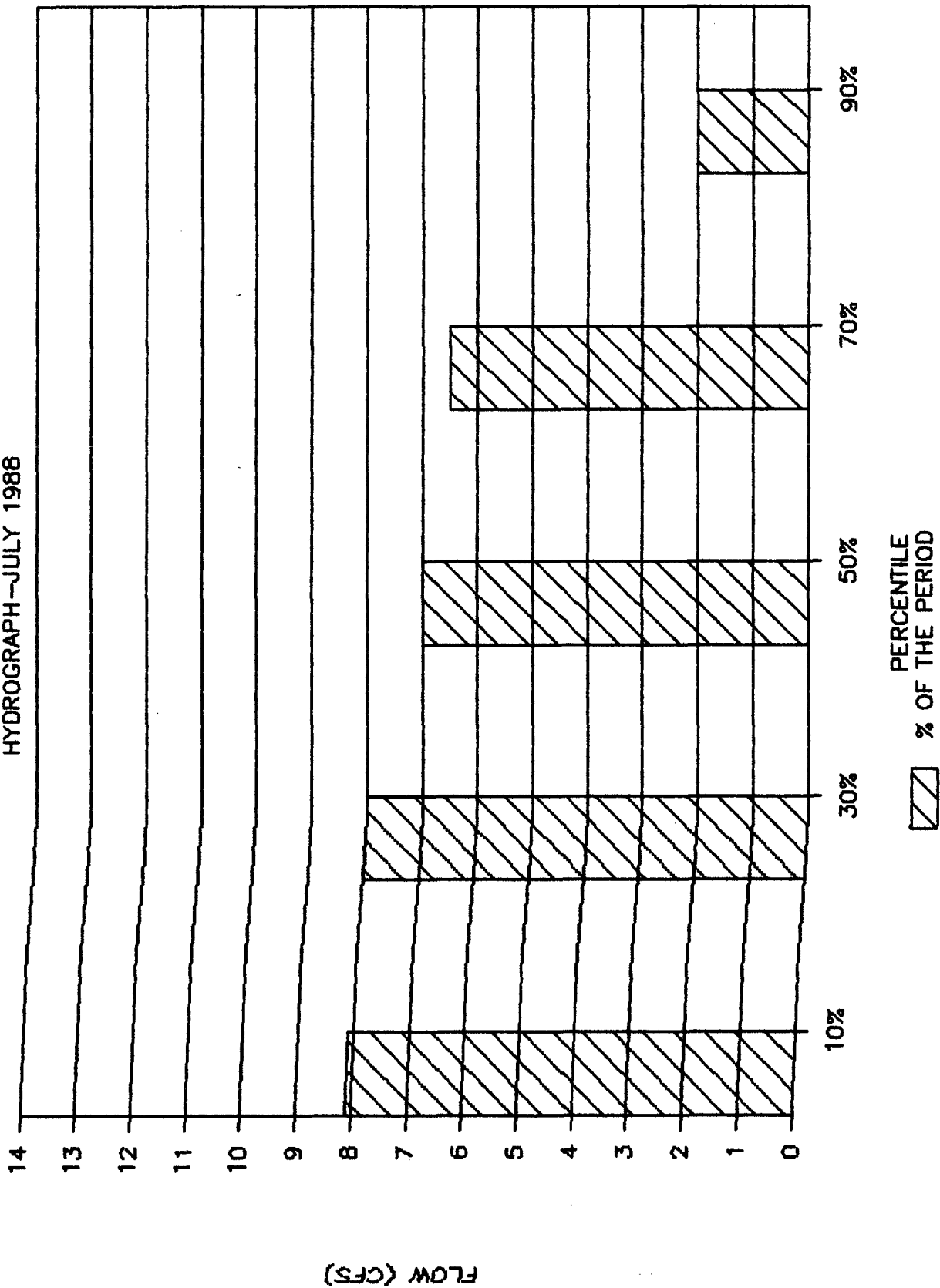
COOK-BURNS DITCH

HYDROGRAPH-JUNE 1988



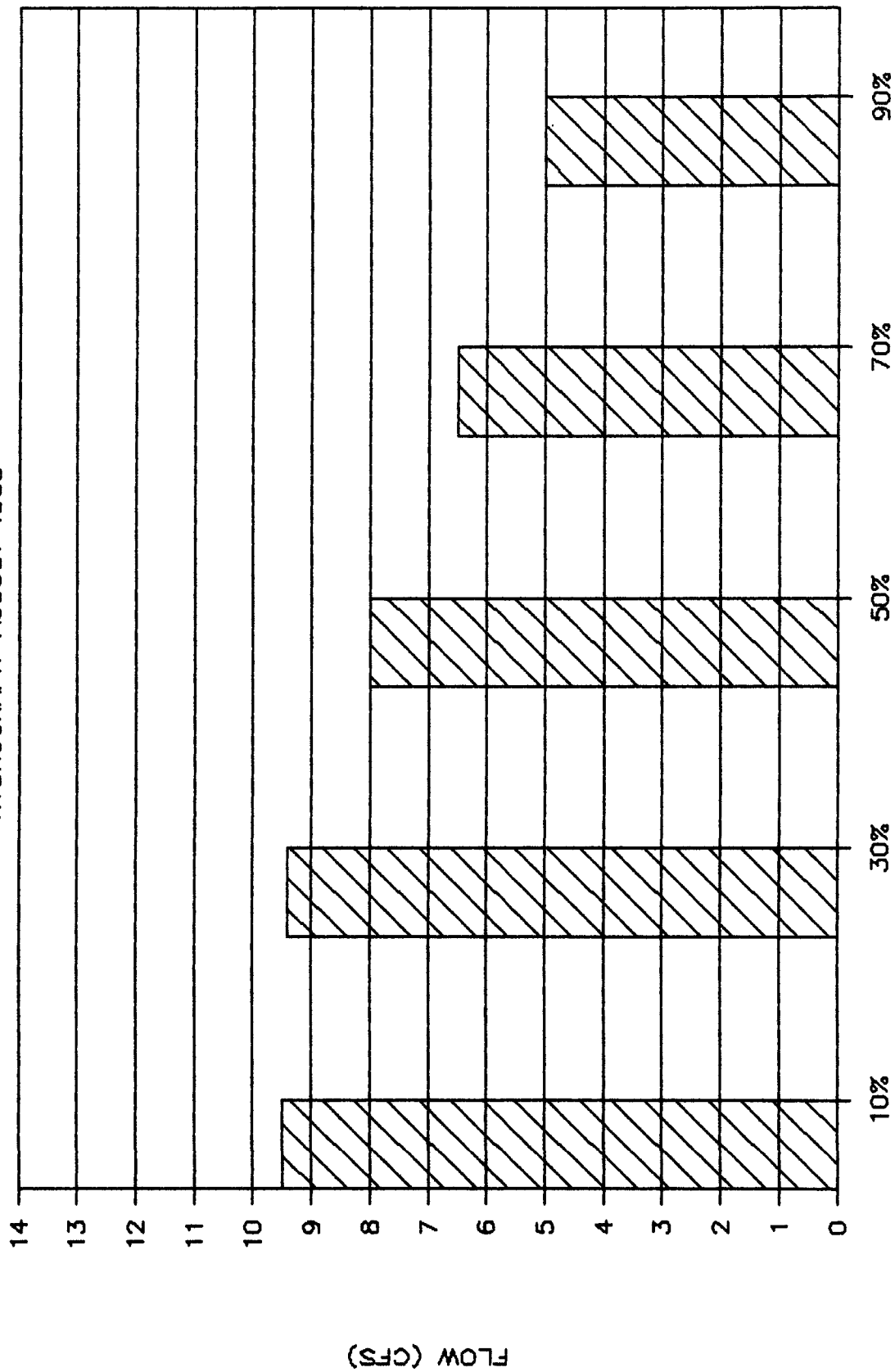
COOK-BURNS DITCH

HYDROGRAPH-JULY 1988



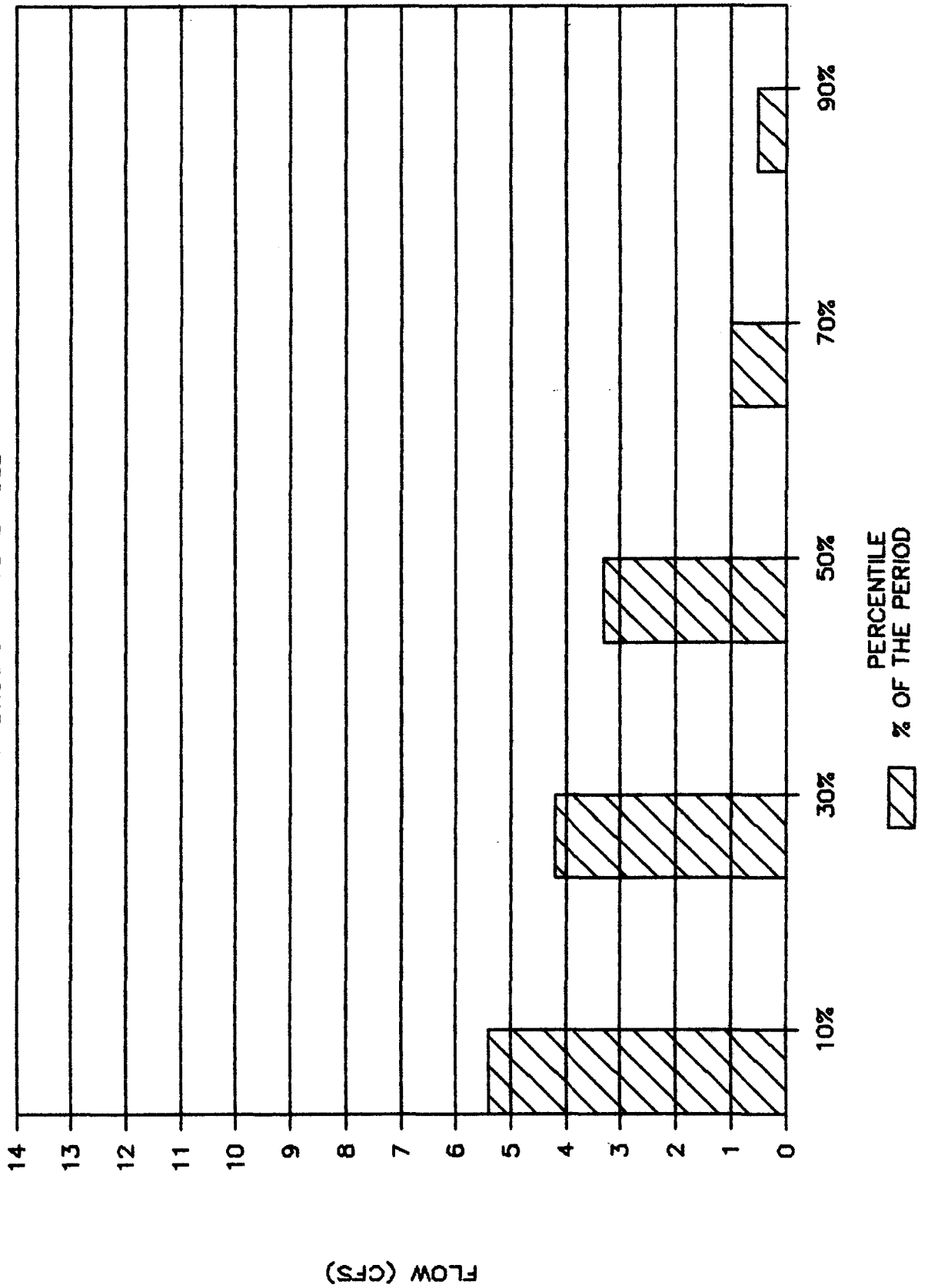
COOK-BURNS DITCH

HYDROGRAPH-AUGUST 1988



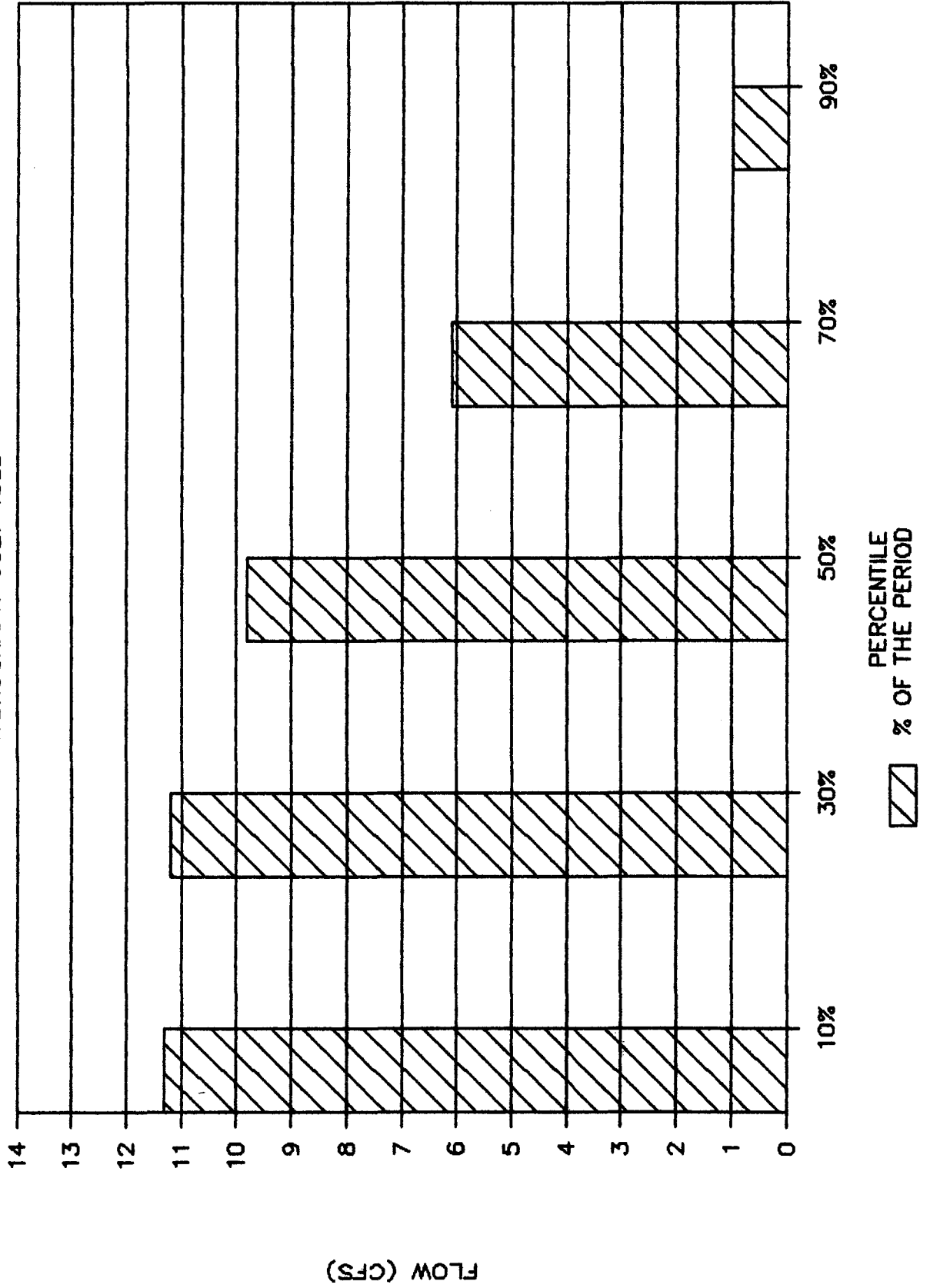
COOK-BURNS DITCH

HYDROGRAPH--JUNE 1989



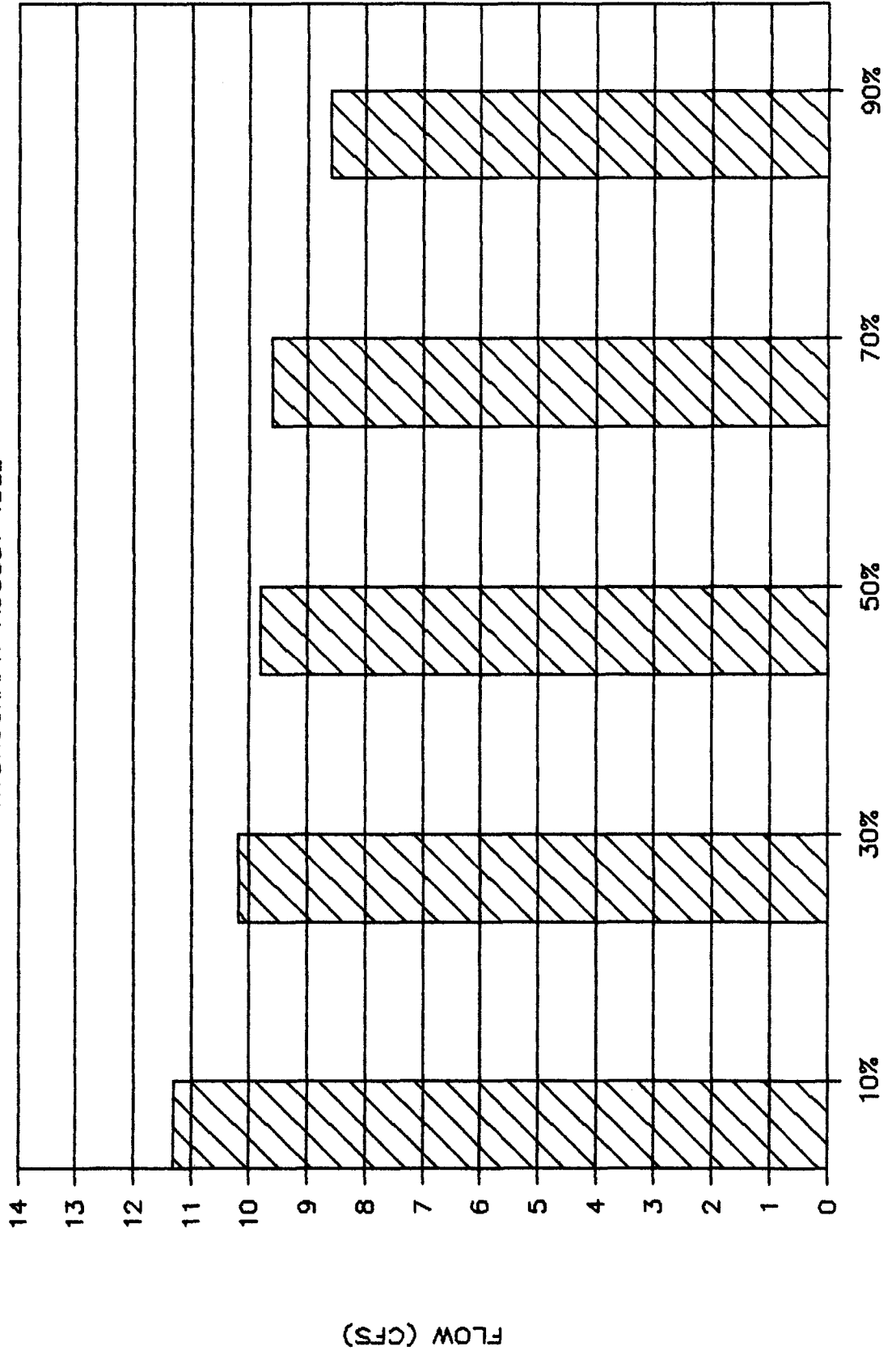
COOK-BURNS DITCH

HYDROGRAPH-JULY 1989



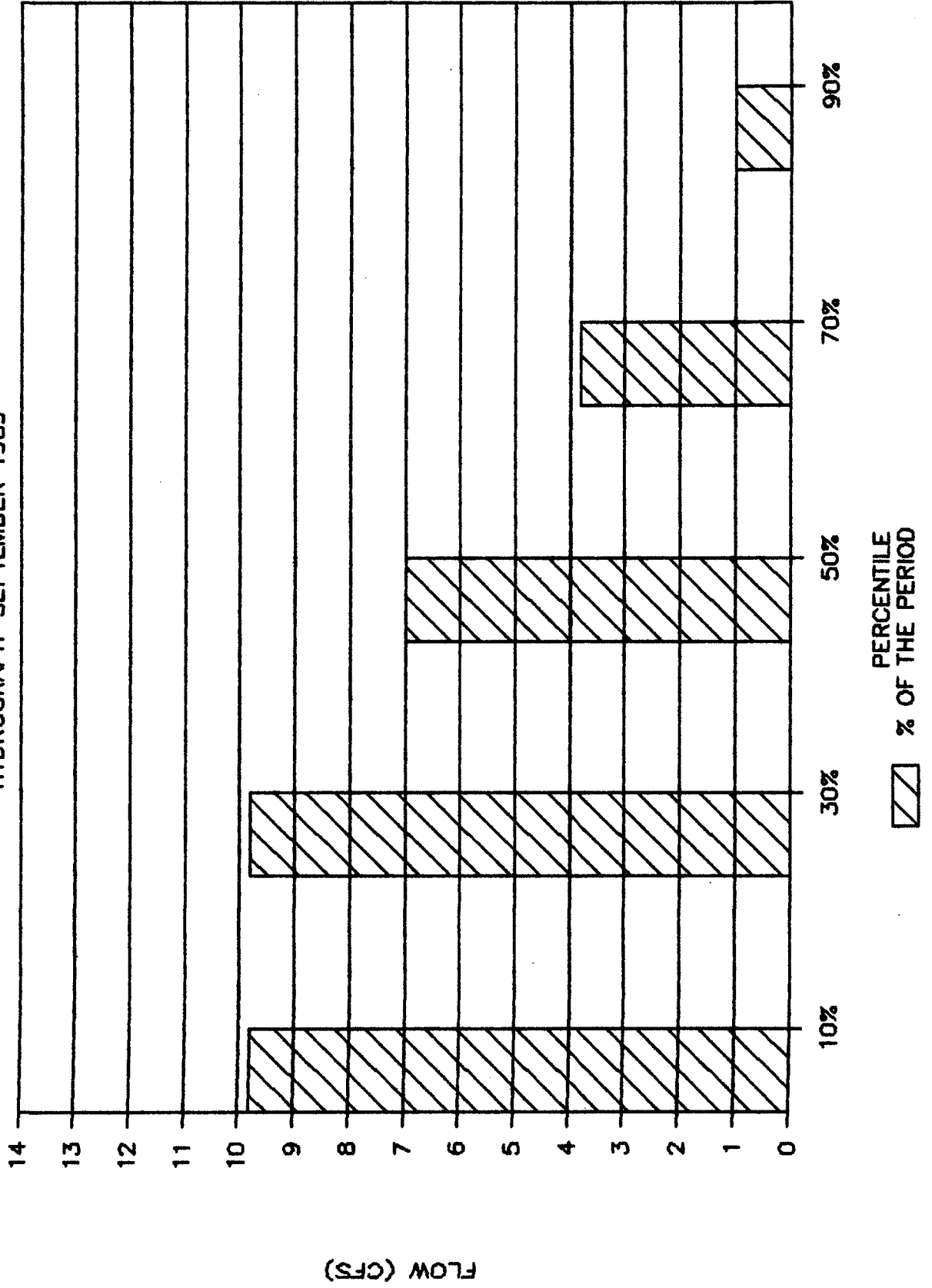
COOK-BURNS DITCH

HYDROGRAPH-AUGUST 1989



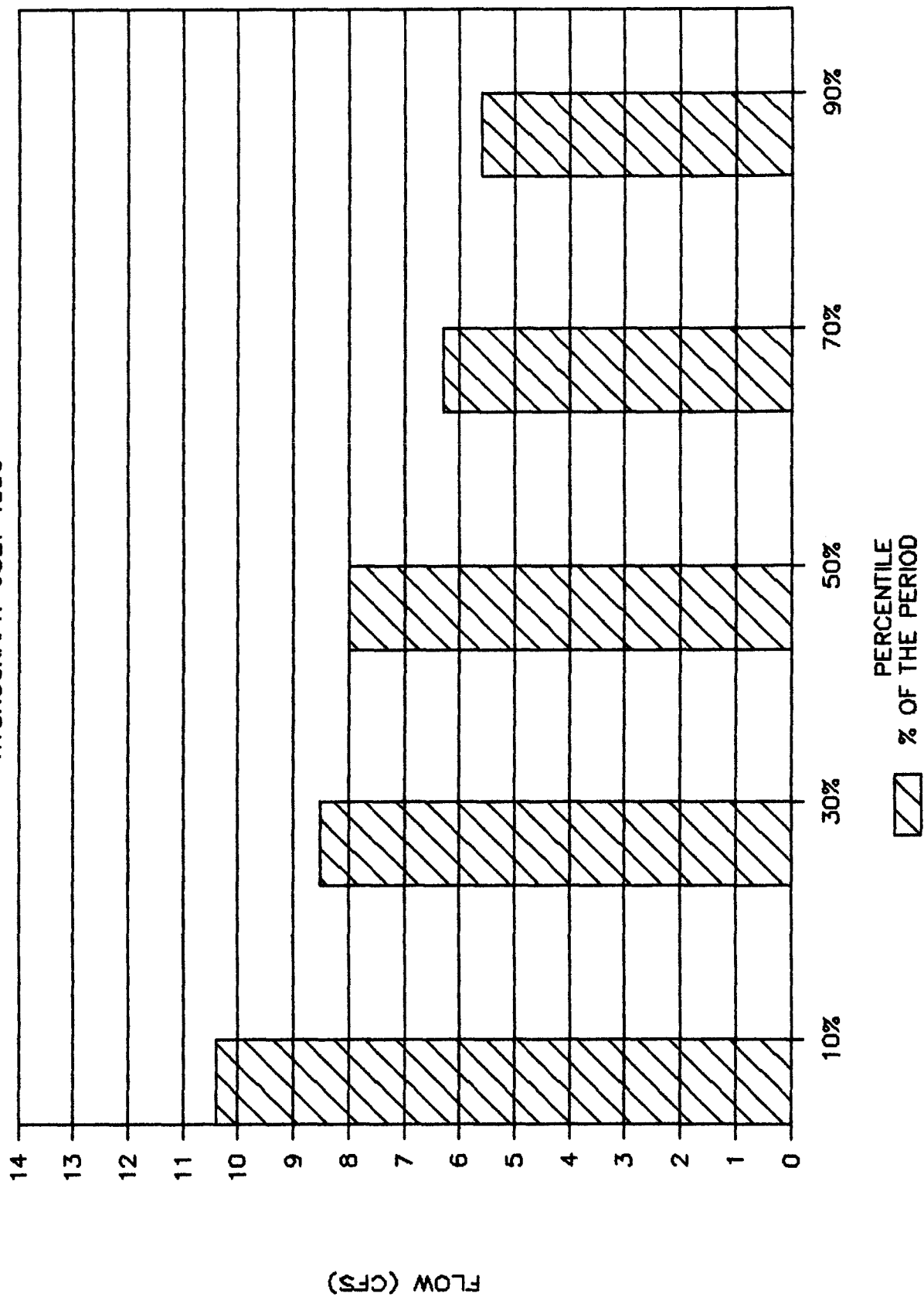
COOK-BURNS DITCH

HYDROGRAPH-SEPTEMBER 1989



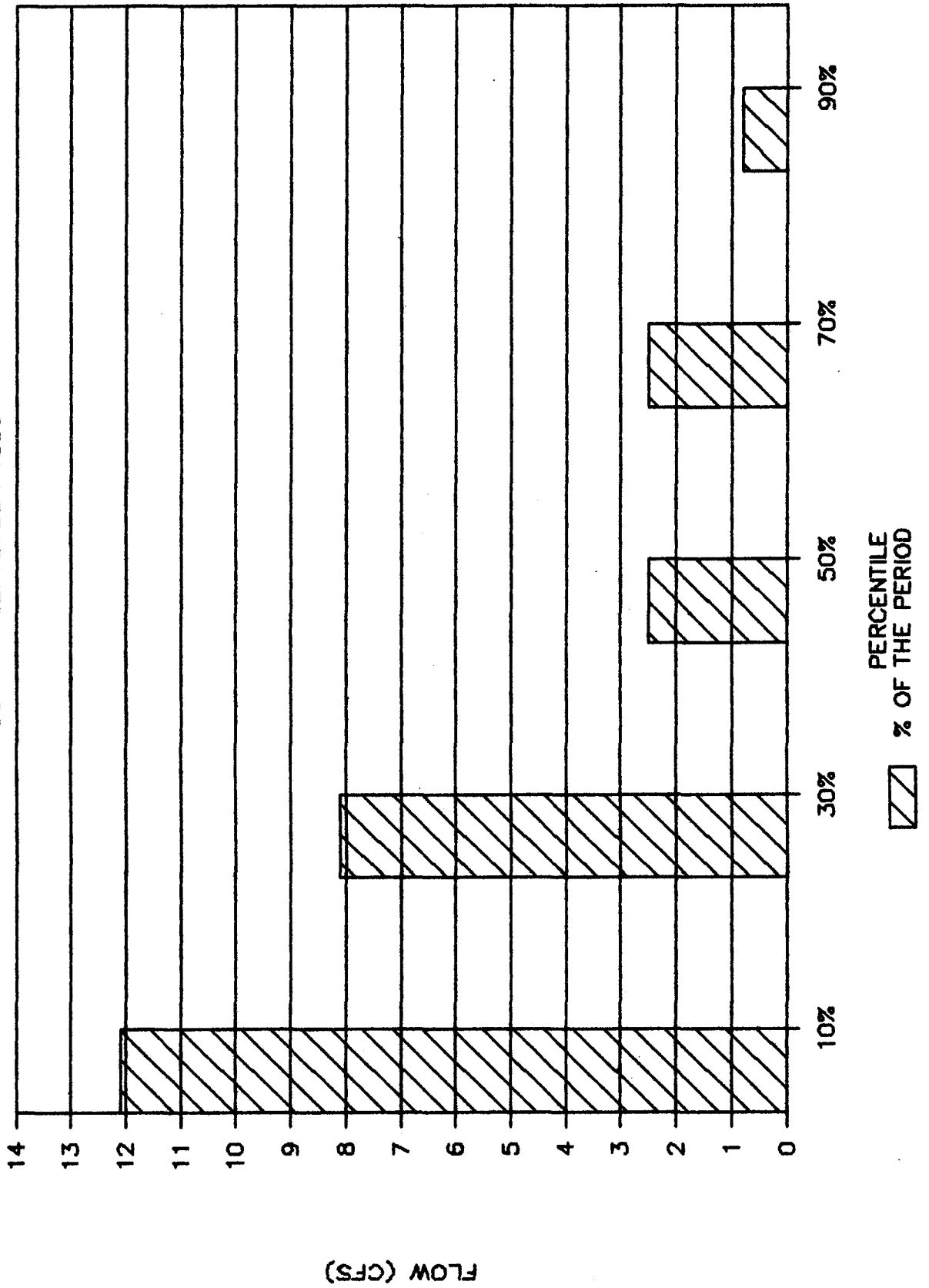
COOK-BURNS DITCH

HYDROGRAPH-JULY 1990



COOK-BURNS DITCH

HYDROGRAPH-SEPTEMBER 1990



Cook-Burns Ditch

DeWild Grant Reckert & Associates Co.

Architecture Engineering and Planning

315 First Avenue
Rock Rapids, Iowa 51246
(712) 472-2531



January 22, 1987

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

Attn: Rassool Ahadi

Re: Cook-Burns Irrigation Ditch, Spearfish Creek,
Lawrence County

Dear Rassool:

Thank you for providing me with information regarding your calculations of ditch capacity on the Cook-Burns ditch. I apologize for the delay in returning my comments to you.

After reviewing your calculations of the flume capacity on the Cook-Burns ditch, I request that you consider using a lower Mannings factor in your calculation. I enclose copies of guidelines from our file literature which indicate that a factor of .010 or .011 would be more appropriate for the smooth steel flume on the Cook-Burns ditch.

Use of the lower factor would result in a calculated flume capacity of approximately 21-23 cubic feet per second. This calculated capacity slightly exceeds the flow which was measured by your personnel at the ditch. However, it is possible that the flume was not completely filled at the time of their measurement, or that maintenance conditions at the head of the flume did not allow full flow at the time of their observations.

The maximum ditch capacity of the Cook-Burns ditch is put to beneficial use for irrigation during the normal irrigation season. Three different operators are involved with the ditch and each maintains multiple outlets. All of the operators are using flood irrigation methods, and it is important to provide an adequate flow rate at the field edge to exceed the rather high infiltration rate of local soils and push the flood wave through the field. It is therefore important that a new water license not restrict the diversion rate for the Cook-Burns ditch to less than current capacity.

Mr. Ahadi
Jan. 22, 1987
Page Two

We are looking forward to reviewing your final report for the ditch and for the creek in general. Please call me if you have any questions.

Sincerely,

DEWILD GRANT RECKERT
& ASSOCIATES COMPANY


Bruce Jennings, P.E.

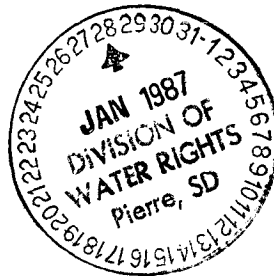
BJ:jkv

cc: Jim Jennings

OPEN-CHANNEL HYDRAULICS

VEN TE CHOW, Ph.D.

*Professor of Hydraulic Engineering
University of Illinois*



McGRAW-HILL BOOK COMPANY, INC.

New York Toronto London

1959

TABLE 5-6. VALUES OF THE ROUGHNESS COEFFICIENT n
(**Boldface** figures are values generally recommended in design)

Type of channel and description	Minimum	Normal	Maximum
A. Closed Conduits Flowing Partially Full			
A-1. Metal			
a. Brass, smooth			
b. Steel	0.009	0.010	0.013
1. Lockbar and welded			
2. Riveted and spiral	0.010	0.012	0.014
c. Cast iron			
1. Coated	0.010	0.013	0.014
2. Uncoated	0.011	0.014	0.016
d. Wrought iron			
1. Black	0.012	0.014	0.015
2. Galvanized	0.013	0.016	0.017
e. Corrugated metal			
1. Subdrain	0.017	0.019	0.021
2. Storm drain	0.021	0.024	0.030
A-2. Nonmetal			
a. Lucite			
b. Glass	0.008	0.009	0.010
c. Cement			
1. Neat, surface	0.010	0.011	0.013
2. Mortar	0.011	0.013	0.015
d. Concrete			
1. Culvert, straight and free of debris	0.010	0.011	0.013
2. Culvert with bends, connections, and some debris	0.011	0.013	0.014
3. Finished	0.011	0.012	0.014
4. Sewer with manholes, inlet, etc., straight	0.013	0.015	0.017
5. Unfinished, steel form	0.012	0.013	0.014
6. Unfinished, smooth wood form	0.012	0.014	0.016
7. Unfinished, rough wood form	0.015	0.017	0.020
e. Wood			
1. Stave	0.010	0.012	0.014
2. Laminated, treated	0.015	0.017	0.020
f. Clay			
1. Common drainage tile	0.011	0.013	0.017
2. Vitrified sewer	0.011	0.014	0.017
3. Vitrified sewer with manholes, inlet, etc.	0.013	0.015	0.017
4. Vitrified subdrain with open joint	0.014	0.016	0.018
g. Brickwork			
1. Glazed	0.011	0.013	0.015
2. Lined with cement mortar	0.012	0.015	0.017
h. Sanitary sewers coated with sewage slimes, with bends and connections	0.012	0.013	0.016
i. Paved invert, sewer, smooth bottom	0.016	0.019	0.020
j. Rubble masonry, cemented	0.018	0.025	0.030

TABLE 5-6. VALUES OF THE ROUGHNESS COEFFICIENT n (continued)

Type of channel and description	Minimum	Normal	Maximum
B. Lined or Built-up Channels			
B-1. Metal			
a. Smooth steel surface			
1. Unpainted	0.011	0.012	0.014
2. Painted	0.012	0.013	0.017
b. Corrugated			
	0.021	0.025	0.030
B-2. Nonmetal			
a. Cement			
1. Neat, surface	0.010	0.011	0.013
2. Mortar	0.011	0.013	0.015
b. Wood			
1. Planed, untreated	0.010	0.012	0.014
2. Planed, creosoted	0.011	0.012	0.015
3. Unplaned	0.011	0.013	0.015
4. Plank with battens	0.012	0.015	0.018
5. Lined with roofing paper	0.010	0.014	0.017
c. Concrete			
1. Trowel finish	0.011	0.013	0.015
2. Float finish	0.013	0.015	0.016
3. Finished, with gravel on bottom	0.015	0.017	0.020
4. Unfinished	0.014	0.017	0.020
5. Gunite, good section	0.016	0.019	0.023
6. Gunite, wavy section	0.018	0.022	0.025
7. On good excavated rock	0.017	0.020	
8. On irregular excavated rock	0.022	0.027	
d. Concrete bottom float finished with sides of			
1. Dressed stone in mortar	0.015	0.017	0.020
2. Random stone in mortar	0.017	0.020	0.024
3. Cement rubble masonry, plastered	0.016	0.020	0.024
4. Cement rubble masonry	0.020	0.025	0.030
5. Dry rubble or riprap	0.020	0.030	0.035
e. Gravel bottom with sides of			
1. Formed concrete	0.017	0.020	0.025
2. Random stone in mortar	0.020	0.023	0.026
3. Dry rubble or riprap	0.023	0.033	0.036
f. Brick			
1. Glazed	0.011	0.013	0.015
2. In cement mortar	0.012	0.015	0.018
g. Masonry			
1. Cemented rubble	0.017	0.025	0.030
2. Dry rubble	0.023	0.032	0.035
h. Dressed ashlar	0.013	0.015	0.017
i. Asphalt			
1. Smooth	0.013	0.013	
2. Rough	0.016	0.016	
j. Vegetal lining	0.030		0.500



Department of Water & Natural Resources

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

August 10, 1987

Cook-Burns Ditch Company
c/o James Jennings
RR 1, Box 182C
Spearfish SD 57783

Dear Mr. Jennings:

This letter is to inform you that the vested right claim for Cook-Burns Ditch Company has been reviewed. A report on the investigation of the vested right claim is being prepared. When the report is finalized your application will be complete pursuant to SDCL 46-2A-2. A recommendation will then be prepared and notice of hearing will be given stating the time and place the Water Management Board will consider the vested right claim. Tentatively, the hearing is to be scheduled for December 2 and 3, 1987 in the Black Hills area.

Please contact us if you have any questions.

Sincerely,

A handwritten signature in cursive script that reads "Ron Duvall".

RON DUVALL
Water Resources Engineer
605 773-3352

Report on the Cook-Burns Ditch (Spearfish Creek)
Vested Water Right Application No. 1399-1
September 21, 1987

Background

Pursuant to SDCL 46-5-49 and ARSD 74:02:01:20, Cook-Burns Ditch has filed an application to validate a vested right claim. The application claims 33 cfs of Spearfish Creek water to irrigate 621.8 acres of land located in Sections 8, 9, 10, and 11, T7N-R2E in Lawrence County. The diversion point is located in the NW1/4 SW1/4 Section 16, T7N-R2E.

Document Search

The following documents were found pertaining to the Cook-Burns Water Right:

- 1) Water Location No. 31661 which was filed August 16, 1886, and claimed the location of water was made June 15, 1881, for 5000 miner's inches of Spearfish Creek water. Location No. 31661 was signed by William Cook and Samuel Burns and filed and recorded in Book 38, Page 574, Lawrence County.
- 2) An Agreement, dated September 29, 1886, filed and recorded May 28, 1888 in Book 51, Page 414, between Cook and Burns and eight other signers in which it is stipulated that the eight other signers shall have the right to enlarge and extend the Cook-Burns Ditch. There is no record of any court case which interpreted, determined, or established this water right.

Discussion

The Water Resources Commission investigated the irrigation from Cook-Burns Ditch in the early 1960's. At that time, 621.8 acres were mapped as being irrigated from the ditch.

Recent investigations by the Water Rights Division engineers have found that the same acreage as in the 1960's is being served by the Cook-Burns Ditch. The investigations also showed that the headgate can divert more water than the amount claimed and the flume can carry 16.44 to 20.5 cfs, depending on the friction coefficient used.

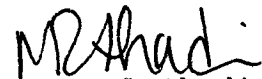
To determine the amount of water necessary to irrigate 621.8 acres, two different methods were used:

- 1) State Law, SDCL 46-5-6 allows 1.0 cfs for each 70 acres of irrigation. If 1.0 cfs of water is necessary to irrigate 70 acres, 8.9 cfs of water will be used to irrigate 621.8 acres. Considering the efficiency of flood irrigation in the area, which according to SCS is 50% for this area, the diversion rate required will be 17.8 cfs.

- 2) Using the SCS, S.D. Irrigation Guide, the peak consumption occurs in July. The crops in the area use 28.8% of their annual water consumption during the Month of July. Assuming the crops need 3.0 feet of water every irrigation season, a total of 1865 acre-feet of water is needed for the season, from which 531 acre-feet or 8.75 cfs will be used in the Month of July. Considering a 50% loss due to the system, the total diversion amount will be 17.5 cfs.

Conclusions and Recommendations

- 1) The headgate divert more water than the amount claimed.
- 2) Based upon the 1.0 cfs per 70 acres criteria plus a 50% loss calculation, the peak quantity of water necessary to irrigate the land served by the Cook-Burns Ditch would be 17.8 cfs. Comparing this to the SCS, South Dakota Irrigation Guide calculations, this quantity of water appears to be reasonable. The application claims 33.0 cfs as the quantity of water necessary for flood irrigation system to irrigate 621.8 acres. The quantity claimed, based on the calculations is in excess of what is reasonable.
- 3) It is recommended that the Cook-Burns Ditch Vested Water Right Claim be validated for a diversion rate of 17.8 cfs for irrigation of 621.8 acres as described in Application No. 1399-1 with a priority date of June 15, 1881.
- 4) It is recommended that if Vested Water Right Application No. 1399-1 is validated, that the applicable portions of Location Notice No. 31661 be incorporated into No. 1399-1 and that the abandoned portions of Location Notice No. 31661 be cancelled.



Rassool Ahadi
Natural Resources Engineer

RECOMMENDATION OF CHIEF ENGINEER FOR VALIDATION OF VESTED WATER
RIGHT APPLICATION NO. 1399-1, Cook-Burns Ditch Company

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 Validation of Vested Water Right Application No. 1399-1, Cook-Burns Ditch Company, c/o James Jennings, RR 1, Box 182C, Spearfish, South Dakota.

The Chief Engineer is recommending VALIDATION of Application No. 1399-1 for 17.8 cfs and that the applicable portions of Location Notice No. 31661 have been incorporated into No. 1399-1 and the abandoned portions of No. 31661 have been cancelled, because 1) water has been appropriated as described for irrigation use with a priority date of June 15, 1881, 2) the use has been developed without unlawful impairment of existing rights, 3) the use is a beneficial use and 4) it is in the public interest with the following qualifications.

1. That Vested Water Right No. 1399-1 is subject to domestic use rights. Diversion of water under Water Right No. 1399-1 is contingent upon supplies being available first to domestic users.
2. That a flow measuring device be installed at or near the point of diversion for Cook-Burns Ditch within one year of validation of Vested Water Right No. 1399-1. The measuring device shall be permanently installed. The design shall be approved prior to construction by the chief engineer.

See the attached report for additional information.


JOHN HATCH, Chief Engineer
October 16, 1987

Revised Report on Vested Water Right Application No. 1399-1
Cook-Burns Ditch (Spearfish Creek)
November 20, 1990

Background

The Water Management Board, at the December 2 and 3, 1987 Board meeting in Rapid City, deferred consideration of Application No. 1399-1 to allow collection of flow data for Cook-Burns Ditch during the 1988 irrigation season. The Division of Water Rights had recommended a diversion rate of 17.8 cubic feet of water per second for Cook-Burns Ditch from Spearfish Creek. The ditch company, however, was not satisfied with the Division's recommendation and requested time to collect flow data to establish a diversion rate base for actual water use. Because of low flow conditions, the ditch company did not believe the data collected during the 1988 irrigation season represented actual conditions. The ditch company requested that collection of flow data be continued during the 1989 and 1990 irrigation seasons.

Discussion

The recommended 17.8 cfs was based on 1.0 cfs for irrigation of 70.0 acres plus 50% water losses due to the method of irrigation and the seepage from the ditch.

Daily flow records were collected, by the ditch company, for three consecutive irrigation seasons. The maximum diversion rate recorded was 12.7 cfs. To provide sufficient water at the Kemper Ditch diversion point which is located downstream from the Cook-Burns Ditch diversion point, and also due to the problems with the Cook-Burns diversion dam, the ditch company was not able to divert more water than what has been recorded. According to the ditch company, the dam has now been repaired.

Cook-Burns Ditch Company, in a letter received on November 14, 1990, agreed with the Division's recommendation of a diversion rate of 17.8 cfs for irrigation of 621.8 acres.

Conclusions

1. The headgate should be controlled in such a manner that the diversion rate does not exceed the recommended rate.
2. Cook-Burns Ditch Company is responsible for maintaining the ditch in its entirety and improvement of the irrigation system so that water losses are kept minimal.

3. Vested Water Right Application No. 1399-1 should be validated for a diversion rate of 17.8 cfs for irrigation of 612.8 acres, as described in Application No. 1399-1, with a priority date of June 15, 1881.
4. The flow measuring device on Cook-Burns Ditch should continue to be maintained and monitored as required by the Chief Engineer.



M. RASSOOL AHADI
Natural Resources Engineer II

Approved By:



DELVIN D. BROSZ, P.E.
Natural Resources Engineer IV



Department of Water & Natural Resources

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

October 22, 1987

NOTE: TO BE SURE OF PUBLICATION ON
THE CORRECT DATES, CONTACT THE
NEWSPAPERS RIGHT AWAY.

Cook-Burns Ditch Company
c/o James Jennings
RR 1, Box 182C
Spearfish SD 57783

Dear Mr. Jennings:

Your Application No. 1399-1 for a vested water right claim has been examined and found to comply with the South Dakota Water Laws and applicable rules. A notice of your claim has been sent to the Publishers of the QUEEN CITY MAIL printed at Spearfish and the BELLE FOURCHE DAILY POST printed at Belle Fourche. For your information, a copy of the notice, the recommendation of the Chief Engineer and a report on the application are enclosed. Please review the notice and notify this office, if you have any corrections or questions.

Be sure to contact the above newspapers to authorize publication of your notice of hearing to validate a vested right and to arrange for payment. Early contact with the papers can eliminate delays. The publishers have been instructed to publish your notice once each week for two consecutive weeks with the last publication to occur twenty days before the board meeting. We must receive Proof of Publication before the application can be considered by the Water Management Board.

Sincerely,

A handwritten signature in cursive script that reads "Ron Duvall".

Ron Duvall
Natural Resources Engineer
605 773-3352

enclosures

SOUTH DAKOTA
Department of
Water & Natural Resources

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

October 22, 1987

BELLE FOURCHE DAILY POST
1004 5th Ave
Belle Fourche SD 57717

Dear Sir:

Enclosed is a Notice of Hearing to Validate Vested Right Application No. 1399-1. Please publish this notice once each week for two consecutive weeks in your paper. The first publication should be on or before October 28, 1987.

The APPLICANT MUST VERIFY TO YOU THAT THE NOTICE IS TO BE PUBLISHED, before you make the first publication. Please BILL the APPLICANT for the cost of publication. The APPLICANT is Cook-Burns Ditch Company, c/o James Jennings, RR 1, Box 182C, Spearfish SD 57783.

A copy of BOTH publications must be SENT to the WATER RIGHTS DIVISION. IMMEDIATELY return the FIRST publication with the FIRST Transmittal form on the bottom of this page. The first copy is needed to check the publication for errors so any corrections can be made in the second publication. Publication errors can invalidate the public notice and cause the applicant costly delays.

Please be sure the SECOND publication is returned IMMEDIATELY with the enclosed Proof of Publication form. DO NOT WAIT until the end of the month or the billing cycle. The permit application cannot be considered by the Water Management Board until proof of publication has been received.

Sincerely,



Ron Duvall
Natural Resources Engineer
605 773-3352

enclosures

-----CUT HERE-----

FIRST TRANSMITTAL NOTICE

TO: Water Rights Division
Joe Foss Building
Pierre SD 57501-3181

Date _____

We are in receipt of your letter of _____ enclosing Notice of Hearing to Validate A Vested Right Application which was first published in our issue of _____. ENCLOSED IS A COPY OF THIS FIRST PUBLICATION.

Name

Newspaper



Department of Water & Natural Resources

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

October 22, 1987

QUEEN CITY MAIL
Box 7
Spearfish SD 57783

Dear Sir:

Enclosed is a Notice of Hearing to Validate Vested Right Application No. 1399-1. Please publish this notice once each week for two consecutive weeks in your paper. The first publication should be on or before October 28, 1987.

The APPLICANT MUST VERIFY TO YOU THAT THE NOTICE IS TO BE PUBLISHED, before you make the first publication. Please BILL the APPLICANT for the cost of publication. The APPLICANT is Cook-Burns Ditch Company, c/o James Jennings, RR 1, Box 182C, Spearfish SD 57783.

A copy of BOTH publications must be SENT to the WATER RIGHTS DIVISION. IMMEDIATELY return the FIRST publication with the FIRST Transmittal form on the bottom of this page. The first copy is needed to check the publication for errors so any corrections can be made in the second publication. Publication errors can invalidate the public notice and cause the applicant costly delays.

Please be sure the SECOND publication is returned IMMEDIATELY with the enclosed Proof of Publication form. DO NOT WAIT until the end of the month or the billing cycle. The permit application cannot be considered by the Water Management Board until proof of publication has been received.

Sincerely,

Ron Duvall
Natural Resources Engineer
605 773-3352

enclosures

-----CUT HERE-----

FIRST TRANSMITTAL NOTICE

TO: Water Rights Division
Joe Foss Building
Pierre SD 57501-3181

Date _____

We are in receipt of your letter of _____ enclosing Notice of Hearing to Validate A Vested Right Application which was first published in our issue of _____. ENCLOSED IS A COPY OF THIS FIRST PUBLICATION.

Name

Newspaper

Instruction to Newspaper - Publish first publication of the following Notice on or before October 28, 1987 with 2nd publication 1 week later. The applicant is responsible for payment.

NOTICE OF HEARING To Validate
Vested Right Application No. 1399-1 to Appropriate Water

Notice is hereby given that Cook-Burns Ditch, c/o James Jennings whose mailing address is RR 1, Box 182C, Spearfish, South Dakota has filed an application to validate a vested right claim to appropriate 33.0 cubic feet of water per second (cfs) from Spearfish Creek to irrigate 621.8 acres via the Cook-Burns Ditch with a claimed priority date of June 15, 1881. The Spearfish Creek diversion point for the Cook-Burns Ditch is located in the NW 1/4 SW 1/4 Section 16, T7N, R2E. The irrigated acreage is located in the E 1/2 SE 1/4 Section 8; NE 1/4, NW 1/4, N 1/2 SW 1/4, SW 1/4 SW 1/4 Section 9; S 1/2 NE 1/4, N 1/2 SE 1/4, W 1/2 NW 1/4, SE 1/4 NW 1/4, N 1/2 SW 1/4 Section 10; SW 1/4 Section 11; all in T7N, R2E.

Pursuant to SDCL 46-2A-2 the Chief Engineer of the Water Rights Division recommends VALIDATION of Vested Water Right Application No. 1399-1 for 17.8 cfs and that the applicable portions of Location Notice No. 31661 be incorporated into NO. 1399-1 and that the abandoned portions of No. 31661 be cancelled, because 1) water has been appropriated as described for irrigation with a priority date of June 15, 1881, 2) the use has been developed without unlawful impairment of existing rights, 3) it is a beneficial use of water and 4) it is in the public interest.

Validation of this application will be considered by the Water Management Board at Howard Johnson's, Roosevelt and Jefferson Rooms, Rapid City SD, December 2, 1987 at 1:00 pm.

The recommendation of the Chief Engineer is not final or binding upon the Board and the Board is authorized to 1) approve validation, 2) approve the validation with qualifications, 3) defer, or 4) deny validation of 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 November 20, 1987. 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, 46-2A-18; 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, 46-5-49; and Board Rules ARSD 74:02:01:01 thru 74:02:01:15 and 74:02:01:19 thru 74:02:01:22.

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 November 20, 1987.

No. 1399-1

PROOF OF PUBLICATION

STATE OF SOUTH DAKOTA)
County Butte) ss.

I, Marion Lucas hereby

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

Water was taken from the Belle Fourche Daily Post

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 Belle Fourche

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

October 28, 1987

November 3, 1987

Marion Lucas
(Signature)

Editor
(Title)

November 3, 1987
(Date Signed)

Cost of Printing: \$44.43

1324 - 2 times



NOTICE OF HEARING
TO VALIDATE
Vested Right Application
No. 1399-1
to Appropriate Water

Notice is hereby given that Cook-Burns Ditch, c/o James Jennings whose mailing address is RR 1, Box 182C, Spearfish, South Dakota has filed an application to validate a vested right claim to appropriate of 33.0 cubic feet of water per second (cfs) from Spearfish Creek to irrigate 621.8 acres via the Cook-Burns Ditch with a claimed priority date of June 15, 1881. The Spearfish Creek diversion point for the Cook-Burns Ditch is located in the NW 1/4 SW 1/4 Section 16, T7N, R2E. The irrigated acreage is located in the E 1/2 SE 1/4 Section 8; NE 1/4, NW 1/4, N 1/2 SW 1/4, SW 1/4 SW 1/4 Section 9; S 1/2 NE 1/4, N 1/2 SE 1/4, W 1/2 NW 1/4, SE 1/4 NW 1/4, N 1/2 SW 1/4 Section 10; SW 1/4 Section 11; all in T7N, R2E.

Pursuant to SDCL 46-2A-2 the Chief Engineer of the Water Rights Division recommends VALIDATION of Vested Water Right Application No. 1399-1 for 17.8 cfs and that the applicable portions of Location Notice No. 31661 be incorporated into No. 1399-1 and that the abandoned portions of No. 31661 be cancelled, because 1) water has been appropriated as described for irrigation with a priority date of June 15, 1881, 2) the use has been developed without unlawful impairment of existing rights, 3) it is a beneficial use of water and 4) it is in the public interest.

Validation of this application will be considered by the Water Management Board at Howard Johnson's, Roosevelt and Jefferson Rooms, 2211 LaCrosse, Rapid City, SD, December 2, 1987 at 1:00 p.m.

The recommendation of the Chief Engineer is not final or binding upon the Board and the Board is authorized to 1) approve validation, 2) approve the validation with qualifications, 3) defer, or 4) deny validation of 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 November 20, 1987. 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, 46-2A-18; 46-5-1 thru 46-5-11, 46-5-13 thru 46-5-15, 46-5-24, 46-5-27, 46-5-30.2, 46-5-30.4, 46-5-31, 46-5-49; and Board Rules ARSD 74:02:01:01 thru 74:02:01:15 and 74:02:01:19 thru 74:02:01:22.

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

20, 1987.

No. 1399-1

PROOF OF PUBLICATION

STATE OF SOUTH DAKOTA)
County Lawrence) ss.

I, Jimmie R. Stephenson hereby

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

Water was taken from the Queen City Mail

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 Spearfish

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

October 28th

November 4th


(Signature)

Publisher

(Title)

11-4-87

(Date Signed)

Cost of Printing: _____

114 x .2564 = 29.23

114 x .2051 = 23.38

Total 52.61

NOTICE OF HEARING
TO VALIDATE VESTED
RIGHT APPLICATION
NO. 1399-1 TO
APPROPRIATE WATER

Notice is hereby given that Cook-Burns Ditch, c/o James Jennings whose mailing address is RR 1, Box 182C, Spearfish, South Dakota has filed an application to validate a vested right claim to appropriate 33.0 cubic feet of water per second (cfs) from Spearfish Creek to irrigate 621.8 acres via the Cook-Burns Ditch with a claimed priority date of June 15, 1881. The Spearfish Creek diversion point for the Cook-Burns Ditch is located in the NW 1/4 SW 1/4 Section 16, T7N, R2E. The irrigated acreage is located in the E 1/2 SE 1/4 Section 8; NE 1/4, NW 1/4, N 1/2 SW 1/4, SW 1/4 SW 1/4 Section 9; S 1/2 NE 1/4, N 1/2 SE 1/4, W 1/2 NW 1/4, SE 1/4 NW 1/4, N 1/2 SW 1/4 Section 10; SW 1/4 Section 11; all in T7N, R2E.

Pursuant to SDCL 46-2A 2 The Chief Engineer of the water rights Division recommends VALIDATION of Vested Water Right Application No. 1399-1 for 17.8 cfs and that the applicable portions of Location Notice No. 31661 be incorporated into No. 1399-1 and that the abandoned portions of No. 31661 be cancelled, because 1) water has been appropriated as described for irrigation with a priority date of June 15, 1881, 2) the use has been developed without unlawful impairment of existing rights, 3) it is a beneficial use of water and 4) it is in the public interest.

Validation of this application will be considered by the Water Management Board at Howard Johnson's, Roosevelt and Jefferson Rooms, 2211 LaCrosse, Rapid City SD, December 2, 1987 at 1:00 pm.

The recommendation of the Chief Engineer is not final or binding upon the Board and the Board is authorized to 1) approve validation, 2) approve the validation with qualifications, 3) defer, or 4) deny validation of 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 November 20, 1987. 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 position 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, 46-2A-18; 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, 46-5-49; and Board Rules ARSD 74:02:01:01 thru 74:02:01:15 and 74:02:01:19 thru 74:02:01:22.

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 November 20, 1987.

Oct 28 Nov 4

November 24, 1987
(date)

page 1

Parties of Record before Water Management Board regarding Vested Right
Application No 1399-1, Cook-Burns Ditch Company

For:

James Jennings
Cook-Burns Ditch Company
RR1, Box 182C
Spearfish SD 57783

Interested:

Richard Beringson, Secretary
SD Dept of Game, Fish & Parks
Anderson Bldg, 445 E Capitol
Pierre SD 57501

Against:

B.E. Martin, Regional Director
Bureau of Reclamation
PO Box 36900
Billings MT 59107-6900

Bruce Laymon
U.S. Bureau of Reclamation
PO Box 226
Newell SD 57760



R.R. 1 Box 182C
Spearfish, SD 57783

November 16, 1987

John Hatch, Chief Engineer
Water Rights Division
Joe Foss Building
Pierre, SD 57501-3181

Dear John;

As an irrigator deriving water from Spearfish Creek via the Cook-Burns ditch, I wish to oppose the reduction of the requested diversion rate of 33 cfs to 17.5 cfs. Said reduction refers to application No. 1399-1.

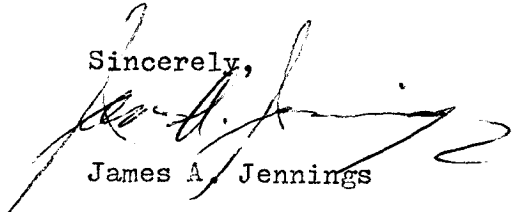
The reasons for the opposition are:

1. The type of soil irrigated requires more water than your allocation.
2. Because of the length of the main ditches and the type of soil they pass through, the water loss in the delivery system exceeds the 50% factor.

I would like an opportunity to express my opposition to the board at the December 2 hearing.

Thank you.

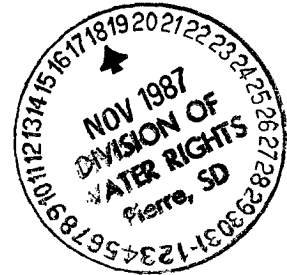
Sincerely,


James A. Jennings

**South Dakota
Department of
Game, Fish and Parks**

Division of Wildlife
Sigurd Anderson Building
445 East Capitol
Pierre, South Dakota 57501-3185
(605) 773-3381

November 16, 1987



Mr. John Hatch, Chief Engineer
Division of Water Rights
S.D. Department of Water & Natural Resources
Joe Foss Building
Pierre, SD 57501

Dear Mr. Hatch:

Pursuant to the notice provided by the Chief Engineer under SDCL 46-2A-4 the South Dakota Department of Game, Fish and Parks intends to be a party to water right claim 1399-1 on Spearfish Creek, Lawrence & Butte County.

GF&P is an interested and potentially affected party by virtue of statutory authority to manage fish and wildlife resources of the state (SDCL Chapter 41). The pending water right claim could affect the quantity of water available for natural resource management.

Thank you for the opportunity to comment on this pending water right application.

Sincerely,

A handwritten signature in cursive script that reads "Richard J. Beringson".

Richard J. Beringson
Secretary

RJB/ld

cc: Cook-Burns Ditch Co. % James Jennings



United States Department of the Interior
BUREAU OF RECLAMATION
Missouri Basin Region
P.O. Box 36900
Billings, Montana 59107-6900



IN REPLY
REFER TO: MB-450
870.

John Hatch, Chief Engineer
Water Rights Division
Joe Foss Building
Pierre, SD 57301

NOV 19 1987

Dear Mr. Hatch:

Pursuant to South Dakota Civil Law 1-26, we hereby make known our objections to Applications to Validate Vested Water Rights (applications) Nos. 1388-1, 1390-1, 1394-1, 1395-1, 1399-1, 1400-1, 1402-1, 1405-1, 1408-1, 1409-1, 1410-1, 1411-1, 1412-1, 1413-1, 1415-1, 1417-1, 1423-1, and 1425-1. These applications are scheduled for consideration by the Water Management Board in Rapid City, South Dakota, on December 2, 1987, at 1:00 pm.

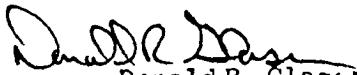
We concur with the Chief Engineer's recommendations regarding the diversion rates for the applications listed above and would object to increases in the diversion rates above those recommended by the Chief Engineer. The Bureau of Reclamation (Bureau) is the owner of water rights for the Belle Fourche Irrigation Project (Project) located on the Belle Fourche River. Most of the vested rights (with the exception of application No. 1423-1) have points of diversion located on tributaries to the Belle Fourche River upstream of the Project diversion dam. The Project could be adversely impacted if the applications are validated with flow rates in excess of those historically utilized.

Finally, we request that you send a copy of the Chief Engineer's recommendation regarding each of the applications listed above to Bruce Laymon who will be representing the Bureau's interests at the hearings. His mailing address is listed below.

U.S. Bureau of Reclamation
Attention: Bruce Laymon
Belle Fourche Project Office
P.O. Box 226
Newell, SD 57760

If you have any questions regarding our interest in these matters, please contact Dave Nelson at (406) 657-6639 or Bob Pike at (406) 657-6469.

Sincerely yours,


Donald R. Glaser

For B. E. Martin
Regional Director

Enclosure

Identical letters sent to attached listing

Mr. Ralph Bahm
RR 1, Box 196
Spearfish, SD 57783

Ms. Della Crago
RR 1, Box 24
Belle Fourche, SD 57717

Mr. Dick Cundy
St. Onge Road
Spearfish, SD 57783

Homestake Mining Company
P.O. Box 875
Lead, SD 57754

Mr. Albert Jeffery
RR 1
Spearfish, SD 57783

Mr. Leland Johnson
Mr. Keith Johnson
RR 1, Box 1011
Spearfish, SD 57783

Mr. Richard Lausser
RR 1, Box 195
Spearfish, SD 57783

Redwater Irrigation Association
P.O. Box 351
Belle Fourche, SD 57717

Mr. R. Thornton Vallery
Star Route, Box 188
Nisland, SD 57762

Mr. James Chenowith
Box 248
Woodrow, CO 80757

Mr. Ralph Crago
RR 1, Box 52B
St. Onge, SD 57779

Mr. Melvin Delzer
Box 1045
Spearfish, SD 57783

Mr. Robert Humphrey
Rt. 1, Box 170
Spearfish, SD 57783

Mr. James Jennings
RR 1, Box 182C
Spearfish, SD 57783

Mr. William Lambert
Box 335
Beulah, WY 82712

Mr. Josef Meier
421 Meier Street
Spearfish, SD 57783

Mr. Wesley W. Thompson
Rt. 1, Box 198A
Spearfish, SD 57783

**South Dakota
Department of
Game, Fish and Parks**

Division of Wildlife
Sigurd Anderson Building
445 East Capitol
Pierre, South Dakota 57501-3185
(605) 773-3381

November 20, 1987

Mr. John Hatch, Chief Engineer
Division of Water Rights
S.D. Department of Water & Natural Resources
Joe Foss Building
Pierre, SD 57501



Dear Mr. Hatch:

Pursuant to the filings made by the S.D. Department of Game, Fish and Parks to the attached list of applicants, some confusion exists regarding the intent of the filings. For your information when dealing with inquiries to the nature of the GF&P interest in the upcoming hearings the following information should be useful.

GF&P intends to participate in the upcoming water right validations by supporting the water rights staff recommendations that will bring each water right into legal compliance with existing laws, e.g. appropriate quantities of water for the land base, appropriately sized and gauged headgates for the right in question, abandonment of unused quantities of water, etc. GF&P filed with your office and each applicant so that we would officially be parties to the hearing process and be able to carry out the mandated duties of the Department under SDCL Chapter 41. We also are of the opinion that the Department would have been negligent in not participating in proceedings that relate to water resource allocation directly affecting waters that support fish and wildlife values.

I hope this information will aid you in describing the nature of the interest the Department of Game, Fish and Parks has in the upcoming proceedings. If you have any questions you can contact me at 773-5511.

Sincerely,

Ron Koth
Water Permits Coordinator

RK/ld

SOUTH DAKOTA
Department of
Water & Natural Resources

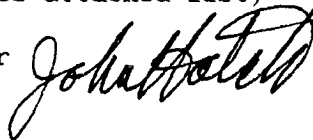
Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3181

December 9, 1987

NOTICE

TO: Cook-Burns Ditch Company, c/o James Jennings
RR 1, Box 182C, Spearfish SD 57783
and Parties of Record (see attached list)

FROM: John Hatch, Chief Engineer
Water Rights Division
605 773-3352



SUBJECT: Deferral of Consideration on Vested Right Application No. 1399-1,
Cook-Burns Ditch

The Water Management Board deferred Vested Right Application No. 1399-1 at the December 2 and 3, 1987 Board meeting in Rapid City. The Board deferred consideration of the application to allow collection of flow data for Cook-Burns Ditch during the 1988 irrigation season. Notice will be given when Application No. 1399-1 is rescheduled for hearing. The Board included in the motion to defer, that a permanent flow measuring device is to be installed on Cook-Burns Ditch at or near the point of diversion. Design is subject to approval by the Chief Engineer. The device is to be used for measuring ditch flows during the 1988 irrigation season. After approval of the device design, a method of record-keeping will then be determined, cooperatively, between the Division of Water Rights and Cook-Burns Ditch. A measuring device design will need to be submitted to the Chief Engineer by February 1, 1988 to ensure approval of the design and installation of the device prior to the beginning of the 1988 irrigation season.

cc: Harold Deering, Assistant Attorney General
John Guhin, Assistant Attorney General

CERTIFICATION

I hereby certify that on December 9, 1987 I have personally deposited with the U.S. Mail, postage prepaid envelopes containing Notice of Deferral of Consideration on Vested Right Application No. 1399-1, Cook-Burns Ditch addressed as shown on the parties of record sheet.

Karen Schlaak
KAREN SCHLAACK
Senior Secretary

STATE OF SOUTH DAKOTA)
) SS
COUNTY OF HUGHES)

Sworn to, before me, this 11th day of December, 1987.

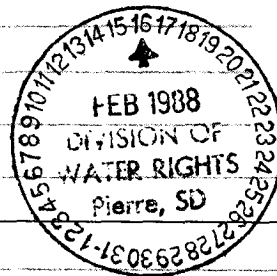


John Hatch
Notary Public

DeWild Grant Reckert & Associates Co.
Architecture, Engineering and Planning

315 First Avenue
Rock Rapids, Iowa 51246
Telephone (712) 472-2531

6521



DATE 2-11-88

South Dakota Dept of Water + Nat'l Resources
Division of Water Rights
Joe Fass Office Building
Pierre SD
Attn: Jim Winterton
SUBJECT Cook-Burns/Kemper Ditches

Jim - Find enclosed literature regarding the long-throated flumes
we expect to use for the above ditches. We are not
yet certain as to dimensions; we will try to match existing
ditch shape as much as possible.

SIGNATURE

Bruce Jennings

REPLY DATE

SIGNATURE

tended accuracy in spite of most field construction anomalies (Replogle, 1977).

An important aspect of flumes is the high submergence limits that can be tolerated as compared with sharp-crested weirs. (Submergence limit is defined here as that point of submergence caused by downstream water level at which the real discharge deviates by 1 percent from that indicated by the observed flow stage). This translates into the minimum required head loss for the measuring device in the canal system. Since sharp-crested weirs can withstand no submergence, the minimum required head loss is equal to the flow depth (actually energy head) over the weir plus about 5 cm, to assure free flow. Flumes, on the other hand, have submergence limits that range from about 50 percent to as high as 95 percent. Thus, the absolute head loss can be relatively low.

The submergence limit of critical-flow devices, like flumes and weirs, is a function of the streamline curvature at the control section and the losses in the downstream expansion. Broad-crested weirs and long-throated flumes, which have straight and parallel streamlines at the control section, can approach the high submergence limit of 95 percent, if part of the kinetic energy is recovered by a proper exit expansion (Bos, 1976). The submergence limits for truncated flumes, i.e., flumes that have no expansion section, are about 70 to 85 percent depending on whether the throat area approximates a rectangular or a triangular shape, respectively, provided that it is long throated.

These submergence limits, even for truncated versions, are higher than those routinely listed for H-flumes, cutthroat flumes, and Parshall flumes, which are 25, 65, and 60 percent, respectively.

The older flumes, however, are quite usable, and many are in continual service and most certainly need not be replaced if they were originally properly installed and subsequently maintained. The preceding discussion attempts to point out that accurate, yet, much less expensive designs are now available for new installations, with the added capability of being tailored to most existing canal systems so that the canals can, in effect, be retrofitted with a low head-loss measuring device that can operate to as high as 95 percent submergence with a single depth reading.

When installing any of the critical-flow flumes, care must be taken to assure adequate free flow discharge at both high and low ranges. Checking at high flow only is risky. For example, a rectangular flume placed in a trapezoidal channel, where the channel controls the flow level and not some type of check gate, may be free flowing at high stages but may be submerged at low flows (Replogle, 1968). Usually, these shape combinations need to be checked for submergence at low flows. On the other hand, a trapezoidal or triangular-shaped flume placed into a rectangular channel will require checking at high flows and will tend to become less submerged at lower flows. Rectangular-shaped flumes, including the Parshall and the cutthroat, are sometimes installed with a vertical offset to avoid submergence at low flows (Replogle, 1968; Humphreys and Bondurant, 1977), however at the expense of higher head loss at maximum flow.

A style of trapezoidal, broad-crested weir particularly suited for slip-formed canals can inexpensively and accurately measure irrigation flows. The weirs are really long-throated flumes since they have an upstream approach ramp. They are usually truncated at the downstream end of the sill although an exit ramp could be built to improve the submer-



FIG. 9.2 Type FBIM flume is near the submergence limit due to the added friction of downstream vegetation, but is functioning well.

from about 85 to 95 percent. Like other long-throated flumes, the throat length (sill length in the direction of flow) is about twice the expected maximum flow head over the sill, and the converging section ramp is constructed with a 3:1 slope. The exit ramp, if used, would be on a 6:1 slope.

Construction tolerances are liberal, with the major emphasis placed on

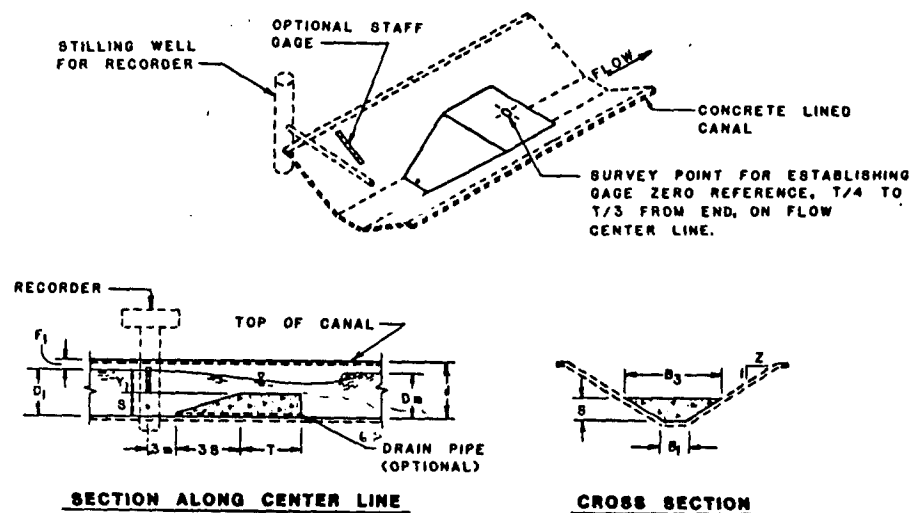


FIG. 9.3 Profile and cross-section of a long-throated flume, broad-crested weir style.

TABLE 9.1. BROAD-CRESTED WEIR DESIGN AND SELECTION

Canal Data		Flow Data for Canal Without Weir in Place		
1. Constructed depth—d =	m	4. Maximum discharge rate — Q_m =	L/s	
2. Bottom width — B_1 =	m	5. Flow depth for Q_m — d_m =	m	
3. Sidelopes — Z =	m	6. Freeboard — f_b =	m	
Weir Selection Using Tables		Trial 1 Trial 2 Trial 3		
7. Trial flume identification:				
8. Bottom width, B_1 (matches line 2)	B_1 =			m
9. Sill width, B_2	B_2 =			m
10. Sidelopes, Z (matches line 3)	Z =			m
11. Critical section (sill) length, T	T =			m
12. Trial sill height, S	S =			m
Submergence — Freeflow Check, Weir in Place				
13. Sill-referenced flow depth for Q_m (tables)	Y_1 =			m
14. Upstream water depth (line 12 plus line 13)	D_1 =			m
15. Actual increase in water depth: (line 14 minus line 5)	ΔY_1 =			m
16. Required increase in water depth: (15 percent x line 13)	ΔY_2 =			m
17. Submergence check: (line 15 minus line 16)	ΔY_3 =			m
(If negative a higher sill must be used, and repeat lines 7-17 with a new trial.)				
(If positive, this flume is okay, but a lower sill might also be used.)				
18. Actual freeboard: (line 1 minus line 14)	f_1 =			m
19. Required freeboard: (20 percent x line 13)	f_2 =			m
20. Freeboard check: (line 18 minus line 19)	f_3 =			m
(If negative, try a lower sill and repeat lines 7-20)				
(If positive, this flume is okay, but a higher sill might also be used.)				
21. Flume selection: if both checks, (lines 17 and 20), are okay, use that trial.				
(If one or the other are not met, repeat lines 7-20 for a new trial.)				
(If none of the standard flumes works, see text.)				
22. Flume selected	Location			
Comments:	How were Q_m and d_m determined?			

making the sill top level, and on careful zeroing of the reference gage. Analysis shows that the error in discharge is almost proportional to the error in sill width, but may be about twice the error that may exist in locating the gage zero (Replogle, 1977; Clemmens and Replogle, 1979).

Sediment movement along the canal floor is interrupted somewhat by these broad-crested weirs. However, the effect is usually minimal. A few meters upstream, the flow is similar to pre-flume installation flows. At the ramp the velocity increases, which helps to carry bedload over the sill. Furthermore, analysis shows that the channel flow area must be obstructed by about 10 percent in the approach section to cause about 1 percent error in final readout.

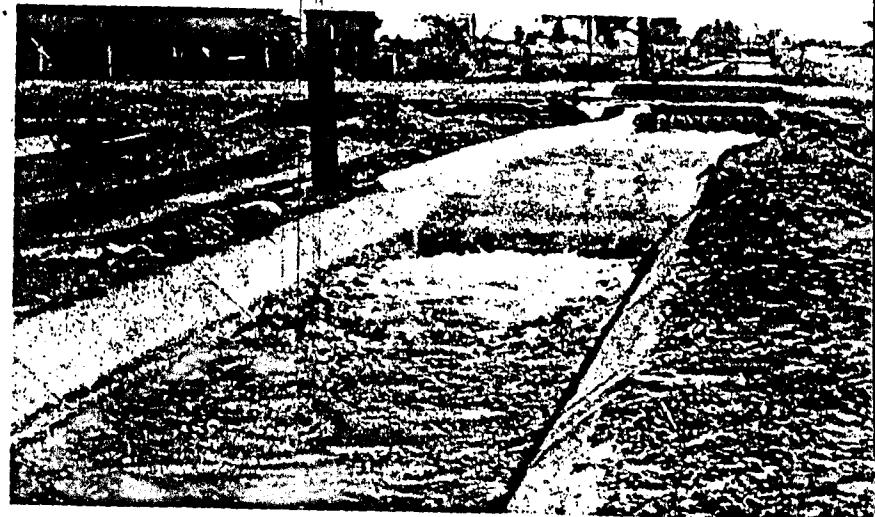
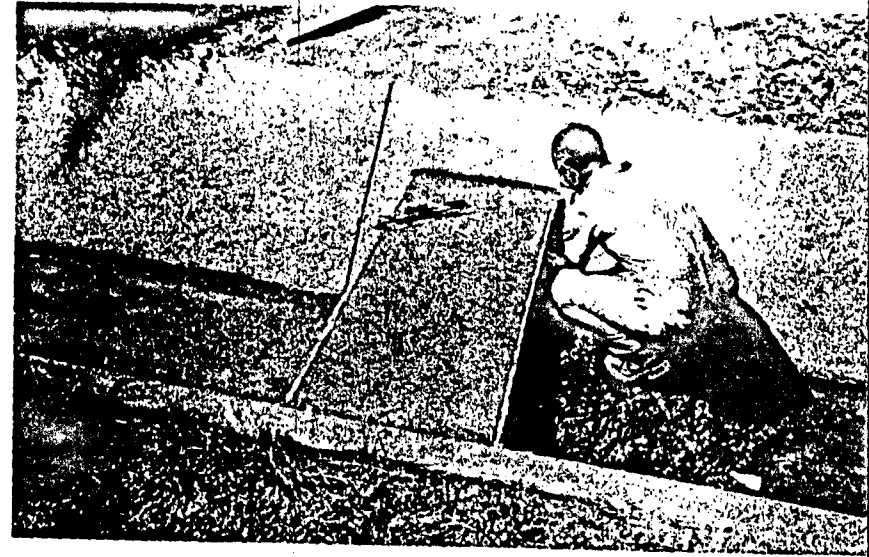
The high accuracy and low cost of these styles of long-throated devices make them highly desirable for measuring irrigation flows in slip-formed canals. The basic shape conforms to the canal which is used as part of the flume structure. Fig. 9.2 shows a broad-crested weir style of flume satisfactorily operating at near the submergence limit, with a head loss in the canal of less than 4 cm.

Fig. 9.3 shows details for installing the broad-crested weir style and defines the symbols used in Table 9.1 and the headings of Table 9.2. Table 9.1 is a flume selection design sheet that can be used to determine a desired sill size (flume or broad-crested weir size) that will operate in a given canal and flow situation. Precomputed discharge tables for nine selected sizes are provided in Table 9.2. Gages, direct reading in discharge units, can be calculated for marking in a machine shop, by multiplying the depth values in Table 9.2 by the appropriate side-slope (for $z = 1$, multiply by 1.414; for $Z = 1.25$, multiply by 1.414; for $Z = 1.5$, multiply by 1.414). Field installation techniques are described

TABLE 9.2. FLUME CALIBRATIONS—WATER DEPTH AT GAGE LOCATION REFERENCED TO SILL CREST (cm)

Canal shape A B ₁ = 30.5 Z = 1:1				Canal shape B B ₁ = 31.0 Z = 1:1				Canal shape C B ₁ = 31.0 Z = 1:25:1			
Flow rate L/s	FA1M B ₁ = 78.2 T=61.0 S=22.9	FA2M B ₁ = 91.4 T=45.7 S=30.5	FA3M B ₁ = 106.6 T=30.5 S=38.1	Flow rate L/s	FB1M B ₁ = 121.9 T=91.4 S=30.5	FB2M B ₁ = 137.2 T=76.2 S=38.1	FB3M B ₁ = 152.4 T=61.0 S=45.7	Flow rate L/s	FC1M B ₁ = 106.2 T=106.2 S=38.1	FC2M B ₁ = 175.3 T=91.4 S=45.7	FC3M B ₁ = 194.7 T=76.2 S=53.3
10	3.89	3.50	3.17	25	5.32	4.94	4.61	50	7.10	6.81	6.47
15	5.06	4.52	4.11	30	6.97	6.53	6.17	60	9.46	9.16	8.82
20	6.06	5.42	4.93	35	8.58	8.11	7.70	70	11.74	11.46	11.14
25	6.93	6.24	5.68	40	10.15	9.65	9.20	80	13.92	13.66	13.31
30	7.75	6.99	6.38	45	11.70	11.16	10.68	90	16.02	15.78	15.45
35	8.52	7.70	7.03	50	13.22	12.65	12.15	100	18.02	17.82	17.50
40	9.25	8.38	7.64	55	14.71	14.10	13.59	110	19.92	19.74	19.48
45	9.94	8.98	8.23	60	16.18	15.54	15.00	120	21.72	21.56	21.34
50	10.59	9.59	8.79	65	17.63	16.96	16.40	130	23.42	23.28	23.08
55	11.21	10.17	9.35	70	19.06	18.36	17.78	140	25.02	24.90	24.72
60	11.81	10.73	9.85	75	20.47	19.74	19.14	150	26.52	26.42	26.26
65	12.39	11.28	10.43	80	21.86	21.11	20.50	160	27.92	27.84	27.70
70	12.94	11.78	10.92	85	23.24	22.47	21.85	170	29.22	29.16	29.04
75	13.47	12.27	11.36	90	24.61	23.82	23.19	180	30.52	30.48	30.38
80	14.00	12.77	11.76	95	25.97	25.16	24.53	190	31.72	31.69	31.62
85	14.50	13.27	12.26	100	27.32	26.49	25.85	200	32.92	32.90	32.84
90	15.00	13.77	12.65	105	28.66	27.81	27.16	210	34.02	34.01	34.00
95	15.49	14.26	13.05	110	29.99	29.12	28.46	220	35.02	35.02	35.02
100	15.98	14.75	13.44	115	31.31	30.43	30.00	230	36.02	36.02	36.02
105	16.46	15.24	13.83	120	32.62	31.74	31.30	240	37.02	37.02	37.02
110	16.94	15.73	14.22	125	33.93	33.04	32.60	250	38.02	38.02	38.02
115	17.41	16.22	14.61	130	35.24	34.35	33.90	260	39.02	39.02	39.02
120	17.88	16.71	15.00	135	36.55	35.65	35.20	270	40.02	40.02	40.02
125	18.35	17.20	15.39	140	37.86	36.95	36.50	280	41.02	41.02	41.02
130	18.82	17.69	15.78	145	39.17	38.25	37.80	290	42.02	42.02	42.02
135	19.29	18.18	16.17	150	40.48	39.55	39.10	300	43.02	43.02	43.02
140	19.76	18.67	16.56	155	41.79	40.85	40.40	310	44.02	44.02	44.02
145	20.23	19.16	16.95	160	43.10	42.15	41.70	320	45.02	45.02	45.02
150	20.70	19.65	17.34	165	44.41	43.45	43.00	330	46.02	46.02	46.02
155	21.17	20.14	17.73	170	45.72	44.75	44.30	340	47.02	47.02	47.02
160	21.64	20.63	18.12	175	47.03	46.05	45.60	350	48.02	48.02	48.02
165	22.11	21.12	18.51	180	48.34	47.35	46.90	360	49.02	49.02	49.02
170	22.58	21.61	18.90	185	49.65	48.65	48.20	370	50.02	50.02	50.02
175	23.05	22.10	19.29	190	50.96	49.95	49.50	380	51.02	51.02	51.02
180	23.52	22.59	19.68	195	52.27	51.25	50.80	390	52.02	52.02	52.02
185	23.99	23.08	20.07	200	53.58	52.55	52.10	400	53.02	53.02	53.02
190	24.46	23.57	20.46	205	54.89	53.85	53.40	410	54.02	54.02	54.02
195	24.93	24.06	20.85	210	56.20	55.15	54.70	420	55.02	55.02	55.02
200	25.40	24.55	21.24	215	57.51	56.45	56.00	430	56.02	56.02	56.02
205	25.87	25.04	21.63	220	58.82	57.75	57.30	440	57.02	57.02	57.02
210	26.34	25.53	22.02	225	60.13	59.05	58.60	450	58.02	58.02	58.02
215	26.81	26.02	22.41	230	61.44	60.35	59.90	460	59.02	59.02	59.02
220	27.28	26.51	22.80	235	62.75	61.65	61.20	470	60.02	60.02	60.02
225	27.75	27.00	23.19	240	64.06	62.95	62.50	480	61.02	61.02	61.02
230	28.22	27.49	23.58	245	65.37	64.25	63.80	490	62.02	62.02	62.02
235	28.69	27.98	23.97	250	66.68	65.55	65.10	500	63.02	63.02	63.02
240	29.16	28.47	24.36	255	67.99	66.85	66.40	510	64.02	64.02	64.02
245	29.63	28.96	24.75	260	69.30	68.15	67.70	520	65.02	65.02	65.02
250	30.10	29.45	25.14	265	70.61	69.45	69.00	530	66.02	66.02	66.02
255	30.57	29.94	25.53	270	71.92	70.75	70.30	540	67.02	67.02	67.02
260	31.04	30.43	25.92	275	73.23	72.05	71.60	550	68.02	68.02	68.02
265	31.51	30.92	26.31	280	74.54	73.35	72.90	560	69.02	69.02	69.02
270	31.98	31.41	26.70	285	75.85	74.65	74.20	570	70.02	70.02	70.02
275	32.45	31.90	27.09	290	77.16	75.95	75.50	580	71.02	71.02	71.02
280	32.92	32.39	27.48	295	78.47	77.25	76.80	590	72.02	72.02	72.02
285	33.39	32.88	27.87	300	79.78	78.55	78.10	600	73.02	73.02	73.02
290	33.86	33.37	28.26	305	81.09	79.85	79.40	610	74.02	74.02	74.02
295	34.33	33.86	28.65	310	82.40	81.15	80.70	620	75.02	75.02	75.02
300	34.80	34.35	29.04	315	83.71	82.45	82.00	630	76.02	76.02	76.02
305	35.27	34.84	29.43	320	85.02	83.75	83.30	640	77.02	77.02	77.02
310	35.74	35.33	29.82	325	86.33	85.05	84.60	650	78.02	78.02	78.02
315	36.21	35.82	30.21	330	87.64	86.35	85.90	660	79.02	79.02	79.02
320	36.68	36.31	30.60	335	88.95	87.65	87.20	670	80.02	80.02	80.02
325	37.15	36.80	30.99	340	90.26	88.95	88.50	680	81.02	81.02	81.02
330	37.62	37.29	31.38	345	91.57	90.25	89.80	690	82.02	82.02	82.02
335	38.09	37.78	31.77	350	92.88	91.55	91.10	700	83.02	83.02	83.02
340	38.56	38.27	32.16	355	94.19	92.85	92.40	710	84.02	84.02	84.02
345	39.03	38.76	32.55	360	95.50	94.15	93.70	720	85.02	85.02	85.02
350	39.50	39.25	32.94	365	96.81	95.45	95.00	730	86.02	86.02	86.02
355	39.97	39.74	33.33	370	98.12	96.75	96.30	740	87.02	87.02	87.02
360	40.44	40.23	33.72	375	99.43	98.05	97.60	750	88.02	88.02	88.02
365	40.91	40.72	34.11	380	100.74	99.35	98.90	760	89.02	89.02	89.02
370	41.38	41.21	34.50	385	102.05	100.65	100.20	770	90.02	90.02	90.02
375	41.85	41.70	34.89	390	103.36	101.95	101.50	780	91.02	91.02	91.02
380	42.32	42.19	35.28	395	104.67	103.25	102.80	790	92.02	92.02	92.02
385	42.79	42.68	35.67	400	105.98	104.55	104.10	800	93.02	93.02	93.02
390	43.26	43.17	36.06	405	107.29	105.85	105.40	810	94.02	94.02	94.02
395	43.73	43.66	36.45	410	108.60	107.15	106.70	820	95.02	95.02	95.02
400	44.20	44.14	36.84	415	109.91	108.45	108.00	830	96.02	96.02	96.02
405	44.67	44.63	37.23	420	111.22	109.75	109.30	840	97.02	97.02	97.02
410	45.14	45.12	37.62	425	112.53	111.05	110.60	850	98.02	98.02	98.02
415	45.61	45.61	38.01	430	113.84	112.35	111.90	860	99.02	99.02	99.02
420	46.08	46.10	38.40	435	115.15	113.65	113.20	870	100.02	100.02	100.02
425	46.55	46.58	38.79	440	116.46	114.95	114.50	880	101.02	101.02	101.02
430	47.02	47.07	39.18	445	117.77	116.25	115.80	890	102.02	102.02	102.02
435	47.49	47.55	39.57	450	119.08	117.55	117.10	900	103.02	103.02	103.02
440	47.96	47.99	39.96	455	120.39	118.85	118.40	910	104.02	104.02	104.02
445	48.43	48.48	40.35	460	121.70	120.15	119.70	920	105.02	105.02	105.02
450	48.90	48.96	40.74	465	123.01	121.45	121.00	930	106.02	106.02	106.02
455	49.37	49.44	41.13	470	124.32	122.75	122.30	940	107.02	107.02	107.02
460	49.84	49.92	41.52	475	125.63	124.05	123.60	950	108.02	108.02	108.02
465	50.31	50.40	41.91	480	126.94	125.35	124.90	960	109.02	109.02	109.02
470	50.78	50.88	42.30	485	128.25	126.65	126.20	970	110.02	110.02	110.02
475	51.25	51.36	42.69	490	129.56	127.95	127.50	980	111.02	111.02	111.02
480	51.72	51.84	43.08	495	130.87	129.25	128.80	990	112.02	112.02	112.02
485	52.19	52.32	43.47	500	132.18	130.55	130.10	1000	113.02	113.02	113.02
490	52.66	52.80	43.86	505	133.49	131.85	131.40	1010	114.02	114.02	114.02
495	53.13	53.29	44.25	510	134.80	133.15	132.70	1020	115.02	115.02	115.02
500	53.60	53.78	44.64	515	136.11	134.45	134.00	1030	116.02	116.02	116.02
505	54.07	54.27	45.03	520	137.42	135.75	135.30	1040	117.02	117.02	117.02

Donnell Landston - of Eng
**Constructing Simple
Measuring Flumes
For Irrigation Canals**



UNITED STATES
DEPARTMENT OF
AGRICULTURE

FARMERS'
BULLETIN
NUMBER 2268

PREPARED BY
SCIENCE AND
EDUCATION
ADMINISTRATION

Constructing Simple Measuring Flumes For Irrigation Canals

Albert J. Clemmens and John A. Replogle¹

Introduction

Poor irrigation water management causes many serious water-supply and water-quality problems. Farmers and other water users are being encouraged to develop their own water management plans or improve existing ones. A major step in implementing any plan is measuring the amount of irrigation water applied. Correct application depends on accurate discharge rate information, both for the main irrigation stream entering the field and for runoff leaving the field.

Typical water-measuring devices—sharp- and broad-crested weirs and flumes such as the parshall, cutthroat, and short- and long-throated trapezoidal that are used in open channels or ditches—are cumbersome and expensive. Since most of these measuring devices require laboratory calibration, flumes used in the field are limited to the particular shapes and sizes for which these calibrations are available.

Issued March 1980

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

Stock No. 001-000-04119-3

¹Research hydraulic engineers, Science and Education Administration, Agricultural Research, U.S. Water Conservation Laboratory, Phoenix, Ariz. 85040.

Any deviation in the field-constructed flumes or weirs from the exact dimensions of the laboratory-calibrated devices may cause the depth-discharge relationship (rating curve) to change and often requires the new as-built flume to be duplicated and recalibrated in the laboratory. This strict dimensional requirement makes most flumes difficult and costly to construct. Another disadvantage of weirs and conventional flumes is the amount of head loss (or water depth change) necessary to obtain a valid measurement of water flow rate.

A new style flume that is simply constructed has been developed that minimizes most of the problems connected with other flumes. The rating curves for these flumes are derived from a laboratory-tested mathematical modeling technique which can be used because the flume has a control section (flume throat) that is long enough to cause nearly parallel flow. The resulting flow properties make it possible to design flumes that cause very low head losses, yet produce accurate discharge measurements. The mathematical model can be used to determine changes in discharge rate that

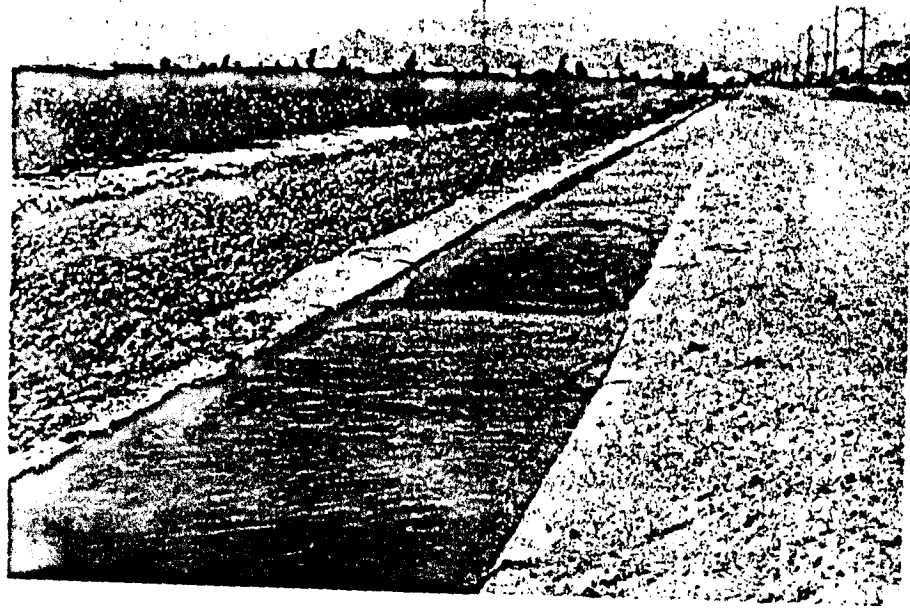


FIGURE 1.—Flume installation at the University of Arizona Cotton Research Center in Phoenix shows the low head loss requirements of the b-c-w style flume. Here, b-c-w flume FA2 is running at 8.9 ft³/s in a 24-in ditch.

PN-6551

result from changes in the flume dimensions. Information on the changes can then be used to determine allowable tolerances in various flume dimensions.

The new, simplified flumes resemble modified broad-crested weirs (b-c-w) and are actually a style of long-throated flume. The b-c-w flumes are generally much easier to construct and have lower absolute design head losses (head loss at design discharge) than conventional trapezoidal flumes. The b-c-w flumes, as shown in figures 1 and 2, and flume designs presented here for standard slipform ditches can make flow measurement simpler, more convenient, and more accurate than formerly available devices.

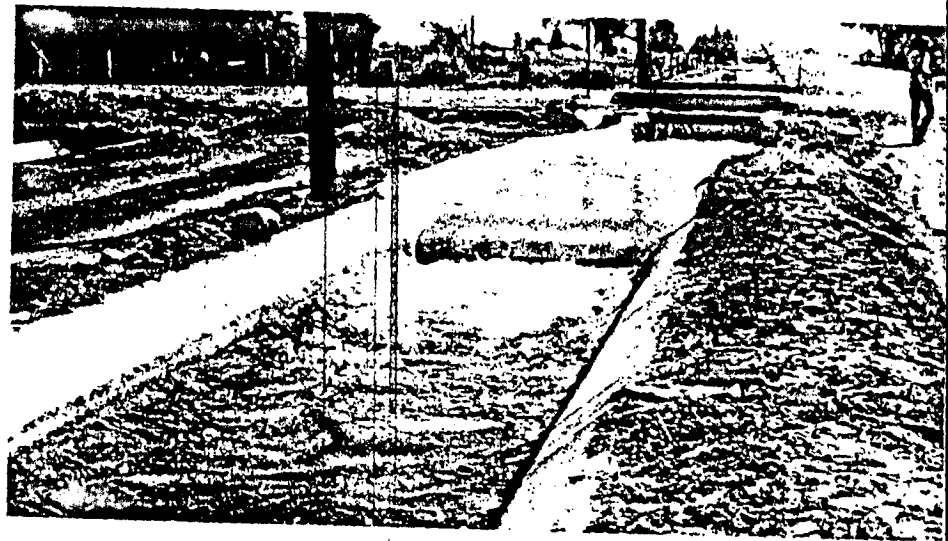


FIGURE 2.—Flume installed near Gilbert, Ariz., for the Salt River Project. The flow rate shown (40 to 50 ft³/s) is much less than the design flow rate (75 ft³/s) resulting in more head loss than necessary. The flume is FC2, but with L = 4.0 feet. The ditch is 36 inches deep.

PN-6552

Flume Design Criteria

The profile and cross section of the b-c-w flume are shown in figure 3. The important design dimensions are the sill height, S , and the sill length, L . The sill represents the floor of the throat section for these flumes. The sides of the throat section are the existing channel walls. The sill length is less important for design and need not be considered in selecting sizes for the new style measuring flume. There are certain conditions, however, under which the sill length limits the design. If it is too short, the flow lines will not be parallel enough in the throat section and the flume ratings may deviate by as much as 7 percent from those presented in this publication (see p.9). When this condition exists, the rating tables are marked to indicate that a longer throat would be used.

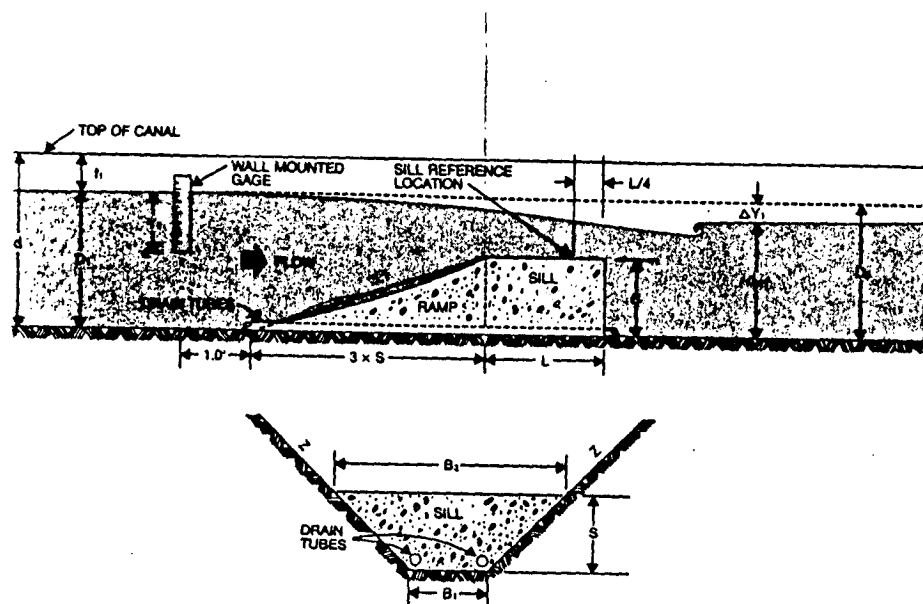


FIGURE 3.—Flume dimensions in profile (top) and cross section (bottom).

Abbreviations used in the profile are as follows: d = constructed depth; D_1 = upstream water depth; t_1 = actual freeboard; Y_1 = sill-referenced flow depth; L = sill length; ΔY_1 = actual increase in water depth caused by the flume; S = sill height; d_m = flow depth; $3 \times S$ = three times the sill height (ramp length).

Abbreviations used in the cross section (bottom) are as follows: B_1 = sill width; Z = canal bottom width; S = sill height.

The sill height is the most important design dimension for controlling the water levels in the ditch. The sill must be high enough so that it obstructs the usual flow in the ditch, causing the water surface upstream from the flume to rise as shown in figure 3. Field and laboratory experience with this style of flume has shown that flumes will operate satisfactorily at 85 percent submergence. For example, the downstream water depth should be no more than 85 percent of the upstream water depth, both measured from the elevation of the top of the sill. Thus, one criterion for design is that the required minimum depth change caused by the flume at maximum flow should be 15 percent of the sill reference depth, Y_1 .

Another criterion of sill height is that it not cause so much of an obstruction in flow that the ditch upstream from the flume is overtopped. The Soil Conservation Service recommends that the freeboard for stable subcritical flow in trapezoidal channels be 20 percent of the energy head at normal depth. (This is approximately 20 percent of the flow depth for canals with very slow-moving flow.) Because of the stable nature of the flow upstream from the b-c-w flumes, the free board requirement there can usually be reduced from 20 percent of D_1 to 20 percent of Y_1 , which is the sill reference depth (fig. 3). These two criteria must be met for the full range of expected flow conditions. The conditions for both criteria are most crucial at the maximum expected flow rate, Q_m , for these shapes of flumes. Thus, the design is based on the maximum expected discharge and the associated depth, d_m . Since this water depth is important to the design, some engineering assistance may be required to get accurate maximum depth-discharge relationships.

Three selected sill heights have been chosen to accommodate the usual range of flows for three standard-sized slipformed canals. Design and selection of a flume is a simple, straightforward procedure.

Flume Design Procedure

Table 1 can be used as a design aid for selecting the appropriate flume. The sample shown in table 1 is for a 36-inch ditch with a 2-foot bottom and 1:1 slopes that is used to carry a maximum of 20 cubic feet per second (cfs). If the ditch flows about 25 inches deep at this discharge, what sill height should be selected? To use the table for this example, begin by entering in the basic information about the canal or ditch where the flume is to be located (lines 1-3). Line 1 is simply the vertical depth of the canal, d , line 2 is the width of the canal bottom, B_1 , and line 3 is the canal wall sideslope, Z , expressed as a ratio of horizontal to vertical distance. Line 4 is the maximum discharge rate. Line 5 is the flow depth. Line 6 is the existing freeboard in the ditch prior to flume construction (line 1 minus line 5).

Once this information is obtained, the selection procedure is straightforward. Table 2 gives flume calibrations for three sizes of flumes (sill heights) for each of three ditch shapes. To begin the selection procedure, select the ditch shape in table 2 (A, B, or C) that matches lines 2 and 3 in table 1. In this example, the ditch shape corresponds to canal shape B. Choose any one of the three flume sizes from that group. For this example, FB1 was tried. Record the information from table 2 for that flume size in the blanks provided for lines 7 through 12 on table 1. (The repetition of some information in table 1 assures that the appropriate flume group and size are chosen from table 2.)

The remaining section of table 1 is a check on the flow conditions that would exist if the trial flume size were installed. Figure 3 shows a profile of flume and a typical water surface resulting from flume placement. From appropriate column of table 2, find the sill-referenced flow depth, Y_1 , for design discharge, Q_m and enter it under line 13 in table 1. For the example, $Y_1 = 1.143$, for $Q_m = 20$. Add lines 12 and 13 to obtain the total ditch depth, line 14, $D_1 = S + Y_1$. Subtract line 5 from line 14 to get the actual increase in water level caused by the flume, line 15, $\Delta Y_1 = D_1 - d_m$ (fig. 3). Next, calculate the rise in water surface that the flume must cause so that it can operate properly, line 16, $\Delta Y_2 = 0.15 Y_1$. If the actual increase in water depth, ΔY_1 , is less than that required, ΔY_2 ($\Delta Y_1 - \Delta Y_2 = \Delta Y_3 < 0$) then the flume cannot be expected to operate properly (line 17), because it will be submerged, as for FB1 of the example.

This limit on the flume submergence assures that the water depth downstream from the flume will not affect the water depth reading upstream in the flume at the gage location. If ΔY_3 is negative, a higher sill must be used, so lines 7-17 are repeated for a higher sill height, as for FB2. For this size, ΔY_3 is positive and the design criteria have been met. Where the selection produces a ΔY_3 that is greater than about 3 inches, a lower and more economical sill should be tried.

Table 1. Broad-crested weir design and selection

Canal Data				Flow Data for Canal Without Weir in Place			
1. Constructed depth-- d	=	3	ft.	4. Maximum discharge rate - Q_m	=	20	cfs
2. Bottom width -- B_1	=	2	ft.	5. Flow depth for Q_m	=	2.08	ft.
3. Sideslopes ----- Z	=	1:1		6. Freeboard ----- f_b	=	0.92	ft.
				(line 1 minus line 5)			
				Weir Selection Using Tables			
				Submergence - Freeflow Check, Weir in Place			
7. Trial flume identification:				Trial 1	Trial 2	Trial 3	
8. Bottom width, B_1 (matches line 2)				FB1	FB2	FB3	
9. Sill width, B_3				2.0	2.0	2.0	ft.
10. Sideslopes, Z (matches line 3)				1:1	1:1	1:1	ft.
11. Critical section (sill) length, L				3.00	2.50	2.00	ft.
12. Trial sill height, S				1.00	1.25	1.50	ft.
				Submergence - Freeflow Check, Weir in Place			
13. Sill-referenced flow depth for Q_m (tables)				1.14	1.09	1.04	ft.
14. Upstream water depth (line 12 plus line 13)				2.14	2.34	2.54	ft.
15. Actual increase in water depth: (line 14 minus line 5)				0.06	0.26	0.46	ft.
16. Required increase in water depth: ($15Z \times$ line 13)				0.17	0.16	0.16	ft.
17. Submergence check: (line 15 minus line 16)				-0.11	0.09	0.30	ft.
				(If negative a higher sill must be used, and repeat lines 7-17 with a new trial).			
18. Actual freeboard: (line 1 minus line 14)				-	0.66	0.46	ft.
19. Required freeboard: ($20Z \times$ line 13)				-	0.22	0.21	ft.
20. Freeboard check: (line 18 minus line 19)				-	0.44	0.25	ft.
				(If negative, try a lower sill and repeat lines 7-20)			
21. Flume selection: this flume is okay, but a higher sill might also be used).							
				Flume selection: If both checks, (lines 17 and 20), are okay, use that trial.			
				If one or the other are not met, repeat lines 7-20 for a new trial.			
				If none of the standard flumes works, see text.			
22. Flume selected	FB3			Example Problem			
Comments				How were Q_m and d_m determined? Estimated			
FB3 was chosen due to uncertainty about the actual water depths. Since ΔY_3 and f_b are both fairly large, FB3							

The actual freeboard with the flume in place, line 1 minus line 14, is entered in line 18. The required freeboard, 20 percent $\times$ line 13, is entered in line 19. If the actual freeboard, f_1 , is less than the required freeboard, f_2 , $-f_2 = f_3 < 0$ then the freeboard requirement has not been met (line 20). If the criteria outlined for lines 17 and 29 are both met ($\Delta Y_3 > 0$ and $f_3 > 0$), in the example for FB2, then the flume trial will work for that situation. If one or the other is not met, a different flume size (sill height) should be tried. In the example, flume FB2 could have been selected; however, if FB3 had been tried first, as shown in trial 3 of table 1, it also would satisfy the criteria of line 19 and could be selected.

For individual situations, the selection may be based on the certainty of the values used for Q_m and d_m . Here, if d_m were actually 27 inches (2.25 ft), Q_m for flume FB2 would be -0.073 , and the flume would be submerged. In flume FB3 would probably be chosen, since there is still plenty of freeboard (line 20, table 1). If two trials work and neither is close to the two limits, then in general, select the lowest sill that satisfies the criteria; in this case FB2 would have been chosen. The reason for choosing the lower sill is that it will cause the least head loss in the canal if it works, and if it doesn't work, the sill can easily be raised by capping it with new concrete. If the highest sill height had been used and the design flow rate had been too low, the canal might overtop and the sill height would be difficult to lower.

In some situations, more than one sill height will work. In other situations one of the flume sizes given here will work. If the highest sill is too low or the lowest sill too high, try another location along the ditch where the flow conditions are different. If a suitable location cannot be found, a new flume can be computed that will be tailored to the particular site. If a flume sill is too low and the next largest sill is too high, either look for a location where a lower sill can be used or use the larger sill and add additional sidewall height to the ditch upstream from the flume.

There are some limitations on these flumes that are related to the ratio between the throat or sill length, L , and the upstream depth, Y_1 , presented in the discussion of parallel flow in the section on Flume Design Criteria (p.4). In table 2, several columns have a horizontal dashed line near the bottom indicating the column (that is, for FA3, between 0.720 and 0.773). If flow depths corresponding discharges below these lines (higher values) are used, about 6 inches should be added to the throat length, L . This will not have a significant effect on the other discharge ratings as listed above the dashed line.

Table 2. Flume calibrations—water depth at gage location referenced to weir crest (in feet)

Flow rate (ft ³ /s)	CANAL SHAPE A B = 1.0' Z = 1:1			CANAL SHAPE B B ₁ = 2.0' Z = 1:1			CANAL SHAPE C B ₁ = 2.0' Z = 1.25:1				
	FA1 B ₂ = 2.50' L = 2.00' S = 0.75'	FA2 B ₂ = 3.00' L = 1.50' S = 1.00'	FA3 B ₂ = 3.50' L = 1.00' S = 1.25'	Flow rate (ft ³ /s)	FB1 B ₂ = 4.00' L = 3.00' S = 1.00'	FB2 B ₂ = 4.50' L = 2.50' S = 1.25'	FB3 B ₂ = 5.00' L = 2.00' S = 1.50'	Flow rate (ft ³ /s)	FC1 B ₂ = 5.125' L = 3.50' S = 1.25'	FC2 B ₂ = 5.75' L = 3.00' S = 1.50'	FC3 B ₂ = 6.375' L = 2.50' S = 1.75'
0.5	0.160	0.143	0.130	1	0.189	0.175	0.164	2	0.252	0.234	0.217
.6	.179	.161	.146	2	.292	.271	.254	4	.387	.362	.340
.7	.197	.177	.161	3	.375	.350	.328	6	.495	.465	.437
.8	.214	.192	.175	4	.447	.418	.393	8	.589	.554	.523
.9	.230	.207	.189	5	.511	.480	.452	10	.673	.634	.599
1.0	.246	.221	.202	6	.570	.536	.506	12	.749	.708	.670
1.2	.275	.248	.226	7	.625	.589	.556	14	.819	.776	.735
1.4	.302	.273	.249	8	.676	.638	.604	16	.885	.839	.796
1.6	.327	.296	.271	9	.725	.685	.649	18	.947	.899	.854
1.8	.351	.318	.292	10	.771	.729	.691	20	1.006	.956	.909
2.0	.374	.340	.312	11	.814	.771	.732	22	1.061	1.010	.962
2.5	.427	.389	.358	12	.856	.812	.771	24	1.115	1.062	1.012
3.0	.476	.434	.400	13	.896	.851	.809	26	1.166	1.112	1.061
3.5	.520	.477	.440	14	.935	.889	.845	28	1.215	1.159	1.107
4.0	.562	.516	.477	15	.973	.925	.881	30	1.26	1.206	1.153
4.5	.601	.553	.512	16	1.009	.960	.915	32	1.31	1.25	1.196
5.0	.638	.588	.546	17	1.044	.994	.948	34	1.35	1.29	1.24
6.0	.707	.654	.608	18	1.078	1.027	.980	36	1.40	1.34	1.28
7.0	.771	.715	.666	20	1.143	1.091	1.042	38	1.44	1.38	1.32
8.0	.829	.772	.720	22	1.205	1.152	1.101	40	1.48	1.42	1.36
9.0	.885	.825	.773	24	1.26	1.21	1.158	45	1.58	1.51	1.45
10.0	.937	.875	.821	26	1.32	1.27	1.21	50	1.67	1.60	1.54
11.0	.986	.923	.867	28	1.38	1.32	1.26	55	1.75	1.69	1.62
12.0	1.033	.968	.911	30	1.43	1.37	1.31	60	1.84	1.77	1.70
13.0	1.078	1.014	.954	32	1.48	1.42	1.37	65	1.92	1.85	1.78
14.0	1.121	1.056	.994	34	1.53	1.47	1.41	70	1.99	1.92	1.85
15.0	1.162	1.096	1.034	36	1.58	1.52	1.46	75	2.06	1.99	1.92
16.0	1.20	1.135	1.071	38	1.62	1.56	1.50	80	2.13	2.06	1.99
17.0	1.24	1.173	1.108	40	1.67	1.60	1.55	85	2.20	2.13	2.06

Flume Construction

Once a satisfactory flume design has been chosen, flume construction is simple and straightforward. The flume has two sections—a ramp and a sill (throat section) (fig. 3). The sill should be level with no large irregularities. The width of the sill, B_s , should be as close to the value given in table 2 as the desired accuracy of measurement (that is, a 1 percent error in B_s will produce roughly a 1 percent error in discharge). With the wide sills used here, an error of one-half inch in sill width would cause about a 1 percent error. Within limits, the sill length in the flow direction has very little effect on the discharge reading. Errors of 2 or 3 inches in length would cause virtually no change in discharge reading, especially if the error makes the throat longer.

While the sill height is of prime importance to design because it controls the water surface elevation and submergence properties, precise vertical location of the sill is not critical to discharge rating, except when it causes the flume width dimension to deviate significantly. For example, an error of one-half inch in sill height, which can be caused by irregularities in the channel bottom, would change the sill width by 1 inch for a channel with 1:1 sideslopes. This would cause only about a 2 percent error. The flume dimensional tolerances thus allow flumes to be placed in slipform ditches, which vary slightly in shape from the standard. These tolerances should not, however, be an excuse for sloppy or poor construction but can make construction quick and easy.

The upper edge of the ramp should join the sill edge such that it does not rise above the sill to cause unpredictable flow separation. Precision edge matching of the two sections or slight rounding of the joint corner is desirable. When the ramp is hand-troweled into place avoid making large lumps or bumps. The ramp should be fairly uniform across with an approximate 3:1 slope. The ramp may be slightly concave as shown in figure 3. The ramp need not taper to zero thickness but can be ended abruptly when it becomes 2 to 3 inches thick.

Drain tubes should be installed as shown in figure 3 to allow the ditch to drain for mosquito control. Flow through the drain tubes will usually be negligible compared with flow through the flume. If tubes 2 to 3 inches in diameter or larger are used, the upper ends can be plugged to stop the flow. Sediment, which tends to accumulate at the base of the ramp, may plug the drains and should be cleaned out periodically. Sediment will not significantly accumulate in the ditch behind the flume if it did not normally accumulate in the ditch previously. Special flumes can be designed for sediment-laden ditches where 6 inches or more of sediment is normally deposited between cleanout periods.

Cast-in-place construction is straightforward. Cut out two pieces of plywood, each matching the cross section of the sill as shown in figure 3, with the corners cut out for inserting the drain tubes (cutting out the corners is necessary anyway since few slipform ditches have distinct corners). Cut 2- by

2-inch spacers to length, L , for holding the two forms apart. With the spacers between the two plywood forms, wire tie the plywood forms together. This makes the form for pouring the sill. Next, clean out a section of the ditch and place the forms on the bottom of the ditch. Insert the drain tubes and shim the forms so that the tops are level in the cross-ditch direction and with respect to each other. It is easy to see whether the form closely matches the ditch. Small errors are not important. As the form is filled with concrete, remove the 2- by 2-inch spacers. The concrete will hold the plywood apart. Use the plywood forms as screed edges for screeding and troweling the sill to a smooth, level surface.

After the concrete in the sill has taken initial set, the upstream form can be removed and the ramp hand-troweled into place (fig. 4). Both the ramp and sill can be broom-finished.

For single-pour construction, the upstream form can be made of a metal frame constructed from angle iron. This frame provides the upstream screeding edge for finishing the sill and is left permanently in place within the flume structure. Thus, both the sill and the ramp can be constructed at the same time, without waiting or returning to the site.

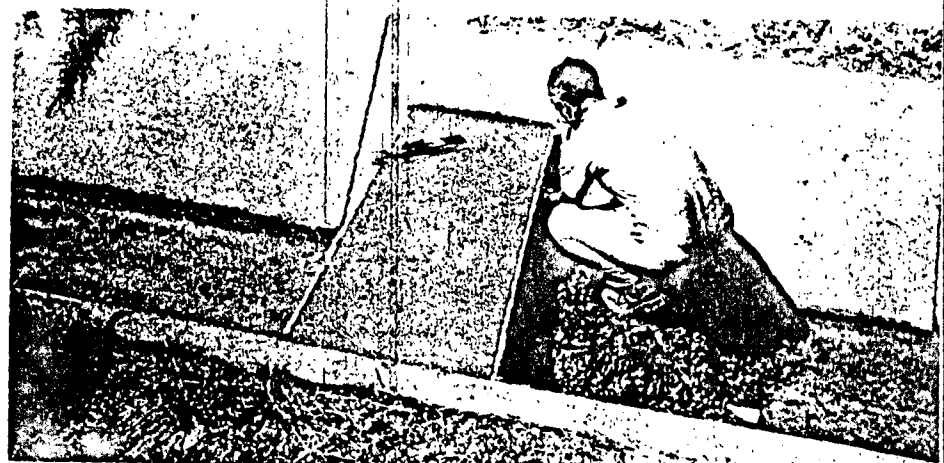


FIGURE 4.—Construction of b-c-w flume FB3 installed in a 30-in ditch near Tacna, Ariz. The sill (throat section) has been poured. The upstream form is being removed so that the ramp can be poured (flow will be from right to left).

PN-6553

Gage Construction and Placement

A convenient type of gage to use is one marked in discharge units and attached to the canal wall. Gages can be constructed of 0.125- by 1.5-inch aluminum bar stock and stamped with a chisel, hammer, and a metal-amping die set. The gages must be cleaned with a wire brush periodically to remove deposits. Since baked enamel gages are easier to read but must be custom ordered, they are considerably more expensive (fig. 5). The gage is placed on the sidewall and the vertical depths given in table 2 must be converted to sloping distances by multiplying the vertical depths by 1.414,

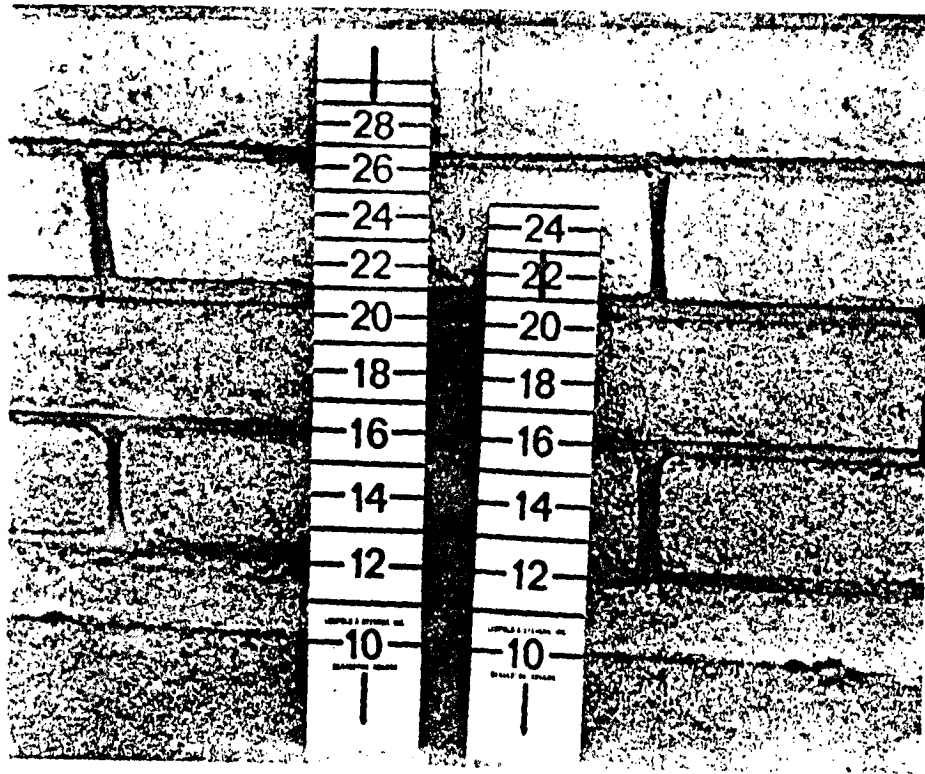


FIGURE 5.—Commercially available baked enamel, wall-mounted gages marked in $\frac{3}{4}$ s. The slotted holes make gage placement easier.

PN-6554

1.414, and 1.601 for ditch shapes A, B, and C, respectively. The discharge values are then marked on the gage at these calculated distances from the gage zero (the zero point need not be marked on the gage).

To obtain accurate discharge ratings, the gage must be carefully surveyed into place with a surveyor's level and rod. The reference elevation for mounting the gage is along the centerline of the canal on top of the sill at about $L/4$ from the downstream end of the flume (fig. 3). This eliminates errors caused by a nonlevel sill. Often the ditch sideslopes are not exactly as intended, thus a wall-mounted gage could be in error. To eliminate most of the error, the gage is referenced and mounted so that the gage is most accurate at the most commonly used discharge. The greatest errors will then occur at gage readings which are seldom used. Mount the gage so that the mark for the most commonly used discharge is at a vertical distance, Y_1 , above the sill reference location, corresponding to the same discharge in table 2.

The gage can be mounted on the wall with lead anchors and screws. A slotted hole can be used to adjust the gage to the proper elevation, or the holes can be drilled in the gage after the anchors are in place. Always check the gage after it has been fastened to make sure that it hasn't slipped. Because of the controlled error in the design and construction processes, which can hold the basic uncertainty of the device to less than ± 2 percent, most of the introduced error will be in the final gage reading. The wall-mounted gage is easily read to within ± 5 percent at most all flows, and for the midrange and higher flows ± 5 percent of the true discharge is easily accomplished. If the water surface is choppy, a skimmer can be placed upstream to reduce the surface waves. Use a stilling well and point gage if greater accuracy is desired.



Department of Water & Natural Resources

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

March 11, 1988

Kemper and Cook-Burns Ditch
c/o Jim Jennings
RR 1, Box 182C
Spearfish SD 57783

RE: Diversion Rate Records, Vested Water Right Application
Nos. 1399-1 and 1394-1

Dear Mr. Jennings:

I am writing to ask for your comments on the enclosed draft of a "Diversion Rate Record" form for recording your ditch flow measurements. The Water Management Board at the December 2 and 3, 1987, Board Meeting in Rapid City, deferred your vested right claims until ditch flows could be measured during the 1988 irrigation season. The Board's motion required a permanent flow measuring device to be installed on the ditch at or near the point of diversion. The motion also stated that a method of record keeping will cooperatively be determined between the Division of Water Rights and the Ditch Company.

The flow measurements will need to be made when water is being diverted and on a daily basis. If the flow is to be recorded following opening or closing the headgate, the gauge reader will need to wait for the flow to stabilize before reading the gauge. The recording time and name of the gauge reader must be recorded. If possible, the number of acres being irrigated should be recorded. The "Remarks" column is provided for any comments you may have during data collection, i.e. "Rainy day, no diversion" etc.

The diversion rate records will need to be submitted to us at the end of each month. If you have any questions or comments regarding the "Diversion Rate Record" form or any suggested changes, please let us know.

Very truly yours,

A handwritten signature in cursive script that reads "John Hatch". The signature is written in black ink and is positioned above the typed name and title.

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

April 22, 1988



South Dakota Department of Water & Natural Resources
Joe Foss Office Building
Pierre, SD 57501-3181

Attn: Rassool Ahadi

Re: Measuring Flume Design - Cookburns, Kemper & Bowman Ditches

Dear Rassool:

Please find enclosed dimensional information for the flumes for the referenced ditches. These ditch companies are planning to use the long-throated weir, trapezoidal channel style flume for water measurement. Flume design is in accordance with USDA literature.

This flume design was selected because it offers relatively simple installation and low operating head loss. All of the referenced ditches have extremely shallow slope at the source end and therefore the use of higher head loss devices, such as a parshall flume is not acceptable.

For the Cookburns ditch, we have selected a type FB1 flume as described by the USDA literature. This flume uses a 2-foot bottom width, 1:1 side slopes and a 1-foot high weir. A dimensional sketch is enclosed. Discharge rating will be in accordance with Table 2 of the literature, flume style FB1.

The Kemper ditch flume will be similar to the Cookburns flume. For these flumes, measurement of flow in the 10 to 25 cfs range is in the middle of the useful range of flow measurement as described by the literature.

The Bowman ditch will use a type FA1 flume. This will provide a bottom width of 1-foot, 1:1 side slopes and a 9-inch high weir. Measurements of flows from 5 to 12 cfs fall in the mid range of the rating for this flume as described by Table 2.

We do not prepare specifications for this project. Instructions to the installing contractor were to use 3,500 psi concrete and to provide 1/2-inch steel enforcing bars on 12-inch centers. Float-well tubes will be Schedule 40 PVC. No other materials are anticipated for the project.

Mr. Rassool Ahadi
April 22, 1988
Page Two

I have requested a base map on which to illustrate flume location but I do not have it available at this time. Flume location for the Cookburns ditch will be downstream of the existing steel flume and upstream of the hard surface road. Location of the Kemper ditch flume will be immediately upstream of the hard surface road nearest the head gate. Location of the Bowman ditch flume will be immediately north of the Jim Jennings' residence, downstream of the long steel culvert. Each of these locations was chosen as the nearest location to the head gate which provided adequate elevation change to provide flume submergence. We will provide map information when base maps are available.

It is my understanding that ditch owners are proceeding with construction of these flumes immediately. I apologize for not providing you more detailed information earlier. We would appreciate your review at your earliest convenience.

Sincerely,

DEWILD GRANT RECKERT
& ASSOCIATES COMPANY


Bruce Jennings, P.E.

BAJ:ldb



Department of Water & Natural Resources

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

April 28, 1988

Kemper and Cook-Burns Ditches, c/o James Jennings
RR 1 Box 182C
Spearfish, S.D. 57783

Re: Approval of the Plans and Specifications for the Measuring
Devices

Dear Mr. Jennings:

We have reviewed the plans and specifications for the measuring devices, designed by Bruce Jennings, to be used to measure the flow in Kemper and Cook-Burns Ditches. The plans propose to use a long-throated trapezoidal channel style flume. Both flumes propose a minimum depth of 2.5 feet, sill height of 1 foot, a bottom width of 2 feet and a side slope of 1:1.

The plans and specifications are approved as submitted for diversion rates of 18 cubic feet per second (cfs) or less. Our review shows this design to be accurate only up to a flow rate of 18 cfs. This should not pose a problem because we do not believe past diversions have exceeded this flow rate.

If you have any questions, 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

cc: Bruce Jennings



Department of Water & Natural Resources

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

January 9, 1989

James Jennings
RR 1, Box 182C
Spearfish SD 57783

Dear Mr. Jennings:

This letter is in response to my January 9, 1989 conversation with Don Smith regarding the transfer of water rights to some land you have obtained.

Vested Water Right Claim No. 1399-1 for the Cook-Burns Ditch claims that 621.8 acres are being irrigated from Spearfish Creek. The legal descriptions of the 621.8 acres are enclosed. If the land you have purchased is irrigated from the Cook-Burns Ditch, then no transfer of water rights is needed due to the acreage being included on the ditch company's vested right claim. Dividing use of the water among the ditch members is the responsibility of the ditch company.

Currently, Vested Right Claim No. 1399-1 is in deferred status pending collection of sufficient flow data to allow the vested right claim to be reconsidered by the Water Management Board. Notice will be given when Claim No. 1399-1 is rescheduled for consideration by the Board.

Please contact me if you have any questions.

Sincerely,

Ron Duvall
Natural Resources Engineer
605 773-3352

enc.

cc: Don Smith, 320 S Poplar, Pierre





R.R. 1 Box 182C
Spearfish, SD 57783
January 19, 1989

John Hatch, Chief Engineer
Division of Water Rights
SD Department of Water and Natural Resources
Joe Foss Building
523 East Capitol
Pierre, SD 57501-3181

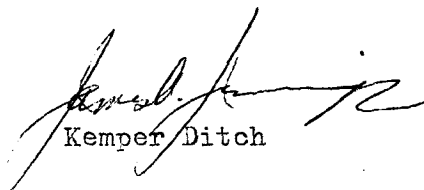
Dear John;

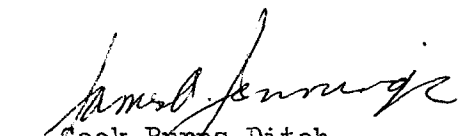
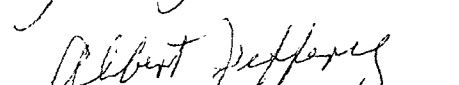
In 1988, at considerable expense to the ditch owners, measuring devices were placed in each ditch. This resulted in being able, for the first time in the history of the ditches, to determine the actual amount of water used on any given day. Records were kept and supplied to your office.

Due to the lack of rainfall during the 1988 growing season, Lawrence county was declared a disaster area. The lack of rainfall resulted in diminished stream flow, above normal water usage by the irrigators above us on the creek, and reduced underground return flow to the creek. The result was insufficient water in the creek to supply our ditches.

Because of the sub-normal 1988 season, we request an additional year's measurement of water diverted before the final ditch allotments are made.

Sincerely yours,


Kemper Ditch


Cook-Burns Ditch

Bowman Ditch



Department of Water & Natural Resources

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

January 24, 1989

NOTICE

TO: Cook-Burns Ditch Company
c/o James Jennings
RR 1, Box 182C
Spearfish SD 57783
and Parties of Record (see attached list)

FROM: John Hatch, Chief Engineer *John Hatch*
Water Rights Division
605 773-3352

SUBJECT: Reconsideration of Deferred Vested Right Application
No. 1399-1

The Water Management Board will reconsider Vested Right Application No. 1399-1 at 11:00 am, March 1, 1989 in the Roosevelt Room, Howard Johnson's, I-90 and La Crosse, Rapid City SD. The agenda time is an estimate. The actual time of hearing may be later than 11:00 am due to prior agenda items. The Board deferred Application No. 1399-1 for one year at the March 2 and 3, 1988 Board meeting to allow collection of flow data for the ditch during the 1988 irrigation season.

The Chief Engineer is recommending that Application No. 1399-1 remain in deferred status due to dry conditions in 1988 and allow collection of additional flow data for another irrigation season. Applicable provisions of the Notice of Hearing published on October 28 and November 3, 1987 in the Belle Fourche Daily Post and October 28 and November 4, 1987 in the Queen City Mail will still apply at this hearing.

cc: Larry Donovan, Assistant Attorney General



CERTIFICATION

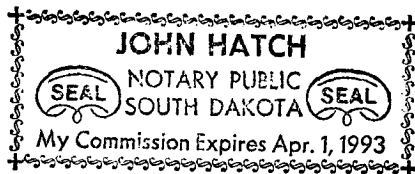
I hereby certify that on January 24, 1989 I have personally deposited with the U.S. Mail postage prepaid envelopes containing a Notice of Reconsideration of Deferred Vested Right Application No. 1399-1 addressed as shown on the Parties of Record sheet.

Karen Schlaak

KAREN SCHLAACK
Senior Secretary

STATE OF SOUTH DAKOTA)
) SS
COUNTY OF HUGHES)

Sworn to, before me, this 26th day of January, 1989.



John Hatch
Notary Public



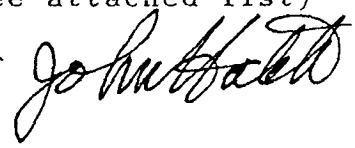
Department of Water & Natural Resources

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

March 8, 1989

NOTICE

TO: Cook-Burns Ditch Company
c/o James Jennings
RR 1, Box 182C
Spearfish SD 57783
and Parties of Record (see attached list)

FROM: John Hatch, Chief Engineer 
Water Rights Division
605 773-3352

SUBJECT: Deferral of Vested Right Application No. 1399-1

On March 1, 1989, the Water Management Board allowed Application No. 1399-1 to remain in deferred status to allow collection of additional flow data during the 1989 irrigation season. Application No. 1399-1 will then be rescheduled for consideration by the Board after the 1989 irrigation season. Notice will be given of the time and place of hearing.

cc: Larry Donovan, Assistant Attorney General

CERTIFICATION

I hereby certify that on March 8, 1989 I have personally deposited with the U.S. Mail postage prepaid envelopes containing a Notice of Deferral of Vested Right Application No. 1399-1 addressed as stated on the Parties of Record sheet.

Karen Schlaak
KAREN SCHLAACK
Senior Secretary

STATE OF SOUTH DAKOTA)
) SS
COUNTY OF HUGHES)

Sworn to, before me, this 9th day of March, 1989.

JOHN HATCH
 (SEAL) NOTARY PUBLIC (SEAL)
 SOUTH DAKOTA
 My Commission Expires Apr. 1, 1993

John P. [Signature]
Notary Public



Department of Water & Natural Resources

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

Cook-Burns Ditch
1399-1

May 4, 1989

James Jennings
RR1, Box 182C
Spearfish, SD 57783

Dear Jim,

Enclosed you will find the diversion rate record forms you requested. I also sent you envelopes you could use to send us the records.

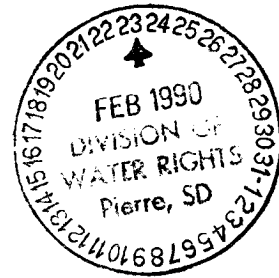
If you have any questions, please contact me.

Sincerely,

A handwritten signature in black ink, appearing to read "M. Rassool Ahadi".

M. RASSOOL AHADI
Natural Resources Engineer.
(605) 773-3352





February 22, 1990

To: John Hatch, Chief Engineer
Water Rights Division
Joe Foss Building
523 East Capitol
Pierre, SD 57501

From: Cook Burns Ditch
R.R. 1 Box 182C
Spearfish, SD 57783

Dear John;

Cook Burns ditch irrigators would appreciate deferral of application No. 1399-1 until March of 1991. This will allow the collection of flow data for the 1990 irrigating season; this will give us three year's data.

After the 1990 irrigating season we would like to meet with you or your representative to determine the amount and rate of flow of water to be allotted to the ditch.

Sincerely yours,



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

February 26, 1990

NOTICE

TO: Cook-Burns Ditch Company
c/o James Jennings
RR 1, Box 182C
Spearfish SD 57783
and Parties of Record (see attached list)

FROM: John Hatch, Chief Engineer
Water Rights Division
605 773-3352

SUBJECT: Reconsideration of Deferred Vested Right Application
No. 1399-1

The Water Management Board will reconsider Vested Water Right Application No. 1399-1 at 10:30 am, March 7, 1990, Roosevelt/Jefferson Room, Howard Johnson's, 2211 LaCrosse Street, Rapid City SD. The agenda time is an estimate. The actual time of hearing may be later than 10:30 am due to prior agenda items. The Board deferred Application No. 1399-1 for one year at the March 2 & 3, 1988 Board meeting to allow collection of flow data during the 1988 irrigation season.

The Chief Engineer is recommending that Application No. 1399-1 remain in deferred status due to dry conditions in 1988 and 1989 and allow collection of additional flow data for another irrigation season. Applicable provisions of the Notice of Hearing published on October 28 and November 3, 1987 in the Belle Fourche Daily Post and October 28 and November 4, 1987 in the Queen City Mail will still apply at this hearing.

cc: John Haak, Assistant Attorney General

CERTIFICATION

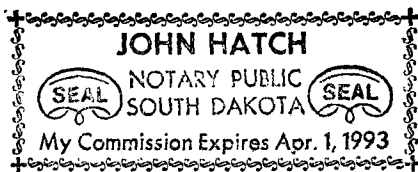
I hereby certify that on February 26, 1990 I have personally deposited with the U.S. Mail postage prepaid envelopes containing a Notice of Hearing on Reconsideration of Deferred Vested Right Application No. 1399-1 addressed as stated on the parties of record sheet.

Karen Schlaak

KAREN SCHLAACK
Senior Secretary

STATE OF SOUTH DAKOTA)
) SS
COUNTY OF HUGHES)

Sworn to, before me, this 5th day of March, 1990.



John Hatch
Notary Public

SOUTH Dakota Department of
Water & Natural Resources

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

March 12, 1990

NOTICE

TO: Cook-Burns Ditch Company
c/o James Jennings
RR 1, Box 182C
Spearfish SD 57783
and Parties of Record (see attached list)

FROM: John Hatch, Chief Engineer *John Hatch*
Water Rights Division
605 773-3352

SUBJECT: Deferral of Vested Right Application No. 1399-1

On March 7, 1990, the Water Management Board allowed Application No. 1399-1 to remain in deferred status to allow collection of additional flow data during the 1990 irrigation season. Application No. 1399-1 will then be rescheduled for consideration by the Board after the 1990 irrigation season. Notice will be given of the time and place of hearing.

cc: John Haak, Assistant Attorney General

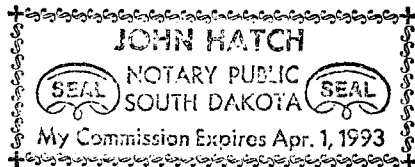
CERTIFICATION

I hereby certify that on March 12, 1990 I have personally deposited with the U.S. Mail postage prepaid envelopes containing a Notice of Hearing on Deferral of Vested Right Application No. 1399-1 addressed as stated on the parties of record sheet.

Karen Schlaak
KAREN SCHLAACK
Senior Secretary

STATE OF SOUTH DAKOTA)
) SS
COUNTY OF HUGHES)

Sworn to, before me, this 13th day of March, 1990.



John Hatch
Notary Public



Cook-Burns

Rassool Ahadi
South Dakota Department of Water and Natural Resources
Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3181

Dear Rassool;

The irrigators have approved the diversion rates from Spearfish Creek as follows:

Cook-Burns	17.8 cfs
Kemper	24 cfs
Bowman	8 cfs

I assume you will recommend these diversion rates to your board for approval at their December meeting in Rapid City.

I would appreciate receiving copies of the 1990 diversion rate records for each of the ditches. I also would like a copy of your graph illustrating water useage of cfs by days.

The notice in th Queen City Mail listed Homestake as applying for the time extension relative to the change of point of diversion for the Ramsdell ditch.

Sincerely yours,

SOUTH Dakota Department of
Water & Natural Resources

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

November 14, 1990

Jim Jennings
RR 1, Box 182C
Spearfish, SD 57783

Dear Jim,

Enclosed please find copies of the diversion rates for Kemper, Cook-Burns, and the Bowman Ditches for the 1990 irrigation season as you requested. Enclosed you will also find copies of the hydrographs for Kemper and Cook-Burns Ditches. Please note that there was not enough data for Bowman Ditch to make a hydrograph for it.

If you have any other questions, please do not hesitate to contact me.

Sincerely,



M. RASSOOL AHADI
Natural Resources Engineer
(605)773-3352

enclosures

56 AM 88-71009

REVISED RECOMMENDATION OF CHIEF ENGINEER FOR VALIDATION OF
VESTED WATER RIGHT APPLICATION NO. 1399-1, Cook-Burns Ditch Company

Pursuant to SDCL 46-2A-2, the following is the revised recommendation of the Chief Engineer, Water Rights Division, Department of Water and Natural Resources concerning Validation of Vested Water Right Application No. 1399-1, Cook-Burns Ditch Company, c/o James Jennings, RR #1 Box 182C, Spearfish SD.

The Chief Engineer is recommending VALIDATION of Application No. 1399-1 for 17.8 cfs and that the applicable portions of Location Notice No. 31661 be incorporated into No. 1399-1 and the abandoned portions of No. 31661 be cancelled, because 1) water has been appropriated as described for irrigation use with a priority date of June 15, 1881, 2) the use has been developed without unlawful impairment of existing rights, 3) the use is a beneficial use and 4) it is in the public interest with the following qualifications.

1. That Vested Water Right No. 1399-1 is subject to domestic use rights. Diversion of water under Water Right No. 1399-1 is contingent upon supplies being available first to domestic users.
2. That the flow measuring device on Cook-Burns Ditch continue to be maintained and records of diversions be kept and reported to the Chief Engineer annually.

See the report on application for additional information.



JOHN HATCH, Chief Engineer
November 20, 1990

SOUTH DAKOTA
Department of
Water & Natural Resources

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

November 21, 1990

NOTICE

TO: Cook-Burns Ditch Company
c/o James Jennings
RR 1, Box 182C
Spearfish, SD 57783
and Parties of Record (see attached list)

FROM: John Hatch, Chief Engineer
Water Rights Division
605 773-3352 

SUBJECT: Validation of Vested Right Claim No. 1399-1, Cook-Burns
Ditch Company

The Water Management Board will consider Validation of Vested Right Claim No. 1399-1 at 9:15 am, December 5, 1990 at the Hilton Inn, Deerfield Room, 445 Mt. Rushmore Road, Rapid City SD. The agenda time is an estimate. The actual time of the hearing may be later than 9:15 am due to prior agenda items. Applicable provisions of the Notice of Hearing published on October 28 and November 3, 1987 in the Belle Fourche Daily Post and October 28 and November 4, 1987 in the Queen City Mail will still apply at this hearing.

The Water Management Board originally deferred Vested Right Claim No. 1399-1 at their December 2 and 3, 1987 meeting to allow collection of flow data for Cook-Burns Ditch. A copy of the revised report and Chief Engineer's revised recommendation are attached.

This hearing is an adversary proceeding. Any person having filed a petition and the Vested Right Claim holder have the right to be represented by a lawyer. These and other due process rights will be forfeited if not exercised. Decisions of the Board may be appealed to the Circuit Court and the State Supreme Court as provided by law.

cc: John Haak, Assistant Attorney General

attachment

CERTIFICATION

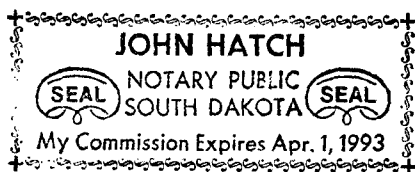
I hereby certify that on November 21, 1990 I have personally deposited with the U.S. Mail postage prepaid envelopes containing a Notice of Validation of Vested Right Claim No. 1399-1, Cook-Burns Ditch Company addressed as stated on the Parties of Record sheet.

Mare R. Arthur

Marie R. Arthur
Secretary

STATE OF SOUTH DAKOTA)
) SS
COUNTY OF HUGHES)

Sworn to, before me, this 27th day of November, 1990.



John Hatch
Notary Public



DEPARTMENT OF WATER & NATURAL RESOURCES

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

GREAT FACES. GREAT PLACES.

December 11, 1990

NOTICE

TO: James Jennings
Cook-Burns Ditch Company
RR 1 Box 182C
Spearfish, SD 57783
(and Parties of Record)

FROM: John Hatch, Chief Engineer
Water Rights Division
605 773-3352

A handwritten signature in dark ink, appearing to read "John Hatch", written over the typed name in the "FROM:" field.

SUBJECT: Preparation of Findings of Fact, Conclusions of Law and
Final Decision

The Water Management Board has directed John Guhin, the Board's attorney to prepare proposed Findings of Fact, Conclusions of Law and a Final Decision on validation of Vested Right Application No. 1399-1. The Board will consider the proposed Findings, Conclusions and Final Decision at 1:00 pm, Meeting Room, Governor's Inn, 700 W Sioux, Pierre SD. The agenda time is an estimate. The actual time of consideration may be delayed due to prior agenda items.

The Board has requested that a copy of the proposed Findings, Conclusions and Final Decision be mailed to each Board member and all Parties of Record (copy enclosed) by February 7, 1991. Any comments pertaining to the proposed Findings, Conclusions and Decision are to be mailed to each Board member, the Board attorney and all Parties of Record by February 18, 1991.

The public hearing was completed December 5, 1990. No additional testimony will be received on February 27, 1991.

cc: John Guhin, Deputy Attorney General
John Haak, Assistant Attorney General

CERTIFICATION

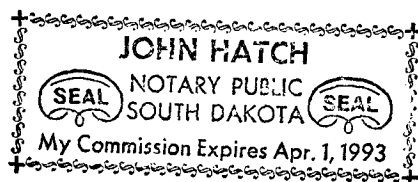
I hereby certify that on December 11, 1990, I have personally deposited with the U.S. Mail postage prepaid envelopes containing a Notice regarding Vested Right Application 1399-1 addressed as stated on the Notice.

Jaci Konop

JACI KONOP
Senior Secretary

STATE OF SOUTH DAKOTA)
) SS
COUNTY OF HUGHES)

Sworn to, before me, this 13th day of December, 1990.



John Hatch
Notary Public



DEPARTMENT OF WATER & NATURAL RESOURCES

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

January 23, 1991

AMENDED NOTICE

TO: James Jennings
Cook-Burns Ditch Company
RR 1 Box 182C
Spearfish, SD 57783
(and Parties of Record)

FROM: John Hatch, Chief Engineer
Water Rights Division
605 773-3352

SUBJECT: Preparation of Findings of Fact, Conclusions of Law and
Final Decision for Vested Right Claim No. 1399-1

The Notice of December 11, 1990, failed to include the date of the Water Management Board meeting at the Governors Inn in Pierre. This Amended Notice is to advise the parties that the Board will consider Findings of Fact, Conclusions of Law and Final Decision at 1:00 pm, February 27, 1991, Meeting Room, Governors Inn, 700 W Sioux, Pierre, SD.

Applicable provisions of the Notice of Preparation of Findings of Fact, Conclusions of Law and Final Decision dated December 11, 1990, will still apply at this time.

cc: John Guhin, Deputy Attorney General
John Haak, Assistant Attorney General

CERTIFICATION

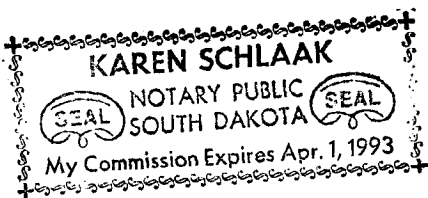
I hereby certify that on January 23, 1991, I have personally deposited with the U.S. Mail postage prepaid envelopes containing an Amended Notice regarding Vested Right Application 1399-1 addressed as stated on the Amended Notice.

Jaci Konop
JACI KONOP
Senior Secretary

STATE OF SOUTH DAKOTA)
) SS
COUNTY OF HUGHES)

Sworn to, before me, this 23rd day of January, 1990.

Karen Schlaack
Notary Public



STATE OF SOUTH DAKOTA

BEFORE THE WATER MANAGEMENT BOARD

IN THE MATTER OF THE VALIDA-	)	FINDINGS OF FACT,
TION OF VESTED WATER RIGHT	)	CONCLUSIONS OF LAW
APPLICATION NO. 1399-1,	)	AND FINAL DECISION
COOK-BURNS DITCH COMPANY	)	

FINDINGS OF FACT

I

This is an application by Cook-Burns Ditch Company to validate a vested water right for 33.0 cfs of Spearfish Creek water to irrigate 621.8 acres of land in Lawrence County, with a claimed priority date of June 15, 1881.

II

The 621.8 acres have been continuously irrigated pursuant to South Dakota law.

III

The ditch company claimed a diversion rate of 33.0 cfs; the original recommendation of the Department was for 17.8 cfs. The Board, after hearing in 1987, required additional data, and data from 1988 through 1990 has been collected and presented to the Board.

IV

The Department demonstrated, to the satisfaction of the Board, that a diversion rate of 17.8 cfs is justified.

V

Several factors combine to justify this conclusion and the diversion rate of 17.8 cfs. First, the ditch

company agrees with the recommendation by the Department of one cubic foot per second per 35 acres irrigated.

VI

Second, the type of irrigation used and the nature of the soil and water in the area justify the diversion rate. The type of irrigation now used in the area is flood irrigation, the same type of irrigation used under this claimed right for more than 100 years. The soils in the area are sandy and are underlain by gravel. When water travels over these lands slowly and at a low diversion rate, it tends to be absorbed quickly and does not reach the end of a large field until the soil near the diversion point is highly saturated. If, on the other hand, a higher rate of diversion is allowed, the water moves more speedily and the water will not be so easily absorbed and will reach the end of the field more quickly. The result is that the allowance of a higher diversion rate, if properly monitored, will result in more efficient use of water.

VII

Third, the Board finds that the hydrology of the area is conducive to the return of excess flows to the stream and to the support of springs in the area. In practical terms, therefore, the allowance of a greater diversion rate does not mean that a greater amount of water is lost to the hydrologic system of the area.

VIII

The Board finds that the opponent of the right failed to show a significant adverse effect from recognition of this right on fish and wildlife. The diversion is from a cold water fishery, Spearfish Creek, but it is also near the point at which that creek empties into Redwater Creek. No portion of the stream which is in the Black Hills National Forest will be affected by the diversion. Moreover, at no time during the three-year study did the irrigators dry up the creek. In addition, the opponent of the right failed to demonstrate that there was any significant public access to Spearfish Creek below the point of diversion of the ditch company. Finally, the recharge of springs caused by the irrigation itself provides positive wildlife benefits, including the support of wetlands.

CONCLUSIONS OF LAW

I

The Board has jurisdiction of this matter.

II

The amount of water provided for in the Final Decision has been appropriated for irrigation use since June 15, 1881.

III

The use has been developed without unlawful impairment of existing rights.

IV

The use for irrigation is a beneficial use.

V

SDCL 46-5-6 is not applicable to this claimed right because the claimed right predates the passage of the act in 1907.

VI

The use is in the public interest as qualified in the Final Decision.

FINAL DECISION

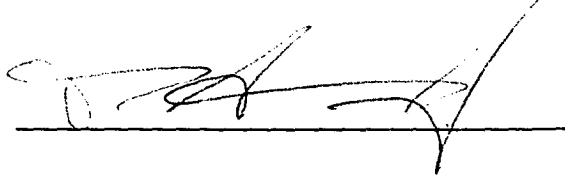
The application for validation of Vested Water Right No. 1399-1, Cook-Burns Ditch Company, is approved for 17.8 cfs with a priority date of June 15, 1881, with the qualifications set out below. The applicable portions of Location Certificate No. 31661 are incorporated into No. 1399-1, and the abandoned portions of Location Certificate No. 31661 are cancelled.

1. That Vested Right No. 1399-1 is subject to domestic use rights. Diversion of water under Water Right No. 1399-1 is contingent upon supplies being available first to domestic users.
2. That the flow measuring device on Cook-Burns Ditch continue to be maintained and records of diversions be kept as directed by the

Chief Engineer and reported to the Chief
Engineer annually.

Dated this 8th day of March, 1991.

BY THE BOARD:

A handwritten signature in dark ink, consisting of several loops and a long horizontal stroke, positioned above a solid horizontal line.

d-pld1.jpg



DEPARTMENT OF WATER & NATURAL RESOURCES

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

March 12, 1991

NOTICE

TO: James Jennings
Cook-Burns Ditch Company
RR 1 Box 182C
Spearfish, SD 57783
(and Parties of Record)

FROM: John Hatch, Chief Engineer
Water Rights Division
605 773-3352

SUBJECT: Adoption of Findings of Fact, Conclusions of Law and
Final Decision

This is to notify you that a Final Decision, including Findings of Fact, Conclusions of Law were adopted by the Water Management Board for Vested Right Application No. 1399-1 which was considered at the February 27, 1991, meeting.

A copy of the signed final Decision, Findings and Conclusion is enclosed for the applicant. Copies will be furnished to anyone else upon request. South Dakota Statutes provide that the decision of the Board may be appealed to the Courts.

cc: Diane Best, Assistant Attorney General

CERTIFICATION

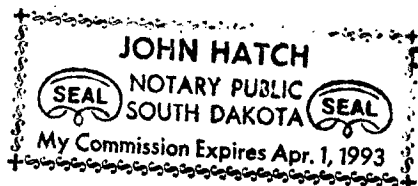
I hereby certify that on March 12, 1991, I have personally deposited with the U.S. Mail, postage prepaid envelopes containing a Notice regarding Adoption of Findings of Fact, Conclusions of Law and Final Decision on Vested Right Application No. 1399-1 addressed as stated on the Notice.

Jaci R Konop

JACI R. KONOP
Senior Secretary

STATE OF SOUTH DAKOTA)
) SS
COUNTY OF HUGHES)

Sworn to, before me, this 13th day of March, 1991.



John Hatch
Notary Public



DEPARTMENT OF WATER & NATURAL RESOURCES

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

1399-1

May 6, 1991

TO: Spearfish Creek Water Right Owners
(See Attached List With Priority Dates)

FROM: John Hatch, Chief Engineer
Division of Water Rights
(605) 773-3352

SUBJECT: Diversions from Spearfish Creek

If drought conditions continue in the Black Hills area during 1991, we expect another irrigation season with very low flows in Spearfish Creek. As I understand it, during the 1990 irrigation season, there were short periods of time when there were no flows in Spearfish Creek at different locations.

I believe that a short reach of the creek channel below Cook Ditch's diversion received the most attention from the news media. Although state law does not require instream flows for fish and wildlife and aesthetic purposes, state law does give preference to water for domestic use which includes livestock watering.

We would like to work with you to maintain minimum flows in the creek for domestic use during 1991. Maintenance of minimum flows should reduce news media attention to Spearfish Creek.

If you have any questions, please contact Del Brosz or Rassool Ahadi, Division of Water Rights, 523 E. Capitol, Pierre, SD 57501. Phone: (605) 773-3352

cc: Representative Harvey Krautschun

SPEARFISH CREEK WATER RIGHTS

PERMIT NO.	NAME	PRIORITY DATE	RATE (CFS)
*43-1	Homestake Mining Co	01/04/1909	100.00
138-1	City of Spearfish	11/12/1917	0.50
141-1	City of Spearfish	03/01/1919	1.10
148-1	City of Spearfish	01/27/1930	1.50
150-1	City of Spearfish	01/27/1930	1.00
+1041-1	US Bur Sport & Fish	02/19/1937	6.66
X1385-1	Homestake Mining Co	10/01/1876	1.67
1386-1	Walton-Schuler Ditch	03/20/1887	8.50
1387-1	Tonn-Evans Ditch	05/01/1876	14.40
1388-1	Bowman Ditch	06/11/1877	8.0
1389-1	Cook Ditch	06/10/1877	21.60
1392-1	Mann Ditch	03/21/1878	1.45
1394-1	Kemper Ditch	07/31/1881	33.00
1399-1	Cook-Burns Ditch	06/15/1881	33.0
1400-1	Owens-Gay Ditch	03/01/1877	1.74
1403-1	Ramsdell Ditch	10/01/1876	2.00
1416-1	Richard Cundy	04/01/1920	0.20

* - Power Generation, non-consumptive

+ - Fish Hatcher in City of Spearfish

X - For municipal use, City of Spearfish



DEPARTMENT OF WATER & NATURAL RESOURCES

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

GREAT FACES. GREAT PLACES.

APR 25 1991

1399-1

James Jennings
Cook-Burns Ditch Company
RR 1 Box 182C
Spearfish, SD 57783

Dear Mr. Jennings:

Enclosed are your Validated Vested Water Right and Water License No. 1399-1. As long as you use the water beneficially, as stated in the Water License, the State Water Laws provide that you have a continuing right to use the water.

Very truly yours,

A handwritten signature in cursive script that reads "John Hatch".

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

enclosures

1399-1

XMap® 4.5



Cook-Burns Ditch



Don Stroup
3/25/05
SD DENR



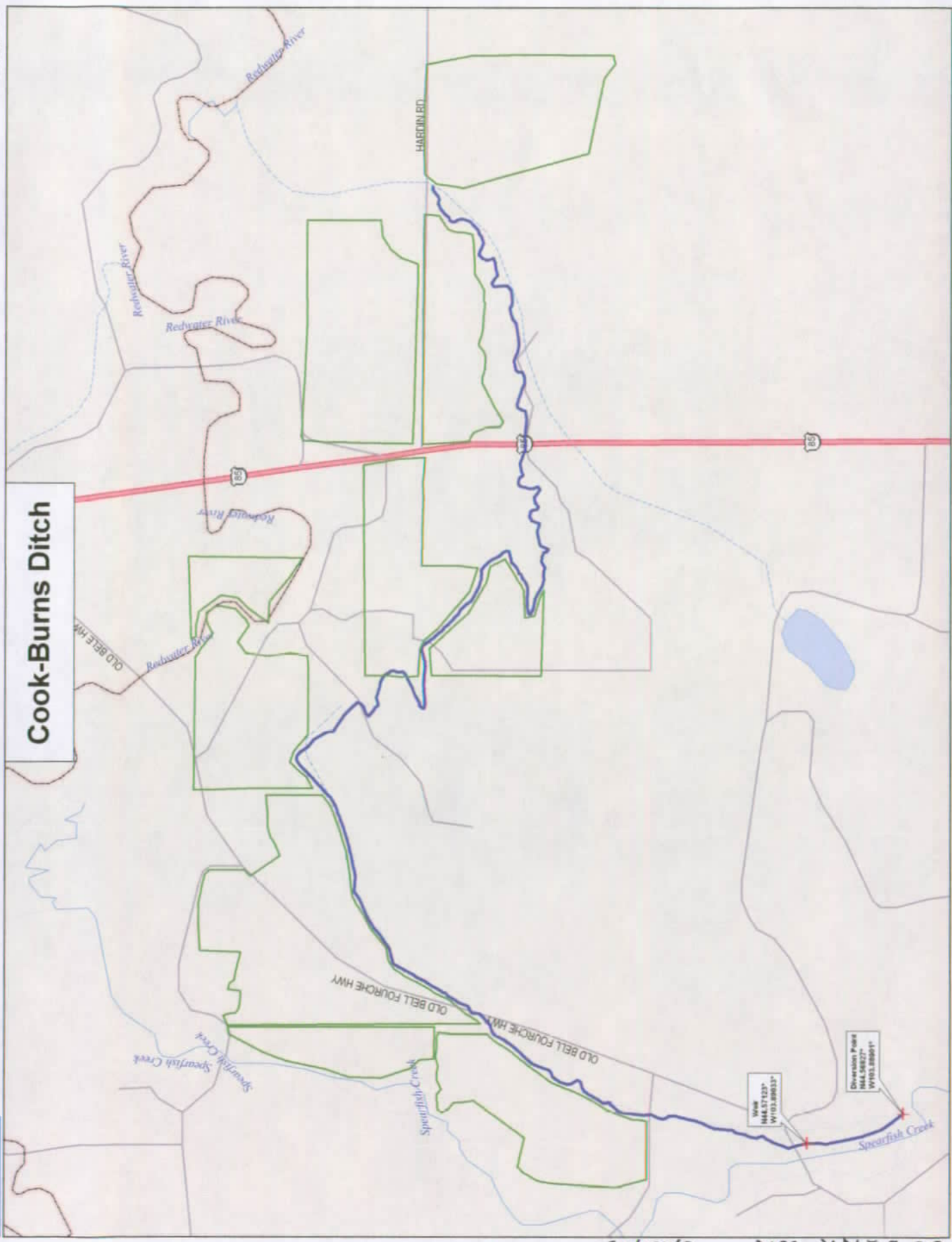
Data use subject to license.
© 2004 DeLorme, XMap® 4.5.
www.delorme.com

#1399-1

XMap® 4.5



Cook-Burns Ditch



Don Strong
8/25/05
SD DENR

SPEARFISH CREEK IRRIGATION DITCHES - CONTACT INFORMATION

Updated 7/8/14

1392-1	<table><tr><td>MANN DITCH</td></tr><tr><td>Edgar Burr</td></tr><tr><td>209 Evans Ln</td></tr><tr><td>Spearfish, SD</td></tr><tr><td>605-642-7963</td></tr></table>	MANN DITCH	Edgar Burr	209 Evans Ln	Spearfish, SD	605-642-7963	<table><tr><td>COOK DITCH</td></tr><tr><td>Mike McGuigan</td></tr><tr><td>2350 Dairy Ln</td></tr><tr><td>Spearfish, SD</td></tr><tr><td>605-641-2052</td></tr></table>	COOK DITCH	Mike McGuigan	2350 Dairy Ln	Spearfish, SD	605-641-2052	1389-1	
MANN DITCH														
Edgar Burr														
209 Evans Ln														
Spearfish, SD														
605-642-7963														
COOK DITCH														
Mike McGuigan														
2350 Dairy Ln														
Spearfish, SD														
605-641-2052														
1403-1	<table><tr><td>RAMSDELL DITCH</td></tr><tr><td>Mike Kyte</td></tr><tr><td>1121 N. Main St.</td></tr><tr><td>Spearfish, SD</td></tr><tr><td>605-642-4932</td></tr></table>	RAMSDELL DITCH	Mike Kyte	1121 N. Main St.	Spearfish, SD	605-642-4932	<table><tr><td>SPRING BRANCH DITCH</td></tr><tr><td>Ross Delzer</td></tr><tr><td>19481 US Hwy 85</td></tr><tr><td>Belle Fourche, SD</td></tr><tr><td>605-642-3778</td></tr></table>	SPRING BRANCH DITCH	Ross Delzer	19481 US Hwy 85	Belle Fourche, SD	605-642-3778	1424-1	
RAMSDELL DITCH														
Mike Kyte														
1121 N. Main St.														
Spearfish, SD														
605-642-4932														
SPRING BRANCH DITCH														
Ross Delzer														
19481 US Hwy 85														
Belle Fourche, SD														
605-642-3778														
1400-1	<table><tr><td>OWENS-GAY DITCH</td></tr><tr><td>Tom Callaway</td></tr><tr><td>City of Spearfish</td></tr><tr><td>Spearfish, SD</td></tr><tr><td>605-642-1333</td></tr></table>	OWENS-GAY DITCH	Tom Callaway	City of Spearfish	Spearfish, SD	605-642-1333	<table><tr><td>KEMPER-COOK-BURNS DITCHES</td></tr><tr><td>Eric Jennings</td></tr><tr><td>19488 Creekside Loop</td></tr><tr><td>Spearfish, SD</td></tr><tr><td>605-642-3411</td></tr></table>	KEMPER-COOK-BURNS DITCHES	Eric Jennings	19488 Creekside Loop	Spearfish, SD	605-642-3411	1399-1 1394-1	
OWENS-GAY DITCH														
Tom Callaway														
City of Spearfish														
Spearfish, SD														
605-642-1333														
KEMPER-COOK-BURNS DITCHES														
Eric Jennings														
19488 Creekside Loop														
Spearfish, SD														
605-642-3411														
1386-1	<table><tr><td>WALTON-SCHULER DITCH</td></tr><tr><td>David Rossi</td></tr><tr><td>Home 605-584-4904</td></tr><tr><td>Work 307-682-8530</td></tr><tr><td>Back up - Woody Hayes 605-645-2007</td></tr></table>	WALTON-SCHULER DITCH	David Rossi	Home 605-584-4904	Work 307-682-8530	Back up - Woody Hayes 605-645-2007	<table><tr><td>HIGGINS GULCH DITCH WEST</td></tr><tr><td>Layton Lensegrav</td></tr><tr><td>10902 SD Hwy 34</td></tr><tr><td>Belle Fourche, SD</td></tr><tr><td>605-641-1124 or 605-723-3095</td></tr></table>	HIGGINS GULCH DITCH WEST	Layton Lensegrav	10902 SD Hwy 34	Belle Fourche, SD	605-641-1124 or 605-723-3095	1412-1	
WALTON-SCHULER DITCH														
David Rossi														
Home 605-584-4904														
Work 307-682-8530														
Back up - Woody Hayes 605-645-2007														
HIGGINS GULCH DITCH WEST														
Layton Lensegrav														
10902 SD Hwy 34														
Belle Fourche, SD														
605-641-1124 or 605-723-3095														
1387-1**	<table><tr><td>TONN-EVANS DITCH</td></tr><tr><td>Jared Capp - President</td></tr><tr><td>609 Nellie Lane</td></tr><tr><td>Spearfish, SD</td></tr><tr><td>605-639-9041</td></tr></table>	TONN-EVANS DITCH	Jared Capp - President	609 Nellie Lane	Spearfish, SD	605-639-9041	<table><tr><td>HIGGINS GULCH DITCH EAST</td></tr><tr><td>Cundy Trust</td></tr><tr><td>c/o Jim Jennings-Co Trustee</td></tr><tr><td>19483 Old Belle Rd</td></tr><tr><td>Spearfish, SD</td></tr><tr><td>605-642-2146</td></tr></table>	HIGGINS GULCH DITCH EAST	Cundy Trust	c/o Jim Jennings-Co Trustee	19483 Old Belle Rd	Spearfish, SD	605-642-2146	1413-1
TONN-EVANS DITCH														
Jared Capp - President														
609 Nellie Lane														
Spearfish, SD														
605-639-9041														
HIGGINS GULCH DITCH EAST														
Cundy Trust														
c/o Jim Jennings-Co Trustee														
19483 Old Belle Rd														
Spearfish, SD														
605-642-2146														
1388-1	<table><tr><td>BOWMAN DITCH</td></tr><tr><td>Phil Kissack</td></tr><tr><td>19460 Creekside Loop</td></tr><tr><td>Spearfish, SD</td></tr><tr><td>605-642-4914</td></tr></table>	BOWMAN DITCH	Phil Kissack	19460 Creekside Loop	Spearfish, SD	605-642-4914								
BOWMAN DITCH														
Phil Kissack														
19460 Creekside Loop														
Spearfish, SD														
605-642-4914														

**1387-1 is actually listed in the name of Spearfish Tonn-Evans Ditch



DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES

JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182

denr.sd.gov

September 8, 2017

Eric Jennings
Kemper-Cook-Burns Ditches
19488 Creekside Loop
Spearfish, SD 57783

Kemper-Cook-Burns Ditches, Vested Water Right No. 1399-1 and 1394-1

Dear Mr. Jennings:

The hydroelectric facility that diverts Spearfish Creek flow near Maurice for power generation is undergoing construction activity. Specifically the city will be replacing the existing redwood penstock located above the hydro plant in the area between the forebay pond and the standpipe structure. This will result in a staged bypass into the natural creek channel at the Maurice dam. There will be a short period when all diversion into the hydro plant's tunnel will cease and the creek will flow freely below Maurice resulting in reduced flows in the creek downstream from the hydro generating plant near the city park.

A bypass at the Maurice dam of 20 cubic feet of water per second into the natural creek channel will begin approximately September 14, 2017. Total bypass into the natural creek channel will occur later in the month with a contractor scheduled completion date of October 3, 2017. While this will likely result in a temporary reduced flow, the city's goal is to keep water flowing through Spearfish and downstream areas without interruption.

While the irrigation season is winding down there are likely Spearfish Creek irrigation ditches still operating from the creek. Please notify others on your ditch of the potential temporary reduction of flow in Spearfish Creek through September to early October. We all know Spearfish Creek is a valuable resource to the area for irrigation, domestic use, aesthetics, and the fishery. As this construction project progresses DENR asks that everyone be mindful to maintain minimum flows in Spearfish Creek from Spearfish to the Redwater River to protect the resource.

If you have any questions please contact either Eric Gronlund of my staff at (605) 773-3352 or Cheryl Johnson, Spearfish Public Works Director at (605) 642-1333.

Thank you,


Jeanne Goodman, Chief Engineer
Water Rights Program

1392-1, 1403-1, 1386-1, 1388-1,
1389-1, 1424-1, 1399-1, 1394-1,
1412-1

SPEARFISH CREEK IRRIGATION DITCHES - CONTACT INFORMATION

Updated 7/8/14

1392-1	MANN DITCH Edgar Burr 209 Evans Ln Spearfish, SD 605-642-7963	COOK DITCH Mike McGuigan 2350 Dairy Ln Spearfish, SD 605-641-2052	1389-1
1403-1	RAMSDELL DITCH Mike Kyte 1121 N. Main St. Spearfish, SD 605-642-4932	SPRING BRANCH DITCH Ross Delzer 19481 US Hwy 85 Belle Fourche, SD 605-642-3778	1424-1
~~1400-1~~	~~OWENS-GAY DITCH Tom Callaway City of Spearfish Spearfish, SD 605-642-1333~~	KEMPER-COOK-BURNS DITCHES Eric Jennings 19488 Creekside Loop Spearfish, SD 605-642-3411	1399-1 1394-1
1386-1	WALTON-SCHULER DITCH David Rossi Home 605-584-4904 Work 307-682-8530 Back up - Woody Hayes 605-645-2007	HIGGENS GULCH DITCH WEST Layton Lensegrav 10902 SD Hwy 34 Belle Fourche, SD 605-641-1124 or 605-723-3095	1412-1
~~1387-1**~~	~~TONN-EVANS DITCH Jared Capp - President 609 Nellie Lane Spearfish, SD 605-639-9041~~	~~HIGGENS GULCH DITCH EAST Cundy Trust c/o Jim Jennings-Co Trustee 19483 Old Belle Rd Spearfish, SD 605-642-2146~~	~~1413-1~~
1388-1	BOWMAN DITCH Phil Kissack 19460 Creekside Loop Spearfish, SD 605-642-4914		

**1387-1 is actually listed in the name of Spearfish Tonn-Evans Ditch