

1. Considered: June 9, 19 82 Water Right No. 4901-3
2. Name of Applicant S.D. DEPARTMENT OF GAME FISH AND PARKS
3. Post Office Address ANDERSON BUILDING, PIERRE, S,D, 57501
4. Amount of Water Claimed 20.0 cfs from march - June and 6.0 cfs from July - February maximum acre feet
5. Source of Water Supply Split Rock Creek
6. Water to be used for REC, DOM & FWP Instream flow use ~~acres to be irrigated~~
7. County Minnehaha about 1½ miles south of Garretson
8. PROOF OF PUBLICATION: Received 6-8-82 Not Received
- APPLICATION: Approved ✓ 6/9/82 Subject to
- Not Approved Action Deferred

PRIORITY
4/13/82

Dated Received 4/13/82 Application complete-yes no FEE n/a
Remarks state agency

Corrected Application received Period of Annual Use continuously

WATER
QUALITY

Received yes no APPROVED/CONDITIONAL (Circle one)

WI-1 Description same as application-yes no Remarks

not applicable

Disapproved Returned

Diversion Point

Sections 30 & 31 - T103N-R47W

Land to be irrigated

 n/a

WELL LOG

Driller Licensed - yes no

Depth

Remarks

MAP Map No. 4047-3 Map located in Water Right xx Map file _____
 Type of Map drawn Prepared by Berg;GFP

+++++

REVIEWED This Application was received within 30 days of the date received, accepted as complete, Number assigned and written up for advertisement before the Board on:

5/17/82

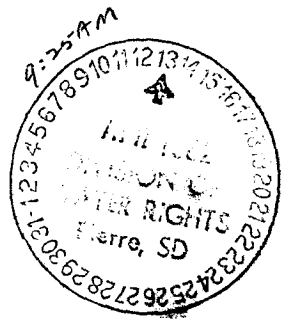

 (Signed)

+++++

PROTESTS Letters/Petitions in File - yes _____ no _____ Remarks _____

REMARKS Date
 F.F. & C. Final Decision, including F.F. & C. of Law were adopted _____

OF LAW, Date
 FINAL Final Decision mailed to parties and/or parties notified that Final Decision was
 DECISIONS adopted _____
 ETC. Remarks _____



No. 4901-B
 Map No. 4047-3 Water Division No. 3 BIG SPOUX RIVER District
 Above for Office Use 10170203

APPLICATION FOR PERMIT To Appropriate Water within the State of South Dakota

Check one of the following:

New ☒ Vested Right _____ Future Use _____Change in Diversion N/A Additional Diversion _____Change in Acreage N/A Additional Acreage _____

1. Name of Applicant S.D. Dept. of Game, Fish & Parks Phone No. (603) 773-3387
 Post Office Address Anderson Building Pierre State S.D. 57501
 (Street, RR, or Box) (Town) (Zip Code)
 If a corporation show date and place of incorporation _____

2. Method of accomplishing work (contract, employment of others, or by direct labor) N/A3. Name of diversion work N/A Palisades State Park4. Amount of water claimed (cubic feet per second) 20 cfs, March-June; 6 cfs, July-February5. Source of water supply Split Rock Creek

6. Location of point of diversion Palisades State Park, Northern Boundary
T 103N, R 47W, Secs. 30 & 31

County Minnehaha7. Annual period or periods during which water is to be used * year round8. Use to be made of water, (irrigation, industrial, municipal, commercial, recreation, etc.) recreation, fisheries & public use

9. For irrigation use, Total number of acres to be irrigated _____

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.

Land Description	No. Acres Irr.

Attach sheet if more space is needed

10. Time required to complete construction of water supply system 0 years. Additional time required to complete application of water to the proposed beneficial use 0 years.

11. Choice of county newspaper for publication of Notice of Intent to Appropriate Water Sioux Falls Argus Leader

12. Principal Features of the Proposed Water Supply System.

A. Works proposed to divert water from its natural source.

N/A

B. Works proposed to transport water to place of use.

N/A

C. Works proposed to apply water to beneficial use.

See Attachment.Estimated Total Cost \$ 0.00

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

STATE OF SOUTH DAKOTA)
) ss.
 County of Hughes)

I, Mikal Hanson the applicant, certify that I have read the foregoing application and 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 Mikal Hanson
 Subscribed and sworn to before me this 13th day of April, 19 82
Jeannette Pfeiffer
 Notary Public (or other qualified officer).

Jeannette Pfeiffer, Notary Public
 My Commission Expires
 April 8, 1984

WATER RIGHT APPLICATION APPROVAL

The Water Management Board hereby approves Water Right Application No. 4901-3
S.D. Department of Game Fish and Parks Anderson Building, Pierre
South Dakota 57501 (Applicant) (Post Office Address)
(State) With the following qualifications.

Date of first receipt of application April 13, 19 82
Date of return to applicant for correction, amendments or changes required _____, 19 _____
Date of receipt of corrected application _____, 19 _____
Approved June 9, 19 82, Recorded in Book _____ Page _____

WATER RIGHT PERMIT NO. 4901-3

The Water Management Board hereby grants and issues this Water Right Permit No. 4901-3 authorizing the construction of the water use system and the putting of water to beneficial use as stated in the Application and as qualified in the Water Right Application approval, subject, however, to the following limitations and conditions:

1. The date from which applicant may claim right is April 13, 19 82.
2. The equivalent of at least one-fifth of the work above specified is ~~to be completed~~ completed.
3. The whole of said work is ~~to be completed~~ completed.
4. The limit of time from proof of beneficial use of water appropriated in accordance herewith is ~~completed~~ completed.
5. The water appropriated shall be used for the purpose of Recreation, Public Use, and Fish and Wildlife propagation- instream flow use.
6. The prior right of all persons who, by compliance with the laws of the State of South Dakota, have acquired a right to the use of water must not be injuriously affected by this appropriation.
7. The amount of the appropriation herein granted is 20.00 cfs during March thru June and 6.00 cfs during July thru February for instream flow use.

~~to not more than 2 acre foot per acre per year and be limited to not more than one-seventieth (1/70) of one cubic foot of water per second of time for each acre of land to which water is actually and beneficially applied~~
~~For Recreation, Domestic and Fish/Wildlife propagation~~
~~for irrigation or before~~ This Date, 19 82, said water to be used during the following described annual period: 20.00 c.f.s. during March thru June and 6.00 c.f.s. during July thru February

Witness my hand this 23 rd day of June, 19 82

THE WATER MANAGEMENT BOARD

By: John Hatch
Chief Engineer, Water Rights
JOHN HATCH

Certificate of Construction Issued _____, 19 _____
Water License Issued July 1, 19 82

Permit No. 4901-3

Water Division 3 Big Sioux River Water District

RECOGNITION OF
APPLICATION OF WATER TO BENEFICIAL USE
FOR INSTREAM FLOW PURPOSES

TO: WATER RIGHTS, WATER MANAGEMENT BOARD/FOSS BUILDING, PIERRE, SOUTH DAKOTA 57501

I have this day recognized that non-consumptive beneficial use of Split Rock Creek water is being made for Recreation, Public Use, and Fish/Wildlife propagation purposes within the boundaries of the Palisades State Park located in Sections 30 and 31-T103-R47 W by the South Dakota Department of Game, Fish and Parks, Pierre, South Dakota holder of Permit No. 4901-3 bearing a priority date of April 13, 1982 authorizing instream flow use of 20.0 cfs during March thru June and 6.0 cfs during July thru February.

Date

July 14, 1982

John Hatch
(Signature)

Water Rights Division (605) 773-3352

July 15, 1982

Game, Fish & Parks
Anderson Building
Pierre, South Dakota 57501

Gentlemen:

Enclosed herewith is your Water Permit No. 4901-3 as approved by the Water Management Board.

Also enclosed is Water License No. 4901-3 which is the final water right document completing your process of obtaining a water right.

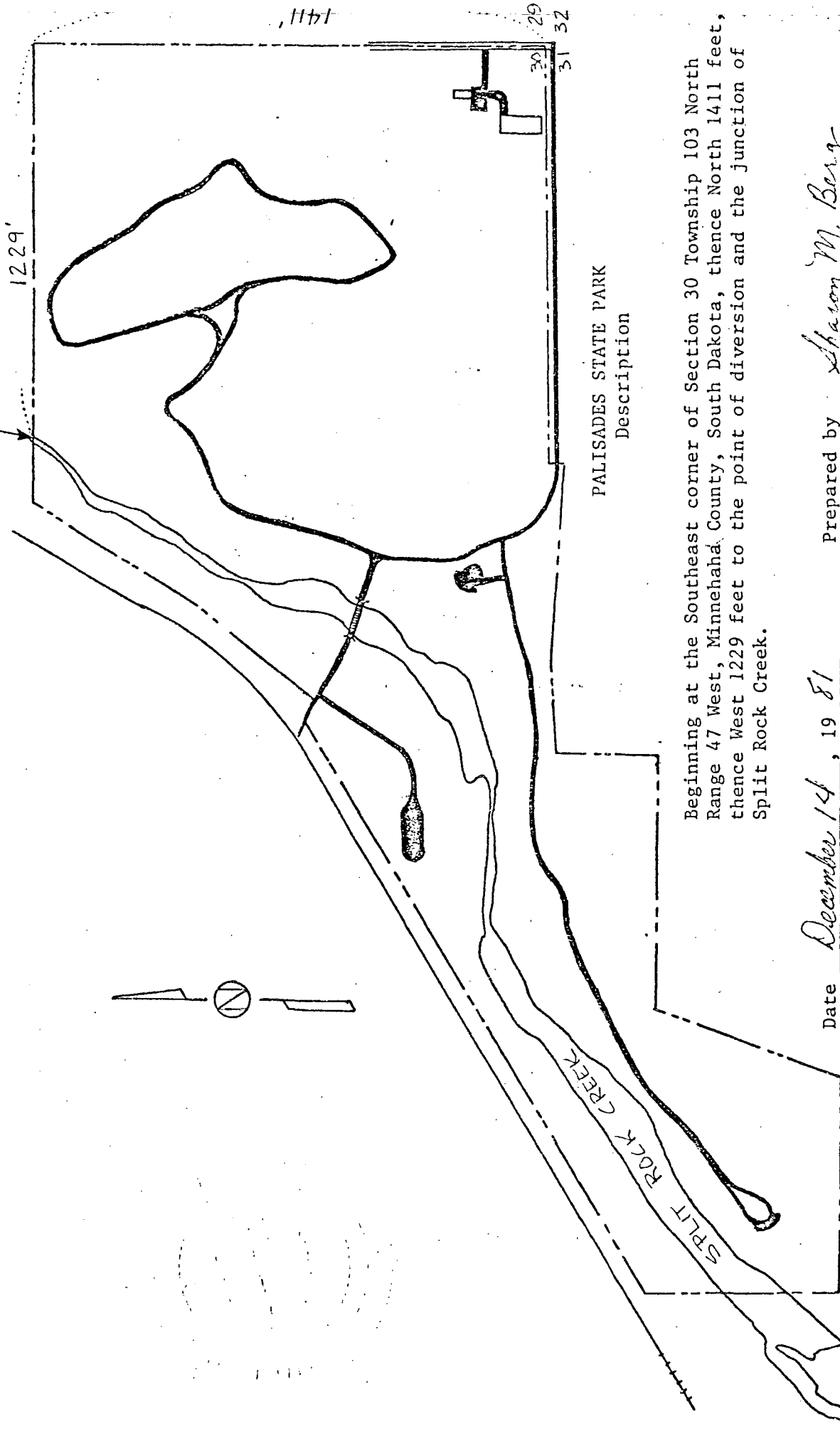
As long as you use the water beneficially, as stated in the Water License, the State Water Laws provide that you have a continuing right to use the water.

Very truly yours,

JOHN HATCH, Chief Engineer
Water Rights Division

JH:ms
Enclosures

POINT OF DIVERSION
1229'



Beginning at the Southeast corner of Section 30 Township 103 North
Range 47 West, Minnehaha County, South Dakota, thence North 1411 feet,
thence West 1229 feet to the point of diversion and the junction of
Split Rock Creek.

PALISADES STATE PARK
Description

Date December 14, 19 81

Prepared by Sharon M. Berg

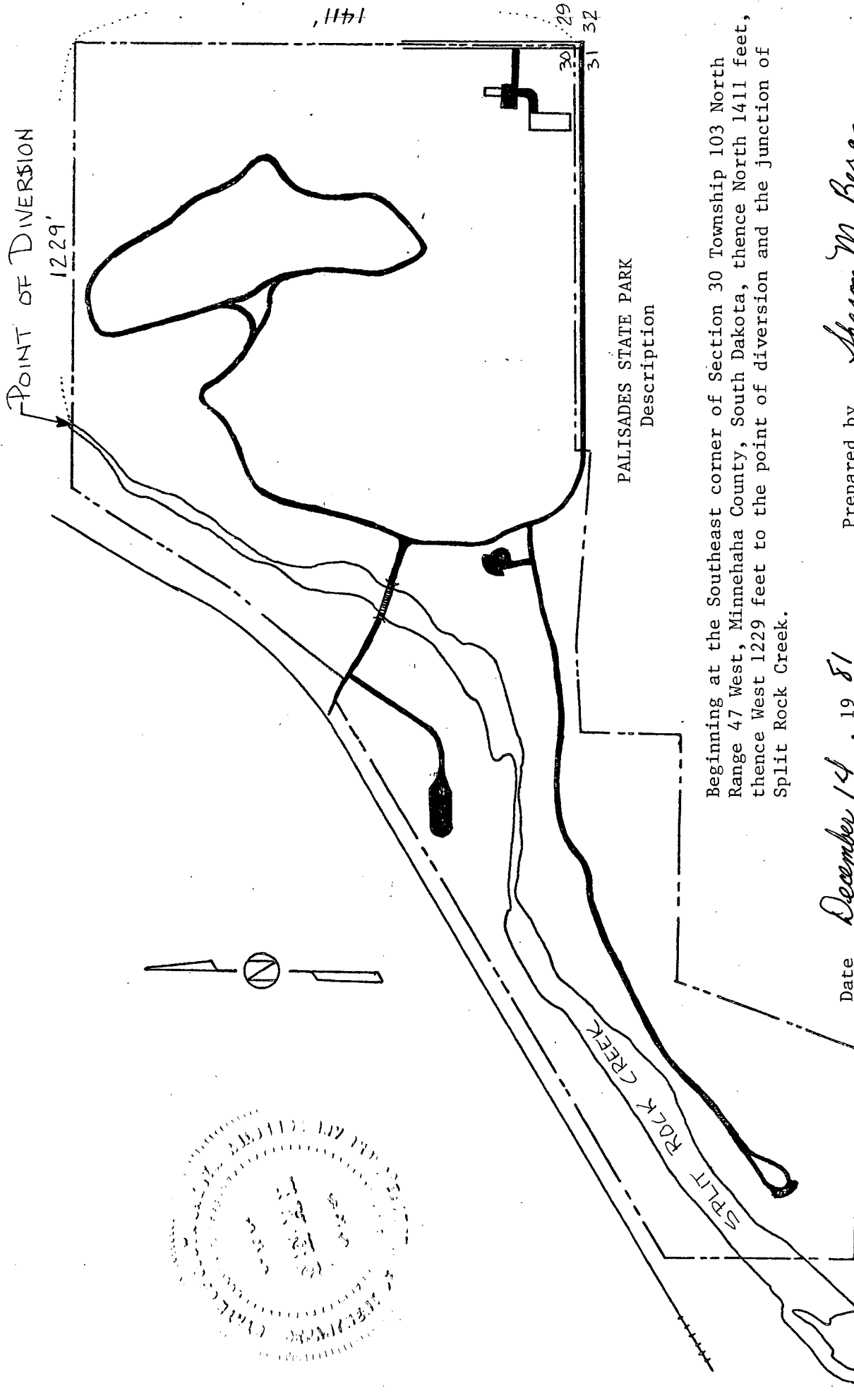
Sharon Berg, Special Programs Supervisor

Requested by Douglas H. Hoyer

Doug Hoyer, Assistant Director

Approved by Winston Douglas

Winston Douglas, Senior Engineer



Beginning at the Southeast corner of Section 30 Township 103 North Range 47 West, Minnehaha County, South Dakota, thence North 1411 feet, thence West 1229 feet to the point of diversion and the junction of Split Rock Creek.

Date December 14, 19 81

Prepared by

Sharon M. Berg

Sharon Berg, Special Programs Supervisor

Requested by

Douglas Hofer

Doug Hofer, Assistant Director

Approved by

Winston Douglas

Winston Douglas, Senior Engineer

MAP # 4047.3 APPL 4 4846.02

12-14-81
Dw

Publish first publication, on or before May 21, 1982NOTICE OF HEARING ON
APPLICATION TO APPROPRIATE WATER

Pierre, South Dakota 57501

May 17, 1982Notice is hereby given the S.D. Dept of Game, Fish & Parks whose post office

address is Anderson Building, Pierre, South Dakota, has made an application in accordance with the provisions of SDCL 46-1-1 thru 46-1-9; 46-1-12 thru 46-1-14; 46-2-9 thru 46-2-11, 46-2-13; 46-5-1 thru 46-5-8, 46-5-10 thru 46-5-22, 46-5-25, 46-5-41 (ground) ~~46-6-3 thru 46-6-5; 46-6-6, 46-6-10, 46-6-13, 46-6-14, (future use) 46-5-38; (transfer lands) 46-5-33 thru 46-5-35 and Board Rules ARSD~~ 74:02:01:01 thru 74:02:01:15, ~~(future use) 74:02:01:25 thru 74:02:01:26 (10,000 APM)~~ ~~74:02:07:01 thru 74:02:07:03~~, for a permit to appropriate for beneficial use 20.0 cubic feet per second during March thru June and
6.0 cubic feet of water per second of time from Split Rock Creek

during July thru February
through the Palisades State Park, ~~the point (s) of diversion which~~

~~is (are) to be located in the~~ Section 30 and 31

~~of Section~~, Twp. 103N, Range 47W. Said water to be used for purpose of providing irrigation on portions of the following described land:

Instream flows for recreational, public use and fish/wildlife propagation

This Application No. 4901-3 will be considered by the Water Management Board at Meeting Room #1, Kneip Bldg. Church & Illinois, Pierre SD upon the 9th day of June, 1982.

at 10 A.M. The Board is authorized to make a determination on this application at the hearing. All interested persons may appear and be heard. Any person who may be affected by a Board decision who desires to present evidence or cross-examine witnesses according to SDCL 1-26 may notify the Board in writing prior to the hearing or orally at the hearing.

This hearing is an adversary proceeding. Any person 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 at the hearing. Decisions of the Board may be appealed to the Circuit Court and the State Supreme Court as provided by law.

Any handicapped person wishing to attend this hearing can contact the Water Rights Division, DWNR, Joe Foss Building, Pierre SD, prior to the hearing date for assistance to assure access to the hearing.

For the Water Management Board

cc: applicant

BETTY WESTLUND, Water Rights Specialist

WNR-806-2/82



Department of Water & Natural Resources

Joe Foss Building
Pierre, South Dakota 57501

Water Rights Division
(605) 773-3352

No. 4901-3

May 17, 1982

ARGUS LEADER
Legal Dept
Sioux Falls SD 57102

Dear Sir:

Enclosed is a Notice of Intent to Appropriate Water by S.D. Dept. of Game, Fish & Parks

Application No. 4901-3, in Minnehaha County, South Dakota. Please publish this notice once each week for two consecutive weeks in your paper. The first

publication should be on, or before May 21, 1982.

The APPLICANT MUST VERIFY TO YOU THAT THE NOTICE IS TO BE PUBLISHED, before you make the first publication. The applicant is to pay the cost of publication and should make the necessary arrangements with you to pay these costs.

Please receipt for this notice IMMEDIATELY after first publication attaching thereto a copy of the first publication so that it may be compared with the records. For your convenience, you may use the printed form below for this purpose.

After final publication, please complete and mail to this office, the enclosed Form 8 to furnish Proof of Publication. The permit to appropriate water cannot be issued until this proof of final publication is received. This Proof of Publication must be filed within 60 days of this notice for the applicant to retain his priority.

For the Water Management Board,

Encl: Forms 6 & 8
cc: Applicant

BETTY WESTLUND, Water Rights Specialist

No. 4901-3

Date _____

TO: Water Rights Division
Joe Foss Building
Pierre, SD 57501

We are in receipt of your letter of _____, 19____ enclosing Notice of Proposed Appropriation of Water, as proposed in Application No. _____ which was first published in our issue of _____, 19____. ENCLOSED IS A COPY OF THIS FIRST PUBLICATION.

NAME _____

NEWSPAPER _____

WNR-807-4/82



Department of Water & Natural Resources

Joe Foss Building
Pierre, South Dakota 57501

Water Rights Division
(605) 733-3352

May 17, 1982

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

S.D. Dept. of Game, Fish & Parks
Anderson Building
Pierre SD 57501

Dear Sir:

You are hereby notified that your Application No. 4901-3 for a permit to
fish & wildlife Propagation
appropriate water for and recreational use, has been examined and
found to comply with the water laws of South Dakota and the regulations
thereunder. A notice of your intent to appropriate water has been sent to the

Publisher of the ARGUS LEADER printed at Sioux Falls,
South Dakota. For your information, a copy of this notice is enclosed.

BE SURE TO CONTACT THE LEGAL AD DEPARTMENT OF THE ABOVE NEWSPAPER TO AUTHORIZE
PUBLICATION OF YOUR NOTICE OF INTENT TO APPROPRIATE WATER AND TO ARRANGE FOR
PAYMENT. EARLY CONTACT WITH THE PAPER CAN ELIMINATE DELAYS IN PRINTING THE
NOTICE AND TRANSMITTAL OF PUBLICATION NOTICES TO THIS OFFICE. THE PUBLISHER HAS
BEEN INSTRUCTED ON WHAT DATES HE IS TO PUBLISH THE NOTICE OF YOUR APPROPRIATION
OF WATER ONCE EACH WEEK FOR TWO CONSECUTIVE WEEKS PRIOR TO THE WATER MANAGEMENT
BOARD MEETING WITH THE LAST PUBLICATION TO OCCUR AT LEAST FOUR LEGAL BUSINESS
DAYS BEFORE THE BOARD MEETING. ANY INTERMEDIATE SATURDAY, SUNDAY OR LEGAL HOLIDAY
DOES NOT COUNT AS A LEGAL BUSINESS DAY. AT LEAST THE FIRST PUBLICATION NOTICE
MUST BE RECEIVED PRIOR TO THE WATER MANAGEMENT BOARD MEETING FOR THE HEARING TO
BE CONDUCTED.

You should know that the Publisher is to furnish proof of publication to the
Water Management Board within 60 days of the date of this letter, otherwise
South Dakota Statute requires that your application lose its priority until
proof of publication is received in proper form.

For the Water Management Board

BETTY WESTLUND
Water Rights Specialist

Encl. Forms 6 & 7

WNR-805-4/82
Publication Notice

AFFIDAVIT OF PUBLICATION

STATE OF SOUTH DAKOTA.

ss.

COUNTY OF MINNEHAHA

David Licko

....., being duly sworn, says: That The Argus Leader is, and during all the times hereinafter mentioned was, a daily legal newspaper as defined by SDCL 17-2-2, as amended published at Sioux Falls, Minnehaha County, South Dakota by Sioux Falls Newspapers Inc.; that affiant is and during all of said times, was an employee of the publisher of such newspaper and has personal knowledge of the facts stated in this affidavit; that the notice, order or advertisement, a printed copy of which is hereto attached, was published in said newspaper upon

Friday, the 21st day of May, 1982

Friday, the 28th day of May, 1982

....., the.....day of....., 19.....,

....., the.....day of....., 19.....,

....., the.....day of....., 19.....,

....., the.....day of....., 19.....,

....., the.....day of....., 19.....,

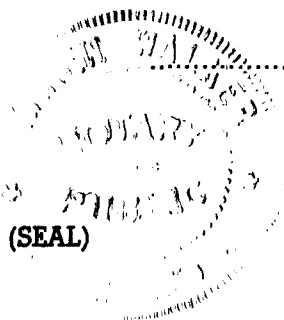
and that \$19.85 was charged for publishing the same.

David Licko

Subscribed and sworn to before me.. June 7, 1982

Karen Walker

Notary Public, South Dakota



State Notices

NOTICE OF HEARING ON APPLICATION TO APPROPRIATE WATER

Pierre, South Dakota 57501
Notice is hereby given that the S.D. Dept. of Game, Fish & Parks, whose post office address is Anderson Building, Pierre, South Dakota, has made an application in accordance with the provisions of SDCL 46-1-1 thru 46-1-9; 46-1-12 thru 46-1-14; 46-2-9 thru 46-2-11; 46-2-13; 46-5-1 thru 46-5-8; 46-5-10 thru 46-5-22; 46-5-25; 46-5-41 and Board Rules ARSD 74:02:01:01 thru 74:02:01:15, for a permit to appropriate for beneficial use 20.0 cubic feet per second during March thru June and 6.0 cubic feet of water per second of time during July thru February from Split Rock Creek through the Pallasades State Park, located in Sections 30 and 31, Twp. 103N, Range 47W. Said water to be used for purpose of providing instream flows for recreational, public use and fish/wildlife propagation.

This Application No. 4901-3 will be considered by the Water Management Board at Meeting Room #1, Kneip Bldg., Church & Illinois, Pierre, SD, upon the 9th day of June, 1982, at 10:00 A.M. The Board is authorized to make a determination on this application at the hearing. All interested persons may appear and be heard. Any person who may be affected by a Board decision who desires to present evidence or cross-examine witnesses according to SDCL 1-26 may notify the Board in writing prior to the hearing or orally at the hearing.

This hearing is an adversary proceeding. Any person 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 at the hearing. Decisions of the Board made pursuant to the Circumstances of the Supreme Court as provided by law.



State of South Dakota
COUNTY OF MINNEHAHA

IN THE CIRCUIT COURT

Judicial Circuit

VS.

Affidavit of Publication

OF

AND

The within Affidavit of Publication of

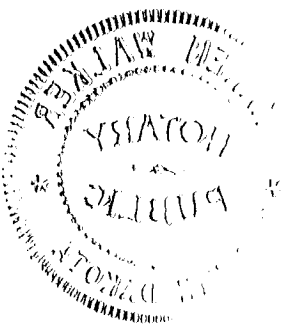
was filed in my office this day of

19

Clerk of the Circuit Court of the

Judicial Circuit of the State of South Dakota,

within and for County.





Department of Water & Natural Resources

Joe Foss Building
Pierre, South Dakota 57501

Water Rights Division
605 773-3352

June 24, 1982

South Dakota Department of
Game, Fish & Parks
Anderson Building
Pierre, South Dakota 57501

Gentlemen:

Enclosed herewith is your Water Right Permit No. 4901-3 as approved by the Water Management Board authorizing the water diversion system and apply the water to beneficial use, not exceeding the limits as specified in said Water Right Permit No. 4901-3.

~~The Board will schedule an inspection so that your Certificate of Construction and Water License may be issued to you, thus completing your acquisition of a Water Rights.~~

Very truly yours,

JOHN HATCH, Chief Engineer
Water Rights Division

JH:ms

enclosure

REPORT

TO THE

BOARD OF WATER MANAGEMENT

ON

FLOW REQUIREMENTS

FOR

PALISADES PARK/SPLIT ROCK CREEK

FROM

SOUTH DAKOTA DEPARTMENT OF WATER AND NATURAL RESOURCES
APRIL, 1982

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1. INTRODUCTION

The South Dakota Department of Game, Fish and Parks (GF & P) has submitted water right applications (4840-3 and 4841-3) for Split Rock Creek in the area of the Palsades State Park, which they manage. These applications indicate recreation as the use intended for the appropriated water. In this case, the term recreation incorporates a number of water-based recreational activities, such as swimming, wading, fishing, canoeing, aesthetic enjoyment, etc.

Under DWNR/Board of Water Management Regulations, titled "Surface Water Quality Standards", ARSD 74:04:04:06, the following beneficial uses have been designated for Split Rock Creek:

- a. Warm water semi-permanent fish life propagation
- b. Immersion recreation
- c. Limited contact recreation
- d. Wildlife propagation and stockwatering
- e. Irrigation

GF&P has entered testimony pertaining to the extensive use made of the facilities at Palsades Park. Additional data pertaining to the fishery in Split Rock Creek has been provided by GF&P, and is included as Attachment 1. Therefore, the utilization of Split Rock Creek for recreational use by the public of the State is supported by the

Palsades ^Park use data, the GF&P fish management data, and the current beneficial use designation in the "Surface Water Quality Standards".

However, the requested amounts of flow need to be evaluated in terms of providing for this use.

- x Ideally, a utility curve should be generated relating each ~~of these~~
- x activities ~~to~~ to flow, and the curves combined to form an overall utility

curve. From this, appropriate flow needs could be determined. However, several of the activities contained under the term "recreation" have utility curves which are difficult or impossible to quantify, ~~precisely~~. The best method available in this situation is to determine flow needs where possible, and compare these flows with the uses for which quantification is impossible. Of the activities listed above, fishing is most amenable to treatment by quantitative methods.

11. Methodologies to Determine Flow Requirements for Fishery Needs

There are three basic methods recognized for establishing flow requirements necessary to support fisheries. These are the Tessman Method, the Montana Method, and the Instream Flow Group (IFG)

✓ Incremental Method. The Tessman and Montana Methods use flow data as their bases while the IFG Method relies upon correlating probability of use curves established for various flow regimes with habitat availability. These methods are explained in more detail below, and are applied to Split Rock Creek. ~~The Tessman method is used for the~~

~~determination of:~~

spice → A. Tessman Method

The Tessman Method is used for the determination of

the flows necessary to support a fishery from flow data typically obtained at USGS gaging stations. The procedure is as follows:

1. Determine the mean monthly flow for each month and the mean annual flow based on the total flow record.
2. The required flow for fishery needs by month for is determined from a set of three conditions.

These three conditions are as follows:

- a. If the mean monthly flow is less than 40% of the mean annual flow, the mean monthly flow is designated as the minimum flow.
- b. If the mean monthly flow is greater than 40% of the mean annual flow but less than the mean annual flow, minimum flow is considered to be 40% of the mean annual flow.
- c. If the mean monthly flow exceeds the mean annual flow, the minimum monthly flow is 40% of the mean monthly flow. Table 1 shows these three possibilities.

Table 1: Formulas for Determining Minimum Flows, Tessman Method

If $X_m < .4X_a$, then $F = X_m$

If $.4X_a < X_m < X_a$, then $F = .4X_a$

If $X_a < X_m$, then $F = .4X_m$, where

X_m = mean monthly flow

X_a = mean annual flow

F = critical instream minimum flow.

3. In addition to the minimum flows determined above, Tessman recommends consideration of a flushing flow of twice the mean annual flow for a period of two consecutive weeks during the month of greatest flow.

This method is relatively quick, easy to apply, and does not require excessive data collection. However, it contains assumptions about fish habitat which may not be valid in a particular instance, and is limited

to those streams with good flow records. Therefore, before this method is applied, field surveys must be conducted in order to observe the existing condition of the stream, and its ability to support a fishery. Results of this method applied to Split Rock Creek are shown in Table II.

Table II: Tessman Method of Assessing Fishery Needs, Applied to Split Rock Creek (figures in cfs).

January	12.8	July	26.8
February	26.8	August	26.8
March	85.2	September	16.2
April	101.0	October	26.7
May	27.2	November	26.8
June	26.8	December	15.7

B. Montana Method.

A second method of assessing instream flow needs for fisheries is the Montana Method. Like the Tessman method, the Montana Method uses flow records such as those collected by USGS. In this case, however, flows are determined as a percentage of the annual average flow, with a range of values presented for various levels of habitat preservation. Table III shows the percentage used for each level.

Table III: Montana Method of Determining Instream Flow Needs

Recommended Base Flow Regimens

Put on
same page
as
Table

Oct - March April - September

Optimum	60-100%	60-100%
Outstanding	40%	60%
Excellent	30%	50%
Good	20%	40%
Fair/Degrading	10%	30%
Poor/Minimum	10%	10%
Severe Degradation	0-10%	0-10%

Insert A →

~~The results of this method, applied to Split Rock Creek, are shown in Table IV.~~

modified

Table IV: Results of ^AMontana Method of Assessing Fishery Needs, Applied to Split Rock Creek (results in cfs).

Recommended Base Flow Regimens

(Flows in cfs)

~~March - June~~ ~~Oct - March~~ ~~April - Sept.~~
March - June
July - April Feb.

Optimum	40-67	40-67
Outstanding	27	40
Excellent	20	34
Good	13	27
Fair/Degrading	6.7	20
Poor/Minimum	6.7	6.7
Severe Degradation	0-6.7	0-6.7

~~Like the Tessman method, this method is quick, easy to apply, and requires only data obtained from USGS flow records and the field.~~

It should be noted that the the Montana Method was developed for use on streams which support coldwater fisheries. This is the reason for the division in time periods (i.e. Oct-March & April-September), as this allows for lower flows during the autumnal spawning and incubation periods associated with coldwater species. At that time, moderate flows ensure that siltation with resultant oxygen deprivation will not occur, yet the eggs will not be displaced by high flows.

The situation in a warm water fishery such as Split Rock Creek is somewhat different. Warm water species such as channel catfish spawn in late winter to spring, as opposed to the fall spawning of cold water species. Also, many of the warm water species use flooded terrestrial vegetation as spawning grounds. Thus, high spring flows are needed for reproduction of the warm water species. As the summer progresses, lower flows in the summer and fall, (assuming the flows are still sufficient to maintain the fish population) will allow the riparian vegetation to reestablish, providing habitat for the spawning the following season.

Because of these considerations, the recommended flow regime for a warm water fishery should be for the higher flows to occur during the spawning period (approximately from March through June), and the lower fishery maintenance flows to occur for the remainder of the year. Therefore, the Montana Method can be modified to reflect these natural conditions by adjusting the flow regimes required for cold water species to those regimes required by warm water species. Using the Montana Method on Split Rock Creek with this modification, the results are shown in Table IV.

delete

~~surveys used to observe the habitat conditions of the stream to insure that ^{the capability} availability of the stream to support a fishery. However, it was designed primarily for use on streams which typically have flow variations less drastic than those found in prairie streams. The difficulties in applying the Montana method to a prairie stream such as Split Rock Creek are overcome at least in part by working with fair or poor flows rather than optimal or outstanding flows.~~

C. IFG Incremental Method

The third method of assessing instream flow needs for fisheries which is that developed by the U. S. Fish and Wildlife Service's Instream Flows Services Group. This group has developed a number of computer-based models of stream reaches, chiefly the WSP or IFG2 and the IFG4 models.

In both of these models, the first component is a hydraulic simulation model which relates depth, velocity, and cross sectional area of a transect to a specific flow rate. The IFG2 or WSP model requires only one set of measurements of a stream, while the IFG4 method demands measurements at 3 flows. A reach is modeled based on measurements taken at several (usually 3 to 7) transects. At each transect, the width of the stream is divided into small discrete subsectional channels. For each flow, the IFG models predict mean depth, area, and velocity for each subsection. The stream is divided into various subsectional reach channels with the surface area of each subsectional channel unit determined by

multiplying the width of the subsection by half the distance to the next transect upstream and downstream.

The second component of the method consists of the determination of the distribution of various combinations of depths, velocities and substrates for all subsectional reach channels. These totals are given in square feet of surface area per 1000 feet of stream.

A third component of the Incremental Method involves the determination of composite probability of use for each combination of depth, velocity and substrate^(u) in a particular subsectional reach channel. The composite probability of a selected species and life stage of fish residing in a particular subsectional reach channel is determined by the preparation of normalized preference curves for depth, velocity and substrate. Each curve offers a comparison of the probability that the selected fish species will utilize some increment of a particular hydraulic or substrate parameter. For any selected fish species, a composite probability is obtained based on these normalized preference curves:

$$p(C)=p(V).p(d).p(s)$$

where

$p(C)$ =the composite usability for any particular hydraulic and substrate parameter configuration

$p(d)$ =the probability obtained from the normalized preference curve for a depth (d).

$p(s)$ =the probability obtained from the normalized preference curve for a particular substrate

$p(v)$ =the probability obtained from the normalized preference curve for a particular velocity (v)

After the composite probability is determined using CVNT of the HABTAT computer program, the fourth component involves the calculation of the weighted useable area for each discharge, species and life history phase under investigation. According to the Cooperative Instream Flow Service Group, the weighted useable area is defined as the total surface area having a certain combination of hydraulic conditions multiplied by the composite useability for the combination of conditions. This calculation is applied to each cell within the multidimensional matrix which in turn is a summation of all stream reach subsections. This procedure roughly equates an area of marginal habitat to an equivalent area of optimal habitat. Each weighted useable optimal area estimation is given in terms of a total stream surface area of 1000 square feet.

Due to the necessary data collection and computer time necessary to perform the IFG Method, this method of assessing instream flow needs for fishery use is obviously the most complex, costly, and difficult. Additionally, the modeling process requires several assumptions, such as substrate composition remaining invariant with flow, which are probably not accurate reflections of reality.

However, the model may be used with specific reference to species and life stages of interest, ^v The output is not designed to be used

which does make the results site specific.

as a predictor of a "minimum" flow. Rather, the output shows effect of change in flow on habitat availability, allowing an assessment of the effect of various alternatives on fishery habitat.

Field data were collected in Split Creek for use in an IFG2 analysis of fisheries. However, because of difficulties encountered in data collection, the stream reach simulated did not adequately reflect all major habitats available in the stream. Specifically, it was not possible to collect depth and velocity information in the deepest part of the pools found in the park. Therefore, the simulation did not include adequate representation of the pool area most likely to be preferred habitat for typical fish species, such as channel catfish, which characteristically utilize the deeper pool areas of a warm water stream. Additionally, it was necessary to measure the stream during a period of high flow. Thus, inferences about habitat available at the low flows under discussion for the water rights in question would of necessity involve extensive extrapolation.

Given these shortcomings in the data, it was decided to use the IFG model in a slightly different manner. The fish species of importance in Split Rock Creek migrate. Extreme low flows of short duration would allow temporary maintenance of reservoirs of fish in the deeper pools, at least for the period in which temperature, oxygen depletion, and food availability did not become critical. However, these low flows would prevent migration of fish from one reservoir to another, due to the extreme shallowness of the riffle

or rapid areas between pools. By determining flows needed to maintain specified minimum depths, critical migration flow needs can be assessed, and this flow can then be assumed to maintain adequate water quality in forms of temperature, oxygen depletion etc. in order to maintain the fishery. For the species of interest in Split Rock Creek, a critical flow level was defined as sufficient to provide a water depth of six inches or greater over twenty-five percent of the bank-to-bank width of the stream. This approach of assessing critical migration flows has been used in Nebraska on similar sand-bed streams.

The results of this type of analysis for each of the six transects measured and for several depths are shown in Table V. The most critical transect is transect 3, which represents the riffle or rapid type of habitat. Note that transects 5 and 6, taken in a pool, require less flow to maintain a given depth than transects 1 through 3, which were located in regions of rapid bed elevation reductions. The six cfs requested under application 4841-3 would provide approximately the minimum sufficient flow to allow migration across this transect. Given the relatively small size of the pools in the park, it is vital that such migration be available throughout the year to allow foraging and migration to the deepest pools in periods of extremes in temperature.

The above analysis, it must be stressed, is based on a consideration of critical or minimum necessary flows for one aspect of fisheries production, rather than an assessment of overall optimum flows. The latter is of course to be preferred if

possible, especially if a water right is to be granted exclusively for fisheries purposes. In this case, however, difficulties in data collection precluded such an approach and, as fisheries maintenance is only one of the beneficial uses enumerated in the applications, the critical migration flow approach may be defended.

Appendix I documents the presence of a wide variety of fish in Split Rock Creek, and includes a partial listing of stocking efforts made in the stream since 1920. The higher flows requested for the March through June period are designed to maintain availability of flooded areas along the creek, thus aiding in reproduction of the most important species in the stream.

As noted, the flow levels requested fall within the minimum range ✓ for a sustained fishery for Split Rock Creek. The limited analysis ✓ which were performed utilizing the composite probability of use curves fish species common to Split Rock Creek do indicate that increased flows would provide better habitat, allowing deeper pools, easier migration, greater food production, cooler temperatures in summer, etc.

Table VI: Flows (In cfs) needed to Maintain 25% of Bank to Bank Width at Specified Depth or Greater

Transect	Depth (ft.)				
	.5	1	2	2.5	3
1	<10	30	170	-	-
2	<10	10	105	-	-

3	<10	40	170	-	-
4	<10	20	95	170	-
5	<10	<10	40	80	130
6	<10	<10	45	50	85

- indicates more than 190 cfs needed to maintain specified depth.

B. Methodologies To Determine Flow Requirements for Other Recreational Uses

The assessment of flow requirements for recreational uses such as wading, swimming, and boating is subject to a number of difficulties.

However, for each of these activities a range of acceptable conditions may be defined. ^{As an} ^{Appendix II shows that} For example, swimming requires water of at least 2.5 feet depth, and is impractical at velocities greater than 3.0 feet per second. These are physical limitations.

Flow regimes of these characteristics may be considered barely marginal

for swimming use. Beyond these strict physical limitations are other, more limiting factors, such as safety. For swimming safety factors may indicate maximum velocity of 2 feet per second rather than the strict physical requirement of 3 feet per second. Finally, there is an optimum range. In the case of swimming, this may be defined as 0.25 to 0.75 feet per second in velocity and a water depth of over 4 feet. Of course, such an approach as this does not consider special problems such as water quality, visibility, or depth needed for

diving. However, it does provide a useful approximation of some of the requirements for good conditions for each type of recreation.

B { Appendix II shows the criteria developed by the Cooperative Instream Flows Services Group for a variety of recreational activities, and the probability of use curves developed from these criteria. Of particular interest in this case are those used for swimming, wading, and canoeing and kayaking, all activities extensively engaged in by visitors to Pallsades Park.

Appendix II shows
For ~~the rest of these~~, canoeing and kayaking, the minimal depth requirement is 0.5 feet. This can be met at all transects with a flow of 10 cfs. The safety requirement of 1.0~~0~~ feet may be obtained at slightly higher flows. Note that transects 1 and 3, for example, would require (Table VI) 30 and 40 cfs, respectively, to satisfy the 25% of channel width deeper than 12" requirement. Yet at 20 cfs sufficient depth and width exist to allow navigation of the stream through these transects. As they represent worst case situations, 20 cfs would be acceptable on an overall basis. At that flow, most of the stream would be above the "minimum" criteria, with the pools providing areas of depth sufficient to be classified as acceptable or optimal.

Suitability of the stream within the park for wading is also important, given the large number of visitors who use the stream in this way. Here the optimal depth criterion could be misleading, as a hypothetical case will illustrate. If, in a

stream reach, the entire area was optimal for wading (depth of 0.75 to 2.5 feet, velocity of 0.25 to 2.0 feet per second), swimming would not be possible. Thus, the need to deal with multiple uses implies a need to attempt to balance each of the uses. (In this case, a flow of 20 cfs will allow wading over substantial portions of the stream. The 6 cfs requested in ~~application 4841-3~~ will also allow wading in some portions of the stream.

With respect to swimming, the proposed 19 cfs appropriation will provide for some areas in the deeper pools suitable for swimming. ~~In the deeper pools.~~ As noted in Section II, data regarding maximum depth of the pools was not obtained, so it is not possible to state with precision the extent of the area available for swimming at a given flow. The 19 cfs levels, however, would seem to provide some areas suitable for swimming with respect to depth and velocity requirements.

From the above discussion, it can be seen that while it is not possible to determine a specific flow as optimum for these activities, it appears that the flow requested would protect these recreational uses, allowing each to be pursued by visitors to Pallsades Park.

IV. Flow Availability Data

Flow availability data is presented in three different modes. Table VI gives the 7-day low flows by month for the period 1966 through 1980 from the USGS Station No. 06482610 located at Corson, which approximately 8 miles below Palisades Park. Table VII presents the flow exceedence values from this gage station for the same time period. Finally, Figure 1 graphically depicts the flow exceedence curves from this station for the time period of 1966 through 1981 for the summer months.

Table : 7-Day Low Flows, Split Rock Creek at Corson
USGS Station No. 06482610

	J	F	M	A	M	J	J	A	S	O	N	D
1965										18.86	13.39	8.61
1966	5.31	4.03	7.14	20.57	27.29	8.49	1.63	1.71	1.07	6.61	8.04	6.89
1967	3.09	3.00	37.14	28.71	6.43	5.91	7.94	4.40	3.90	0.99	2.31	0.94
1968	0.60	3.90	5.46	5.23	7.36	5.21	5.24	0.30	2.01	4.13	13.77	5.21
1969	7.50	9.20	10.00	92.24	38.00	16.71	36.29	12.00	9.73	10.86	15.86	14.57
1970	9.21	9.07	42.43	148.43	20.43	19.43	4.47	2.07	3.24	7.57	14.14	5.20
1971	1.60	2.07	75.43	33.57	16.00	6.76	14.43	4.01	4.51	5.43	12.71	16.43
1972	2.30	1.24	6.69	29.00	86.00	43.57	40.57	13.71	10.57	12.86	22.71	8.76
1973	8.73	40.86	89.00	42.71	24.43	9.93	9.00	2.09	3.17	12.76	19.71	16.43
1974	7.89	12.00	78.00	40.43	23.43	10.41	3.97	4.11	3.87	3.29	6.47	5.26
1975	2.84	3.54	4.26	23.14	18.14	11.04	4.36	5.89	4.11	3.86	3.10	5.54
1976	5.86	7.03	54.71	28.86	10.39	1.79	1.19	0.28	0.69	2.60	3.64	1.13
1977	0.02	0.00	1.43	15.29	6.06	1.97	2.50	5.44	13.51	26.29	25.71	26.14
1978	2.86	1.27	4.49	152.71	41.00	28.29	21.57	12.14	7.47	7.70	7.09	10.10
1979	6.41	5.96	7.76	129.57	68.29	59.00	34.43	41.57	45.14	30.28	82.14	42.43
1980	20.14	17.86	15.29	53.14	28.71	23.00	7.06	4.91	4.64			
Average	5.6	8.1	29.3	56.2	28.1	16.8	13.0	7.6	7.8	10.3	16.7	11.6

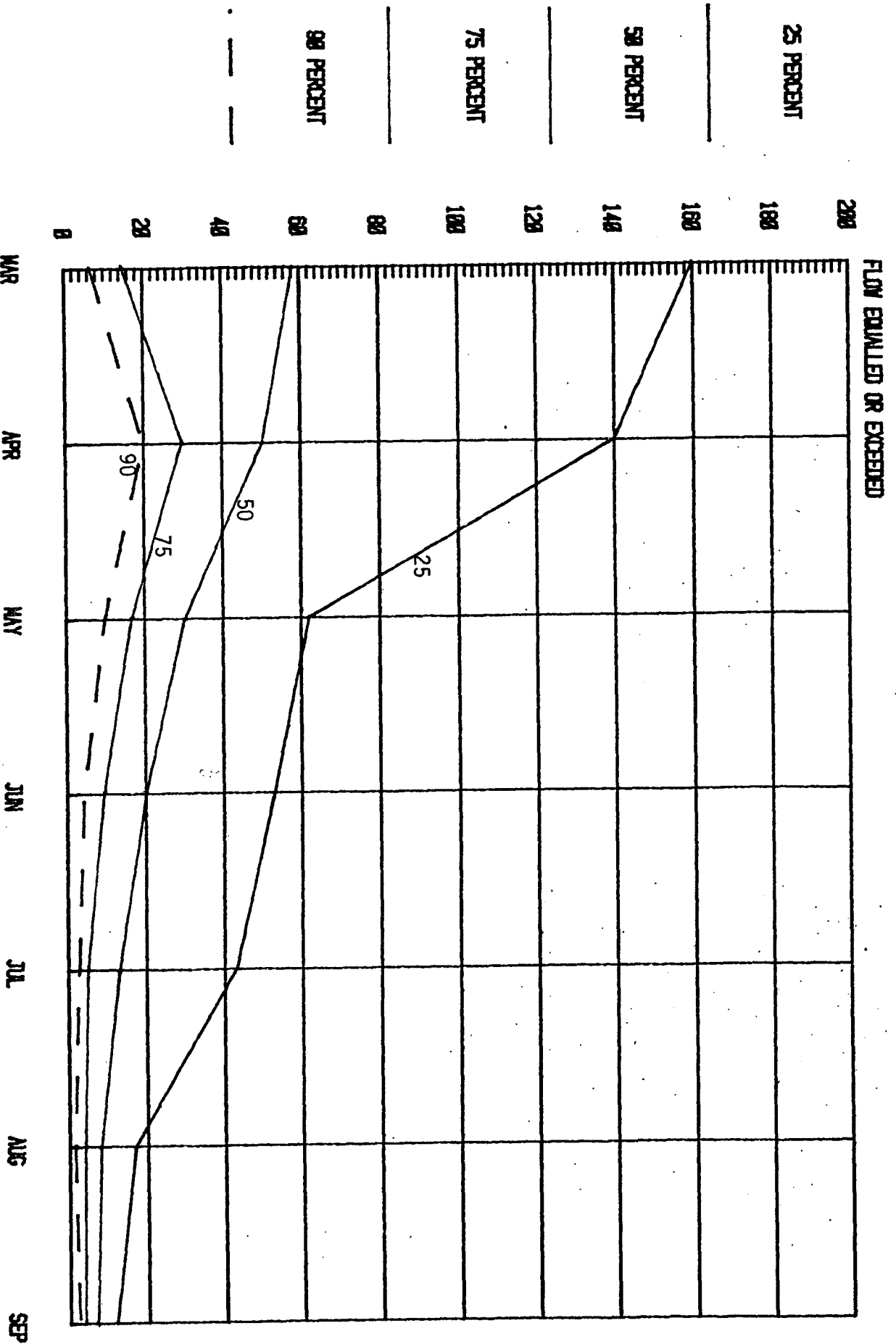
Split Rock Creek at Corson, South Dakota USGS Station No. 06482610
Flow Exceedence Values for
October 1965-September 1980

	90	80	70	60	50	40	30	20	10
January	1.3	2.9	3.7	5.8	6.8	7.7	8.8	10	13
February	1.5	3.0	3.9	5.9	6.3	7.7	9.5	15	17
March	6.2	10	15	32	54	81	115	182	348
April	20	30	35	43	53	69	114	178	300
May	12	16	22	27	31	36	51	77	108
June	4.8	8.8	13	16	21	29	44	65	132
July	3.0	4.7	6.3	8.6	14	19	32	47	60
August	1.5	3.4	4.8	6.0	7.6	9.9	13	17	29
September	2.4	3.7	4.8	5.4	6.7	8.9	11	14	25
October	3.4	4.4	6.4	8.0	10	12	16	24	49
November	4.2	6.4	8.1	9.2	13	16	20	23	29
December	3.0	5.8	7.2	8.8	10	12	16	18	22

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MEAN DAILY FLOW-CFS

SPLITROCK CREEK AT CORSON 1968-1981



IV. Summary

The information compiled for each of the fishery determination methods together with the flow availability data are summarized in Table VIII. It is noted that the Tessman Method produced recommended fishery flow needs in excess of the 50 percent flow exceedance values. Therefore, in this case, the Tessman Method appears to be too high to be a realistic preservation flow. However, the ^{Modified} Montana Method produces values that ^{depict} resemble those amounts requested, ~~even though the time periods are not identical.~~ Likewise, the requested flows fall within the range of values produced by using only the hydraulic simulation capabilities of the IFG Model to predict the flows necessary to provide critical migration paths of 0.5 foot to 1.0 foot in depth. Finally, in comparing the requested flows against the data used to present the flow availability, it is noted that the average 7-day low flows indicate that the requested flows are not unreasonable. To be more specific, it appears that the requested flows fall roughly in ^{to} the ~~70~~ ⁷⁰ percent flow exceedance category, which means that there will be approximately a 70 percent chance in any one year of flows of these values or greater being present. It was also noted that the requested flow amounts should be sufficient to support other recreational uses, such as swimming, wading, etc. Therefore, on the basis of the calculations made, it is concluded that the requested flow amounts will support the designated beneficial uses of the stream, and on the basis of the flow records, ^{the requested flow amounts} will likely be present.

Table VIII: Summary of Flow Data (all values in cfs)

A) Tessman Method

March - June July - April

(average) (average)

60

22

B) Montana Method

March - June
~~April~~ - Sept.

July - ~~April~~ Feb.
~~Oct.~~ - March

(Fair/Degrading) (Fair/Degrading)

20

6.7

C) IFG/Critical Migration

Path Only

0.5 foot depth 1.0 foot depth March - June

6-10

10-40

ave 7-day

low flow=33

70% probability

= 13 to 35

= 21 average

July - April

ave 7-day

low flow=10

70% probability

= 3.7 to 8.1

= 5.7 average

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REPORT
TO THE
BOARD OF WATER MANAGEMENT
ON
FLOW REQUIREMENTS
FOR
PALISADES PARK/SPLIT ROCK CREEK
FROM
SOUTH DAKOTA DEPARTMENT OF WATER AND NATURAL RESOURCES
JUNE, 1982

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1. INTRODUCTION

The South Dakota Department of Game, Fish and Parks (GF & P) has submitted a water right application (4901-3) for Split Rock Creek in the area of the Palsades State Park, which they manage. This application indicates recreation, domestic, & fish and wildlife propagation as the uses intended for the appropriated water. In this case, the term recreation incorporates a number of water-based recreational activities, such as swimming, wading, fishing, canoeing, aesthetic enjoyment, etc.

Under DWNR/Board of Water Management Regulations, titled "Surface Water Quality Standards", ARSD 74:03:04:06, the following beneficial uses have been designated for Split Rock Creek:

- a. Warm water semi-permanent fish life propagation
- b. Immersion recreation
- c. Limited contact recreation
- d. Wildlife propagation and stockwatering
- e. Irrigation

Although available water quality information is not comprehensive, the data do not indicate any exceedences of the applicable standards for these uses.

GF&P has entered testimony pertaining to the extensive use made of the facilities at Palsades Park. Additional data pertaining to the fishery in Split Rock Creek have been provided by GF&P, and is included as Appendix I. Therefore, the utilization of Split Rock Creek for recreational use by the public of the State is supported by the Palsades Park use data, the GF&P fish management data, and the current beneficial use designation in the

"Surface Water Quality Standards". However, the requested amounts of flow need to be evaluated in terms of providing for this use.

Ideally, a utility curve should be generated relating each activity to flow, and the curves combined to form an overall utility curve. From this, appropriate flow needs could be determined. However, several of the activities contained under the term "recreation" have utility curves which are difficult or impossible to quantify. The best method available in this situation is to determine flow needs where possible, and compare these flows with the uses for which quantification is impossible. Of the activities listed above, fishing is most amenable to treatment by quantitative methods.

II. Methodologies to Determine Flow Requirements for Fishery Needs

There are three basic methods recognized for establishing flow requirements necessary to support fisheries. These are the Tessman Method, the Montana Method, and the Instream Flow Group (IFG) Incremental Method. The Tessman and Montana Methods use flow data as their bases while the IFG Method relies upon correlating probability of use curves established for various flow regimes with habitat availability. These methods are explained in more detail below, and are applied to Split Rock Creek.

A. Tessman Method

The Tessman Method is used for the determination of the flows necessary to support a fishery from flow data typically obtained at USGS gaging stations. The procedure is as follows:

1. Determine the mean monthly flow for each month and the mean annual flow based on the total flow record.

2. The required flow for fishery needs by month is determined from a set of three conditions. These three conditions are as follows:
- If the mean monthly flow is less than 40% of the mean annual flow, the mean monthly flow is designated as the minimum flow.
 - If the mean monthly flow is greater than 40% of the mean annual flow but less than the mean annual flow, minimum flow is considered to be 40% of the mean annual flow.
 - If the mean monthly flow exceeds the mean annual flow, the minimum monthly flow is 40% of the mean monthly flow. Table 1 shows these three possibilities.

Table 1: Formulas for Determining Minimum Flows, Tessman Method

If $X_m < .4X_a$, then $F = X_m$

If $.4X_a < X_m < X_a$, then $F = .4X_a$

If $X_a < X_m$, then $F = .4X_m$, where

X_m = mean monthly flow

X_a = mean annual flow

F = critical instream minimum flow.

3. In addition to the minimum flows determined above, Tessman recommends consideration of a flushing flow of twice the mean annual flow for a period of two consecutive weeks during the month of greatest flow.

This method is relatively quick, easy to apply, and does not require excessive data collection. However, it contains assumptions about fish habitat which may not be valid in a particular instance, and is limited to those streams with good flow records. Therefore, before this method is when applied, field surveys must be conducted in order to observe the existing condition of the stream, and its ability to support a fishery. Results of this method when applied to Split Rock Creek are shown in Table II.

Table II: Tessman Method of Assessing Fishery Needs,
Applied to Split Rock Creek (figures in cfs).

January	12.8	July	26.8
February	26.8	August	26.8
March	85.2	September	16.2
April	101.0	October	26.7
May	27.2	November	26.8
June	26.8	December	15.7

B. Montana Method.

A second method of assessing instream flow needs for fisheries is the Montana Method. Like the Tessman method, the Montana Method uses flow records such as those collected by USGS. In this case, however, flows are determined as a percentage of the annual average flow, with a range of values presented for various levels of habitat preservation. Table III shows the percentage used for each level.

Table III: Montana Method of Determining Instream Flow Needs

Recommended Base Flow Regimes		
	Oct - March	April - September
Optimum	60-100%	60-100%
Outstanding	40%	60%
Excellent	30%	50%
Good	20%	40%
Fair/Degrading	10%	30%
Poor/Minimum	10%	10%
Severe Degradation	0-10%	0-10%

It should be noted that the Montana Method was developed for use on streams which support coldwater fisheries. This is the reason for the division in time periods (i.e. Oct-March & April-September), as this allows for lower

flows during the autumnal spawning and incubation periods generally associated with coldwater species. At that time, moderate flows ensure that siltation with resultant oxygen deprivation will not occur, yet the eggs will not be displaced by high flows.

The situation in a warm water fishery such as Split Rock Creek is somewhat different. Warm water species such as channel catfish spawn in the spring and early summer months, as opposed to the fall spawning of cold water species. Also, many of the warm water species use flooded terrestrial vegetation as spawning grounds. Thus, high spring flows are needed for reproduction of the warm water species. As the summer progresses, lower flows in the summer and fall, (assuming the flows are still sufficient to maintain the fish population) will allow the riparian vegetation to reestablish, providing habitat for spawning the following season.

Because of these considerations, the recommended flow regime for a warm water fishery should be for the higher flows to occur during the spawning period (approximately from March through June), and the lower fishery maintenance flows to occur for the remainder of the year. Therefore, the Montana Method can be modified to reflect these natural conditions by adjusting the flow regimes required for cold water species to those regimes required by warm water species. Using the Montana Method on Split Rock Creek with this modification, the results are shown in Table IV.

Table IV: Results of Modified Montana Method of Assessing Fishery Needs, Applied to Split Rock Creek (results in cfs).

Recommended Base Flow Regimens		
(Flows in cfs)		
	July - Feb.	March - June
Optimum	40-67	40-67
Outstanding	27	40
Excellent	20	34
Good	13	27
Fair/Degrading	6.7	20
Poor/Minimum	6.7	6.7
Severe Degradation	0-6.7	0-6.7

C. IFG Incremental Method

The third method of assessing instream flow needs for fisheries has been developed by the U. S. Fish and Wildlife Service's Instream Flows Services Group. This group has developed a number of computer-based models of stream reaches, chiefly the WSP or IFG2 and the IFG4 models.

In both of these models, the first component is a hydraulic simulation model which relates depth, velocity, and cross sectional area of a transect to a specific flow rate. The IFG2 or WSP model requires only one set of measurements of a stream, while the IFG4 method demands measurements at 3 flows. A reach is modeled based on measurements taken at several (usually 3 to 7) transects. At each transect, the width of the stream is divided into

small discrete subsectional channels. For each flow, the IFG models predict mean depth, area, and velocity for each subsection. The stream is divided into various subsectional reach channels with the surface area of each subsectional channel unit determined by multiplying the width of the subsection by half the distance to the next transect upstream and downstream.

The second component of the method consists of the determination of the distribution of various combinations of depths, velocities and substrates for all subsectional reach channels. These totals are given in square feet of surface area per 1000 feet of stream.

A third component of the Incremental Method involves the determination of composite probability of use for each combination of depth, velocity and substrate in a particular subsectional reach channel. The composite probability of a selected species and life stage of fish residing in a particular subsectional reach channel is determined by the preparation of normalized preference curves for depth, velocity and substrate. Each curve offers a comparison of the probability that the selected fish species will utilize some increment of a particular hydraulic or substrate parameter. For any selected fish species, a composite probability is obtained based on these normalized preference curves:

$$p(C) = p(V) \cdot p(d) \cdot p(s)$$

where

$p(C)$ = the composite usability for any particular hydraulic and substrate parameter configuration

$p(d)$ =the probability obtained from the normalized preference curve for a depth (d).

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After the composite probability is determined using the HABTAT computer program, the fourth component involves the calculation of the weighted useable area for each discharge, species and life history phase under investigation. According to the Cooperative Instream Flow Service Group, the weighted useable area is defined as the total surface area having a certain combination of hydraulic conditions multiplied by the composite useability for the combination of conditions. This calculation is applied to each cell within the multidimensional matrix which in turn is a summation of all stream reach subsections. This procedure roughly equates an area of marginal habitat to an equivalent area of optimal habitat. Each weighted useable optimal area estimation is given in terms of a total stream surface area of 1000 square feet.

Due to the necessary data collection and computer time necessary to perform the IFG Method, this method of assessing instream flow needs for fishery use is obviously the most complex, costly, and difficult. Additionally, the modeling process requires several assumptions, such as substrate composition remaining invariant with flow. However, the model may be used with specific reference to species and life stages of interest, which does make the results site specific. The output is not designed to be used as a predictor of a

"minimum" flow. Rather, the output shows effect of change in flow on habitat availability, allowing an assessment of the effect of various alternatives on fishery habitat. A sample output of an IFG analysis which has been prepared for Castle Creek is included as an example in this report as Appendix II.

Field data were collected in Split Creek for use in an IFG2 analysis of fisheries. However, because of difficulties encountered in data collection, the stream reach simulated did not adequately reflect all major habitats available in the stream. Specifically, it was not possible to collect depth and velocity information in the deepest part of the pools found in the park. Therefore, the simulation did not include adequate representation of the pool area most likely to be preferred habitat for typical fish species, such as channel catfish, which characteristically utilize the deeper pool areas of a warm water stream. Additionally, it was necessary to measure the stream during a period of high flow. Thus, inferences about habitat available at the low flows under discussion for the water rights in question would of necessity involve extensive extrapolation.

Given these shortcomings in the data, it was decided to use the IFG model in a slightly different manner. The fish species of importance in Split Rock Creek migrate. Extreme low flows of short duration would allow temporary maintenance of reservoirs of fish in the deeper pools, at least for the period in which food availability, temperature, oxygen depletion, and other water quality parameters did not reach critical values. However, these low flows would prevent migration of fish from one reservoir to another, due to the extreme shallowness of the riffle or rapid areas between pools. By determining flows needed to maintain specified minimum depths, critical migration flow needs can be assessed, and this flow can then be assumed to

maintain adequate water quality in forms of temperature, oxygen depletion, etc., in order to maintain the fishery. For the species of interest in Split Rock Creek, a critical flow level was defined as sufficient to provide a water depth of six inches or greater over twenty-five percent of the bank-to-bank width of the stream. This approach of assessing critical migration flows has been used in Nebraska on similar sand-bed streams.

The results of this type of analysis for each of the six transects measured and for several depths are shown in Table V. The most critical transect is transect 3, which represents the riffle or rapid type of habitat. Note that transects 5 and 6, taken in a pool, require less flow to maintain a given depth than transects 1 through 3, which were located in regions of rapid bed elevation reductions. The six cfs requested under application 4901-3 would provide approximately the minimum sufficient flow to allow migration across this transect. Given the relatively small size of the pools in the park, it is vital that such migration be available throughout the year to allow foraging and migration to the deepest pools in periods of extremes in temperature.

The above analysis, it must be stressed, is based on a consideration of critical or minimum necessary flows for one aspect of fisheries production, rather than an assessment of overall optimum flows. The latter is of course to be preferred if possible, especially if a water right is to be granted exclusively for fisheries purposes. In this case, however, difficulties in data collection precluded such an approach and, as fisheries maintenance is only one of the beneficial uses enumerated in the application, the critical migration flow approach may be defended.

Appendix I documents the presence of a wide variety of fish in Split Rock Creek, and includes a partial listing of stocking efforts made in the stream since 1920. The higher flows requested for the March through June period are designed to maintain availability of flooded areas along the creek, thus aiding in reproduction of the most important species in the stream.

As noted, the flow levels requested fall within the minimum range for a sustained fishery for Split Rock Creek. The limited analyses which were performed utilizing the composite probability of use curves for species common to Split Rock Creek do indicate that increased flows would provide better habitat, allowing deeper pools, easier migration, greater food production, cooler temperatures in summer, etc.

Table V: Flows (In cfs) needed to Maintain 25% of Bank to Bank Width at Specified Depth or Greater

Transect	Depth (ft.)				
	.5	1	2	2.5	3
1	<10	30	170	-	-
2	<10	10	105	-	-
3	<10	40	170	-	-
4	<10	20	95	170	-
5	<10	<10	40	80	130
6	<10	<10	45	50	85

- Indicates more than 190 cfs needed to maintain specified depth.

III. Methodologies To Determine Flow Requirements for Other Recreational Uses

The assessment of flow requirements for recreational uses such as wading, swimming, and boating is subject to a number of difficulties. However, for each of these activities a range of acceptable conditions may be defined.

Appendix III shows the criteria developed by the Cooperative Instream Flows Services Group for a variety of recreational activities, and the probability of use curves developed from these criteria. Of particular interest in this case are those used for swimming, wading, and canoeing and kayaking, all activities extensively engaged in by visitors to Pallsades Park.

As an example, Appendix III shows that swimming requires water of at least 2.5 feet depth, and is impractical at velocities greater than 3.0 feet per second. These are physical limitations. Flow regimes of these characteristics may be considered barely marginal for swimming use. Beyond these strict physical limitations are other, more limiting factors, such as safety. For swimming safety factors may indicate maximum velocity of 2 feet per second rather than the strict physical requirement of 3 feet per second. Finally, there is an optimum range. In the case of swimming, this may be defined as 0.25 to 0.75 feet per second in velocity and a water depth of over 4 feet. Of course, such an approach as this does not consider special problems such as water quality, visibility, or depth needed for diving. However, it does provide a useful approximation of some of the requirements for good conditions for each type of recreation.

For canoeing and kayaking, Appendix III shows the minimal depth requirement is 0.5 feet. This can be met at all transects with a flow of 10 cfs. The safety requirement of 1.0 feet may be obtained at slightly higher flows. Note that transects 1 and 3, for example, would require (Table VI) 30 and 40 cfs, respectively, to satisfy the 25% of channel width deeper than 12" requirement. Yet at 20 cfs sufficient depth and width exist to allow navigation of the stream through these transects. As they represent worst case situations, 20 cfs would be acceptable on an overall basis. At that flow, most of the stream would be above the "minimum" criteria, with the pools providing areas of depth sufficient to be classified as acceptable or optimal.

Suitability of the stream within the park for wading is also important, given the large number of visitors who use the stream in this way. Here the

optimal depth criterion could be misleading, as a hypothetical case will illustrate. If, in a stream reach, the entire area was optimal for wading (depth of 0.75 to 2.5 feet, velocity of 0.25 to 2.0 feet per second), swimming would not be possible. Thus, the need to deal with multiple uses implies a need to attempt to balance each of the uses. In this case, a flow of 20 cfs will allow wading over substantial portions of the stream. The 6 cfs requested will also allow wading in some portions of the stream.

With respect to swimming, the proposed 19 cfs appropriation will provide for some areas in the deeper pools suitable for swimming. As noted in Section II, data regarding maximum depth of the pools was not obtained, so it is not possible to state with precision the extent of the area available for swimming at a given flow. The 19 cfs levels, however, would seem to provide some areas suitable for swimming with respect to depth and velocity requirements.

From the above discussion, it can be seen that while it is not possible to determine a specific flow as optimum for these activities, it appears that the flow requested would protect these recreational uses, allowing each to be pursued by visitors to Palisades Park.

IV. Flow Availability Data

Flow availability data is presented in three different modes. Table VI gives the 7-day low flows by month for the period 1966 through 1980 from the USGS Station No. 06482610 located at Corson, which approximately 8 miles below Palisades Park. Table VII presents the flow exceedence values from this gage station for the same time period. Finally, Figure 1 graphically depicts the

Table VI: 7-Day Low Flows, Split Rock Creek at Corson
USGS Station No. 06482610
(Values in cfs)

	J	F	M	A	M	J	J	A	S	O	N	D
1965										18.86	13.39	8.61
1966	5.31	4.03	7.14	20.57	27.29	8.49	1.63	1.71	1.07	6.61	8.04	6.89
1967	3.09	3.00	37.14	28.71	6.43	5.91	7.94	4.40	3.90	0.99	2.31	0.94
1968	0.60	3.90	5.46	5.23	7.36	5.21	5.24	0.30	2.01	4.13	13.77	5.21
1969	7.50	9.20	10.00	92.24	38.00	16.71	36.29	12.00	9.73	10.86	15.86	14.57
1970	9.21	9.07	42.43	148.43	20.43	19.43	4.47	2.07	3.24	7.57	14.14	5.20
1971	1.60	2.07	75.43	33.57	16.00	6.76	14.43	4.01	4.51	5.43	12.71	16.43
1972	2.30	1.24	6.69	29.00	86.00	43.57	40.57	13.71	10.57	12.86	22.71	8.76
1973	8.73	40.86	89.00	42.71	24.43	9.93	9.00	2.09	3.17	12.76	19.71	16.43
1974	7.89	12.00	73.00	40.43	23.43	10.41	3.97	4.11	3.87	3.29	6.47	5.26
1975	2.84	3.54	4.26	23.14	18.14	11.04	4.36	5.89	4.11	3.86	3.10	5.54
1976	5.86	7.03	54.71	28.86	10.39	1.79	1.19	0.28	0.69	2.60	3.64	1.13
1977	0.02	0.00	1.43	15.29	6.06	1.97	2.50	5.44	13.51	26.29	25.71	26.14
1978	2.86	1.27	4.49	152.71	41.00	28.29	21.57	12.14	7.47	7.70	7.09	10.10
1979	6.41	5.96	7.76	129.57	68.29	59.00	34.43	41.57	45.14	30.28	92.14	42.43
1980	20.14	17.86	15.29	53.14	28.71	23.00	7.06	4.91	4.64			
Average	5.6	8.1	29.3	56.2	28.1	16.8	13.0	7.6	7.8	10.3	16.7	11.6

TABLE VII
Split Rock Creek at Corson, South Dakota USGS Station No. 06482610
Flow Exceedence Values for
October 1965-September 1980

(Values in cfs)

Probability (in %) of Flow Exceedence

	90	80	70	60	50	40	30	20	10
January	1.3	2.9	3.7	5.8	6.8	7.7	8.8	10	13
February	1.5	3.0	3.9	5.9	6.3	7.7	9.5	15	17
March	6.2	10	15	32	54	81	115	182	348
April	20	30	35	43	53	69	114	178	300
May	12	16	22	27	31	36	51	77	108
June	4.8	8.8	13	16	21	29	44	65	132
July	3.0	4.7	6.3	8.6	14	19	32	47	60
August	1.5	3.4	4.8	6.0	7.6	9.9	13	17	29
September	2.4	3.7	4.8	5.4	6.7	8.9	11	14	25
October	3.4	4.4	6.4	8.0	10	12	16	24	49
November	4.2	6.4	8.1	9.2	13	16	20	23	29
December	3.0	5.8	7.2	8.8	10	12	16	18	22

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flow exceedance curves from this station for the time period of 1966 through 1981 for the summer months.

V. Summary

The information compiled for each of the fishery determination methods together with the flow availability data are summarized in Table VIII. It is noted that the Tessman Method produced recommended fishery flow needs in excess of the 50 percent flow exceedance values. Therefore, in this case, the Tessman Method appears to be too high to be a realistic preservation flow. However, the Modified Montana Method produces values that depict those amounts requested. Likewise, the requested flows fall within the range of values produced by using only the hydraulic simulation capabilities of the IFG Model to predict the flows necessary to provide critical migration paths of 0.5 foot to 1.0 foot in depth. Finally, in comparing the requested flows against the data used to present the flow availability, it is noted that the average 7-day low flows indicate that the requested flows are not unreasonable. To be more specific, it appears that the requested flows fall roughly into the 70 percent flow exceedance category, which means that there will be approximately a 70 percent chance in any one year of flows of these values or greater being present. It was also noted that the requested flow amounts should be sufficient to support other recreational uses, such as swimming, wading, etc. Therefore, on the basis of the calculations made, it is concluded that the requested flow amounts will support the designated beneficial uses of the stream, and on the basis of the flow records, the requested flow amounts will likely be present.

MEAN DAILY FLOW-CFS

SPLITROCK CREEK AT CORSON 1958-1961

FLOW EQUALLED OR EXCEEDED

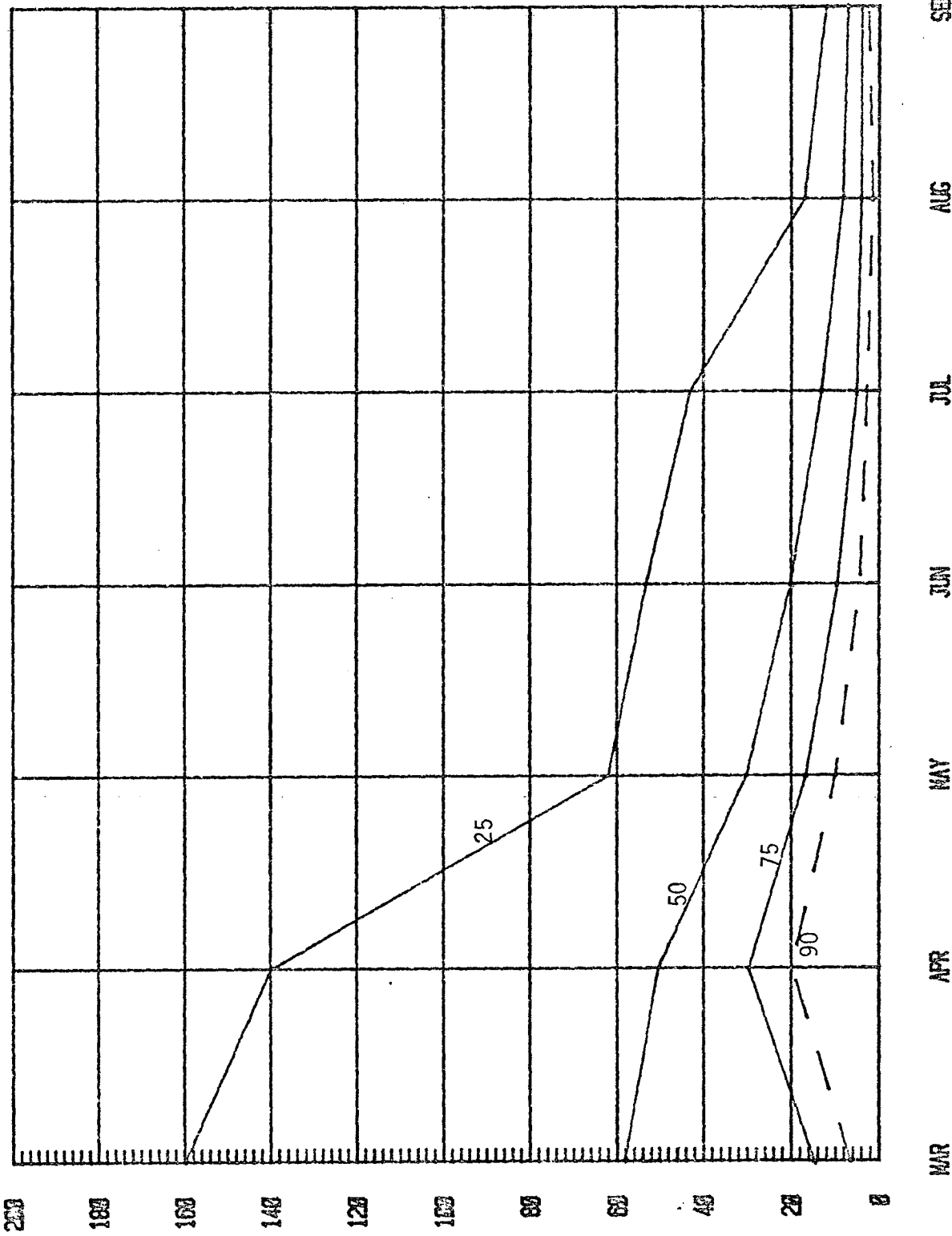


Table VIII: Summary of Flow Data (all values in cfs)

A) Tessman Method

March - June July - ^{FEBRUARY} April
(average) (average)

60

22

B) Montana Method

March - June July - Feb.
(Fair/Degrading) (Fair/Degrading)

20

6.7

C) JFG/Critical Migration

Path Only

0.5 foot depth 1.0 foot depth

6-10

10-40

D) Flow Availability

March - June

July - April

ave 7-day

ave 7-day

low flow=33

low flow=10

70% probability

70% probability

= 13 to 35

= 3.7 to 8.1

= 21 average

= 5.7 average

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APPENDIX I

SPLIT ROCK CREEK

Fisheries

The State of South Dakota Department of Game, Fish & Parks has long been interested and involved in the management of the fisheries in Split Rock Creek. Early records indicated the Department actively managed the stream as early as 1920 when the first Department stocking records are available. More elaborate searches of pre-departmental records would undoubtedly show stocking efforts prior to this date.

The quality and quantity of flow of Split Rock Creek in the 1920's was apparently very good, for during that period brook, brown (Lock Leven) and rainbow trout were stocked into the streams. Rainbows were again tried in the early fifties. From 1931 consistently into the 1950's largemouth bass and other warmwater species were stocked. (See attached records). Records during the 1970's and early 1980's showed that the stream's fishes were adequately reproducing in sufficient numbers and diversity to maintain the sport fisheries. Black bullheads, crappies, and channel catfish comprise the majority of the sportfishes, although northern pike, walleye and largemouth bass are presently in adequate numbers to provide for an interesting and diverse fisheries. Reproduction of channel catfish, walleye, northern pike and abundant quantities of forage species also makes the stream an important contributor to the Big Sioux River and lower Missouri River ecosystem.

Fisherman use has over the years been significant, comparing to Wall Lake in importance. Split Rock Creek's use is important to local citizens within 25 miles of the stream and of course; to the park users. This area of South Dakota has an annual fishing deficit of over 500,000 fisherman days.

Split Rock Creek's aquatic habitat and water quality classification are listed as a substantial fisheries resources and support a warmwater semi-permanent fisheries. Future management plans are to stock smallmouth bass and possibly muskellunge into creek in sufficient numbers establish and maintain fishable populations of those fishes as soon as the new Blue Dog Lake Fish Hatchery is in production. The abundant forage and habitat for both these species are available.

The flows requested will provide an assurance that water will be available in the stream throughout the year, when nature cooperates and will provide of fisheries production. During time of abundant flows, when the requested flows are exceeded which should occur at least more than 50% of the time, reproduction and growth of stream's fishes will be satisfactory. During times of drought when stream flows will be reduced to zero, fish survival will occur in the deeper pools and in downstream areas. Re-population of food organisms will naturally occur within a one year period with the return of normal flows. Fish populations will be restored to fishable levels within two to three years depending on survival levels, the success of natural recruitment and the restocking efforts.

Attachments:

- Stocking history
- Test netting data

Submitted by: Robert L. Hanten
Fisheries Staff Specialist
February, 1982

STOCKING RECORD *C F & P*

Split Rock Creek - Minnehaha County

<u>Year</u>	<u>Species</u>	<u>Number</u>	<u>Size</u>
1920	Brook trout	5,000	flg.
1924	Brook trout	20,000	flg.
1928	Loch Leven trout	150	flg.
1929	Brook trout	200	flg.
1930	Loch Leven trout	365	flg.
1930	Rainbow trout	300	Catchable
1931	Largemouth bass	350	flg.
1933	Largemouth bass	400	flg.
1934	Largemouth bass (Garretson Dam)	1,600	flg.
1935	" " "	600	flg.
1936	" " "	800	flg.
1937	Largemouth bass	2,025	flg.
		350	flg.
	Rainbow trout	200	flg.
		20	Catchable
1938	Largemouth bass	2,700	flg.
	Perch	330	Ad.
1939	Northern pike	100,000	fry
	Perch	3,000	Ad
	Largemouth bass	600	Ad
1940	Largemouth bass	2,000	flg.
1941	Largemouth bass	12,000	flg.
1942	Largemouth bass	12,000	flg.
1945	Largemouth bass	500	flg.
1946	Largemouth bass	2,000	flg.
1950	Largemouth bass	2,000	flg.
	Rainbow trout	4,000	flg.
	Channel catfish	1,000	flg.
1951	Rainbow trout	4,000	flg.
	Walleye	88,000	fry
1967	Black bullhead	600	Ad.
	Crappie	600	Ad.
1968	Mixed species	169	Ad.

EXHIBIT 1: EVALUATION CRITERIA MATRIX

ce S. Dak. County Minnehaha Stream Spilt Rock Reach: from Big Sioux R. to State Line State Code
 Mmm-SD

Overall Evaluation: III

Aquatic Habitat Value Classification	Criteria				Comments
	I. Critical	II. High Priority	III. Substantial	IV. Limited	
Status of endangered species					
Status of threatened species					
Importance for species of high Interest			X		N. pike, panfish, bullheads Silver chub * hornyhead chub * Topeka shiner * Blackside darter * Blacknose shiner **
Restoration/reclama- tion/mitigation potential			X		Scenic - moderate, restoration possible

/1 No classification will be made on the basis of Criterion 4 alone.

* Being considered by State for threatened species list.
 ** Being considered by State for endangered species list.

12/4/51 - Copies to:
 Long Haper
 (DWAR) Murphy & Nelson
 Interchanged

Name	Split Rock Creek	County(ies)	No.	Watershed	Ident.No.
At or Near	Eastern Minnehaha County	Minnehaha	01	Missouri River	01-R2
Township(s)	Range(s)	Section(s)	Population:		
T101N,R48W,S10,2;	T102N,R48W,S35,	26,23,15,10,11,2,1;	Minnehaha County 110,029		
T103N,R48W,S36;	T103N,R48W,S36;	T103N,R48W,S31,30	20 miles	40 miles	100 miles
Mgt.Classification	Ecological Classification	Fishing Water:	20 miles	40 miles	100 miles
Warmwater River	Gamefish-Roughfish	Perm.,Semi-perm.	ac	ac	ac
		Marginal	ac	ac	ac

Item	Data		Source
Area-Acres	NA		
Meander Ar-Ac	NA		
Max. Depth- Ft.	NA		
Median Depth- Ft.	NA		
Littoral Area - %	NA		
Shore Length - Mi.	NA		
In South Dakota xxxxxx Length - Mi.	19 Mi.		8
Meandered - Yes or No	No		
Annual Fluctuation - Ft.	+	ND , -	
Long-term Fluctuation - Ft.	+	ND , -	
No. Islands	0		10
No. Dwellings	ND		
No. Resorts, Units at Resorts	0	0	10
No. Boats - Resort, Private	0	0	10
No. Boat Liveries	0		10

Sequence of Waterways to Major Drainage Basin
Split Rock Creek-Sioux River-Missouri River

Watershed Description

55%	Cropland
43%	Pasture
2%	Wooded

Benchmark: Water level
feet below

Additional comments:

% Emergent Cover	0	Dist.
% Occur. Submerged Veg.	0	Dist.

[illegible]

Fish Species	ABUND. No.	Wt.	Gear	Growth Rate	Spawning Facilities	S.	Items	Surface	S.	Below Therm.	S.
Northern Pike	4	6	G		Poor	10	Temp. -°F.				
Northern Pike	4		Seine		Poor		D.O. - p.p.m.				
Channel Catfish	16		Seine		Good		T.Alk. - p.p.m.				
Channel Catfish	2	0.4	T		Good		SO ₄ - p.p.m.				
Bullhead	810	203	T		Good		Cl. - p.p.m.				
Bullhead	505		Seine		Good		T.P. - p.p.m.				
White Crayfish	2	0.56	T		Poor		T.N. - p.p.m.				
Carp sucker	180	347	T		Good		Color				
Carp sucker	21	39	G		Good		Secchi Disc Reading		Ft.		
White Sucker	202	139	T		Good		Cause of Turbidity				
White Sucker	24	17	G		Good		Loc. of Therm.		Ft. from surf.		
Carp	1	0.6	T		Fair		Winter D.O.				
Winterkill Dates					No Data		G. 1 T. 6				
Special Problems					Turbidity, Low Summer flows, Irrigation, Increasing water use demands.						
P = present. S = source of data.											

ABBREVIATIONS: A - abundant, C - common, O - occasional, R - rare, P - present, S - source of data,
G - 250' gillnet set for 24 hours, T - trapnet set for 24 hours, E - Electrofishing

WATERFOWL HABITAT						S.
Nesting Cover						
Brood Cover						
Loafing Areas						
Utilization - Species	No. Adults	No. Broods	Species	No. Adults	No. Broods	
Aquatic Furbearer Habitat						
Other Wildlife						

Recreational Use	Amount and/or Success	S.
Summer Angling	Moderate-High some areas/ fair success	10
Winter Angling		
Spearing		
Hunting	Light	10
Trapping	Moderate	10
Snowmobiling	Heavy some areas	10
Boating		
Canoeing		
Waterskiing		
Picnicking	Light	10
Camping	Light	10
Swimming	Light	10

GFP-WLF-600-2/80

Additional information: (Netting tables, shoreline seining, other surveys, rough removal, stocking records, etc.)

- A. Table I shows the locations of trapnets and seine hauls made on Split Rock Creek 09/16/81 and 09/17/81.
- B. Comparing the 1972 and 1981 seining data indicates no drastic change in population structure except for a significant increase in the number of bullheads sampled.

Management Recommendations:

I. Stocking

- A. The small impoundment at Garretson was drained in the fall of 1980 to facilitate repair of the dam. As the 1981 test netting showed, this probably destroyed most of the gamefish population so northern pike, largemouth bass, white crappie, and bluegill should be stocked in 1982.
- B. Smallmouth bass should be stocked if the water quality is found suitable.

II. Further water quality investigations, including turbidity, temperatures, and flows, should be conducted to determine this stream's suitability for smallmouth bass.

III. The stream and Garretson impoundment should be test netted on a three-year schedule.

By L.C. Jindrich

Date 11/24/81

35. Natural Reproduction of Fish - Shoal Water Seining

Seine Measurements: Length 50 feet, Depth 6 feet,
Mesh size 1 inch square.

Lake Split Rock Creek
County (ies) Minnesota
Date 09/16/81
Collector(s) Jindrich, Yost

	Show number of seine hauls made at each station in ()						Totals
	Station Number 1 ()	2 ()	3 ()	4 ()	5 ()	6 ()	
Total linear distance covered - feet	250x20 (5000 sq. ft.)	150x50 (7500 sq. ft.)	50x20 (1000 sq. ft.)	100x40 (4000 sq. ft.)			Linear Feet 17,500 sq. ft.
Greatest water depth - feet	3'	3'	2'	4'			
Bottom Soil Type	Mud-	Rock-	Rock	Rock-			
Amount of Vegetation ++	Rock	Gravel		Sand			40 Acre(s)
Water Temperature - °F.	69°F	69°F	69°F	69°F			
Wind Intensity & Direction +							
Time of Day & Date	1:00 PM	2:00 PM	2:30	3:30			
Location on Lake	Sta. Sec. 10	Sta. Sec. 10	Sta. Sec. 23	Sta. Sec. 1			
	T101N, R48W	T102N, R48W	T102N, R48W	T102N, R48W			

Species ***	Station #1		Station #2		Station #3		Station #4		Station #5		Station #6		TOTALS	
	YY**	0*	YY	0	YY	0	YY	0	YY	0	YY	0	YY	0
Minnows		287		35		9	21				880		352	352
Chinners		220		84		13					805		322	322
Northern Pike		2		2							10		4	4
Orange-spotted Sunfish	6	4	12	16		4	3		45	68	18		27	45
Johnny Darter		4					13				43		17	17
River Carpsucker	2		2	1		2			15	3	6		1	7
Bullhead			489	7		9			1245	18	493		7	505
Channel Catfish			11			5			40		16		16	16
Carp				1							3		1	1
White Sucker			7	1		3			25		10		1	11

++ Heavy, Moderate, Light, None, etc.

+ Strong, Moderate, Light, Calm.

*** Group separately minnows and darters without identifying them, unless readily identifiable in field.
Preserve sample for later identification in laboratory.

** YY - Young-of-year or fingerlings.

* Others, includes yearlings and adults, minnows and darters. Take scale samples from sizes of fish, especially game fish, not taken in test nets.

36. Fish Abundance

NETTING SUMMARY SHEET

Observer Jindrich, PetersonLAKE Split Rock Creek COUNTY 01 Date 09/23/81

a. Total Gillnet Sets _____ 250 ft. Experiment nylon nets.

SPECIES	TOTAL CATCH		Ave. Size		Average Catch/Net		Statewide Median/net	
	No. (%)	Wt. (%)	Ins.	Lbs.	No.	Wt.	No.	Wt.

Total
b. Trapnet sets 3, mesh size 3/4. Total
Pocketnet sets _____, mesh size _____.

SPECIES	TOTAL CATCH		Ave. Size		Average Catch/Net		Statewide Median/net	
	No. (%)	Wt. (%)	Ins.	Lbs.	No.	Wt.	No.	Wt.
Bullhead	528 (57)	132 (21)	7.24	0.25				
White Sucker	197 (21)	136 (22)	12.12	0.69				
River Campsucker	188 (20)	344 (55)	15.73	1.83				
Redhorse Sucker	5 (1)	2.9 (1)	11.70	0.59				
White Crappie	1 (1)	0.28 (1)	7.90	0.28				

36. Fish Abundance

NETTING SUMMARY SHEET

Observer Jindrich, PetersonLAKE Split Rock Creek COUNTY MinnehahaDate 09/23/81a. Total Gillnet Sets 1 250 ft. Experiment nylon nets. 24 hours

SPECIES	TOTAL CATCH		Ave. Size		Average Catch/Net		Statewide Median/net	
	No. (%)	Wt. (%)	Ins.	Lbs.	No.	Wt.	No.	Wt.
Northern Pike	4 (6)	6 (5)	19.1	1.47	4	5.88		
Redhorse Sucker	18 (27)	53 (47)	11.7	2.93				
White Sucker	24 (36)	17 (15)	12.1	0.69				
River Carpsucker	21 (31)	38 (33)	15.7	1.83				

Total
b. Trapnet sets 3, mesh size 1/4. Total
Pocketnet sets _____, mesh size _____.

SPECIES	TOTAL CATCH		Ave. Size		Average Catch/Net		Statewide Median/net	
	No. (%)	Wt. (%)	Ins.	Lbs.	No.	Wt.	No.	Wt.
Charel Catfish	2 (1)	0.4 (1)	6.3	0.21				
Bullhead	282 (89)	71 (85)	7.2	0.25				
O.S. Sunfish	11 (3)	0.10 (1)	1.5	0.01				
White Crappie	1 (1)	0.1 (1)	5.2	0.14				
Buffalo	5 (1)	4 (4)	13.7	0.81				
White Sucker	5 (1)	3 (3)	10.4	0.58				
Redhorse Sucker	1 (1)	0.5 (1)	10.9	0.50				
River Carpsucker	2 (1)	2.5 (2)	13.2	1.27				
(GF-Form 71-6) Page 8								
Carp	1 (1)	0.6 (1)	11.0	0.56				
Stone Cat	1 (1)	0.2 (1)	6.4	0.20				

LENGTH - FREQUENCY DISTRIBUTIONS
SPECIES AND NUMBERS OF FISH IN LENGTH GROUPS

Total length in inches	Bullhead	White Sucker	River Carp- sucker	Redhorse Sucker	White Crappie	Northern Pike	Channel Catfish			
3.0 - 3.4										
3.5 - 3.9										
4.0 - 4.4										
4.5 - 4.9	2									
5.0 - 5.4	3									
5.5 - 5.9	5									
6.0 - 6.4	7						2			
6.5 - 6.9	2				1					
7.0 - 7.4	4									
7.5 - 7.9	5				1					
8.0 - 8.4	6									
8.5 - 8.9	2									
9.0 - 9.4	3	1		1						
9.5 - 9.9	4	3								
10.0 - 10.4	5	2								
10.5 - 10.9	3	4								
11.0 - 11.4	1	3								
11.5 - 11.9		5		1						
12.0 - 12.9		3	2	2						
13.0 - 13.9		4	2	1						
14.0 - 14.9			4							
15.0 - 15.9			3							
16.0 - 16.9			5							
17.0 - 17.9			2							
18.0 - 18.9			1			2				
19.0 - 19.9						1				
20.0 - 20.9						1				
21.0 - 21.9										
22.0 - 22.9										
23.0 - 23.9										
24.0 - 24.9										
25.0 - 25.9										
26.0 - 26.9										
27.0 - 27.9										
28.0 - 28.9										
29.0 - 29.9										
30.0 - 30.9										
31.0 - 31.9										
32.0 - 32.9										
33.0 - 33.9										
34.0 - 34.9										
35.0 - 35.9										
36.0 - 36.9										
TOTALS	52	25	19	5	2	4	2			

35. Natural Reproduction of Fish - Shool Water Seining

Seine Measurements: Length 40 feet, Depth 6 feet,
Mesh size 1/4 inch square.

Lake Split Rock Creek
County(ies) Minnesota
Date September 12, 1972
Collectors Schmitt and Bradshaw

Total linear distance covered-feet	Station Number In ()			Show number of seine hauls made at each station			Totals
	1 ()	2 ()	3 ()	4 ()	5 ()	6 ()	
100		30	30	300			460 Linear Feet
Greatest water depth - feet	2	4	3½	2			
Bottom Soil Type	Gravel	Muck	Rubble	Gravel			
Amount of Vegetation ++	None	None	None	None			0 Acre(s)
Water Temperature - F.	No data	No data	No data	No data			
Wind Intensity & Direction +	Light North	Light North	Strong West	Light North			
Time of Day & Date	Afternoon 9/12/72	Afternoon 9/12/72	Afternoon 9/12/72	Afternoon 9/12/72			
Location on Lake	Imi.N. Corson	Imi.N. Corson	P.N.W. Crsn	Mouth Spl. Rk. Cr.			

Species ***	YY**	O*	YY	SIZE AND NUMBERS												TOTALS	
				0	YY	0	YY	0	YY	0	YY	0	YY	0	YY	0	All
Black bullhead		3		1												4	4
Channel catfish	4		5		1					10						20	20
Carp		3		2		4		3		5						3	14
Bigmouth buffalo		3														3	3
Carp sucker	2	7		3						5						2	15
Northern redborse		6														8	8
Walleye	1															1	1
White sucker	2		1					17		3						20	3
Variety of minnows	Many		Many					few		Many						Many	Many
Northern pike				4				1		1						1	4
Stone cat																	
Carp																2	

++ Heavy, Moderate, Light, None, etc. + Strong, Moderate, Light, Calm.

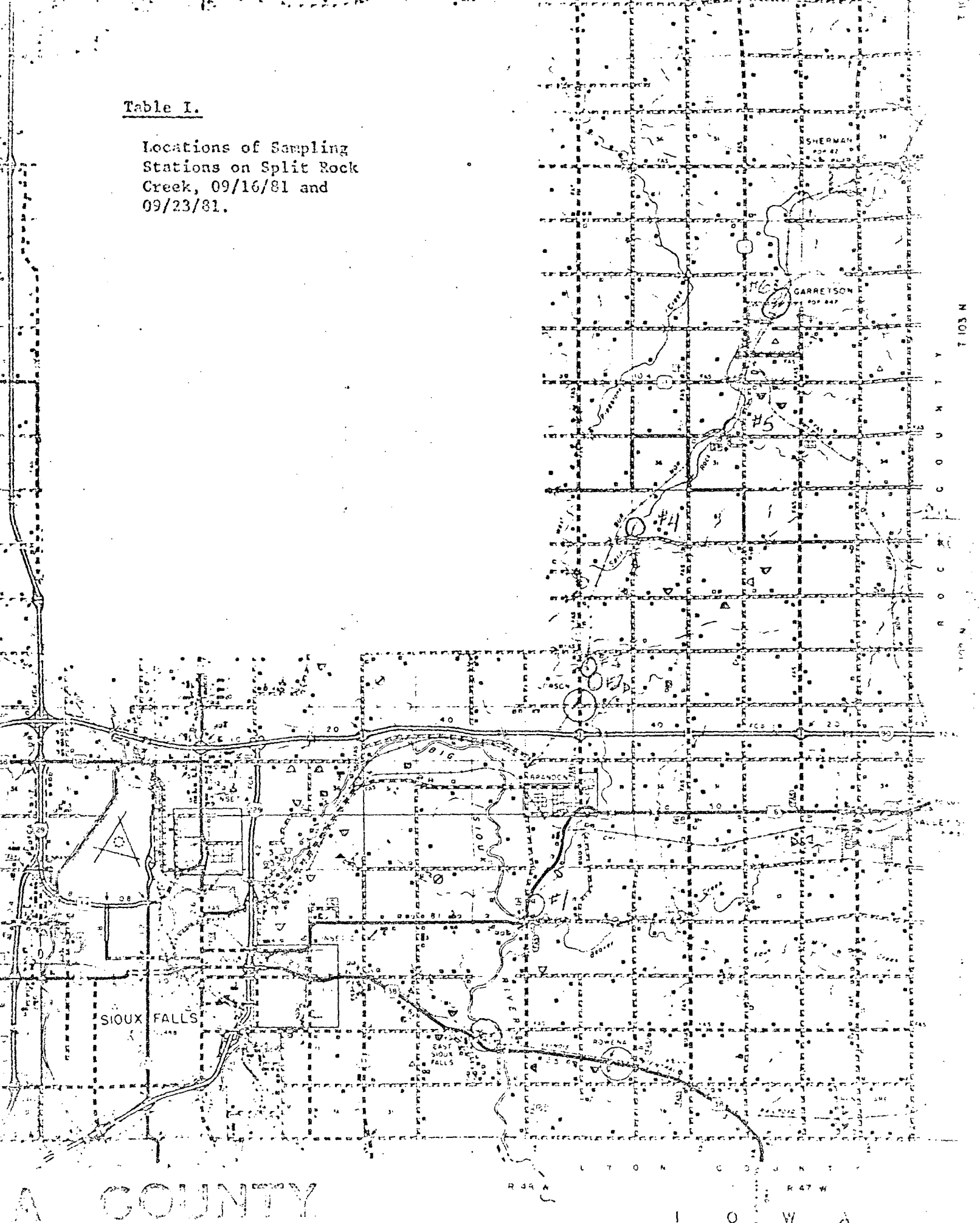
*** Group separately minnows and darters without identifying them, unless readily identifiable in field.

** YY - Young-of-year or fingerlings.

* Others, includes yearlings and adults, minnows and darters. Take scale samples from sizes of fish, especially game fish, not taken in test nets.

Table I.

Locations of Sampling
Stations on Split Rock
Creek, 09/16/81 and
09/23/81.

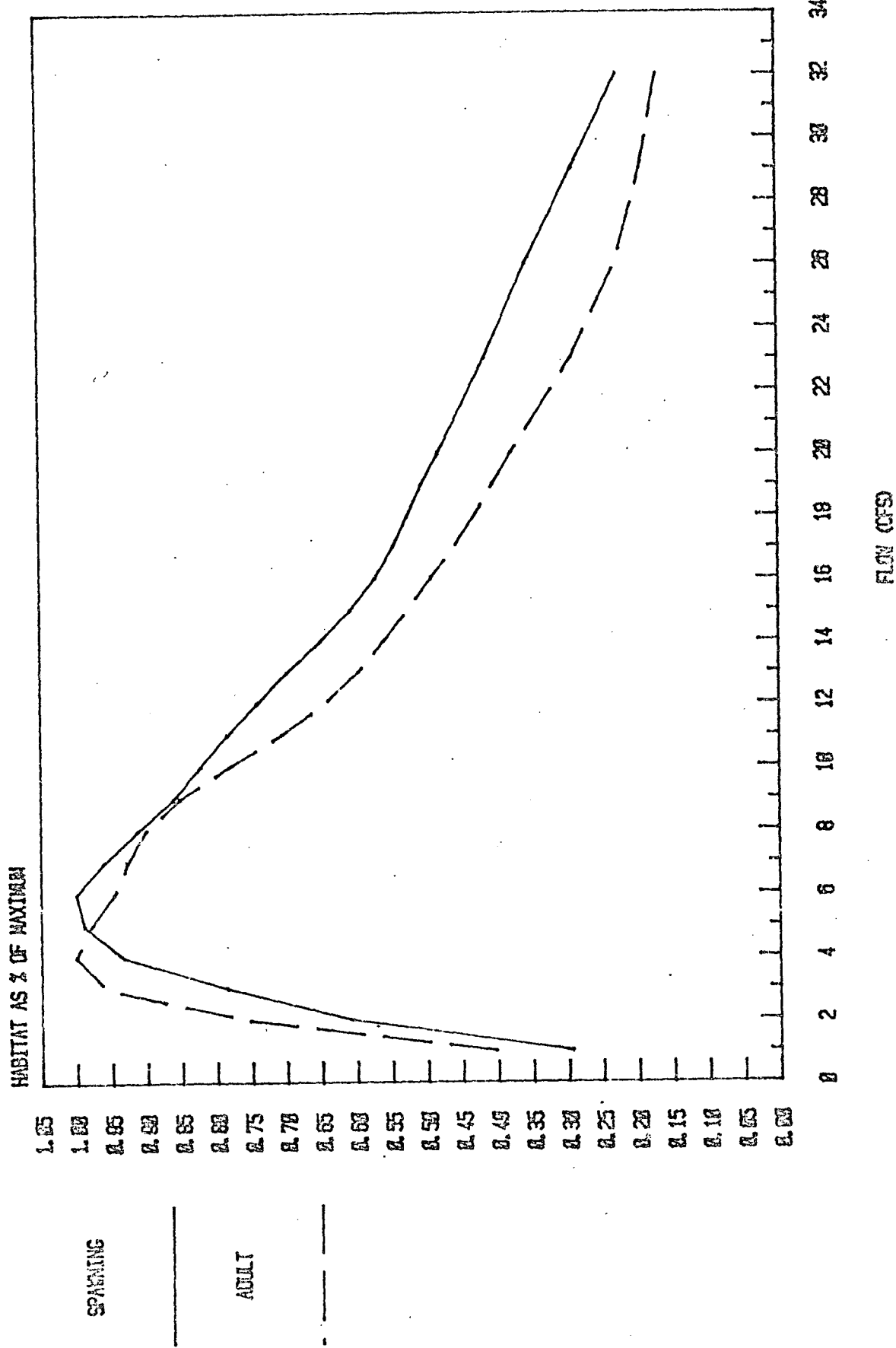


APPENDIX II

Figure III: Normalized Weighted Usable Area, Brook Trout

CASTLE CREEK BELOW DEERFIELD DAM

IFG4 BROOK TROUT



APPENDIX III

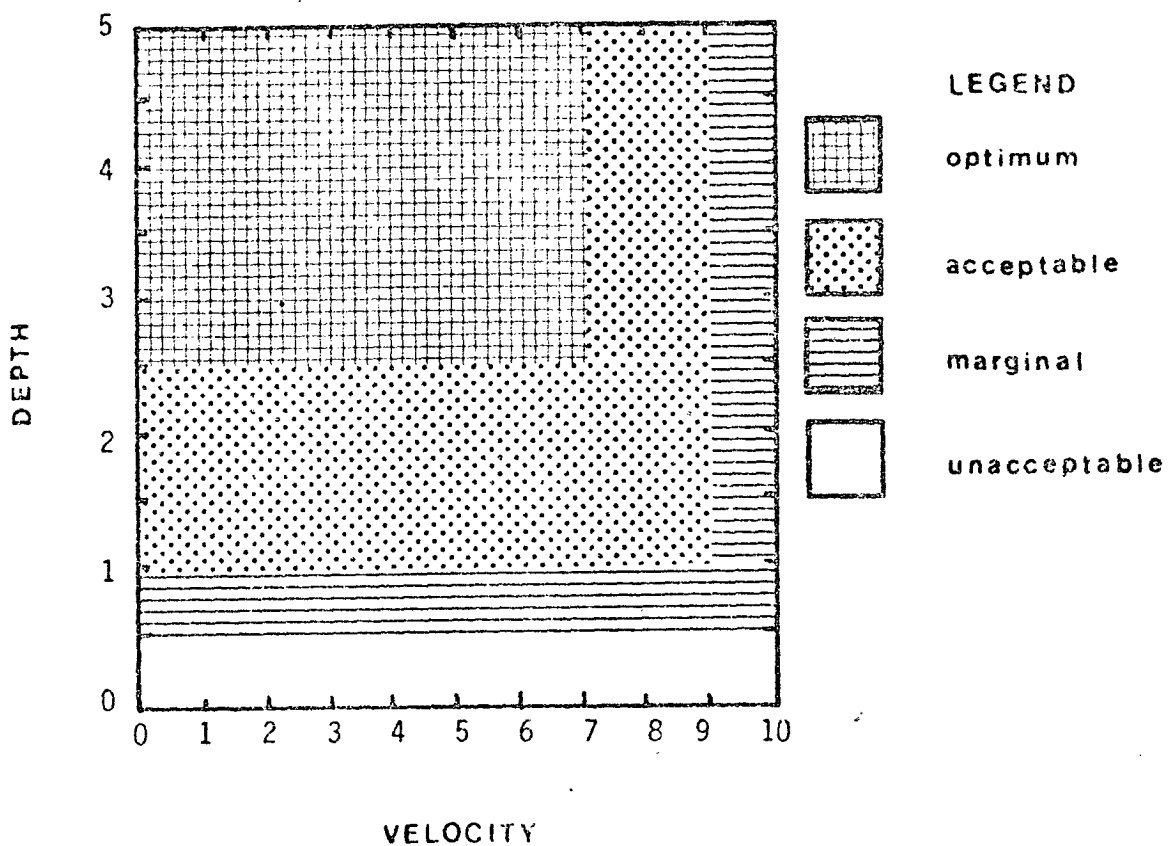
From Bovee and Cochnauer, 1977

BOATING CANOEING-KAYAKING

CRITERIA

	PHYSICAL	SAFETY	OPTIMUM
DEPTH			2.5 ft +
minimum	0.5 ft	1.0 ft	
maximum	NA	NA	
VELOCITY			0.5-7.0 fps
minimum	0 fps	0 fps	
maximum	10.0 fps	9.0 fps	

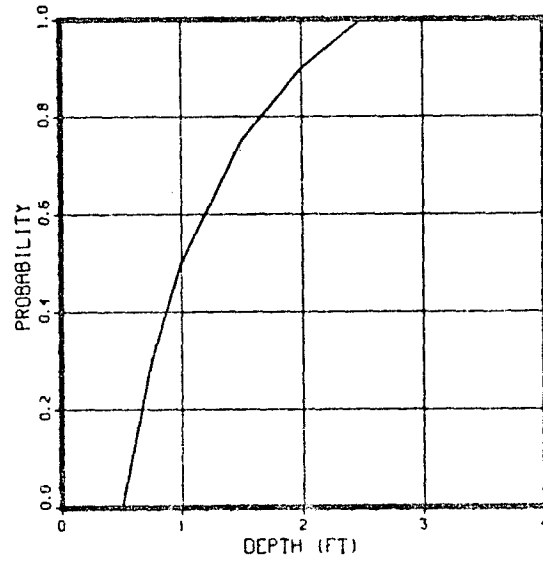
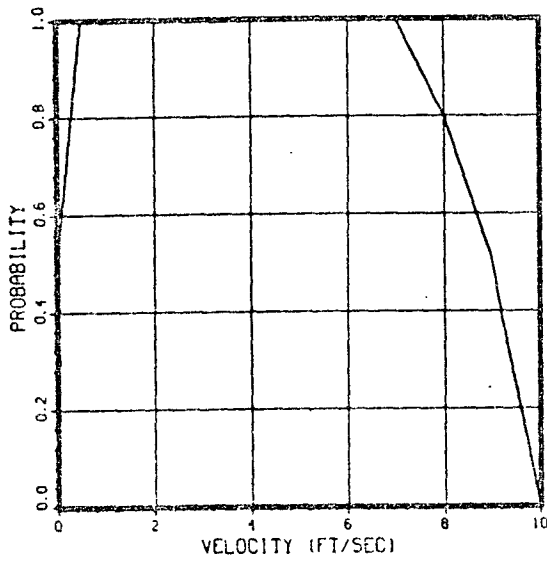
COMMENTS: Higher velocities exclude open canoes. Higher velocities safe only under certain conditions.



BOATING CANOEING KAYAKING

720300

78/06/26.

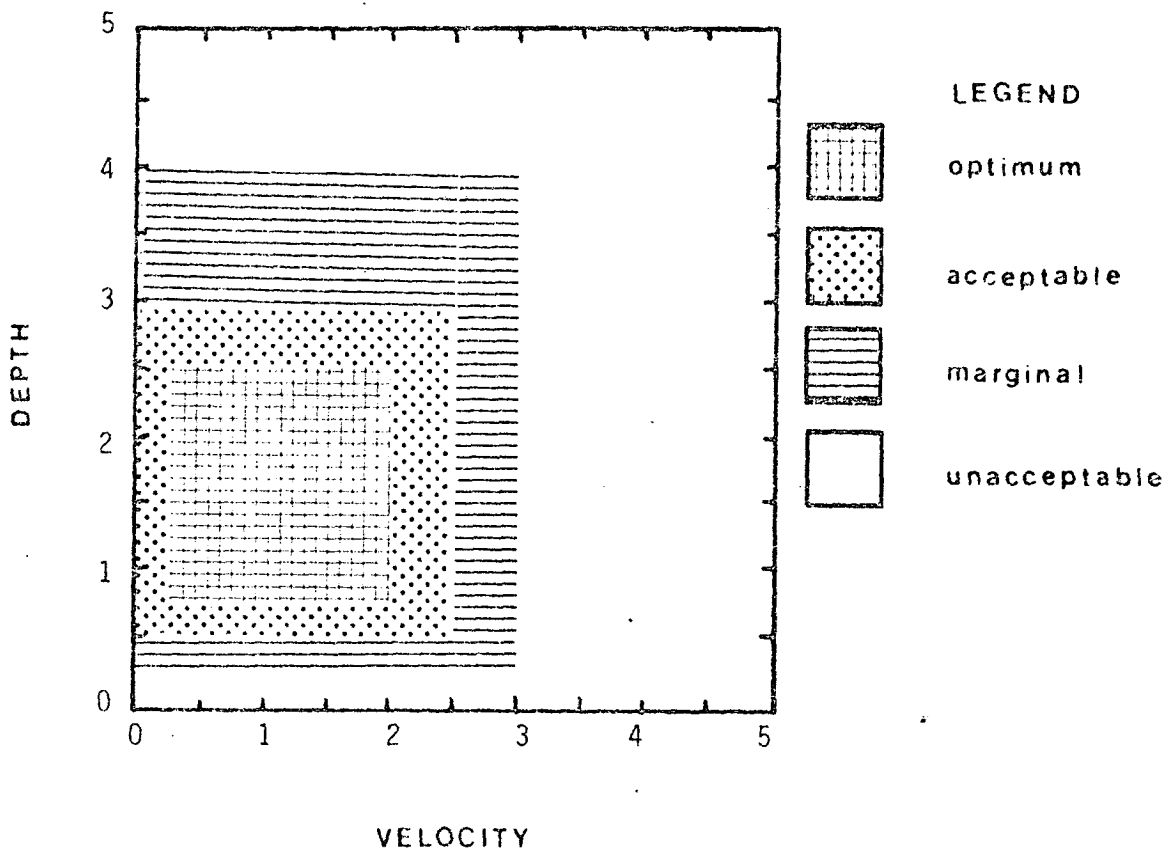


WATER CONTACT WADING

CRITERIA

	PHYSICAL	SAFETY	OPTIMUM
DEPTH			0.75-2.5 ft
minimum	0.25 ft	0.5 ft	
maximum	4.0 ft	3.0 ft	
VELOCITY			0.25-2.0 fps
minimum	0 fps	0 fps	
maximum	3.0 fps	2.5 fps	

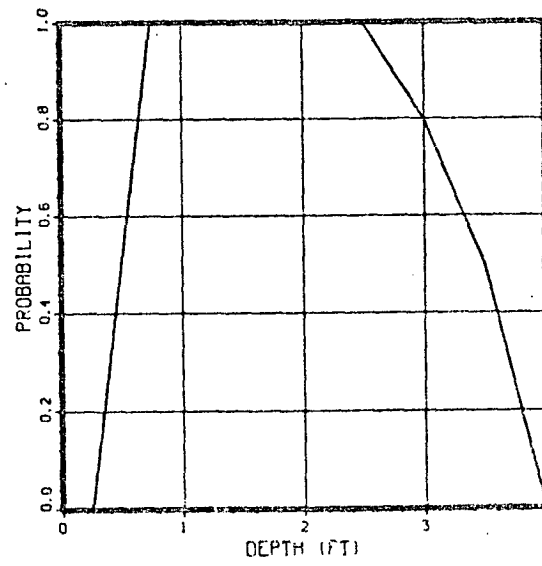
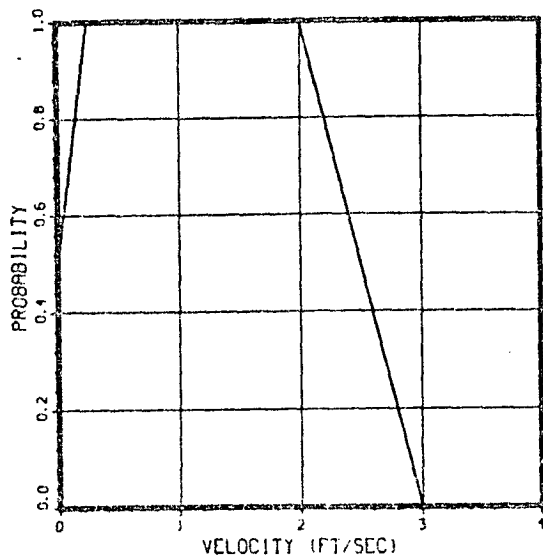
COMMENTS: Depth in feet multiplied by velocity in fps should equal 10 or less. Safety depends upon height and weight of individual as well as substrate type.



WATER CONTACT WADING

710100

78/06/26.

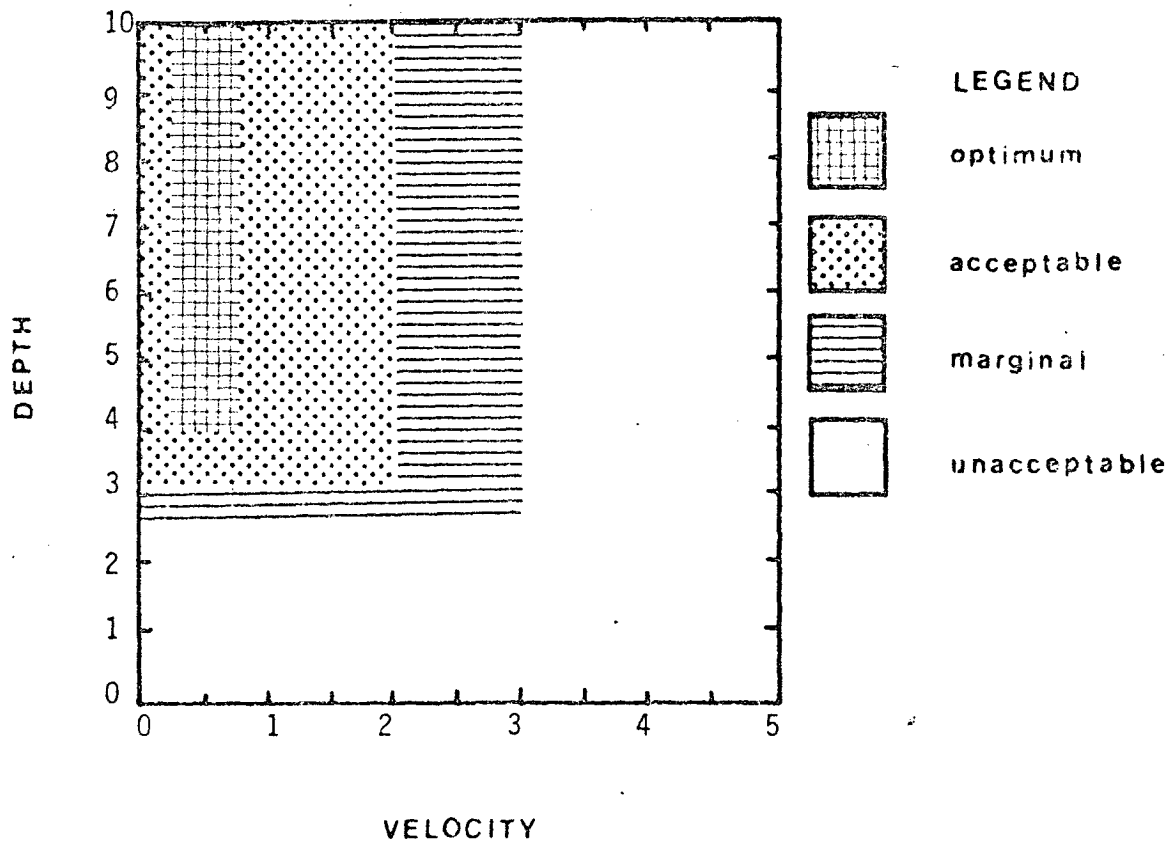


WATER CONTACT SWIMMING

CRITERIA

	PHYSICAL	SAFETY	OPTIMUM
DEPTH			4 ft +
minimum	2.5 ft	3.0 ft	
maximum	NA	NA	
VELOCITY			0.25-0.75 fps
minimum	0 fps	0 fps	
maximum	3.0 fps	2.0 fps	

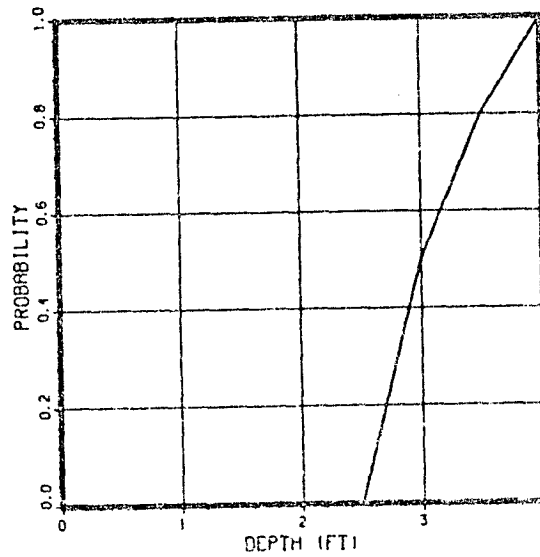
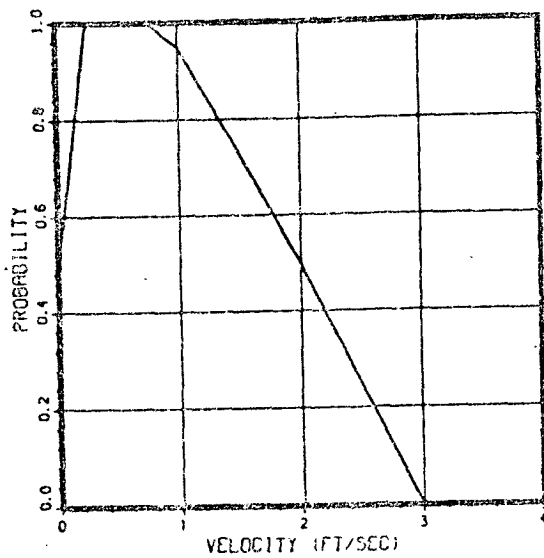
COMMENTS: Water quality, temperature, slope of beach, visibility and underwater slope important.
Depth safety criteria does not permit diving.



WATER CONTACT SWIMMING

710000

78/06/26.



STATE OF SOUTH DAKOTA

WATER LICENSE NO. 4901-3.

(1) WHEREAS, On the 13th day of April A. D. 19 82
 the South Dakota Department of Game, Fish & Parks

made Water Right Application No. 4901-3 for a permit to use 20.0 cubic feet per second ~~of the waters~~
~~from March thru June and 6.0 cubic feet per second from July thru February of the~~
waters of Split Rock Creek
 County of Minnehaha, State of South Dakota, for recreation, public use and
fish and wildlife propagation purposes; and

(2) WHEREAS, On the 9th day of June A. D. 19 1982
 Permit No. 4901-3, with a date of priority of April 13, 1982

was issued to said applicant instream flow use recognizing that non-consumptive beneficial use
is being made for ~~the diversion~~ of said water, and ~~provided for the completion of construction~~ of the water
~~supply system therein described on or before the~~ day of April 19 1982 and for the
 application to beneficial use of said water on or before the day of April 19 1982

and:

~~(3) WHEREAS, It is hereby certified that the applicant has complied with the provisions of the laws of the State of South Dakota~~
~~relating to completion of the construction of the water supply system and is entitled to divert~~ cubic feet
~~per second of water for beneficial use and,~~

(4) WHEREAS, It is hereby certified that the applicant has complied with the provisions of the laws of the State of South Dakota
 relating to the application of water to beneficial use of the following extent,

It has been recognized that non-consumptive beneficial use of Split Rock Creek
water is being made for recreation, public use and fish/wildlife propagation
purposes authorizing instream flow use of 20.0 cfs during March thru June and
6.0 cfs during July thru February.

(5) NOW, THEREFORE. By the virtue of the authority vested in us by the laws of the State of South Dakota, We hereby grant and confirm to the South Dakota Department of Game, Fish & Parks

of Pierre, South Dakota

the holder _____ and owner _____ of said permit No. 4901-3 a water right, dating from April 13, 1982
20 cubic feet per second during during July thru February
to use of March thru June and 6.0 cubic feet per second of the waters

of Split Rock Creek for instream flow use

in the County of Minnehaha and State of South Dakota, or so much thereof as may be necessary for the purposes hereinbelow mentioned, to be ~~used~~ ^{used} within the boundaries of Palsades State Park
located in Sections 30 and 31, T103N, R47W.

~~and conducted to and upon~~

for the purpose of recreation, public use and fish and wildlife propagation

Subject to any limitations listed in Water Right Permit No. 4901-3 and subject to the laws of the State of South Dakota.

WITNESS, My hand and seal of our office at Pierre, South Dakota
this 14th day of July A. D.
Nineteen Hundred and Eighty-Two

WATER MANAGEMENT BOARD

By: John Hatch
Chief Engineer, Executive Officer
JOHN HATCH



**DEPARTMENT of AGRICULTURE
and NATURAL RESOURCES**

JOE FOSS BUILDING
523 E. CAPITOL AVE
PIERRE SD 57501-3182
danr.sd.gov

April 23, 2026

Dear Split Rock Creek Water Right Holder:

I am writing to the water right holders and operators who use water from Split Rock Creek regarding below normal streamflow for this time of year.

South Dakota law gives the highest priority to domestic use, including livestock watering. There is generally adequate water available to meet both domestic use and other needs. However, once water availability reaches critically low levels, water use may begin to interfere with domestic use and senior water rights. If water levels become critically low, the Department may be forced to issue shutoff orders to protect domestic use, including livestock watering, and those water rights that are most senior.

This not a shutoff order. We are only speculating that shutoff orders may become necessary, if severe drought conditions persist. This letter is intended to give you advanced notice shutoff orders may be necessary this year. If shutoff orders are issued, you will receive another letter from the Department. In the meantime, water right holders can help by closely monitoring water usage to minimize use when possible and avoid any waste of water.

If you are interested, the US Geological Survey has an Internet site showing current flows at stream gauging stations across the state, including a station on Split Rock Creek near Corson, SD. To view the latest real-time stream flow, go to:

<https://waterdata.usgs.gov/state/south-dakota/>

Thank you for your cooperation. If you have any questions, please contact either Whitney Kilts, Adam Mathiowetz, or Amanda Dewell, with the Water Rights Program, at (605) 773-3352.

Sincerely,

Adam Mathiowetz, Acting Chief Engineer
Water Rights Program