

WATER PERMIT NO. 1836-1

Name of Applicant: USDA, Forest Service

Address: PO Box 50760, Billings MT 59105

Phone: 406 657-6200

Amount of Water Claimed: 378 AF

Total Acres: NA

Source of Water Supply: runoff – Campbell Creek

Water to be used for: fish & wildlife propagation and recreational

County: Harding

Type of Waste Disposal System:

Location: 15 miles northeast of Buffalo

PRIORITY

Date Received: 2-22-05

Application/License Fee: \$335.00

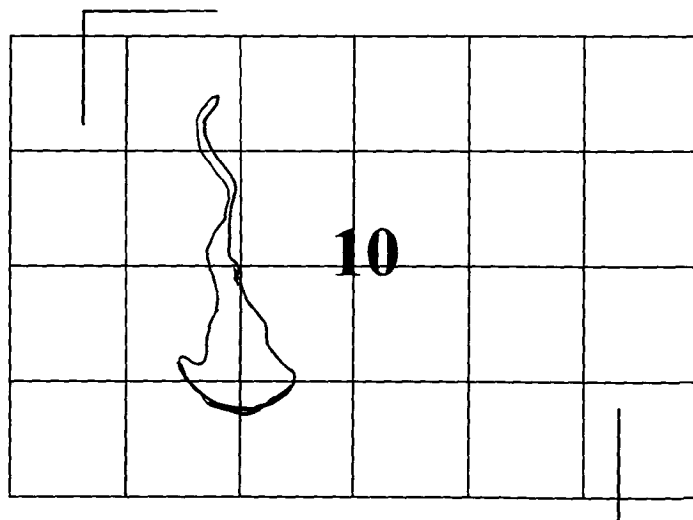
Corrected Application Received:

Period of Annual Use: January 1 – December 31

Remarks: dam has been in place since early 1960's

Diversion Point: SW ¼ Sec 10-T21N-R5E

Land to be Irrigated: SW ¼, W ½ NW ¼ Sec 10-
T21N-R5E



Depth of Well: NA

Well Driller: : NA

Remarks:

Type of Map: topo

Prepared by: Mark P Nienow, Custer Nat'l Forest

Reviewed and the Number Assigned on: 2-22-2005

By: Karen Schlaak

Notice of Hearing - date to intervene: _____

SD EForm - 1585 V1
FORM 2: Application for uses other than irrigation
(type or print)

Mail to: Water Rights Program Joe Foss Building 523 E. Capitol Pierre, SD 57501-3181 (605) 773-3352	No. <u>1836-1</u> (office use only)	Hydrologic Unit <u>10130302</u>
	Basin <u>Grand River</u>	
	Newspaper <u>Nation's Center News, Buffalo</u>	

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

Check use(s) of water:

☐ Municipal	☐ Suburban Housing	☒ Recreational	☐ Institutional
☐ Rural Water System	☐ Commercial	☒ Fish & Wildlife	☐ Geothermal Heat
☒ Domestic (over 18 gpm)	☐ Industrial	☒ Other <u>USDA - Forest Service</u>	

Type of Application:
(check one)

☒ **New** ☐ **Vested Right** (Use predates Mar 2, 1955) ☐ **Future Use Reservation**
☐ **Place to Beneficial Use Water Reserved by Future Use Permit No.** _____
☐ **Amendment/Correction to Permit No.** _____

Description of amendment/correction: (i.e. change diversion point(s), add diversion point(s), change use, etc.)

1. Name of Applicant USA, Dept. of Agriculture - Forest Service Phone (406) 657-6200
(check one) ☒ Owner ☐ Tenant/lessee
Mailing Address PO Box 50760 Billings State MT 59105
1310 Main (Street, RR, or Box and City) (Zip Code)
2. Amount of water claimed _____ *CFS or _____ **GPM 378.00 ***AF
(*Cubic Feet per Second) (**Gallons per Minute) (***)Acre Feet - storage capacity of dam/dugout or annual use if applicable)
3. Source of water supply Campbell Creek
4. Location of point of diversion (example - 3 wells in SW1/4 NE1/4 section 12-T104N-R53W) County Harding
SW 1/4 section 10, T21N, R5E Water Impounded: SW 1/4, W 1/2 NW 1/4 Sec 10-T21N-R5E
5. County or counties where water will be used Harding
6. Annual period during which water is to be used January 1 to December 31.
7. Give a description of the 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)

800 foot long earthen dam impounds 40.5 acre reservoir.

STATE OF ~~SOUTH DAKOTA~~ ^{Montana}

County of Yellowstone

Attachments: Attach Form 2A if diversion is from a well or dugout, or if storage of water is proposed. Attach map and any other technical information. (see instructions)

I, USDA FOREST SERVICE, the applicant, certify that I have read this application, have examined the attached map and that the matters stated are true and that I intend, and am able to complete the necessary construction.

Applicant's signature Gary P. Bonar, Deputy Forest Supervisor

Subscribed and sworn to before me this 10th day of February 20 05

Pusan W. Newell

Notary Public signature

(type or print in ink)

1. Well Information - Proposed Construction

- a) Drill Hole Diameter _____ Depth _____
- b) Casing Type _____ Diameter _____ Thickness _____
- c) Screen Type _____ Diameter _____ Thickness _____
- d) Gravel Pack _____ Length of Gravel Pack _____
- e) Depth to Top of Water Bearing Material _____
- f) Depth to Water (ground surface to water level) _____
- g) Distance to nearest existing domestic well: _____
- On applicants property _____ On property owned by others _____

2. Wastewater Disposal System Information

- a) Type of System (i.e. septic tank, drain field) _____
- b) System Capacity (gallons) _____ Year Constructed _____
- c) Connected to the City of _____ Sanitary System _____

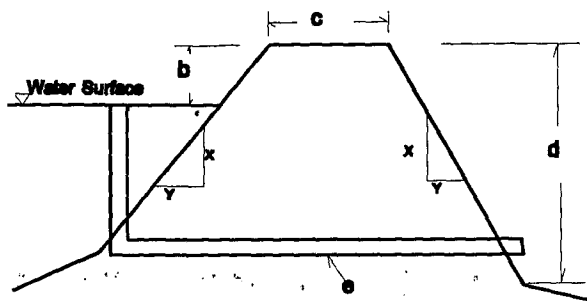
3. Dugout Information

- a) Surface Dimensions _____ Depth _____
- b) Depth to water (ground surface to water level) _____

4. Water Storage Dams

If the proposed water use system contains one or more storage dams, please furnish the information requested below for each dam. The locations of the dams need to be shown on the map submitted with the application.

- a) If a private engineering firm or government agency was involved in the design of this dam, please give their name and address:



- b) Freeboard _____ 4'
- c) Crest Width _____ 20'
- Crest Length _____ 800'
- d) Height _____ 25'
- e) Primary Outlet Capacity _____ not known
If pipe, diameter _____ 24" cnp (plugged)
- f) Secondary Spillway Capacity _____ not known
Spillway Width _____ 150'
- g) X & Y Slope _____
Upstream _____ 30 degrees
Downstream _____ 33 degrees
- h) Surface Area of Impoundment _____ 40.5
- i) Storage _____ 378.0 Acre Feet
- j) Drainage Area Above Dam _____ 8,320.0 Acres

**SOUTH DAKOTA
WATER PERMIT NO. 1836-1**

Date of first receipt of application February 22, 2005.

The Chief Engineer, on behalf of the Water Management Board, issues Water Permit No. 1836-1 to USDA, Forest Service, 1310 Main, Billings MT 59105 authorizing the construction of the water use system and the placing of water to beneficial use subject to the following limitations, conditions and qualifications:

1. Water Permit No. 1836-1 impound 378 acre-feet of water in an existing dam on Campbell Creek located in the SW $\frac{1}{4}$ Section 10 with water impounded in the SW $\frac{1}{4}$, W $\frac{1}{2}$ NW $\frac{1}{4}$ Section 10; all in T21N-R5E.
2. The water appropriated shall be used for the purpose of fish and wildlife propagation, recreational use, and livestock water and may not exceed the amount of water needed for beneficial use.
3. The water is to be used during the following described annual period: January 1 – December 31.
4. The date of approval of Permit No. 1836-1 is April 11, 2005.
5. The date from which applicant may claim right is February 22, 2005.
6. One-fifth of the construction is to be completed on or before October 11, 2007.
7. All construction is to be completed on or before April 11, 2010.
8. Water is to be put to beneficial use on or before April 11, 2014.
9. Water rights obtained in compliance with the laws of the State of South Dakota may not be unlawfully impaired by this appropriation.

QUALIFICATIONS

1. Water Permit No. 1836-1 authorizes a dam with a storage capacity of 378 acre feet of water and sufficient water annually to maintain the water level to the outlet elevation.
2. Low flows as needed for downstream domestic use, including livestock water and prior water rights must be by-passed.

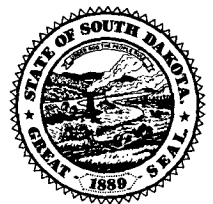
WATER MANAGEMENT BOARD

By: Garland Erbele

Garland Erbele, Chief Engineer
Water Rights Program
Department of Environment and Natural Resources

MAY 02 2005

date



RECEIPT

WATER RIGHTS PROGRAM

South Dakota Department of Environment and Natural Resources

Date February 22, 2005

Brenda Pretty Point, USDA, Custer NF SC, 1310 Main, Billings MT 59105

RECEIVED OF _____

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

Fee for Application for Permit No. _____ to Appropriate Water, to construct and to put water to beneficial use	285	00
Fee for Application for Permit No. _____ to Appropriate Water for Future use		
Fee to retain Future Use Permit No. _____ after period of seven years.		
Fee for Inspecting Constructed Works, confirming beneficial use and issuing Water License No. _____	50	00
Fee for Filing Transfer Form _____		
Fee for _____		
Fee for Issuing New Well Driller's License No. _____ for C.Y. _____		
Fee for Renewal of Well Driller's License No. _____ for C.Y. _____		
Fee for Issuing Well Pump Installer's License No. _____ for C.Y. _____		
Fee for Renewal of Well Pump Installer's License No. _____ for C.Y. _____		
(Any Other Work Provided by Law)	TOTAL	335.00

No.

001773

By

Garland Erbeke

Chief Engineer

KS



Prepared by:

Mark P. Nienow

Mark P. Nienow
Hydrologist
Custer National Forest
Billings, Montana

1/19/05

BM
2903

ADNER SE
OUTH RAY
MINUT/EY

Ludlow Page 2

DEPARTMENT OF AGRICULTURE
FOREST SERVICE



Browns
Pond →
SW 1/4, T21N, R5E
Hendling County





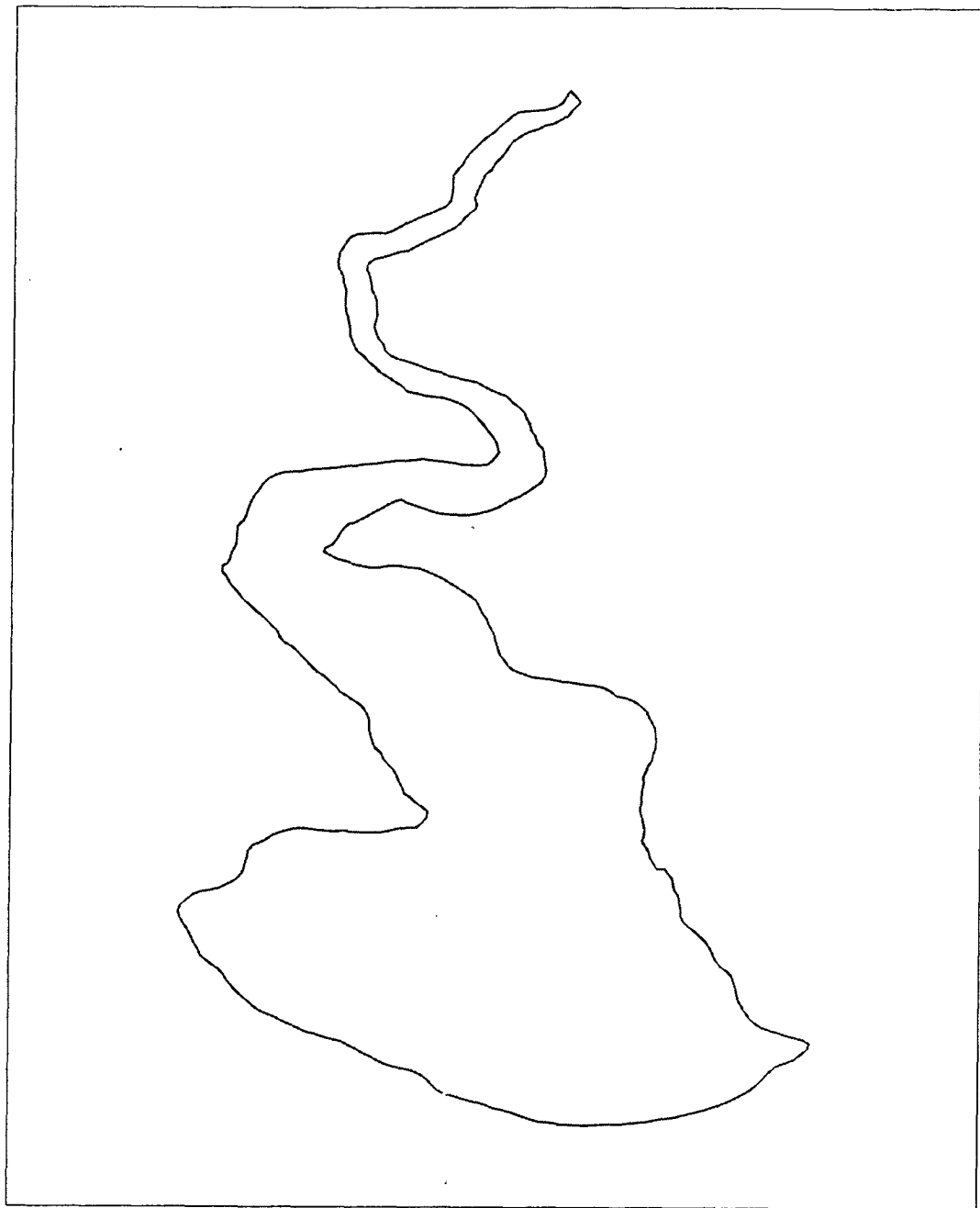
At SE corner of pond looking north



En dam looking west

Brown's Pond
T21N, R5E Sec 10
10/14/04

At spillway looking south.



40.45 ACRES

PERIMETER = 10,984'

Lat/Long
WGS 1984



Scale 1:5000
0 600.0
Feet

browndam.ssf
05/09/2000
Pathfinder Office
 **Trimble**

Water Permit Application No. 1836-1
 USDA - Forest Service
 Existing Dam - "Browns Pond"

Top of Dam Elev. - 2904
 Spillway Elev. - 2900
 Dis Toe Elev. - 2879

Cat. 3 Low Hazard Dam

Ht = 25 ft

Normal Storage Capacity - 378 A.-Ft
 Max Storage Capacity - 512

Max Capacity $\times$ Ht = $512 \times 25 = 12,800 > 3000$ i. 50 year
Min Spillway Design

The "Browns Pond Dam" was constructed in the early 1960s. Water Permit No. 409-1 was approved in 1959 and the dam was listed as a "Proposed Reservoir" with this permit. According to Safety of Dams Rules, Section 74.02:08:02 the dam is exempt from spillway requirements since it was constructed before 1966. If not, it would be required to have a Minimum Spillway Design capable of passing a 50 yr event.

From USGS Report 98-4055 - "Tech for Est Peak Flows ... for SD Streams"
 $CA = 8320 \text{ ac} = 13 \text{ mi}^2$
 Region C

$$Q_{50} = 286 CA^{.570}$$

$$= 286 (13)^{.57}$$

$$= \underline{1235 \text{ A.-Ft}}$$

$$Q_{100} = 379 CA^{.566}$$

$$= 379 (13)^{.566}$$

$$= \underline{1619 \text{ cfs}}$$

Spillway Flow

$$Q = CLH^{3/2}$$

$$= (2.6)(150)(4)^{1.5}$$

$$= \underline{3120 \text{ cfs}}$$

$C = 2.6$
 $L = 150$
 $H = 4 \text{ ft}$

NRCS Annual Yield

Soil types B&D ISO = 1

Pasture/Range land

Poor CN = 79-89 } use
 Good = 61-80 } 75

80% chance = $0.05 \times 8320/12 = \underline{35 \text{ A.-Ft}}$
 50% chance = $0.16 \times \text{ " } = \underline{110}$
 10% chance = $1.0 \times \text{ " } = \underline{693}$



July 28, 2000

**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

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

Susan Newell
Custer National Forest
PO Box 50760
Billings, MT 59105

Dear Ms. Newell:

On July 27th we spoke concerning the existence of a water permit or location notice on a dam located in the S $\frac{1}{2}$ SW $\frac{1}{4}$ Section 3 or the W $\frac{1}{2}$, S $\frac{1}{2}$ SE $\frac{1}{4}$ Section 10, T21N, R5E in Harding County, SD. I reviewed our files again and was unable to find a permit or location notice for the storage dam you mentioned.

It is my understanding that the storage dam has been there for 50-60 years and stores at least 45-acre feet of water. This size of storage dam would require a regular water permit as opposed to a location notice.

Enclosed, as we discussed, are water permit application forms and an instruction sheet. I have included an additional instruction sheet explaining how to file a vested right claim. If you can provide documentation (Affidavit of Water Use – Form 2B) showing that the storage dam impounded water prior to March 2, 1955, it would qualify for a vested right. The application for a vested right in the same as for a regular water permit but includes the additional information on the "Affidavit of Water Use" form. The filing fee for a vested right is \$15.00. The filing fee for a regular water permit (up to 120-acre feet of water) is \$200.00.

If you have any questions when completing the application, you may contact either Eric Gronlund or myself with our program at (605) 773-3352.

Sincerely,

Genny McMath
Environmental Scientist
Water Rights Program

enclosures



United States
Department of
Agriculture

Forest
Service

Region One

200 East Broadway
P.O. Box 7669
Missoula, MT 59807

File Code: 7500

Route To:

Date: July 13, 2001

Subject: Hazard Classification of Browns Pond Dam and Blacks Pond Dam

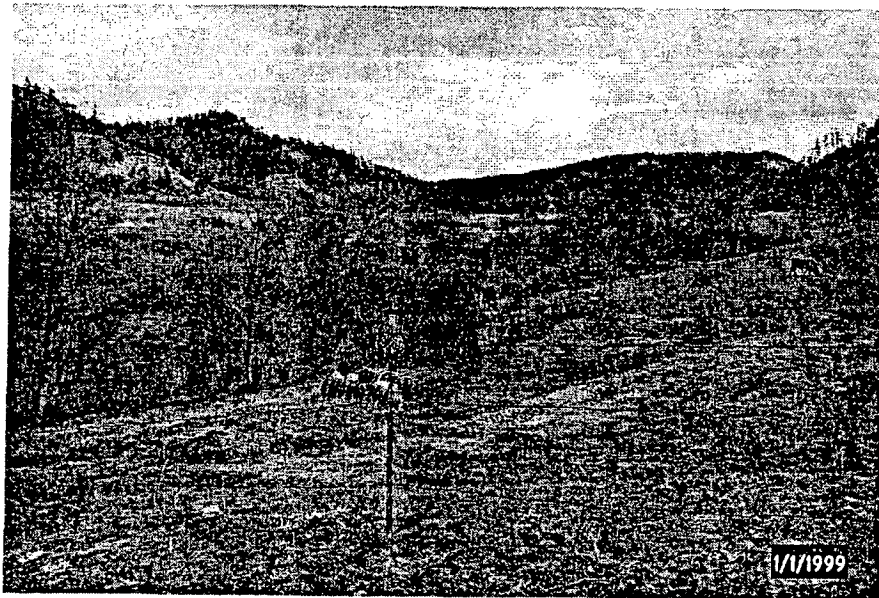
To: Forest Supervisor Custer National Forest

In accordance with FSM 7500, the hazard assessments for Browns Pond and Blacks Pond dams have been completed to the extent that neither dam is considered high hazard because no lives would likely be lost as a result of failure of either dam. The hazard assessment is predicated on routing the "clear weather" breach flood flow, and determining if any lives would likely be lost, and the extent of resource and economic damage. The difference between the remaining two hazard classifications, moderate and low, is the severity of the resource and economic damage due to the flood. A moderate hazard rating is assigned to dams where failure would result in severe resource and/or economic damage whereas a low hazard rating would imply minor resource and/or economic damage. The Forest should make the determination between moderate and low hazard based on the potential damages. The only management difference between moderate and low hazard dams is the required design emergency spillway flood flow, which is $\frac{1}{2}$ the Probable Maximum Flood (PMF) for moderate hazard and either 50 or 100 year floods for the low hazard dams.

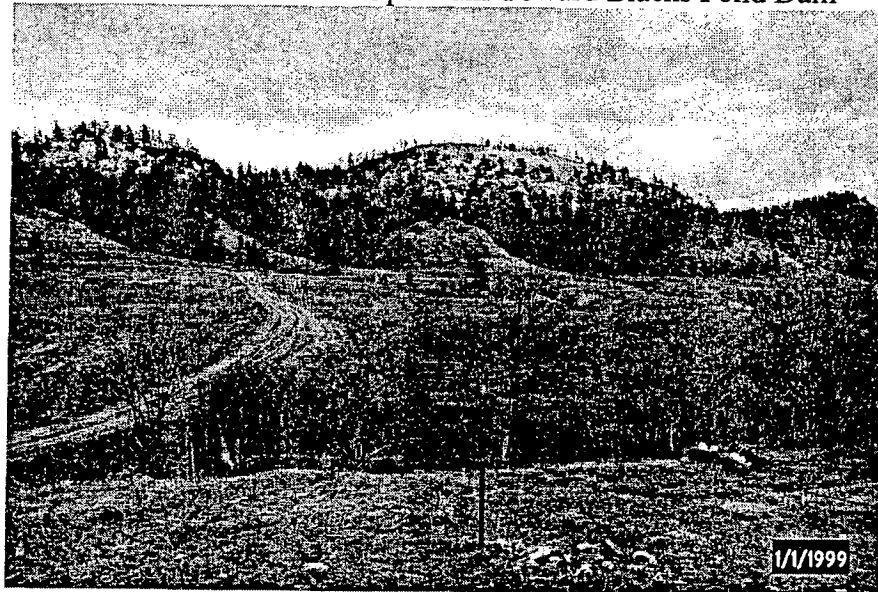
The "clear weather" dam failure and flood routing was performed using the Corp of Engineers HEC 1 program which is a state-of-the-practice dam breach, flood routing program. Copies of the printouts have been enclosed for completeness and documentation.

The primary concern in routing the Blacks Pond flood flow was potential impacts to the Bull Ranch, which is, located approximately 3 miles downstream. From the enclosed photos and the site survey by Terry Hoffman, Joe Gibbs and Doug McClelland, it is evident that there is approximately 15 feet of freeboard between the stream and the residence. The estimated flood depth was less than 8 feet.



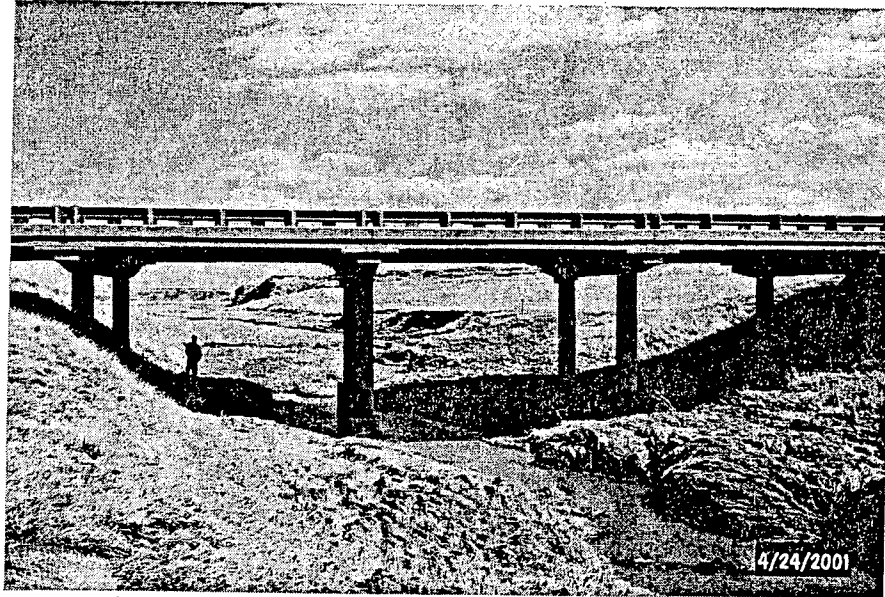


View from Bull Ranch Upstream Toward Blacks Pond Dam



View from Bull Ranch Residence Downstream of above photo

For Browns Pond the primary issue was the ability of the South Dakota State Highway 85 Bridge to pass the flood flow, which is shown in the enclosed photo. Although there is a new ranch development downstream of the dam and above the highway bridge, the residence is substantially above the floodplain. Using conservative parameters in the analyses, the flood flow at the bridge would be less than 400 cubic feet per second (cfs) estimated bridge capacity is approximately 1000 cfs.



View of Highway 85 Bridge Looking Downstream

In conclusion, neither dam is high hazard. The final determination between moderate and low hazard should be made by the Forest based on the estimated resource and/or economic damages. If there are questions, contact Doug McClelland, Regional Geotech/Dams engineer, who performed the analyses.

/s/ Thomas Pettigrew, Jr.
THOMAS PETTIGREW, JR.
Director of Engineering

IN-SERVICE DATE

Property No.: 3486

Property Name: BROWN'S POND

In-service Date: 4/30/1962

I have reviewed the In-service Date for the structure/facility listed above. I have visually observed the structure/facility and noted the materials used in the construction, the architecture and appearance, and other information available on it. I believe the In-service date is a reasonable and accurate representation of the period in time that the facility/structure was placed in service by the Forest Service.

Engineering Representative: De Kay

Date: 09/24/01



United States
Department of
Agriculture

Forest
Service

Custer National Forest

1310 Main Street
Billings, MT 59105
406 657-6200

File Code: 2500

Date: February 9, 2005

Genny McMath
Water Rights Program, DENR
Joe Foss Building
523 E. Capitol
Pierre, SD 57501-3181

RECEIVED
FEB 22 2005
WATER RIGHTS
PROGRAM

Dear Ms. McMath:

Through a land purchase in 2000, the Custer National Forest acquired private property in Harding County. A 40 acre reservoir and dam are located on this property in the SW ¼ of section 10, T21N, R5E. Past discussion and correspondence with you indicate that a water right permit or location notice has not been filed for this reservoir. I would like to proceed with the filing process at this time.

To the best of my knowledge, the dam was constructed in the early 1960's. As such, it does not qualify for a vested right under South Dakota Water Law and therefore a regular water permit is required. Although the reservoir water initially may have been used for irrigation, the primary use now is for recreation, fish and wildlife habitat, and stockwater.

Attached are copies of:

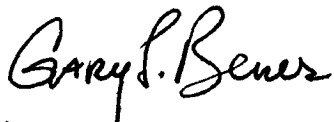
- 1) SD EForm-1585 V1, Form 2: Application for uses other than irrigation (2 copies)
- 2) SD EForm-0459 V1, Location notice for dam/dugout
- 3) 2-11" x 17" topographic maps identifying the location of the reservoir and delineation of the contributing watershed
- 4) GPS delineation of reservoir perimeter
- 5) Hazard Classification documentation and supporting HEC-1 program results
- 6) In-service date documentation
- 7) Photos of dam and spillway channel
- 8) Orthophoto of reservoir and surrounding land
- 9) Past correspondence between you and the Forest
- 10) A check for \$335.00 for application fees

The hazard classification documentation is provided in lieu of dam construction plans and specifications. Phone conversations with Tim Schaal indicated this is appropriate.



If you have questions concerning this application, please contact Mark Nienow (Forest Hydrologist) at 406-657-6207 - ext. 227.

Sincerely,

A handwritten signature in cursive script that reads "Gary L. Bener".

for

NANCY T. CURRIDEN
Forest Supervisor

Enclosures

Mail to: Water Rights Program
DENR, Foss Bldg.
523 E. Capitol
Pierre, SD 57501-3181
(605) 773-3352

LOCATION NOTICE FOR DAM\DUGOUT

Location Notice No. (Office Use)

I, Nancy T. Curriden, Forest Supervisor, Custer National Forest, of
Name

<u>1310 Main Street</u>	<u>Billings</u>	<u>MT</u>	<u>59105</u>
Address	City	State	Zip Code

(check one) ☐ owner, ☒ operator, of the following described land, do hereby notify the Water Management Board of the State of South Dakota and all others concerned that I am exercising my right under SDCL 46-4, for construction of a (check one) ☒ dam, ☐ *dugout for the purpose of impounding runoff waters for recreation, fish and wildlife habitat and other Forest Service purposes.
type of use - livestock, recreation, fish & wildlife, etc.

The following data is presented in compliance with SDCL 46-4-3 and 46-4-4.

(1) Date of:

(a) This notice 2/1/2005

(b) Proposed construction _____

(2) Legal description of the land upon which the dam\dugout is located:

SW 1/4 section 10, T21N, R5E

(describe to the nearest 40 acre subdivision, e.g. NE1/4SW1/4 section 10-T98N-R65W)

(3) Location of the dam\dugout from a section corner:

3800' northwest from section 10/section 4 corner.

(describe distance N.S.E.W. in feet from the section corner)

(4) County where dam\dugout is located Harding

(5) Name of landowner USA, Dept. of Agriculture, Forest Service

(6) **Acre feet of water claimed annually 378.00

* A location notice is required for a dugout only if the dugout captures surface runoff.

** If the storage of the proposed structure at the spillway crest or overflow elevation exceeds twenty five (25) acre feet, a water permit from the Water Management Board is required.

(7) Complete the following information for the proposed dam/dugout:

*Items to be completed for a dugout

*a) Dam/Dugout designed by

b) Freeboard 4'

c) Crest Width 20'

Crest Length 800'

d) Height 25'

*Depth, if Dugout _____

e) Outlet Dimensions

Pipe diameter 24" cmp

Spillway width 150'

f) X & Y Slope: _____

Upstream 30 degrees

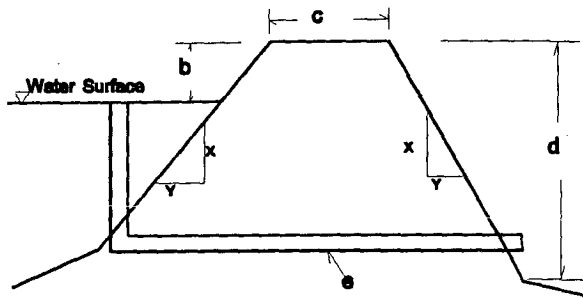
Downstream 33 degrees

*g) Water surface area 40.5 acres

*h) Storage at spillway crest or overflow elevation
(acre feet) 378

i) Maximum storage to top of dam crest
(acre feet) not known

*j) Drainage area above dam/dugout
(acres) 8320



Enclosed is ten dollars (\$10.00). The Water Management Board is requested to file this copy of the Location Notice in their official records. The original Location Notice has been filed (do not record) with the Register of Deeds of Harding County in accordance with SDCL 46-4-3.

USDA FOREST SERVICE

(or)

Owner

Locator

STATE OF ~~SOUTH DAKOTA~~ Montana)
COUNTY OF Yellowstone) SS

☒ USDA FOREST SERVICE the applicant, certify that I have read this Location Notice and that the matters stated in this notice are true and that I intend, and am able to start construction within sixty days after the filing of this notice.

Signed Gary P. Benes, Deputy Forest Supervisor

Subscribed and sworn to before me this 10th day of February, 20 05

(seal)

Susan W. Newell

Notary

Browns Pond

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1*****
*****
*
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* U.S. ARMY CORPS OF ENGINEERS
* JUN 1998
* HYDROLOGIC ENGINEERING CENTER
* VERSION 4.1
* 609 SECOND STREET
*
* DAVIS, CALIFORNIA 95616
* RUN DATE 21JUN01 TIME 15:43:06
* (916) 756-1104
*
*****
*****

```

X		X	X	XXXXXXX	XXXXX
XX		X	X	X	X
X		X	X	X	
XXXXX	X			XXXXXX	XXXX
X		X	X	X	
X		X	X	X	X
XXX		X	X	XXXXXXX	XXXXX

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.

THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION

NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,

DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION

KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

LINE
ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....
10

		1	ID	Browns Pond Dam						
		2	ID	Custer NF						
		3	ID	March 2001						
		4	ID	Normal Reservoir Elevation at 2900						
			*	** TIME SPECIFICATION						
		5	IT	2	300					
			*							
			*	*** GLOBAL OUTPUT OPTIONS						
		6	IO	1	0					
			*							
			*	*** Breach of dam						
			*							
		7	KK	Breach						
		8	KM	Breach of dam						
		9	RS	1.0	ELEV	2900				
		10	SA	0.0	13.0	27.0	40.45			
		11	SE	2881	2887	2893	2900			
		12	SQ	0.0						
		13	SE	2900						
		14	ST	2900	800	3.0	1.5			
		15	SB	2881	75	1.0	0.3	2900		
			*							
			*	***						
		16	KK	REACH1						
		17	KM	Dam-2000						
		18	RD							
		19	RC	0.040	0.040	0.040	2000	0.005		
		20	RX	0.0	100	700	800	950	955	
960	965									
		21	RY	2900	2880	2870	2880	2900	2901	
2902	2903									
			*							
			*	***						
			*							
		22	KK	REACH2						
		23	KM	2000-11,000						
		24	RD							
		25	RC	0.040	0.040	0.040	9000	0.005		
		26	RX	0.0	100	600	1500	1600	1605	
1610	1615									
		27	RY	2860	2840	2831	2840	2860	2861	
2862	2863									
		28	KK	REACH3						
		29	KM	11,000-16,000						
		30	RD							
		31	RC	0.040	0.040	0.040	5000	0.001		
		32	RX	1.0	200	250	300	1700	1800	
1805	1810									

		33		RY	2880	2860	2840	2825	2840	2860
2861	2862									
		34		KK	REACH4					
		35		KM	16,000-20,000					
		36		RD						
		37		RC	0.040	0.040	0.040	4000	0.001	
		38		RX	1.0	100	150	200	250	1300
1305	1310									
		39		RY	2860	2840	2820	2817	2820	2840
2841	2842									
1					HEC-1 INPUT					
PAGE	2									

LINE
ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....
10

		40		KK	REACH5					
		41		KM	20,000-29,000					
		42		RD						
		43		RC	0.040	0.040	0.040	9000	0.001	
		44		RX	1.0	700	1500	2250	2950	2951
2952	2953									
		45		RY	2840	2820	2807	2820	2840	2841
2842	2843									
		46		ZZ						

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1*****
*****
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* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* U.S. ARMY CORPS OF ENGINEERS
* JUN 1998
* HYDROLOGIC ENGINEERING CENTER
* VERSION 4.1
* 609 SECOND STREET
*
* DAVIS, CALIFORNIA 95616
* RUN DATE 21JUN01 TIME 15:43:06
* (916) 756-1104
*
*
*****
*****

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Browns Pond Dam
Custer NF
March 2001
Normal Reservoir Elevation at 2900

IPRNT 1 PRINT CONTROL
 IPLOT 0 PLOT CONTROL
 QSCAL 0. HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA
 NMIN 2 MINUTES IN COMPUTATION INTERVAL
 IDATE 1 3 0 STARTING DATE
 ITIME 0000 STARTING TIME
 NQ 101 NUMBER OF HYDROGRAPH ORDINATES
 NDDATE 1 0 ENDING DATE
 NDTIME 0320 ENDING TIME
 ICENT 19 CENTURY MARK

COMPUTATION INTERVAL .03 HOURS
 TOTAL TIME BASE 3.33 HOURS

ENGLISH UNITS
 DRAINAGE AREA SQUARE MILES
 PRECIPITATION DEPTH INCHES
 LENGTH, ELEVATION FEET
 FLOW CUBIC FEET PER SECOND
 STORAGE VOLUME ACRE-FEET
 SURFACE AREA ACRES
 TEMPERATURE DEGREES FAHRENHEIT

*** **
 *** **

 * Breach *
 *

 Breach of dam

HYDROGRAPH ROUTING DATA
 9 RS STORAGE ROUTING
 NSTPS 1 NUMBER OF SUBREACHES
 ITYP ELEV TYPE OF INITIAL CONDITION
 RSVRIC 2900.00 INITIAL CONDITION
 X .00 WORKING R AND D COEFFICIENT
 10 SA AREA .0 13.0 27.0 40.5
 11 SE ELEVATION 2881.00 2887.00 2893.00 2900.00
 12 SQ DISCHARGE 0.
 13 SE ELEVATION 2900.00
 14 ST TOP OF DAM
 TOPEL 2900.00 ELEVATION AT TOP OF DAM
 DAMWID 800.00 DAM WIDTH

*Probably wrong
 Top of Dam Elev
 should be 2904
 Normal Pool & Spilling
 @ Elev. 2900*

COQD 3.00 WEIR COEFFICIENT
 EXPD 1.50 EXPONENT OF HEAD

15 SB BREACH DATA
 ELBM 2881.00 ELEVATION AT BOTTOM OF BREACH
 BRWID 75.00 WIDTH OF BREACH BOTTOM
 Z 1.00 BREACH SIDE SLOPE
 TFAIL .30 TIME FOR BREACH TO DEVELOP
 FAILEL 2900.00 W.S. ELEVATION TO TRIGGER FAILURE

DATA COMPUTED STORAGE-ELEVATION

STORAGE	.00	26.00	143.47	377.96
ELEVATION	2881.00	2887.00	2893.00	2900.00

DATA COMPUTED STORAGE-OUTFLOW-ELEVATION

(INCLUDING FLOW OVER DAM)

STORAGE	.00	26.00	143.47	377.96	512
OUTFLOW	.00	.00	.00	.00	
ELEVATION	2881.00	2887.00	2893.00	2900.00	2904

BEGIN DAM FAILURE AT .00 HOURS

HYDROGRAPH AT STATION

Breach

*

*

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE			
STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE

*

*

1	0000	1	0.	378.0	2900.0	*	1	0108	35	0.	.0
2881.0	*	1	0216	69	0.	.0	2881.0				
1	0002	2	94.	377.9	2900.0	*	1	0110	36	0.	.0
2881.0	*	1	0218	70	0.	.0	2881.0				
1	0004	3	530.	377.1	2900.0	*	1	0112	37	0.	.0
2881.0	*	1	0220	71	0.	.0	2881.0				
1	0006	4	1441.	374.5	2899.9	*	1	0114	38	0.	.0
2881.0	*	1	0222	72	0.	.0	2881.0				
1	0008	5	2888.	368.7	2899.8	*	1	0116	39	0.	.0
2881.0	*	1	0224	73	0.	.0	2881.0				
1	0010	6	4876.	358.1	2899.5	*	1	0118	40	0.	.0
2881.0	*	1	0226	74	0.	.0	2881.0				

1	0012	7	7346.	341.3	2899.1	* 1	0120	41	0.	.0
2881.0	*	1	0228 75	0.	.0	2881.0				
1	0014	8	10179.	317.3	2898.4	* 1	0122	42	0.	.0
2881.0	*	1	0230 76	0.	.0	2881.0				
1	0016	9	13199.	285.1	2897.6	* 1	0124	43	0.	.0
2881.0	*	1	0232 77	0.	.0	2881.0				
1	0018	10	16177.	244.6	2896.4	* 1	0126	44	0.	.0
2881.0	*	1	0234 78	0.	.0	2881.0				
1	0020	11	14000.	203.1	2895.1	* 1	0128	45	0.	.0
2881.0	*	1	0236 79	0.	.0	2881.0				
1	0022	12	12092.	167.2	2893.9	* 1	0130	46	0.	.0
2881.0	*	1	0238 80	0.	.0	2881.0				
1	0024	13	10427.	136.2	2892.7	* 1	0132	47	0.	.0
2881.0	*	1	0240 81	0.	.0	2881.0				
1	0026	14	8938.	109.6	2891.7	* 1	0134	48	0.	.0
2881.0	*	1	0242 82	0.	.0	2881.0				
1	0028	15	7602.	86.8	2890.6	* 1	0136	49	0.	.0
2881.0	*	1	0244 83	0.	.0	2881.0				
1	0030	16	6412.	67.6	2889.6	* 1	0138	50	0.	.0
2881.0	*	1	0246 84	0.	.0	2881.0				
1	0032	17	5364.	51.4	2888.7	* 1	0140	51	0.	.0
2881.0	*	1	0248 85	0.	.0	2881.0				
1	0034	18	4451.	37.9	2887.9	* 1	0142	52	0.	.0
2881.0	*	1	0250 86	0.	.0	2881.0				
1	0036	19	3664.	26.7	2887.1	* 1	0144	53	0.	.0
2881.0	*	1	0252 87	0.	.0	2881.0				
1	0038	20	2952.	17.6	2886.3	* 1	0146	54	0.	.0
2881.0	*	1	0254 88	0.	.0	2881.0				
1	0040	21	2255.	10.5	2885.4	* 1	0148	55	0.	.0
2881.0	*	1	0256 89	0.	.0	2881.0				
1	0042	22	1574.	5.2	2884.5	* 1	0150	56	0.	.0
2881.0	*	1	0258 90	0.	.0	2881.0				
1	0044	23	910.	1.8	2883.5	* 1	0152	57	0.	.0
2881.0	*	1	0300 91	0.	.0	2881.0				
1	0046	24	268.	.2	2882.1	* 1	0154	58	0.	.0
2881.0	*	1	0302 92	0.	.0	2881.0				
1	0048	25	0.	.0	2881.0	* 1	0156	59	0.	.0
2881.0	*	1	0304 93	0.	.0	2881.0				
1	0050	26	0.	.0	2881.0	* 1	0158	60	0.	.0
2881.0	*	1	0306 94	0.	.0	2881.0				
1	0052	27	0.	.0	2881.0	* 1	0200	61	0.	.0
2881.0	*	1	0308 95	0.	.0	2881.0				
1	0054	28	0.	.0	2881.0	* 1	0202	62	0.	.0
2881.0	*	1	0310 96	0.	.0	2881.0				
1	0056	29	0.	.0	2881.0	* 1	0204	63	0.	.0
2881.0	*	1	0312 97	0.	.0	2881.0				
1	0058	30	0.	.0	2881.0	* 1	0206	64	0.	.0
2881.0	*	1	0314 98	0.	.0	2881.0				
1	0100	31	0.	.0	2881.0	* 1	0208	65	0.	.0
2881.0	*	1	0316 99	0.	.0	2881.0				

*

*

PEAK OUTFLOW IS 16177. AT TIME .30 HOURS

1THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .006 HOURS DURING BREACH FORMATION.

DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF .033 HOURS.

THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.

INTERMEDIATE FLOWS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

ERROR	ACCUMULATED	TIME ACCUMULATED	TIME FROM BEGINNING	INTERPOLATED BREACH	-	COMPUTED BREACH	=
ERROR	ERROR	(HOURS)	OF BREACH	HYDROGRAPH		HYDROGRAPH	
(CFS)	(CFS)	(AC-FT)	(HOURS)	(CFS)		(CFS)	
		.000	.000	0.		0.	
0.	0.	0.	.006	16.		1.	
15.	15.	0.	.011	31.		6.	
25.	40.	0.	.017	47.		17.	
30.	71.	0.	.022	63.		34.	
29.	99.	0.	.028	79.		60.	
19.	118.	0.	.033	94.		94.	
0.	118.	0.	.039	167.		139.	
28.	146.	0.	.044	240.		193.	
46.	193.	0.	.050	312.		259.	
53.	245.	0.	.056	385.		337.	
48.	293.	0.	.061	458.		427.	
30.	324.	0.	.067	530.		530.	
0.	324.	0.	.072	682.		647.	
35.	359.	0.	.078	834.		777.	
57.	416.	0.	.083	985.		921.	
65.	481.	0.	.089	1137.		1079.	
58.	538.	0.					

			.094	.094	1289.	1253.
36.	575.	0.	.100	.100	1441.	1441.
0.	575.	0.	.106	.106	1682.	1644.
38.	613.	0.	.111	.111	1923.	1862.
61.	674.	0.	.117	.117	2164.	2096.
69.	743.	0.	.122	.122	2406.	2345.
61.	804.	0.	.128	.128	2647.	2609.
38.	842.	0.	.133	.133	2888.	2888.
0.	842.	0.	.139	.139	3220.	3183.
37.	879.	0.	.144	.144	3551.	3493.
58.	937.	0.	.150	.150	3882.	3817.
65.	1002.	0.	.156	.156	4214.	4156.
58.	1060.	0.	.161	.161	4545.	4509.
36.	1096.	1.	.167	.167	4876.	4876.
0.	1096.	1.	.172	.172	5288.	5257.
31.	1127.	1.	.178	.178	5700.	5651.
49.	1176.	1.	.183	.183	6111.	6057.
54.	1230.	1.	.189	.189	6523.	6475.
48.	1278.	1.	.194	.194	6934.	6905.
29.	1307.	1.	.200	.200	7346.	7346.
0.	1307.	1.	.206	.206	7818.	7797.
21.	1328.	1.	.211	.211	8290.	8257.
33.	1361.	1.	.217	.217	8763.	8727.
36.	1397.	1.	.222	.222	9235.	9204.
31.	1428.	1.	.228	.228	9707.	9688.
19.	1447.	1.	.233	.233	10179.	10179.
0.	1447.	1.	.239	.239	10682.	10675.
8.	1454.	1.	.244	.244	11186.	11175.
11.	1465.	1.				

10.	1475.	1.	.250	.250	11689.	11679.
			.256	.256	12192.	12185.
7.	1483.	1.	.261	.261	12696.	12692.
4.	1487.	1.	.267	.267	13199.	13199.
0.	1487.	1.	.272	.272	13695.	13705.
-10.	1477.	1.	.278	.278	14192.	14209.
-17.	1459.	1.	.283	.283	14688.	14710.
-22.	1438.	1.	.289	.289	15184.	15205.
-21.	1416.	1.	.294	.294	15681.	15695.
-14.	1402.	1.	.300	.300	16177.	16177.
0.	1402.	1.				

1

TIME	(O) INTERPOLATED BREACH HYDROGRAPH	STATION	Breach (*)
POINTS AT NORMAL TIME INTERVAL			
(HRS)			

	0.	2000.	4000.	6000.	8000.	10000.	12000.
14000.	16000.	18000.	0.	0.	0.		
.00	1 *						
.01	2 B	.	.	.	.	.	.
.01	3 B	.	.	.	.	.	.
.02	4 B	.	.	.	.	.	.
.02	5 B	.	.	.	.	.	.
.03	6 B	.	.	.	.	.	.
.03	7 *	.	.	.	.	.	.
.04	8 .B	.	.	.	.	.	.
.04	9 .B	.	.	.	.	.	.
.05	10 .BO	.	.	.	.	.	.
.06	11 . B	.	.	.	.	.	.
.06	12 . B	.	.	.	.	.	.
.07	13 . *	.	.	.	.	.	.
.07	14 . B	.	.	.	.	.	.
.08	15 . B	.	.	.	.	.	.

.08	16	.	B	.	.	.	.	.	.	.	.
.09	17	.	BO	.	.	.	.	.	.	.	.
.09	18	.	B	.	.	.	.	.	.	.	.
.10	19	.	*	.	.	.	.	.	.	.	.
.11	20	.	B	.	.	.	.	.	.	.	.
.11	21	.	.	BO	.	.	.	.	.	.	.
.12	22	.	.	BO	.	.	.	.	.	.	.
.12	23	.	.	B	.	.	.	.	.	.	.
.13	24	.	.	B	.	.	.	.	.	.	.
.13	25	.	.	*	.	.	.	.	.	.	.
.14	26	.	.	B	.	.	.	.	.	.	.
.14	27	.	.	BO	.	.	.	.	.	.	.
.15	28	.	.	B.	.	.	.	.	.	.	.
.16	29	.	.	.	B	.	.	.	.	.	.
.16	30	.	.	.	B	.	.	.	.	.	.
.17	31	.	.	.	.	*	.	.	.	.	.
.17	32	.	.	.	B	.	.	.	.	.	.
.18	33	.	.	.	B	.	.	.	.	.	.
.18	34	.	.	.	BO	.	.	.	.	.	.
.19	35	.	.	.	.	BO	.	.	.	.	.
.19	36	.	.	.	.	B	.	.	.	.	.
.20	37	.	.	.	.	*	.	.	.	.	.
.21	38	.	.	.	.	B.	.	.	.	.	.
.21	39	.	.	.	.	.	B	.	.	.	.
.22	40	.	.	.	.	.	B	.	.	.	.
.22	41	.	.	.	.	.	.	B	.	.	.
.23	42	.	.	.	.	.	.	BO.	.	.	.
.23	43	.	.	.	.	.	.	.	*	.	.

.24	44	.	.	.	.	.	B	.
.24	45	.	.	.	.	.	B	.
.25	46	.	.	.	.	.	B	.
.26	47	.	.	.	.	.	B	.
.26	48	.	.	.	.	.	B	.
.27	49	.	.	.	.	.	*	.
.27	50	.	.	.	.	.	.	.
OB.	.28	51	.	.	.	.	.	.
B.	.28	52	.	.	.	.	.	.
OB	.29	53	.	.	.	.	.	.
B	.29	54	.	.	.	.	.	.
B	.30	55	.	.	.	.	.	.
.	.	*	.	.	.	.	.	.
1								

PEAK FLOW	TIME		6-HR	24-HR	72-HR	3.33-HR
+	(CFS)	(HR)				
+	16177.	.30	1376.	1376.	1376.	1376.
		(CFS)				
		(INCHES)	.000	.000	.000	.000
		(AC-FT)	379.	379.	379.	379.

PEAK STORAGE	TIME		6-HR	24-HR	72-HR	3.33-HR
+	(AC-FT)	(HR)				
+	378.	.00	42.	42.	42.	42.

PEAK STAGE	TIME		6-HR	24-HR	72-HR	3.33-HR
+	(FEET)	(HR)				
+	2900.00	.01	2883.76	2883.76	2883.76	2883.76

CUMULATIVE AREA = .00 SQ MI

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16 KK * REACH1 *

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Dam-2000

HYDROGRAPH ROUTING DATA

18 RD MUSKINGUM-CUNGE CHANNEL ROUTING

19 RC NORMAL DEPTH CHANNEL

ANL	.040	LEFT OVBANK N-VALUE
ANCH	.040	MAIN CHANNEL N-VALUE
ANR	.040	RIGHT OVBANK N-VALUE
RLNTH	2000.	REACH LENGTH
SEL	.0050	ENERGY SLOPE
ELMAX	.0	MAX. ELEV. FOR STORAGE/OUTFLOW

CALCULATION

CROSS-SECTION DATA

+ --- RIGHT OVBANK ---			--- LEFT OVBANK ---		+ --- MAIN CHANNEL ---		
21 RY	ELEVATION		2900.00	2880.00	2870.00	2880.00	2900.00
2901.00	2902.00	2903.00					
20 RX	DISTANCE		.00	100.00	700.00	800.00	950.00
955.00	960.00	965.00					

COMPUTED STORAGE-OUTFLOW-ELEVATION

DATA

	STORAGE	.00	4.85	19.39	43.63	77.56
121.19	174.28	231.38	290.22	350.79		
	OUTFLOW	.00	252.99	1606.36	4736.09	10199.76
18493.39	30687.84	48262.62	69107.80	93095.40		
	ELEVATION	2870.00	2871.74	2873.47	2875.21	2876.95
2878.68	2880.42	2882.16	2883.89	2885.63		
	STORAGE	413.09	477.12	542.88	610.37	679.60
750.55	823.24	897.66	973.53	1050.14		
	OUTFLOW	120139.20	150180.10	183177.30	219103.30	257940.80
299680.20	344317.80	391854.80	445189.10	503932.40		
	ELEVATION	2887.37	2889.10	2890.84	2892.58	2894.32
2896.05	2897.79	2899.53	2901.26	2903.00		

COMPUTED MUSKINGUM-CUNGE PARAMETERS

COMPUTATION TIME STEP

TIME TO	VOLUME	ELEMENT MAXIMUM	ALPHA	M	DT	DX	PEAK
PEAK		CELERITY					
(MIN)	(IN)	(FPS)			(MIN)	(FT)	(CFS)
		MAIN			.90	400.00	13760.70
22.50	-1.00	6.83					

INTERPOLATED TO SPECIFIED COMPUTATION

INTERVAL

22.00 -1.00 MAIN 2.00 13658.78

HYDROGRAPH AT STATION

REACH1

* DA MON HRMN ORD				* DA MON HRMN ORD				* DA MON			
HRMN	ORD	FLOW	*	DA MON	HRMN	ORD	FLOW	FLOW	*	DA MON	
1	0000	1	0.	1	0052	27	1222.	1			
0144	53	0.	*	1	0236	79	0.				
1	0002	2	0.	1	0054	28	910.	1			
0146	54	0.	*	1	0238	80	0.				
1	0004	3	0.	1	0056	29	628.	1			
0148	55	0.	*	1	0240	81	0.				
1	0006	4	6.	1	0058	30	349.	1			
0150	56	0.	*	1	0242	82	0.				
1	0008	5	40.	1	0100	31	145.	1			
0152	57	0.	*	1	0244	83	0.				
1	0010	6	136.	1	0102	32	42.	1			
0154	58	0.	*	1	0246	84	0.				
1	0012	7	680.	1	0104	33	9.	1			
0156	59	0.	*	1	0248	85	0.				
1	0014	8	2637.	1	0106	34	2.	1			
0158	60	0.	*	1	0250	86	0.				
1	0016	9	5673.	1	0108	35	0.	1			
0200	61	0.	*	1	0252	87	0.				
1	0018	10	9111.	1	0110	36	0.	1			
0202	62	0.	*	1	0254	88	0.				
1	0020	11	12217.	1	0112	37	0.	1			
0204	63	0.	*	1	0256	89	0.				
1	0022	12	13659.	1	0114	38	0.	1			
0206	64	0.	*	1	0258	90	0.				
1	0024	13	13380.	1	0116	39	0.	1			
0208	65	0.	*	1	0300	91	0.				
1	0026	14	12225.	1	0118	40	0.	1			
0210	66	0.	*	1	0302	92	0.				
1	0028	15	10823.	1	0120	41	0.	1			
0212	67	0.	*	1	0304	93	0.				
1	0030	16	9467.	1	0122	42	0.	1			
0214	68	0.	*	1	0306	94	0.				
1	0032	17	8231.	1	0124	43	0.	1			
0216	69	0.	*	1	0308	95	0.				

1	0034	18	7114.	*	1	0126	44	0.	*	1
0218	70	0.	*	1	0310	96	0.			
1	0036	19	6108.	*	1	0128	45	0.	*	1
0220	71	0.	*	1	0312	97	0.			
1	0038	20	5216.	*	1	0130	46	0.	*	1
0222	72	0.	*	1	0314	98	0.			
1	0040	21	4441.	*	1	0132	47	0.	*	1
0224	73	0.	*	1	0316	99	0.			
1	0042	22	3764.	*	1	0134	48	0.	*	1
0226	74	0.	*	1	0318	100	0.			
1	0044	23	3149.	*	1	0136	49	0.	*	1
0228	75	0.	*	1	0320	101	0.			
1	0046	24	2577.	*	1	0138	50	0.	*	1
0230	76	0.	*							
1	0048	25	2049.	*	1	0140	51	0.	*	1
0232	77	0.	*							
1	0050	26	1591.	*	1	0142	52	0.	*	1
0234	78	0.	*							

*

PEAK FLOW		TIME	MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	3.33-HR
+	(CFS)	(HR)	(CFS)			
+	13659.	.37	1376.	1376.	1376.	1376.
			(INCHES)	.000	.000	.000
			(AC-FT)	379.	379.	379.

CUMULATIVE AREA = .00 SQ MI

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* *
22 KK * REACH2 *
* *

2000-11,000

HYDROGRAPH ROUTING DATA

24 RD MUSKINGUM-CUNGE CHANNEL ROUTING

25 RC NORMAL DEPTH CHANNEL

ANL	.040	LEFT OVBANK N-VALUE
ANCH	.040	MAIN CHANNEL N-VALUE
ANR	.040	RIGHT OVBANK N-VALUE
RLNTH	9000.	REACH LENGTH

SEL .0050 ENERGY SLOPE
ELMAX .0 MAX. ELEV. FOR STORAGE/OUTFLOW

CALCULATION

CROSS-SECTION DATA

--- LEFT OVERBANK --- + ----- MAIN CHANNEL -----
+ --- RIGHT OVERBANK ---
27 RY ELEVATION 2860.00 2840.00 2831.00 2840.00 2860.00
2861.00 2862.00 2863.00
26 RX DISTANCE .00 100.00 600.00 1500.00 1600.00
1605.00 1610.00 1615.00

COMPUTED STORAGE-OUTFLOW-ELEVATION

DATA

	STORAGE	.00	45.59	182.36	410.30	729.43
1139.73	1622.82 2116.80	2616.65	3122.35			
	OUTFLOW	.00	518.27	3290.82	9702.43	20895.39
37885.88	64968.81 100359.00	141756.60	188810.40			
	ELEVATION	2831.00	2832.68	2834.37	2836.05	2837.74
2839.42	2841.11 2842.79	2844.47	2846.16			
	STORAGE	3633.92	4151.34	4674.63	5203.78	5738.79
6279.67	6826.40 7379.00	7936.56	8497.12			
	OUTFLOW	241255.50	298883.80	361527.70	429048.60	501331.30
578277.90	659804.90 745840.80	838960.60	939661.80			
	ELEVATION	2847.84	2849.53	2851.21	2852.90	2854.58
2856.26	2857.95 2859.63	2861.32	2863.00			

COMPUTED MUSKINGUM-CUNGE PARAMETERS

		COMPUTATION TIME STEP					
TIME TO	VOLUME	ELEMENT MAXIMUM	ALPHA	M	DT	DX	PEAK
PEAK		CELERITY					
(MIN)	(IN)	(FPS)			(MIN)	(FT)	(CFS)
54.90	-1.00	MAIN 5.08			.90	272.73	9204.81

INTERPOLATED TO SPECIFIED COMPUTATION

INTERVAL

54.00	-1.00	MAIN	2.00	9182.95
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HYDROGRAPH AT STATION

REACH2

*					*					*				
DA MON		HRMN	ORD		FLOW	DA MON		HRMN	ORD		FLOW	DA MON		
HRMN	ORD		FLOW	*	DA MON	HRMN	ORD		FLOW	*	DA MON	HRMN	ORD	
	1	0000	1		0.	*	1	0052	27		8419.	*	1	
0144	53	1342.		*	1	0236	79		0.					
	1	0002	2		0.	*	1	0054	28		9183.	*	1	
0146	54	1232.		*	1	0238	80		0.					
	1	0004	3		0.	*	1	0056	29		9081.	*	1	
0148	55	1127.		*	1	0240	81		0.					
	1	0006	4		0.	*	1	0058	30		8648.	*	1	
0150	56	1027.		*	1	0242	82		0.					
	1	0008	5		0.	*	1	0100	31		8097.	*	1	
0152	57	933.		*	1	0244	83		0.					
	1	0010	6		0.	*	1	0102	32		7516.	*	1	
0154	58	844.		*	1	0246	84		0.					
	1	0012	7		0.	*	1	0104	33		6944.	*	1	
0156	59	760.		*	1	0248	85		0.					
	1	0014	8		0.	*	1	0106	34		6393.	*	1	
0158	60	681.		*	1	0250	86		0.					
	1	0016	9		0.	*	1	0108	35		5871.	*	1	
0200	61	607.		*	1	0252	87		0.					
	1	0018	10		0.	*	1	0110	36		5377.	*	1	
0202	62	537.		*	1	0254	88		0.					
	1	0020	11		0.	*	1	0112	37		4915.	*	1	
0204	63	472.		*	1	0256	89		0.					
	1	0022	12		0.	*	1	0114	38		4486.	*	1	
0206	64	404.		*	1	0258	90		0.					
	1	0024	13		0.	*	1	0116	39		4090.	*	1	
0208	65	320.		*	1	0300	91		0.					
	1	0026	14		0.	*	1	0118	40		3731.	*	1	
0210	66	209.		*	1	0302	92		0.					
	1	0028	15		0.	*	1	0120	41		3413.	*	1	
0212	67	88.		*	1	0304	93		0.					
	1	0030	16		0.	*	1	0122	42		3139.	*	1	
0214	68	17.		*	1	0306	94		0.					
	1	0032	17		0.	*	1	0124	43		2902.	*	1	
0216	69	2.		*	1	0308	95		0.					
	1	0034	18		0.	*	1	0126	44		2690.	*	1	
0218	70	0.		*	1	0310	96		0.					
	1	0036	19		0.	*	1	0128	45		2496.	*	1	
0220	71	0.		*	1	0312	97		0.					
	1	0038	20		0.	*	1	0130	46		2318.	*	1	
0222	72	0.		*	1	0314	98		0.					
	1	0040	21		0.	*	1	0132	47		2152.	*	1	
0224	73	0.		*	1	0316	99		0.					
	1	0042	22		1.	*	1	0134	48		1996.	*	1	
0226	74	0.		*	1	0318	100		0.					
	1	0044	23		3.	*	1	0136	49		1850.	*	1	
0228	75	0.		*	1	0320	101		0.					

1	0046	24	61.	*	1	0138	50	1712.	*	1
0230	76	0.	*							
1	0048	25	2339.	*	1	0140	51	1582.	*	1
0232	77	0.	*							
1	0050	26	6106.	*	1	0142	52	1459.	*	1
0234	78	0.	*							

*

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	3.33-HR
+	(CFS)	(HR)				
+	9183.	.90	(CFS)			
			1396.	1396.	1396.	1396.
			(INCHES)	.000	.000	.000
			(AC-FT)	384.	384.	384.

CUMULATIVE AREA = .00 SQ MI

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28 KK REACH3

11,000-16,000

HYDROGRAPH ROUTING DATA

30 RD	MUSKINGUM-CUNGE CHANNEL ROUTING	
31 RC	NORMAL DEPTH CHANNEL	
	ANL	.040 LEFT OVERBANK N-VALUE
	ANCH	.040 MAIN CHANNEL N-VALUE
	ANR	.040 RIGHT OVERBANK N-VALUE
	RLNTH	5000. REACH LENGTH
	SEL	.0010 ENERGY SLOPE
	ELMAX	.0 MAX. ELEV. FOR STORAGE/OUTFLOW

CALCULATION

CROSS-SECTION DATA						
--- LEFT OVERBANK ---		+	----- MAIN CHANNEL -----			
+	--- RIGHT OVERBANK ---					
33 RY	ELEVATION	2880.00	2860.00	2840.00	2825.00	2840.00
2860.00	2861.00 2862.00					
32 RX	DISTANCE	1.00	200.00	250.00	300.00	1700.00
1800.00	1805.00 1810.00					

COMPUTED STORAGE-OUTFLOW-ELEVATION

DATA

	STORAGE	.00	46.49	185.96	418.41	743.84
1162.25	1644.92	2136.23	2634.75	3140.49		
	OUTFLOW	.00	609.82	3872.14	11416.35	24586.54
44578.36	77178.48	118301.90	166343.70	220934.20		
	ELEVATION	2825.00	2827.89	2830.79	2833.68	2836.58
2839.47	2842.37	2845.26	2848.16	2851.05		

	STORAGE	3653.44	4173.60	4700.98	5238.42	5786.87
6344.89	6912.48	7489.64	8076.37	8672.67		
	OUTFLOW	281795.90	348712.30	421510.30	502208.50	589398.60
682713.40	782069.50	887418.80	998730.30	1115983.00		
	ELEVATION	2853.95	2856.84	2859.74	2862.63	2865.53
2868.42	2871.32	2874.21	2877.11	2880.00		

COMPUTED MUSKINGUM-CUNGE PARAMETERS

TIME TO	VOLUME	ELEMENT MAXIMUM	ALPHA	M	DT	DX	PEAK
PEAK		CELERITY					
(MIN)	(IN)	(FPS)			(MIN)	(FT)	(CFS)
102.00	-1.00	MAIN 2.78			2.00	333.33	3002.46

INTERPOLATED TO SPECIFIED COMPUTATION

INTERVAL

		MAIN		2.00		3002.46
102.00	-1.00					

HYDROGRAPH AT STATION

REACH3

*				*			*			*			*
DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON		
HRMN	ORD		FLOW	*	DA	MON	HRMN	ORD	FLOW				
				*					*				
1	0000	1	0.	*	1	0052	27	0.	*	1			
0144	53	2991.	*	1	0236	79	1312.						

1	0002	2	0.	*	1	0054	28	0.	*	1
0146	54	2967.	*	1	0238	80	1253.			
1	0004	3	0.	*	1	0056	29	0.	*	1
0148	55	2933.	*	1	0240	81	1196.			
1	0006	4	0.	*	1	0058	30	0.	*	1
0150	56	2889.	*	1	0242	82	1140.			
1	0008	5	0.	*	1	0100	31	0.	*	1
0152	57	2838.	*	1	0244	83	1087.			
1	0010	6	0.	*	1	0102	32	0.	*	1
0154	58	2781.	*	1	0246	84	1035.			
1	0012	7	0.	*	1	0104	33	0.	*	1
0156	59	2719.	*	1	0248	85	986.			
1	0014	8	0.	*	1	0106	34	0.	*	1
0158	60	2653.	*	1	0250	86	938.			
1	0016	9	0.	*	1	0108	35	10.	*	1
0200	61	2583.	*	1	0252	87	892.			
1	0018	10	0.	*	1	0110	36	138.	*	1
0202	62	2512.	*	1	0254	88	848.			
1	0020	11	0.	*	1	0112	37	453.	*	1
0204	63	2439.	*	1	0256	89	806.			
1	0022	12	0.	*	1	0114	38	787.	*	1
0206	64	2364.	*	1	0258	90	766.			
1	0024	13	0.	*	1	0116	39	1110.	*	1
0208	65	2289.	*	1	0300	91	728.			
1	0026	14	0.	*	1	0118	40	1415.	*	1
0210	66	2214.	*	1	0302	92	691.			
1	0028	15	0.	*	1	0120	41	1696.	*	1
0212	67	2138.	*	1	0304	93	657.			
1	0030	16	0.	*	1	0122	42	1951.	*	1
0214	68	2063.	*	1	0306	94	624.			
1	0032	17	0.	*	1	0124	43	2178.	*	1
0216	69	1989.	*	1	0308	95	594.			
1	0034	18	0.	*	1	0126	44	2376.	*	1
0218	70	1915.	*	1	0310	96	565.			
1	0036	19	0.	*	1	0128	45	2543.	*	1
0220	71	1842.	*	1	0312	97	538.			
1	0038	20	0.	*	1	0130	46	2682.	*	1
0222	72	1771.	*	1	0314	98	513.			
1	0040	21	0.	*	1	0132	47	2793.	*	1
0224	73	1701.	*	1	0316	99	490.			
1	0042	22	0.	*	1	0134	48	2878.	*	1
0226	74	1632.	*	1	0318	100	467.			
1	0044	23	0.	*	1	0136	49	2939.	*	1
0228	75	1565.	*	1	0320	101	446.			
1	0046	24	0.	*	1	0138	50	2979.	*	1
0230	76	1499.	*							
1	0048	25	0.	*	1	0140	51	2999.	*	1
0232	77	1435.	*							
1	0050	26	0.	*	1	0142	52	3002.	*	1
0234	78	1372.	*							

*

PEAK FLOW TIME

MAXIMUM AVERAGE FLOW

	(CFS)	(HR)	(CFS)	6-HR	24-HR	72-HR	3.33-HR
+	3002.	1.70		1114.	1114.	1114.	1114.
			(INCHES)	.000	.000	.000	.000
			(AC-FT)	307.	307.	307.	307.

CUMULATIVE AREA = .00 SQ MI

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34 KK REACH4

16,000-20,000

HYDROGRAPH ROUTING DATA

36 RD MUSKINGUM-CUNGE CHANNEL ROUTING

37 RC NORMAL DEPTH CHANNEL

ANL	.040	LEFT OVBANK N-VALUE
ANCH	.040	MAIN CHANNEL N-VALUE
ANR	.040	RIGHT OVBANK N-VALUE
RLNTH	4000.	REACH LENGTH
SEL	.0010	ENERGY SLOPE
ELMAX	.0	MAX. ELEV. FOR STORAGE/OUTFLOW

CALCULATION

CROSS-SECTION DATA

--- LEFT OVBANK ---			+ --- MAIN CHANNEL ---			
39 RY	ELEVATION	2860.00	2840.00	2820.00	2817.00	2820.00
2840.00	2841.00	2842.00				
38 RX	DISTANCE	1.00	100.00	150.00	200.00	250.00
1300.00	1305.00	1310.00				

COMPUTED STORAGE-OUTFLOW-ELEVATION

DATA

STORAGE	.00	7.84	33.67	84.84	161.87
264.77	393.54	548.18	728.68	935.06	
OUTFLOW	.00	109.07	686.91	2264.40	5294.67
10151.79	17174.24	26675.40	38949.70	54276.55	
ELEVATION	2817.00	2819.26	2821.53	2823.79	2826.05
2828.32	2830.58	2832.84	2835.11	2837.37	

	STORAGE	1167.30	1417.99	1672.56	1929.47	2188.71
2450.27	2714.16	2980.38	3248.93	3519.80		
	OUTFLOW	72923.00	99239.60	129932.70	164037.50	201424.20
241991.30	285655.60	332347.70	382008.80	434588.70		
	ELEVATION	2839.63	2841.90	2844.16	2846.42	2848.68
2850.95	2853.21	2855.47	2857.74	2860.00		

COMPUTED MUSKINGUM-CUNGE PARAMETERS
COMPUTATION TIME STEP

TIME TO	VOLUME	ELEMENT MAXIMUM	ALPHA	M	DT	DX	PEAK
PEAK		CELERITY			(MIN)	(FT)	(CFS)
(MIN)	(IN)	(FPS)					
		MAIN			2.00	285.71	2356.00
132.00	-1.00	2.46					

INTERPOLATED TO SPECIFIED COMPUTATION

INTERVAL		MAIN				
132.00	-1.00			2.00		2356.00

HYDROGRAPH AT STATION

REACH4

* DA MON HRMN ORD				* FLOW				* DA MON HRMN ORD				* FLOW			
HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*
*															
1	0000	1		0.	*	1	0052	27		0.	*	1			
0144	53	1299.	*	1	0236	79	2010.								
1	0002	2		0.	*	1	0054	28		0.	*	1			
0146	54	1444.	*	1	0238	80	1962.								
1	0004	3		0.	*	1	0056	29		0.	*	1			
0148	55	1582.	*	1	0240	81	1914.								
1	0006	4		0.	*	1	0058	30		0.	*	1			
0150	56	1709.	*	1	0242	82	1865.								
1	0008	5		0.	*	1	0100	31		0.	*	1			
0152	57	1826.	*	1	0244	83	1815.								
1	0010	6		0.	*	1	0102	32		0.	*	1			
0154	58	1931.	*	1	0246	84	1765.								
1	0012	7		0.	*	1	0104	33		0.	*	1			
0156	59	2024.	*	1	0248	85	1715.								

1	0014	8	0.	*	1	0106	34	0.	*	1
0158	60	2105.	*	1	0250	86	1666.			
1	0016	9	0.	*	1	0108	35	0.	*	1
0200	61	2174.	*	1	0252	87	1616.			
1	0018	10	0.	*	1	0110	36	0.	*	1
0202	62	2230.	*	1	0254	88	1567.			
1	0020	11	0.	*	1	0112	37	0.	*	1
0204	63	2276.	*	1	0256	89	1518.			
1	0022	12	0.	*	1	0114	38	0.	*	1
0206	64	2310.	*	1	0258	90	1470.			
1	0024	13	0.	*	1	0116	39	0.	*	1
0208	65	2334.	*	1	0300	91	1423.			
1	0026	14	0.	*	1	0118	40	0.	*	1
0210	66	2349.	*	1	0302	92	1376.			
1	0028	15	0.	*	1	0120	41	0.	*	1
0212	67	2356.	*	1	0304	93	1330.			
1	0030	16	0.	*	1	0122	42	0.	*	1
0214	68	2355.	*	1	0306	94	1285.			
1	0032	17	0.	*	1	0124	43	25.	*	1
0216	69	2346.	*	1	0308	95	1241.			
1	0034	18	0.	*	1	0126	44	82.	*	1
0218	70	2332.	*	1	0310	96	1198.			
1	0036	19	0.	*	1	0128	45	167.	*	1
0220	71	2311.	*	1	0312	97	1156.			
1	0038	20	0.	*	1	0130	46	273.	*	1
0222	72	2286.	*	1	0314	98	1115.			
1	0040	21	0.	*	1	0132	47	396.	*	1
0224	73	2255.	*	1	0316	99	1075.			
1	0042	22	0.	*	1	0134	48	534.	*	1
0226	74	2221.	*	1	0318	100	1036.			
1	0044	23	0.	*	1	0136	49	682.	*	1
0228	75	2184.	*	1	0320	101	998.			
1	0046	24	0.	*	1	0138	50	836.	*	1
0230	76	2144.	*							
1	0048	25	0.	*	1	0140	51	992.	*	1
0232	77	2101.	*							
1	0050	26	0.	*	1	0142	52	1148.	*	1
0234	78	2056.	*							

*

PEAK FLOW		TIME	MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	3.33-HR
+	(CFS)	(HR)				
			(CFS)			
+	2356.	2.20	933.	933.	933.	933.
			(INCHES)	.000	.000	.000
			(AC-FT)	257.	257.	257.
CUMULATIVE AREA =			.00 SQ MI			

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*****
*
40 KK  *   REACH5  *
*
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20,000-29,000

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HYDROGRAPH ROUTING DATA

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42 RD      MUSKINGUM-CUNGE CHANNEL ROUTING

43 RC      NORMAL DEPTH CHANNEL
          ANL      .040  LEFT OVERBANK N-VALUE
          ANCH     .040  MAIN CHANNEL N-VALUE
          ANR      .040  RIGHT OVERBANK N-VALUE
          RLNTH    9000. REACH LENGTH
          SEL      .0010 ENERGY SLOPE
          ELMAX     .0   MAX. ELEV. FOR STORAGE/OUTFLOW

```

CALCULATION

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                                CROSS-SECTION DATA
                                --- LEFT OVERBANK --- + ----- MAIN CHANNEL -----
+ --- RIGHT OVERBANK ---
  45 RY      ELEVATION  2840.00   2820.00   2807.00   2820.00   2840.00
2841.00  2842.00  2843.00
  44 RX      DISTANCE    1.00    700.00   1500.00   2250.00   2950.00
2951.00  2952.00  2953.00

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COMPUTED STORAGE-OUTFLOW-ELEVATION

```

DATA
          STORAGE      .00    44.22    176.88    397.99    707.54
1105.52  1591.96  2166.48   2806.43   3498.27
          OUTFLOW      .00    243.17   1544.04   4552.34   9804.03
17775.88 28905.55 43830.22 63916.91 87778.37
          ELEVATION    2807.00   2808.89   2810.79   2812.68   2814.58
2816.47  2818.37   2820.26   2822.16   2824.05

          STORAGE      4242.00   5037.62   5885.12   6784.51   7735.79
8738.95  9794.00 10900.94 12051.05 13206.33
          OUTFLOW    115533.10 147312.50 183255.30 223504.00 268203.20
317498.20 371534.50 430456.90 502254.10 585009.00
          ELEVATION    2825.95   2827.84   2829.74   2831.63   2833.53
2835.42  2837.32   2839.21   2841.11   2843.00

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COMPUTED MUSKINGUM-CUNGE PARAMETERS

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          ELEMENT      ALPHA      M      DT      DX      PEAK
TIME TO  VOLUME      MAXIMUM
PEAK          CELERITY

```

(MIN)	(IN)	(FPS)	(MIN)	(FT)	(CFS)
		MAIN	2.00	214.29	175.30
200.00	-1.00	1.78			

INTERPOLATED TO SPECIFIED COMPUTATION

INTERVAL

		MAIN	2.00	175.30
200.00	-1.00			

HYDROGRAPH AT STATION

REACH5

*					*					*					
DA	MON	HRMN	ORD		FLOW	*	DA	MON	HRMN	ORD		FLOW	*	DA	MON
HRMN	ORD		FLOW	*	DA	MON	HRMN	ORD		FLOW	*	DA	MON	HRMN	ORD
*															
1		0000	1		0.	*	1		0052	27		0.	*	1	
0144	53		0.	*	1		0236	79		0.					
1		0002	2		0.	*	1		0054	28		0.	*	1	
0146	54		0.	*	1		0238	80		0.					
1		0004	3		0.	*	1		0056	29		0.	*	1	
0148	55		0.	*	1		0240	81		0.					
1		0006	4		0.	*	1		0058	30		0.	*	1	
0150	56		0.	*	1		0242	82		0.					
1		0008	5		0.	*	1		0100	31		0.	*	1	
0152	57		0.	*	1		0244	83		0.					
1		0010	6		0.	*	1		0102	32		0.	*	1	
0154	58		0.	*	1		0246	84		0.					
1		0012	7		0.	*	1		0104	33		0.	*	1	
0156	59		0.	*	1		0248	85		0.					
1		0014	8		0.	*	1		0106	34		0.	*	1	
0158	60		0.	*	1		0250	86		0.					
1		0016	9		0.	*	1		0108	35		0.	*	1	
0200	61		0.	*	1		0252	87		0.					
1		0018	10		0.	*	1		0110	36		0.	*	1	
0202	62		0.	*	1		0254	88		0.					
1		0020	11		0.	*	1		0112	37		0.	*	1	
0204	63		0.	*	1		0256	89		0.					
1		0022	12		0.	*	1		0114	38		0.	*	1	
0206	64		0.	*	1		0258	90		0.					
1		0024	13		0.	*	1		0116	39		0.	*	1	
0208	65		0.	*	1		0300	91		0.					

1	0026	14	0.	*	1	0118	40	0.	*	1
0210	66	0.	*	1	0302	92	0.			
1	0028	15	0.	*	1	0120	41	0.	*	1
0212	67	0.	*	1	0304	93	0.			
1	0030	16	0.	*	1	0122	42	0.	*	1
0214	68	0.	*	1	0306	94	0.			
1	0032	17	0.	*	1	0124	43	0.	*	1
0216	69	0.	*	1	0308	95	0.			
1	0034	18	0.	*	1	0126	44	0.	*	1
0218	70	0.	*	1	0310	96	0.			
1	0036	19	0.	*	1	0128	45	0.	*	1
0220	71	0.	*	1	0312	97	1.			
1	0038	20	0.	*	1	0130	46	0.	*	1
0222	72	0.	*	1	0314	98	2.			
1	0040	21	0.	*	1	0132	47	0.	*	1
0224	73	0.	*	1	0316	99	11.			
1	0042	22	0.	*	1	0134	48	0.	*	1
0226	74	0.	*	1	0318	100	74.			
1	0044	23	0.	*	1	0136	49	0.	*	1
0228	75	0.	*	1	0320	101	175.			
1	0046	24	0.	*	1	0138	50	0.	*	1
0230	76	0.	*							
1	0048	25	0.	*	1	0140	51	0.	*	1
0232	77	0.	*							
1	0050	26	0.	*	1	0142	52	0.	*	1
0234	78	0.	*							

*

PEAK FLOW	TIME		6-HR	24-HR	72-HR	3.33-HR
+	(CFS)	(HR)				
		(CFS)				
+	175.	3.33	2.	2.	2.	2.
		(INCHES)	.000	.000	.000	.000
		(AC-FT)	0.	0.	0.	0.

CUMULATIVE AREA = .00 SQ MI

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE

MILES

MAXIMUM PERIOD	BASIN	MAXIMUM	PEAK	TIME OF	AVERAGE FLOW FOR
AREA	OPERATION	STATION	FLOW	TIME OF	
	STAGE	MAX STAGE		PEAK	
+					6-HOUR
72-HOUR					24-HOUR

ROUTED TO

+		Breach	16177.	.30	1376.	1376.
1376.	.00					
+						
2900.00	.01					

	ROUTED TO					
+		REACH1	13659.	.37	1376.	1376.
1376.	.00					

	ROUTED TO					
+		REACH2	9183.	.90	1396.	1396.
1396.	.00					

	ROUTED TO					
+		REACH3	3002.	1.70	1114.	1114.
1114.	.00					

	ROUTED TO					
+		REACH4	2356.	2.20	933.	933.
933.	.00					

	ROUTED TO					
+		REACH5	175.	3.33	2.	2.
2.	.00					
1						

SUMMARY OF KINEMATIC WAVE -

MUSKINGUM-CUNGE ROUTING

(FLOW IS DIRECT RUNOFF WITHOUT

BASE FLOW)

INTERPOLATED TO

COMPUTATION INTERVAL

PEAK	ISTAQ TIME TO	ELEMENT VOLUME	DT	PEAK	TIME TO PEAK	VOLUME	DT
------	------------------	-------------------	----	------	-----------------	--------	----

(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)	(MIN)
-------	-------	------	-------	-------	-------	------	-------

13658.78	REACH1 22.00	MANE -1.00	.90	13760.70	22.50	-1.00	2.00
----------	-----------------	---------------	-----	----------	-------	-------	------

9182.95	REACH2 54.00	MANE -1.00	.90	9204.81	54.90	-1.00	2.00
---------	-----------------	---------------	-----	---------	-------	-------	------

3002.46	REACH3 102.00	MANE -1.00	2.00	3002.46	102.00	-1.00	2.00
---------	------------------	---------------	------	---------	--------	-------	------

	REACH4	MANE	2.00	2356.00	132.00	-1.00	2.00
2356.00	132.00	-1.00					

	REACH5	MANE	2.00	175.30	200.00	-1.00	2.00
175.30	200.00	-1.00					

1
 FOR STATION Breach
 DURING BREACH FORMATION)

SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS
 (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED

PLAN 1	INITIAL VALUE	SPILLWAY CREST
TOP OF DAM		
	ELEVATION	2900.00
2900.00		2900.00
	STORAGE	378.
378.		378.
	OUTFLOW	0.
0.		0.

DURATION	TIME OF	RATIO	MAXIMUM	MAXIMUM	MAXIMUM	MAXIMUM
OVER TOP	MAX OUTFLOW	TIME OF	RESERVOIR	DEPTH	STORAGE	OUTFLOW
HOURS	HOURS	OF	W.S.ELEV	OVER DAM	AC-FT	CFS
		PMF				
		HOURS				
.00	.30	1.00	2900.00	.00	378.	16177.
		.00				

*** NORMAL END OF HEC-1 ***

REPORT ON
WATER PERMIT APPLICATION No. 1836-1
USDA Forest Service
March 9, 2005

Water Permit Application No. 1836-1 has been filed by the USDA Forest Service to impound 378 acre-feet of water in an existing dam located on Campbell Creek in the SW ¼ of Section 10-T21N-R5E, in Harding County. The application also requests impoundment of sufficient water to maintain water at the outlet elevation. The water will be used for fish and wildlife production, recreation and livestock water purposes.

Discussion:

The existing dam is locally known as the "Brown's Pond Dam" and was constructed in the early 1960's. It is located on Campbell Creek in the SW ¼ of Section 10-T21N-R5E approximately one-quarter mile upstream of the confluence of Campbell Creek and Bull Creek. Water Right No. 409-1 was issued to Lawrence Brown in October of 1959 to irrigated 800 acres from Bull Creek. The irrigation was along Bull Creek for a distance of approximately 5 miles downstream of the existing dam. Brown's Pond Dam was listed as a proposed reservoir site on Water Right No. 409-1. Water Right No. 409-1 was transferred to the Cave Hills Cattle Company in 1985 and was later cancelled in 1992 due to abandonment and forfeiture for non-use. Through a land purchase in 2000, the Custer National Forest acquired the private property and existing dam.

The dam will be classified as a small size, Category 3, Low Hazard dam. Since it was constructed before 1986, the date our Safety of Rules Chapter 74:02:08 was adopted, it is exempt from minimum spillway design flood requirement. However, if minimum spillway requirement were in affect, a dam of this size and hazard classification would be required to pass a 50-year frequency event.

The Brown's Pond Dam is 25 feet high with a normal storage capacity of 378 acre-feet with a reservoir level at the primary spillway elevation, and a maximum storage capacity of 512 acre-feet with a reservoir level at the top of dam elevation. It has a drainage area of 8320 acres or 13 square miles. The dam has a 150 foot wide earthcut spillway with 4 feet of available freeboard. A 50-year frequency event for this drainage produces a peak runoff off of approximately 1235 cfs and a 100-year frequency event produces a peak runoff of approximately 1619 cfs. The 150 foot wide spillway has a capacity of approximately 3120 cfs.

The annual yield for this drainage area with an 80 percent chance of occurrence, or 8 out of 10 years, is expected to be 35 acre-feet. The annual yield with a 50 percent chance of occurrence, or 1 out of 2 years, is expected to be 110 acre-feet and the annual yield with a 10 percent chance of occurrence, or 1 out of 10 years, is expected to be 693 acre-feet.

The Brown's Pond Dam is located in the SW ¼ Section 10-T21N-R5E on Campbell Creek about one-quarter mile upstream of the confluence of Campbell Creek and Bull Creek and about 12 miles upstream of the confluence of Bull Creek and the South Fork of the Grand River. There are no existing Water Permits/Rights located between the existing dam and the Grand River. Besides Water Permit No. 409-1 mentioned above, there was another permit located along Bull Creek. Water Right No. 258-1 was issued to Owen Stensland in 1953 to irrigate 441 acres along Bull Creek immediately downstream of Water Right No. 409-1. It was cancelled in 1987 due to abandonment and forfeiture for non-use.

Page 2
Water Permit No. 1836-1
March 9, 2005

Conclusions:

1. Water Permit Application No. 1836-1 should be approved since unappropriated water is available and approval should not have any adverse effect on existing Water Permits/Rights.
2. If approved, the low flow bypass requirement for downstream domestic use should be a qualification on Water Permit Application No. 1836-1.



Timothy G. Schaal, P.E.
Natural Resources Engineer Specialist

Approved by:



Gale N. Selken, P.E.
Natural Resources Engineer Director



**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

PMB 2020
JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182
www.state.sd.us/denr

**RECOMMENDATION OF CHIEF ENGINEER FOR WATER PERMIT
APPLICATION NO. 1836-1, USDA Forest Service**

Pursuant to SDCL 46-2A-2, the following is the recommendation of the Chief Engineer, Water Rights Program, Department of Environment and Natural Resources concerning Water Permit Application No. 1836-1, USDA Forest Service, c/o Nancy T. Curriden, PO Box 50760, Billings MT 59105.

The Chief Engineer is recommending APPROVAL of Application No. 1836-1 because 1) there is reasonable probability that there is unappropriated water available for the applicant's proposed use, 2) the proposed diversion can be developed without unlawful impairment of existing rights, 3) the proposed use is a beneficial use and 4) it is in the public interest with the following qualifications:

1. Water Permit No. 1836-1 authorizes a dam with a storage capacity of 378 acre feet of water and sufficient water annually to maintain the water level to an outlet elevation.
2. Low flows as needed for downstream domestic use, including livestock water and prior water rights must be by-passed.

See report on application for additional information.

Garland Erbele, Chief Engineer
March 14, 2005

Affidavit of Publication

STATE OF SOUTH DAKOTA:

COUNTY OF HARDING:

Stewart Huntington of said County and State being first duly sworn, on his oath says: That the NATION'S CENTER NEWS is a legal weekly newspaper of general circulation, printed and published in the City of Buffalo, in said County and State by Stewart Huntington, and has been such a newspaper during the times hereinafter mentioned; and that said newspaper has a bonafide circulation of at least 200 copies weekly, and has been published within said County in the English language for at least one year prior to the first publication of the notice herein mentioned, and is printed in whole or in part in an office maintained at the place of publication; and that I, Stewart Huntington, the undersigned, am the Publisher of said newspaper and have personal knowledge of all the facts stated in this affidavit; and that the advertisement headed:

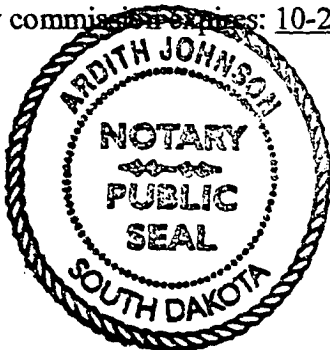
Notice of Application
No. 1836-1

a printed copy of which is hereto attached, was printed and published in said newspaper for 2 successive and consecutive weeks, the first publication being made on the 24th day of March 2005, and the last publication on the 31st day of March 2005, that the full amount of fees charged for publishing same, to-wit: The sum of \$ 36.88, insures solely to the benefit of the publisher of the NATION CENTER NEWS, that no agreement or understanding for a division thereof has been made with any person and that no part thereof has been agreed to be paid to any other person whomsoever.



Subscribed and sworn to before me this 31st day of March 2005


Notary Public, Lawrence County, South Dakota
My commission expires: 10-24-2010



NOTICE OF APPLICATION NO. 1836-1 to Appropriate Water

Notice is given that US Dept of Agriculture - Forest Service, PO Box 50760, Billings MT 59105 has filed an application for a water permit to impound 378 Acre-feet of Water in an existing dam on Campbell Creek located in the SW 1/4 Section 10 with water impounded in the SW 1/4, W 1/2 NW 1/4 Section 10; all in T21N-R5E. This application requests impoundment of sufficient water to maintain water to the outlet elevation. The water is for fish and wildlife propagation, recreational use, and livestock water.

Pursuant to SDCL 46-2A-2, the Chief Engineer recommends APPROVAL of Application No. 1836-1, because 1) unappropriated water is available, 2) existing rights will not be unlawfully impaired, 3) it is a beneficial use of water, and 4) it is in the public interest. In accordance with SDCL 46-2A-23, the Chief Engineer will act on the application, as recommended, unless a petition is filed opposing the application or the applicant files a petition contesting the Chief Engineer's recommendation. If a petition opposing the application or contesting the recommendation is filed, then a hearing will be scheduled and the Water Management Board will consider the application. Notice of the hearing will be given to the applicant and any person filing a petition.

Any person interested in opposing or supporting this application or recommendation must file a written petition with BOTH the applicant and Chief Engineer. The applicant must file a petition if contesting the Chief Engineer's recommendation. The Chief Engineer's address is "Water Rights Program, Foss Building, 523 E Capitol, Pierre SD 57501(605 773-3352)" and the applicant's mailing address is given above. A petition filed by either an interested person or the applicant must be filed by April 11, 2005.

The petition may be informal, but must include a statement describing the petitioner's interest in the application, the petitioner's reasons for opposing or supporting the application, and the signature and mailing address of the petitioner or the petitioner's legal counsel, if legal counsel is obtained. Contact Eric Gronlund at the above Water Rights Program address to request copies of information pertaining to this application.

Steven M. Pirner,
Secretary, Department of Environment and Natural Resources.

#45
March 24, 31

REC
APR - 6 2005
WATER RIGHTS PROGRAM

Instruction to Newspaper - Publish first Notice on March 24, 2005 with the second publication 7 days later. The applicant is responsible for payment.

NOTICE OF APPLICATION NO. 1836-1 to Appropriate Water

Notice is given that US Dept of Agriculture – Forest Service, PO Box 50760, Billings MT 59105 has filed an application for a water permit to impound 378 acre-feet of water in an existing dam on Campbell Creek located in the SW ¼ Section 10 with water impounded in the SW ¼, W ½ NW ¼ Section 10; all in T21N-R5E. This application requests impoundment of sufficient water to maintain water to the outlet elevation. The water is for fish and wildlife propagation, recreational use, and livestock water.

Pursuant to SDCL 46-2A-2, the Chief Engineer recommends APPROVAL of Application No. 1836-1_ because 1) unappropriated water is available, 2) existing rights will not be unlawfully impaired, 3) it is a beneficial use of water, and 4) it is in the public interest. In accordance with SDCL 46-2A-23, the Chief Engineer will act on the application, as recommended, unless a petition is filed opposing the application or the applicant files a petition contesting the Chief Engineer's recommendation. If a petition opposing the application or contesting the recommendation is filed, then a hearing will be scheduled and the Water Management Board will consider the application. Notice of the hearing will be given to the applicant and any person filing a petition.

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The petition may be informal, but must include a statement describing the petitioner's interest in the application, the petitioner's reasons for opposing or supporting the application, and the signature and mailing address of the petitioner or the petitioner's legal counsel, if legal counsel is obtained. Contact Eric Gronlund at the above Water Rights Program address to request copies of information pertaining to this application. Steven M. Pirner, Secretary, Department of Environment and Natural Resources.



DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES

PMB 2020
JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182
www.state.sd.us/denr

March 14, 2005

Nation's Center News
PO Box 107
Buffalo SD 57720-0107

ATTENTION: Legal Public Notice

Enclosed is a Notice on Application No. 1836-1 to Appropriate Water to be published twice. Please publish the first notice on March 24, 2005 with the second publication 7 days later. The text of the notice can be e-mailed to your paper by contacting Karen Schlaak at (605) 773-3352.

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 USA Dept. of Agriculture – Forest Service, % Gary Benes, PO Box 50760, Billings MT 59105 (Ph # 406-657-6200).

Please send the Water Rights Program the first publication immediately. The publication is checked for accuracy so any corrections can be made in the second publication. You may use the form below or fax a copy of the first publication. Any fax should be sent to the attention of Karen Schlaak at (605) 773-4068. Publication errors can invalidate the public notice.

After the second publication, **please send us an affidavit or use the enclosed Proof of Publication form.** The applicant pays the cost of publication, but the Water Rights Program records require an affidavit or Proof of Publication. Delays in receiving the affidavit can be costly to the applicant.

Sincerely,

Eric Gronlund
Natural Resources Engineer
605 773-3352

enclosures

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

No. 1836-1

TO: Eric Gronlund
Water Rights Program
Joe Foss Building
Pierre SD 57501-3181

Date _____

We are in receipt of your letter of March 14, 2005 enclosing Notice to Appropriate Water by Application No. 1836-1 which was first published in our issue of _____. **ENCLOSED IS A COPY OF THIS FIRST PUBLICATION.**

Name

Newspaper



**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

PMB 2020
JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182
www.state.sd.us/denr

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

March 14, 2005

Gary Benes
USA Dept. of Agriculture – Forest Service
PO Box 50760
Billings MT 59105

Dear Mr. Benes:

Water Permit Application No. 1836-1 for fish and wildlife propagation and recreational use has been examined and found to comply with the South Dakota Water Laws and applicable rules. A notice has been sent to the Publisher of the Nation's Center News printed at Buffalo, SD (Ph # 605-375-3228). You will need to contact the newspaper and authorize publication of this notice. 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 prior to publication and notify this office, if you have any corrections or questions.

Be sure to contact the above newspaper to authorize publication of your Notice and to arrange for payment. Early contact with the paper can eliminate delays. Upon receiving authorization, the publisher has been instructed to publish your notice once each week for two consecutive weeks. The newspaper has also been instructed to send us the Proof of Publication. We must receive Proof of Publication before action can be taken on the application.

Sincerely,

Eric Gronlund
Natural Resources Engineer
(605) 773-3352

enclosures

NOTE: If you plan to contest any part of the Chief Engineer's recommendation, you must file a petition pursuant to the procedures outlined in the attached notice of hearing. The Water Management Board will then consider your concerns during a hearing on the application.



MAY 02 2005

**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

PMB 2020
JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182
www.state.sd.us/denr

Gary Benes
USA Dept of Agriculture Forest Service
1310 Main
Billings MT 59105

Dear Mr. Benes:

Enclosed is Water Permit No. 1836-1 authorizing construction of your water diversion system and beneficial use of the water, not exceeding the limits as specified in the Water Permit.

Form 10, *Notice of Completion of Works and Application of Water to Beneficial Use*, is enclosed. Please return this completed form after you have finished the system and have put the water to beneficial use. An investigation can then be scheduled so the water license may be issued, thus completing the acquisition of a water right.

An informational sheet *Common Water Right Questions?* is also enclosed. This sheet is intended to answer some of the questions associated with obtaining and keeping a water right.

Sincerely,

Garland Erbele, Chief Engineer
Water Rights Program
(605) 773-3352

enclosures

PAYMENT REQUEST FORM

PAYEE: USDA - Forest Service
1310 Main
Billings MT 59105

FROM: Water Rights Program
523 E. Capitol
Pierre, SD 57501-3181

DESCRIPTION OF SERVICE, PRODUCE OR TRANSFER

Refund of overpayment of application fee.

AMOUNT: \$10.00

FUNDING SOURCE:

GENERAL: X

FEDERAL:

COMMENTS:

AUTHORIZATION:

Darland Erbe 5-2-05

I declare and affirm under the penalties of perjury that this claim is in all things, true and correct. I further agree to comply with the provisions of the Civil Rights Act of 1964 and regulations issued thereunder relating to nondiscrimination in federal assisted programs.



**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

PMB 2020
JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182
www.state.sd.us/denr

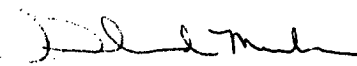
May 11, 2005

USDA Forest Service
1310 Main,
Billings MT 59105

Dear Sir:

Enclosed please find a \$10.00 refund that is for overpayment on your application fee of
Water Permit No. 1836-1.

Thank you,


Glenda Marks
Water Rights
(605)773-3352

1836-1



United States
Department of
Agriculture

Forest
Service

Custer National Forest

1310 Main Street
Billings, MT 59105
406 657-6200

File Code: 2500

Date: May 9, 2005

Garland Erbele
Water Rights Program, SD DENR
Joe Foss Building
523 E. Capitol
Pierre, SD 57501-3182

RECEIVED
MAY 16 2005
WATER RIGHTS
PROGRAM

Dear Mr. Erbele:

Enclosed are a Notice of Completion of Works and Application of Water to Beneficial Use (Form 10) and Proof of Publication (Form 8) concerning Water Permit 1836-1. Please note that the associated earthen dam and water impoundment existed previous to filing the Application for Permit to Appropriate Water within the State of South Dakota (SD EForm-1585 V1, Form 2) received by your office on February 22, 2005. The cover letter attached to that application indicated that the dam was constructed sometime in the early 1960's. A copy of that cover letter and the in-service date documentation are also enclosed.

If you have questions concerning these forms, please contact Mark Nienow, Forest Hydrologist at 406-657-6207 ext. 227.

Sincerely,

Nancy T. Curriden

NANCY T. CURRIDEN
Forest Supervisor

Enclosure



NOTICE OF COMPLETION OF WORKS AND
APPLICATION OF WATER TO BENEFICIAL USE

Date May 9, 2005

TO: Water Rights Program, DENR
523 E. Capitol
Pierre, SD 57501-3181

FROM: Nancy Curriden, Custer National Forest
(name)

1310 Main Street
(address)

Billings, MT 59105
(city, state, zip)

406-657-6200
(phone)

I have completed the construction of the water use system and I have put the water to beneficial use to the maximum extent it is going to be used.

Water Permit No. 1836-1 states that the water use system is to be constructed by
April 11, 2010 , and water is to be put to beneficial use by April 11, 2014 .
(date) (date)

The water use system was completed on June 30, 1962 .
(date)

Applying the water to beneficial use was completed on June 30, 1962 .
(date)

You may schedule an investigation so that the water license may be issued.

Nancy T. Curriden
(signature)





File Code: 2500

Date: February 9, 2005

Genny McMath
Water Rights Program, DENR
Joe Foss Building
523 E. Capitol
Pierre, SD 57501-3181

Dear Ms. McMath:

Through a land purchase in 2000, the Custer National Forest acquired private property in Harding County. A 40 acre reservoir and dam are located on this property in the SW ¼ of section 10, T21N, R5E. Past discussion and correspondence with you indicate that a water right permit or location notice has not been filed for this reservoir. I would like to proceed with the filing process at this time.

To the best of my knowledge, the dam was constructed in the early 1960's. As such, it does not qualify for a vested right under South Dakota Water Law and therefore a regular water permit is required. Although the reservoir water initially may have been used for irrigation, the primary use now is for recreation, fish and wildlife habitat, and stockwater.

Attached are copies of:

- 1) SD EForm-1585 V1, Form 2: Application for uses other than irrigation (2 copies)
- 2) SD EForm-0459 V1, Location notice for dam/dugout
- 3) 2-11" x 17" topographic maps identifying the location of the reservoir and delineation of the contributing watershed
- 4) GPS delineation of reservoir perimeter
- 5) Hazard Classification documentation and supporting HEC-1 program results
- 6) In-service date documentation
- 7) Photos of dam and spillway channel
- 8) Orthophoto of reservoir and surrounding land
- 9) Past correspondence between you and the Forest
- 10) A check for \$335.00 for application fees

The hazard classification documentation is provided in lieu of dam construction plans and specifications. Phone conversations with Tim Schaal indicated this is appropriate.



If you have questions concerning this application, please contact Mark Nienow (Forest Hydrologist) at 406-657-6207 - ext. 227.

Sincerely,

A handwritten signature in cursive script that reads "Gary L. Bener".

for NANCY T. CURRIDEN
Forest Supervisor

Enclosures

IN-SERVICE DATE

Property No.: 3486

Property Name: BROWN'S POND

In-service Date: 6/30/1962

I have reviewed the In-service Date for the structure/facility listed above. I have visually observed the structure/facility and noted the materials used in the construction, the architecture and appearance, and other information available on it. I believe the In-service date is a reasonable and accurate representation of the period in time that the facility/structure was placed in service by the Forest Service.

Engineering Representative: De Kay

Date: 09/24/01

Permit No. 1836-1
Grand River - Water District

Report Of Examination Of Works And/Or Application of Water To Beneficial Use

TO: Chief Engineer, Water Rights Program, DENR, Foss Bldg., Pierre, SD 57501

I have this day, May 9, 2012, made a thorough examination of the water use system for USDA, Forest Service of 1310 Main Street, Billings, MT 59105 holder of Permit No. 1836-1, bearing the priority of February 22, 2005 authorizing the storage of 378 acre-feet of the waters of runoff - Campbell Creek for fish & wildlife propagation and recreational purposes, in Harding County.

I have to report on the conditions of the same as follows:

A. Works used to divert the water:

A 25 ft. high earth dam with a normal storage capacity of 378 ac-ft.

B. Works used to transport water to place of use:

N/A

C. Works used to apply water to beneficial use:

A 25 ft. high earth dam with a normal storage capacity of 378 ac-ft.

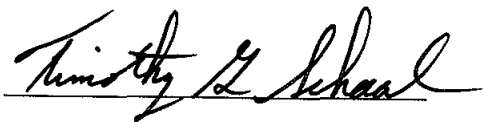
The system is in the following condition good. The point of diversion is located 1150 ft. north & 1320 ft. east of the SW corner of Sec.10-T21N-R5E (S ½ SW ¼ (Lat. 45.794360, Long. -103.495400)). The works are capable of storing 378 acre-feet of water which is to be used for fish & wildlife propagation and recreational purposes. Water has been put to beneficial use to the maximum extent as follows:

A 25 ft. high earth dam with a normal storage capacity of 378 ac-ft.

and the license should be issued for 378 acre-feet of storage.

Applicable permit qualifications have been complied with: Yes X

Exceptions to compliance are: none Date Report Completed: April 2, 2013



Timothy G. Schaal, P.E.
Engineer IV
SD DENR, Water Rights Program

REPORT ON INSPECTION OF PERMIT NO. 1836-1

DATE OF INSPECTION: May 9, 2012

NAME & ADDRESS OF PERMIT HOLDER: USDA, Forest Service, 1310 Main St., Billings, MT 59105

DIVERSION POINT LEGAL LOCATION: 1150 ft. north & 1320 ft. east of the SW corner of Sec. 10-T21N-R5E (S ½ SW ¼) (Lat. 45.794360 & Long. -103.495400).

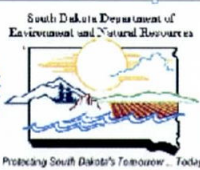
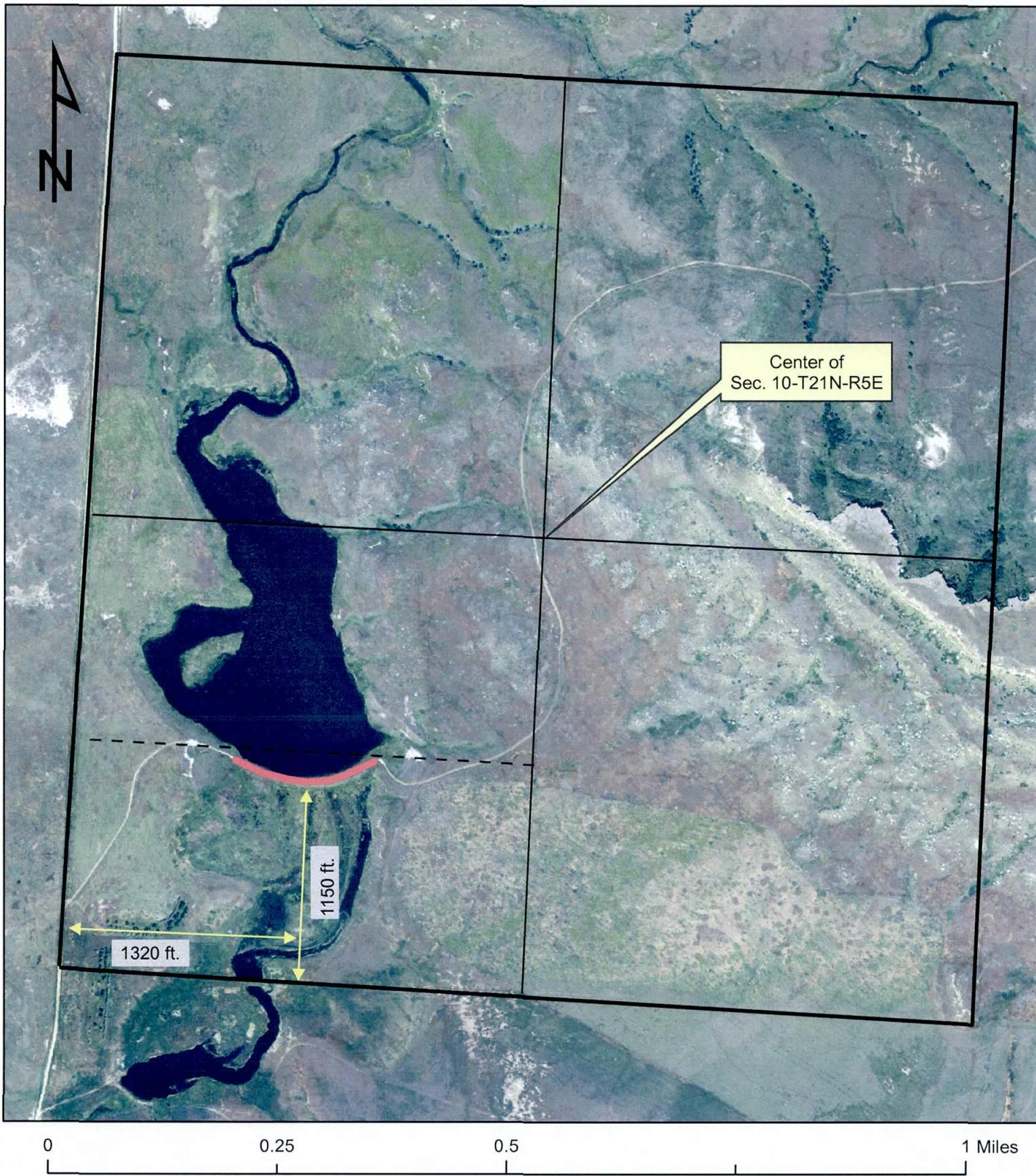
DAM INFORMATION:

- 1) Height to crest 25 feet
- 2) Height to primary spillway 21 feet
- 3) Height to secondary spillway N/A feet
- 4) Crest width 20 feet
- 5) Crest length 800 feet
- 6) Spillway length XXX feet
- 7) Spillway width 150 feet
- 8) Approx. storage (Normal) 378 acre-feet
- 9) Approx. storage (Maximum) 512 acre-feet
- 10) Date constructed: 1962

PERMIT QUALIFICATIONS AND REGULATIONS:

- 1) Soil and water permit lands agree with lands being irrigated and lands listed on permit N/A
- 2) Special qualifications to permit being abided by yes
- 3) All structures, wells and lands on map yes
- 4) Irrigation Questionnaires checked to determine if permit owner started irrigation by the end of construction period N/A

Water Permit Application No. 1836-1



Timothy G. Schaal

Timothy G. Schaal, P.E.
Engineer IV
SD DENR, Water Rights Program

4/2/13



**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

PMB 2020
JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3182

denr.sd.gov

MAY 17 2013

1836-1

Pam Gardner, Deputy Forest Supervisor
USDA Forest Service
1310 Main
Billings MT 59105

Dear Ms. Gardner:

Enclosed is Water License No. 1836-1. This is the final water right document completing your process of obtaining a Water Right. Included with your license is a map prepared by the staff engineer who conducted the field investigation.

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

Sincerely,

Jeanne Goodman, Chief Engineer
Water Rights Program
(605) 773-3352

enclosures

STATE OF SOUTH DAKOTA

WATER LICENSE NO. 1836-1

(1) The USDA – Forest Service, 1310 Main St, Billings MT 59105 made Application No. 1836-1, February 22, 2005 for a water permit to impound 378 acre feet of water in an existing dam on Campbell Creek, in Harding County, South Dakota for fish & wildlife propagation, recreational use and livestock watering purposes. Permit No. 1836-1, with a priority date of February 22, 2005 was approved April 11, 2005 and issued to the applicant for diversion of water with construction of the described water supply system to be completed on or before April 11, 2010 and for the application to beneficial use of said water on or before April 11, 2014.

(2) It is certified that the permit holder has complied with the provisions of South Dakota State Law relating to completion of the water supply system and is entitled to impound 378 acre feet of water for beneficial use.

The location of the storage dam is 1,150 feet north and 1,320 feet east of the SW corner of Section 10, T21N, R5E (S ½ SW ¼). Water is impounded in the SW ¼ and W ½ NW ¼ Section 10.

(3) The permit holder has complied with the provisions of South Dakota State Law relating to the application of water to beneficial use.

(4) Pursuant to South Dakota Water Law 46-5-30.1 the USDA – Forest Service, 1310 Main St, Billings MT 59105 the holder and/or owner of Water Right No. 1836-1 is issued a license to appropriate water, the right to impound 378 acre feet of water in a storage dam on Campbell Creek with a priority date of February 22, 2005 from the location specified in (2) of this license for fish & wildlife propagation, recreational use and livestock watering purposes.

This license is subject to South Dakota Water Law, any limitations or conditions listed in Water Right No. 1836-1 and subject to the following qualifications:

- Water Permit No. 1836-1 authorizes a dam with a storage capacity of 378 acre feet of water and sufficient water annually to maintain the water level to the outlet elevation.
- Low flows as needed for downstream domestic use, including livestock water and prior water rights must be bypassed.



Jeanne Goodman, Chief Engineer
Water Rights Program
Department of Environment and Natural Resources

MAY 17 2013

date

