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Report on the Feasibility of Providing Instream Flow in Segment Number One of Tensleep Creek

Wyoming Water Development Commission

March, 1989

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L I S T O F F I G U R E S

REPORT
ON THE FEASIBILITY OF PROVIDING INSTREAM FLOW IN SEGMENT NUMBER ONE OF TENSLEEP CREEK

Wyoming Water Development Commission
March, 1989

Summary

As required by W.S. 41-3-1004(a), the Wyoming Water Development Commission (WWDC) has completed a determination of the feasibility of providing instream flow in a segment of Tensleep Creek. The Wyoming Game and Fish Department (WG&F) has requested that the WWDC apply for a direct flow water right of 22 cubic feet per second (cfs) during all months of the year for the purpose of instream flow for fisheries in Tensleep Creek. This instream flow application has been filed with the State Engineer who has assigned the application Temporary Filing Number 26 5/157.

Instream Flow Segment Number 1 of the Tensleep Creek is defined by an upstream point located at the confluence of the East and West Tensleep Creeks in Lot 23, Section 6, Township 48 North, Range 86 West and a downstream point defined where the creek crosses the west section line of Lot 4, Section 4, Township 47 North, Range 87 West, a stream length of approximately 7.95 miles, all in Washakie County, Wyoming. The segment location is shown in Figure 1 on page 2.

A monthly flow analysis and a daily flow exceedence analysis were conducted. The monthly flow analysis showed that the requested flow of 22 cfs is available at the downstream end of the segment as direct flow during April through November, but is not available during December through March of the average year. The daily flow analysis indicates that, on the average, the requested instream flows are equalled or exceeded at least 50 percent of the days during May through November, but less than 50 percent of the days during December through April. The Wyoming Game and Fish Department has stated that it is not their intention to cause a reservoir to be constructed in order to supply the missing flows that occur from December through April of the average year.

Water Rights

Table 1 lists all direct flow surface water rights and permits that are located upstream of the downstream end of the instream flow segment as of September, 1987. Table 2 lists the water rights and permits for reservoirs located within the drainage basin upstream of the instream flow segment as of September, 1987. The total annual storage in these reservoir permits is 3,510 acre-feet.

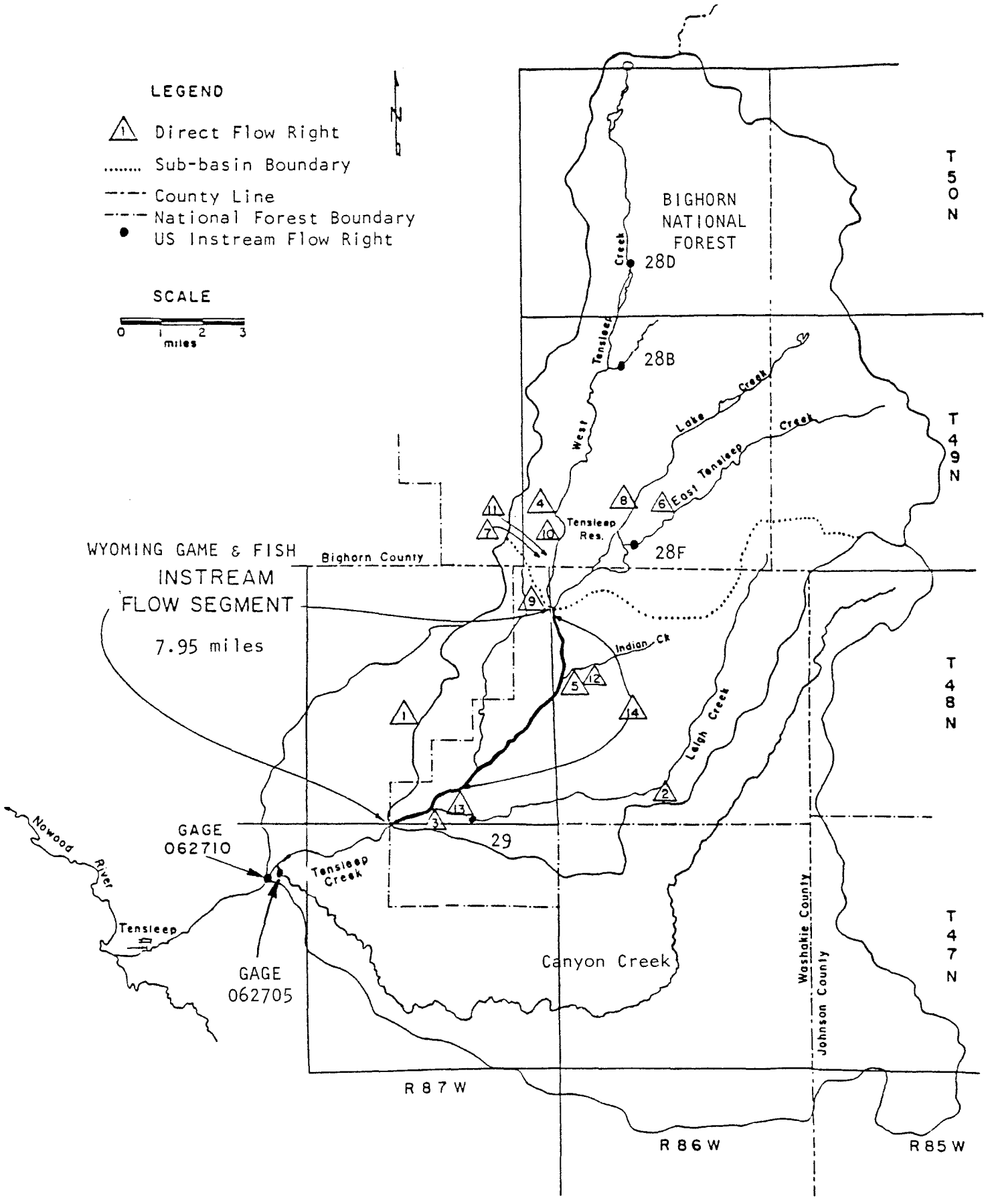


FIGURE 1. Location Map of the Tensleep Creek Instream Flow Segment No. 1

Table 1. Direct Flow Water Rights,Permits and Filings Located Upstream of the Downstream End of Instream Flow Segment No. 1 on Tensleep Creek as of September 1987

MAP NUMBER (Fig.1)	PERMIT NUMBER	FACILITY	SOURCE	PRIORITY DATE			AMOUNT	USES		DIVERSION LOCATION			ADJ/ UNADJ	2 TIMES PRE-3/1/1985 IRR. RIGHTS	NON-IRRIG DIVERSIONS
				MONTH	DAY	YEAR	(cfs)	IRR.	CONTINUOUS	SEC	TNSHP	RNG			
1	13139	Red Spring Ditch	Red Spring	6	7	1915	0.114	1		21	48	87	ADJ	0.228	
2	18664	Tolman Pipeline	Leigh Creek	8	19	1936	0.030		3	33	48	86	ADJ		0.030
3	19360	Hatchery Pipeline	Leigh(Lee) Creek	4	18	1940	1.110		6	33	48	87	?		1.110
3	19361	Hatchery Pipeline	Leigh(Lee) Creek	4	18	1940	1.110		6	33	48	87	ADJ		1.110
3	19362	Hatchery Pipeline	Leigh(Lee) Creek	4	18	1940	1.110		6	33	48	87	ADJ		1.110
3	19383	Tensleep Hatchery	Leigh(Lee) Creek	5	29	1940	10.500		5	33	48	87	UNADJ		10.500
4	19667	Tyrell Ranger Station	West Tensleep Ck.	7	3	1941	Supply-5436R			30	49	86	ADJ		
5	21398	Varney PIpeline	Indian Creek	6	31	1954	3.000		5	18	48	86	UNADJ		3.000
6	21790	Nielson Pipeline	Tensleep Creek	10	19	1956	0.050		2	27	49	86	ADJ		0.050
7	22167	Deer Haven Pipeline	Deer Haven Creek	7	22	1960	0.200		2	31	49	86	ADJ		0.200
7	22168	Deer Haven Supply	Deer Haven Creek	7	22	1960	Supply-6543R			6	48	86	ADJ		
7	22169	Evert Pipeline	Deer Haven Creek	8	15	1960	0.030		2	31	49	86	ADJ		0.030
7	22170	Joffe Pipeline	Deer Haven Creek	8	15	1960	0.030		2	31	49	86	ADJ		0.030
4	22228	Tyrell Center	West Tensleep Ck.	9	18	1961	0.060		3	30	49	86	UNADJ		0.060
8	22229	Sitting Bull Camp	Lake Creek	9	26	1961	0.060		2 3	28	49	86	UNADJ		0.060
9	22340	Upper Willow #2	Dry Tensleep Ck.	12	7	1962	0.076		2	1	48	87	UNADJ		0.076
9	22341	Stockwater Pipeline	Dry Tensleep Ck.	12	7	1962	0.068		2	1	48	87	UNADJ		0.068
10	22538	Lost Spring Pipeline	West Tensleep Ck.	8	1	1963	0.060		2	32	49	86	ADJ		0.060
11	22558	Groshart Pipeline	Merz Creek	12	4	1964	0.020		2	31	49	86	ADJ		0.020
10	22560	Christiansen Pipeline	West Tensleep Ck.	9	27	1963	0.040		2	31	49	86	ADJ		0.040
10	22561	Gordon Pipeline	West Tensleep Ck.	9	27	1963	0.030		2	31	49	86	ADJ		0.030
11	22562	Clare Pipeline	Merz Creek	9	27	1963	0.030		2	31	49	86	ADJ		0.030
11	22564	Merz Pipeline	Merz Creek	9	27	1963	0.030		2	31	49	86	ADJ		0.030
12	22776	Iversen Pipeline	Indian Creek	12	1	1966	0.060		2	18	48	86	ADJ		0.060
13	29619	Tensleep Fish Hatchery	Leigh(Lee) Creek	5	31	1984	0.580	1		34	48	87	UNADJ	1.16	
13	29620	Tensleep Fish Hatchery	Leigh(Lee) Creek	5	31	1984	0.580	1		34	48	87	UNADJ	1.16	
13	6837E	Hatchery Pipe Enl.1	Leigh(Lee) Creek	5	31	1984	0.045		2	34	48	87	UNADJ		0.045
13	6838E	Hatchery Pipe Enl.1	Leigh(Lee) Creek	5	31	1984	0.029		6	34	48	87	UNADJ		0.029
13	6839E	Hatchery Pipe Enl.2	Leigh(Lee) Creek	5	31	1984	0.912*	1	6	34	48	87	UNADJ	0.426	0.699
14	25 4/374	Tensleep Hydropower	Tensleep Creek	10	23	1985	72.000		5	7	48	86	UNADJ		varies

Key to Uses:

1 = Irrigation 4 = Highway
2 = Domestic 5 = Power
3 = Stock 6 = Fish

* Irr.=.213 cfs, Fish=remainder

Max Irrigation Diversions= 2.97 CFS

Non Irrigation Diversions = 18.48 CFS

Total Diversions = 21.45 CFS

Table 2. Reservoir Water Rights and Permits Located Upstream of the Downstream End of Instream Flow Segment No. 1 on Tensleep Creek as of September 1987

RESERVOIR PERMIT NUMBER	FACILITY	SOURCE	PRIORITY DATE MONTH	DAY	YEAR	AMOUNT (ac-ft)	WATER USE	DIVERSION LOCATION SEC	TNSHP	RNG	ADJ/ UNADJ	
4923	Tensleep Reservoir	East Tensleep Ck.	1	31	1938	3508.90	F,R,I,D,S	5	48	86	UNADJ	
5436	Tyrell Ranger Station R. Pond	West Tensleep Ck.	7	3	1941	0.73	F	30	49	86	ADJ	Key to
6543	Deer Haven Reservoir	Deer Haven Creek	7	22	1960	0.07	F,S	6	48	86	ADJ	uses
9236	Tensleep Fish Reservoir #1	Leigh (Lee) Creek	5	31	1984	0.01	F	34	48	87	UNADJ	--------
9237	Tensleep Fish Reservoir #2	Leigh (Lee) Creek	5	31	1984	0.02	F	34	48	87	UNADJ	S = Stock
9238	Tensleep Fish Reservoir #3	Leigh (Lee) Creek	5	31	1984	0.06	F	34	48	87	UNADJ	D = Domestic
9239	Tensleep Fish Reservoir #4	Leigh (Lee) Creek	5	31	1984	0.07	F	34	48	87	UNADJ	F = Fish
9240	Tensleep Fish Reservoir #8	Leigh (Lee) Creek	5	31	1984	0.04	F	33	48	87	UNADJ	R = Recreation
9241	Tensleep Fish Reservoir #14	Leigh (Lee) Creek	5	31	1984	0.09	F	33	48	87	UNADJ	I = Irrigation
						--------						

Any secondaries for 4923 irrigation right? Total Storage = 3510 ac-ft

It is assumed that the streamflow gaging records discussed later reflect the actual diversions of the upstream water rights and permits listed in Tables 1 and 2. Since instream flow water rights are non-consumptive, existing and future diversions downstream of the segment will not be affected. The proposed Tensleep Hydroelectric Project will divert water from within the segment. This report assumes that the project owners have agreed with the Wyoming Game and Fish Department to divert only those flows that exceed 22.0 cfs in the stream. This report does not address the effect of the instream flow demand upon future power production of the proposed Tensleep Hydropower Project.

Flow Records

Two U.S. Geological Survey streamflow gaging stations were used to estimate the flows in the instream flow segment. Gage 062710 (Tensleep Creek near Tensleep, Wyoming) is located approximately four stream-miles downstream from the downstream end of the segment and has a period of record of 1911 to 1972. Data at Gage 062710 are missing for all or parts of the years of 1913-14, 1925-43, and 1972-73. Gage 062705 (Canyon Creek near Tensleep, Wyoming) is located near the mouth of Canyon Creek where it enters Tensleep Creek about 1,000 feet upstream of gage 062710. The period of record for gage 062705 is 1939 through 1944.

Hydrology

A hydrologic analysis was conducted to estimate mean annual flowrates for three points: the upstream end, the Tensleep Hydroelectric Project's proposed penstock diversion point, and the downstream end of the instream flow segment. The penstock diversion point is located approximately one-half mile downstream of the upstream end of the segment. Water for the proposed Tensleep Creek hydroelectric plant would be diverted from Tensleep Creek at this point.

Mean annual flow in the segment was determined using the U.S. Bureau of Reclamation's Precipitation - Altitude - Area method. This method distributes runoff measured at a base station over the drainage area that contributes flow to the base station. The runoff distribution is based on the distribution of precipitation over the drainage area.

The drainage area was divided into sub-areas based on 1000 feet elevation intervals as listed in Column A of Table 3. The mean annual precipitation (Column C of Table 3) for each elevation band was found using an isohyetal map of Wyoming developed by Brooks E. Martner in the Wyoming Climate Atlas, using precipitation data from 1951 through 1980. Figure 2 on page 6 shows the distribution of average annual precipitation as adapted from the Wyoming Climate Atlas. The runoff factor (Column D of Table 3) was determined by dividing the precipitation for each elevation band by the precipitation for the top elevation band. The actual area within each band (Column B of Table 3) was multiplied by the runoff factor to give an equivalent area (Column E). The equivalent areas of all the elevation bands were added together (bottom of Column E) and the total was divided into the average annual runoff at the base station gage 062710 (bottom line of Column G), resulting in a unit runoff in acre-feet per square mile for the top elevation band (top line of Column F). The product of the unit runoff for the top elevation band and the runoff factor for each lower band gave the unit runoff for each elevation band in acre-feet per square mile (Column F

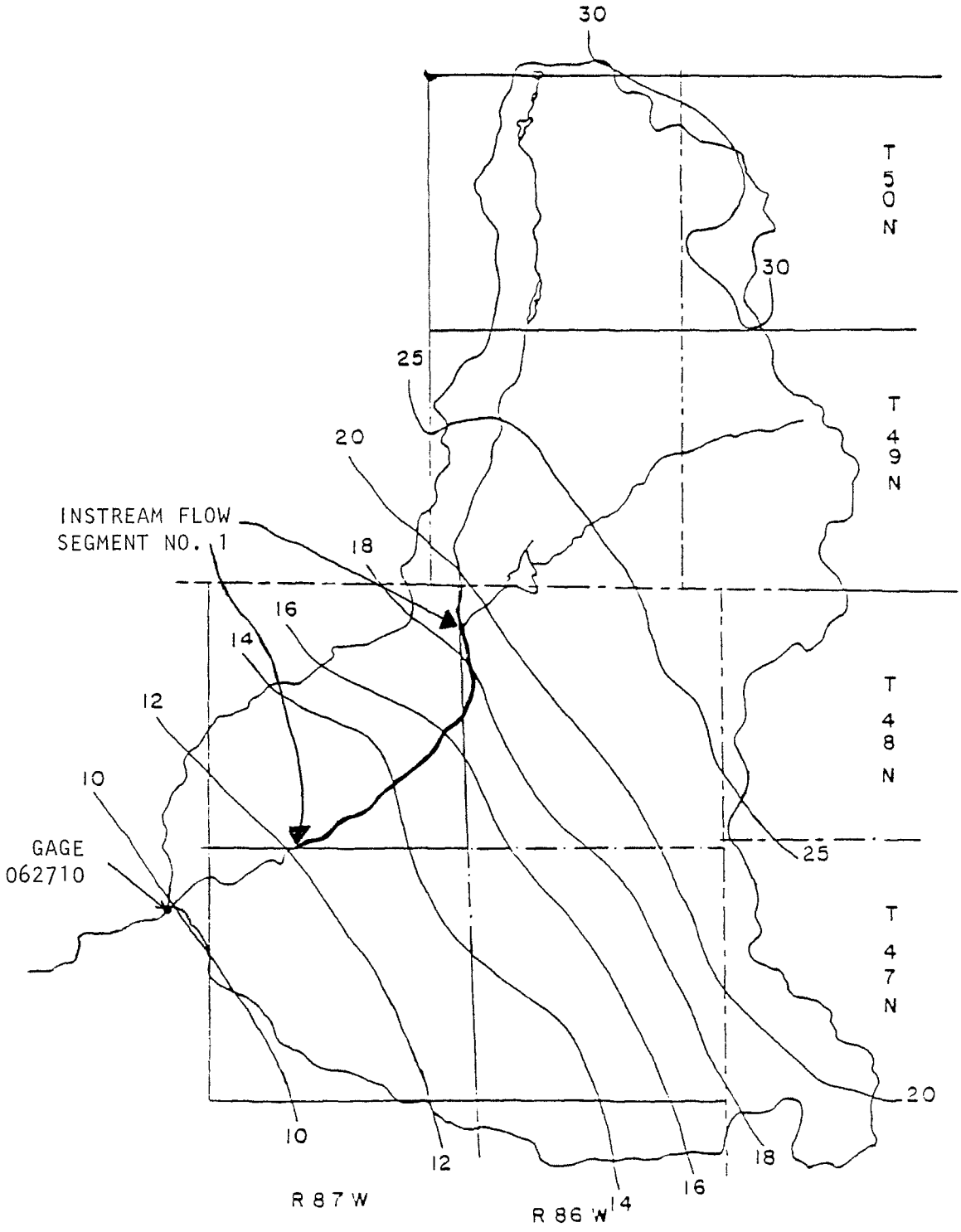


FIGURE 2

Isohyetal lines for Tensleep Creek Drainage Area
(Annual Precipitation in inches)

Adapted from the Wyoming Climate Atlas, 1951 through 1980 data.

TABLE 3. Area Altitude Precipitation Results for Tensleep Creek above gage 062710.0

A ELEVATION RANGE (FEET)	B ACTUAL AREA (SQ. MILES)	C PRECIP-ITATION (INCHES)	D RUNOFF FACTOR C/30	E EQUIVALENT AREA (SQ. MILES) B*D	F UNIT RUNOFF (AC-FT/MI^2) (105908/148)*D	G RUNOFF (AC-FT) B*F
11,000-12,000	11.9	30	1.00	11.9	715	8509
10,000-11,000	23.8	25	0.83	19.8	596	14185
9,000-10,000	45.1	21	0.70	31.6	501	22595
8,000- 9,000	64.1	17	0.57	36.3	405	25960
7,000- 8,000	49.9	15	0.50	25.0	358	17864
6,000- 7,000	26.1	14	0.47	12.2	334	8717
5,000- 6,000	23.8	13	0.43	10.3	310	7378
4,000- 5,000	2.4	12	0.40	1.0	286	686
Totals	247.1			148.0		105908 a

a = mean annual flow at gage 062710 "base station", see Table 7

Table 4. Calculation of Mean Annual Runoff at Upstream End of Instream Flow Segment

ELEVATION RANGE (FEET)	ACTUAL AREA (SQ. MILES)	UNIT RUNOFF (AC-FT/MI^2)	RUNOFF (AC-FT)
11,000-12,000	11.9	715	8509
10,000-11,000	23.8	596	14185
9,000-10,000	33.5	501	16784
8,000- 9,000	15.6	405	6318
7,000- 8,000	0.3	358	107
6,000- 7,000	0	334	0
5,000- 6,000	0	310	0
4,000- 5,000	0	286	0
Totals	85.1		45902

Table 5. Calculation of Mean Annual Runoff at Tensleep Hydropower Diversion Point

ELEVATION RANGE (FEET)	ACTUAL AREA (SQ. MILES)	UNIT RUNOFF (AC-FT/MI^2)	RUNOFF (AC-FT)
11,000-12,000	11.9	715	8509
10,000-11,000	23.8	596	14185
9,000-10,000	33.5	501	16784
8,000- 9,000	17.8	405	7209
7,000- 8,000	1.4	358	501
6,000- 7,000	0	334	0
5,000- 6,000	0	310	0
4,000- 5,000	0	286	0
Totals	88.4		47187

of Table 3). The mean annual runoffs from each elevation band were computed in Column G, but these values are of no consequence in this study.

The average annual runoffs at the three points of interest were determined using the unit runoff values listed in Column F of Table 3. The drainage area above each point was outlined and the area within each elevation band was determined. The runoff at each point was found as the product of the unit runoff values and the contributing area within each band (Tables 4, 5, and 6). The total annual average runoff is the summed value of all the contributing runoff values from the different elevation bands (last columns in Tables 4, 5 and 6).

The average annual flow at each point of interest was distributed over the year to give average monthly flows at each point. The average monthly distribution was computed using the Tensleep Creek gaging station data less the flow from the Canyon Creek gaging station (Table 7, Column C). Dividing the monthly flows by the total of the monthly flows gives a monthly percentage of the total annual flow (Table 7, Column D). Monthly distributions of flow at the penstock diversion point and the upstream end of the segment were assumed to be the same as the downstream distribution. The average annual flows calculated in Tables 4, 5, and 6 were distributed over the year using the monthly percentages for the three points of interest (Table 8).

Monthly Flow Analysis

Computed mean monthly flows for the average year case are listed in Table 8. Mean monthly flows at the upstream end were estimated in Column C of Table 8 by distributing the mean annual runoff from Table 4 across the twelve months according to the monthly percentage distribution of flow calculated in Table 7. Mean monthly flows at the downstream end are estimated in Column I of Table 8 in a similar way using a mean annual flow from Table 6. Figure 3, on page 10, is a bar graph showing the average year case mean monthly flows at the upstream and downstream ends of the segment as well as the requested instream flow. As shown at the bottom of Column L of Table 8, the estimated total annual shortfall at the downstream end of the segment equals 1123 acre-feet.

Mean monthly flows for the dry year case (1960) of record are listed in Table 9. The last column in Table 9 lists the shortfalls of monthly flow computed by subtracting the flows in Column H from the requested instream flow (Column I). Although 1960 was the driest total flow water year of record, the winter months were unusually wet resulting in only one month of shortfall relative to the 22 cfs request.

Since it is assumed that the gage records reflect recent actual water use, the water rights in Tables 1 and 2 were not subtracted from the mean monthly flows. These water rights are senior to the instream flow permit and, according to Wyoming prior appropriations water law, will not be damaged by the instream flow permit. In the case of the Tensleep Hydropower Project, the project has agreed to never allow the streamflow at the diversion point to drop below 22.0 cfs as a result of hydropower diversions within the segment. See Appendix B, Correspondence from Tensleep Hydropower Project.

Table 6. Calculation of Mean Annual Runoff at Downstream End of Instream Flow Segment

ELEVATION RANGE (FEET)	ACTUAL AREA (SQ. MILES)	UNIT RUNOFF (AC-FT/MI^2)	RUNOFF (AC-FT)
11,000-12,000	11.9	715	8509
10,000-11,000	23.8	596	14185
9,000-10,000	39.4	501	19739
8,000- 9,000	33.2	405	13446
7,000- 8,000	17.7	358	6337
6,000- 7,000	5.1	334	1703
5,000- 6,000	1.3	310	403
4,000- 5,000	0	286	0
Totals	132.4		64322

Table 7. Calculation of the Monthly Distribution of the Mean Annual Flow Upstream of the Confluence of Canyon and Tensleep Creeks

	Tensleep Creek gage 062710.0	Canyon Creek gage 062705.0		
	A	B	C	D
MONTH	MONTHLY AVE FLOW AC-FT 1911-1973	MONTHLY AVE FLOW AC-FT Gage 062705 1939-1944	TENSLEEP CREEK MINUS CANYON CREEK WEIGHTED AVE, AC-FT	MONTHLY DISTRIBUTION OF FLOW Percent (C/83055.7)
OCT	4367.7	1526.1	2841.6	3.42%
NOV	3443.5	1463.4	1980.1	2.38%
DEC	3043.1	1492.8	1550.3	1.87%
JAN	2814.4	1484.4	1330.0	1.60%
FEB	2590.5	1378.7	1211.8	1.46%
MAR	2854.0	1584.0	1270.0	1.53%
APR	3765.9	2060.8	1705.1	2.05%
MAY	21228.3	4885.4	16342.9	19.68%
JUN	37633.2	2901.7	34731.5	41.82%
JUL	14411.8	1476.8	12935.0	15.57%
AUG	5312.4	1229.9	4082.5	4.92%
SEP	4453.2	1378.3	3074.9	3.70%
TOTALS	105918 *	22862.3	83055.7	100.00%

* Although this total is 10 acre-feet larger than the mean annual flow at gage 062710.0 as reported in Table 3, this total is the true total of the mean monthly flows as reported in the Water Research Center's DAYAVE printout. This is a small error, and is probably due to rounding.

FIGURE 3. MEAN MONTHLY FLOWS AND REQUESTED

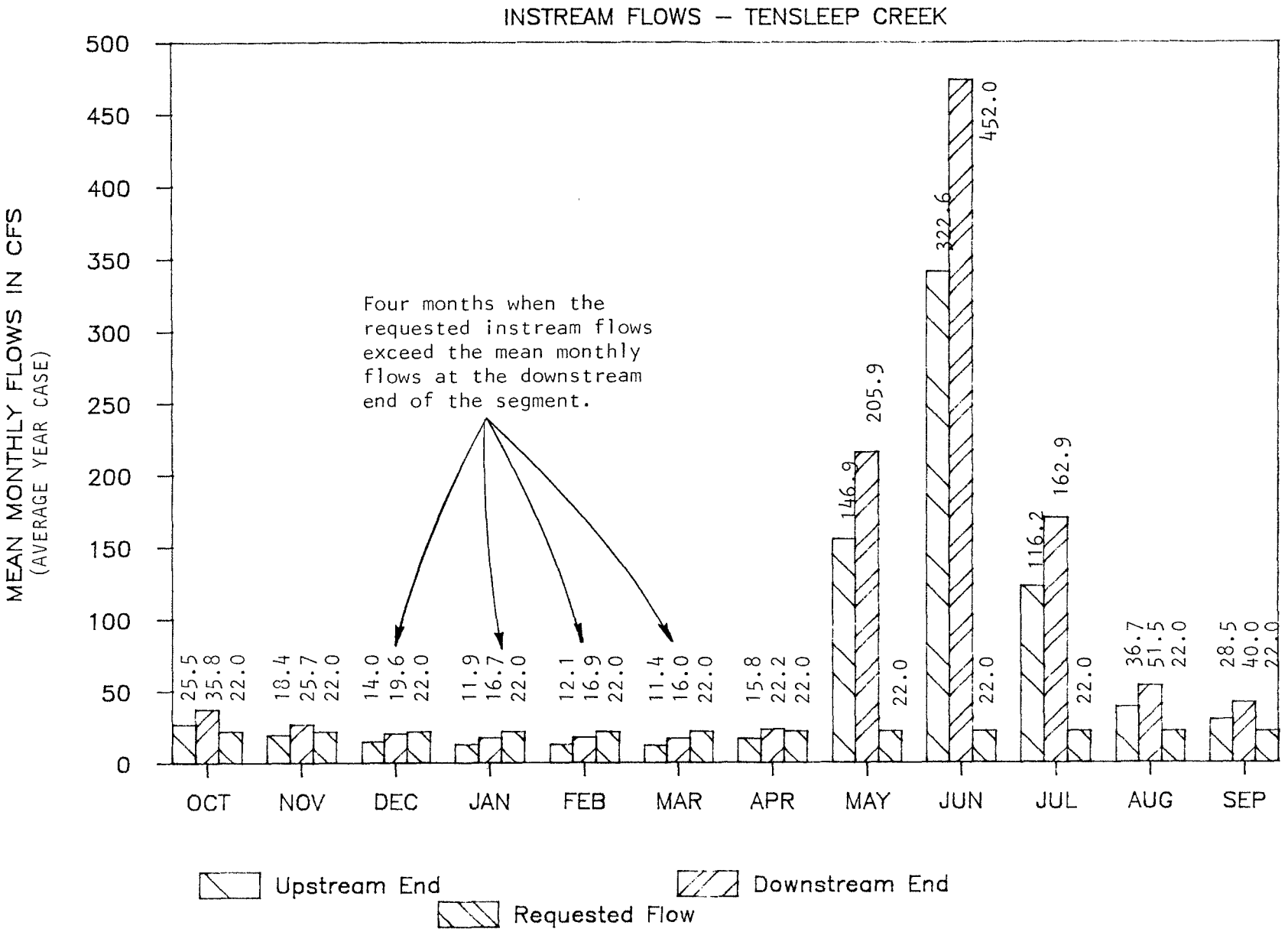


Table 8. Calculation of Mean Monthly Flows and Shortfalls, Average Year Case

MONTH	COMPUTED MEAN MONTHLY FLOW AT UPSTREAM END OF SEGMENT			COMPUTED MEAN MONTHLY FLOW AT PENSTOCK DIVERSION POINT			COMPUTED MEAN MONTHLY FLOW AT DOWNSTREAM END OF SEGMENT			REQUESTED INSTREAM FLOW AT DOWNSTREAM END (CFS)	AVERAGE YEAR SHORTFALL	
	(% TOTAL)	(AC-FT)	(CFS)	(% TOTAL)	(AC-FT)	(CFS)	(% TOTAL)	(AC-FT)	(CFS)		J - I (CFS)	(AC-FT)
	A	B	C	D	E	F	G	H	I	J	K	L
OCT	3.42 d	1569.8	25.5	3.42 d	1613.8	26.2	3.42 d	2199.8	35.8	22	0.0 e	0
NOV	2.38 d	1092.5	18.4	2.38 d	1123.1	18.9	2.38 d	1530.9	25.7	22	0.0 e	0
DEC	1.87 d	858.4	14.0	1.87 d	882.4	14.4	1.87 d	1202.8	19.6	22	2.4	150
JAN	1.60 d	734.4	11.9	1.60 d	755.0	12.3	1.60 d	1029.2	16.7	22	5.3	323
FEB	1.46 d	670.2	12.1	1.46 d	688.9	12.4	1.46 d	939.1	16.9	22	5.1	282
MAR	1.53 d	702.3	11.4	1.53 d	722.0	11.7	1.53 d	984.1	16.0	22	6.0	368
APR	2.05 d	941.0	15.8	2.05 d	967.3	16.3	2.05 d	1318.6	22.2	22	0.0 e	0
MAY	19.68 d	9033.5	146.9	19.68 d	9286.4	151.0	19.68 d	12658.6	205.9	22	0.0 e	0
JUN	41.82 d	19196.2	322.6	41.82 d	19733.6	331.6	41.82 d	26899.5	452.0	22	0.0 e	0
JUL	15.57 d	7146.9	116.2	15.57 d	7347.0	119.5	15.57 d	10014.9	162.9	22	0.0 e	0
AUG	4.92 d	2258.4	36.7	4.92 d	2321.6	37.8	4.92 d	3164.6	51.5	22	0.0 e	0
SEP	3.70 d	1698.4	28.5	3.70 d	1745.9	29.3	3.70 d	2379.9	40.0	22	0.0 e	0
Totals	100.0	45902.0 a		100.00	47187.0 b		100.00	64322.0 c				1123 f

a From Table 4.

b From Table 5.

c From Table 6.

d Percentages From Table 7 column D.

e Negative values replaced by zeros.

f Total average annual shortfall at downstream end of segment equals 1123 acre-feet.

Table 9. Calculation of Mean Monthly Flows and Shortfalls, Dry Year Case (1960)

MONTH	1960 GAGE 062710 MONTHLY FLOW (AC-FT)	PERCENT OF TOTAL 1960 FLOW A/61860*100	COMPUTED DRY YEAR MONTHLY FLOW AT UPSTREAM END OF SEGMENT (AC-FT)	(CFS)	COMPUTED DRY YEAR MONTHLY FLOW AT PENSTOCK DIVERSION POINT (AC-FT)	(CFS)	COMPUTED DRY YEAR MONTHLY FLOW AT DOWNSTREAM END OF SEGMENT (AC-FT)	(CFS)	REQUESTED INSTREAM FLOW (CFS)	DRY YEAR SHORTFALL AT DOWNSTREAM END OF SEGMENT I - H (CFS)
	A	B	C	D	E	F	G	H	I	J
OCT	3,530	5.71%	1,530	24.9	1,573	25.6	2,144	34.9	22	0 a
NOV	2,970	4.80%	1,287	21.6	1,323	22.2	1,804	30.3	22	0
DEC	2,440	3.94%	1,058	17.2	1,087	17.7	1,482	24.1	22	0
JAN	2,220	3.59%	962	15.6	989	16.1	1,348	21.9	22	0.1
FEB	2,280	3.69%	988	17.8	1,016	18.3	1,385	24.9	22	0
MAR	2,630	4.25%	1,140	18.5	1,172	19.1	1,597	26.0	22	0
APR	4,030	6.51%	1,747	29.4	1,796	30.2	2,448	41.1	22	0
MAY	14,020	22.66%	6,076	98.8	6,246	101.6	8,515	138.5	22	0
JUN	17,650	28.53%	7,650	128.6	7,864	132.2	10,720	180.1	22	0
JUL	4,890	7.90%	2,119	34.5	2,179	35.4	2,970	48.3	22	0
AUG	2,520	4.07%	1,092	17.8	1,123	18.3	1,530	24.9	22	0
SEP	2,680	4.33%	1,162	19.5	1,194	20.1	1,628	27.4	22	0
Totals	61,860	100.00%	26,811	b	27,561	b	37,570	b		

a Negative values replaced by zero.

b Computed by finding ratios of average year case runoff at the points of interest relative to gage runoff, then applying the ratio to 1960 gaged mean annual flow. i.e.: At the upstream end of the segment, the ratio was 45,902 divided by 105,908 acre-feet which equals .4334. Then .4334 times 61,860 acre-feet reveals a dry year case annual flow of 26,811 acre-feet at the upstream end of the segment.

Daily Flow Exceedence Analysis

A daily flow exceedence analysis was conducted to determine the feasibility of using direct flow to meet the WG&F criteria of 50 percent exceedence of the requested 22 cfs during the months of July through September. A daily flow exceedence analysis was also conducted for the other months for informational purposes. Table 10 summarizes the daily flow exceedence analysis.

Daily flow duration statistics for gaging station 062710 were obtained for each month. Since the statistics apply to the gaged point only, it was necessary to increase the requested instream flow to obtain corresponding flows at gage 062710 as listed in Column D of Table 10. These corresponding flows were compared to DURCUR program printouts from the Wyoming Water Research Center to determine the percent of days each corresponding flow was exceeded during each month.

Table 11 is included as an example of this procedure. For the month of October, the corresponding flow at gage 062710 is 43.6 cfs as listed in Column D of Table 10. Interpolation in Table 11 shows that the corresponding flow of 43.6 cfs was equalled or exceeded 90.9 percent of the days in October during the period of record.

Column F of Table 10 shows that the 50% exceedence criteria for the months of July through September has been met by direct flow according to this analysis and available data. During the months of December through April, however, the requested flow of 22 cfs occurred less than 50 percent of the days in each month during the period of record.

Conclusions

The following conclusions are based on the premise that any future hydropower projects will not allow instream flow to drop below 22.0 cfs at the upstream end as a result of hydropower diversions when natural flow conditions provide 22.0 cfs at the upstream end. The monthly flow analysis (using actual gage records in the vicinity) indicates that direct flows in the Tensleep Creek Instream Flow Segment No. 1 are sufficient to meet the requested instream flows only eight months of the year. Average annual runoff during the four months of December through March fall short of meeting the requested instream flow by a total of 1123 acre-feet. At first glance, it appears that Tensleep Reservoir (also known as Meadowlark Reservoir) is large enough (3,508.9 acre-feet) to supply the missing flows. This reservoir is operated by the Forest Service as a steady state reservoir, that is, whatever flows in also flows out without deliberate retention other than to replace incidental losses and minimal consumptive uses. This report does not attempt to determine whether or not Meadowlark Lake's operation can be changed to provide the missing flows during December through March.

The daily flow analysis shows that the Wyoming Game and Fish criteria of 50 percent exceedence during July through September has been met by direct flow.

Table 10. Summary of Daily Flow Exceedence Analysis, Tensleep Creek Instream Flow Segment No. 1

Month	A Requested Instream Flow at Downstream End (cfs)	B Computed Mean Monthly Flow at Downstream End (cfs)a	C Actual Mean Monthly Flow at Gage 062710 (cfs)b	D Corresponding Flow at Gage 062710 A/B*C (cfs)	E WG&F Exceedence Criteria	F Percent Exceedence During Period of Record for Gage 062710 c
OCT	22	35.8	71.0	43.6	N/A	90.9
NOV	22	25.7	57.9	49.6	N/A	69.9
DEC	22	19.6	49.5	55.6	N/A	33.2
JAN	22	16.7	45.8	60.3	N/A	13.9
FEB	22	16.9	45.0	58.6	N/A	15.5
MAR	22	16.0	46.4	63.8	N/A	11.6
APR	22	22.2	63.3	62.7	N/A	26.9
MAY	22	205.9	345.2	36.9	N/A	100.0
JUN	22	452.0	632.4	30.8	N/A	100.0
JUL	22	162.9	234.4	31.7	50.0%	100.0
AUG	22	51.5	86.4	36.9	50.0%	96.4
SEP	22	40.0	74.8	41.1	50.0%	88.8

a From Table 8

b From UW Water Research Center (USGS data)

c From UW Water Research Center DURCUR program

TENSLEEP CREEK NEAR TENSLEEP, WYOMING STATION NO. 062710.00
LATITUDE 44-03-28 LONGITUDE 107-23-14 NW1/4SW1/4NW1/4 SECTION 12 TOWNSHIP 47 N,RANGE 88 W 6TH P.M.
ELEVATION 4667.59 FT DRAINAGE AREA 247.00 SQ MI NONCONTRIBUTING 0.00 SQ MI BASIN 03231210
WASHAKIE COUNTY DATA FROM USGS (P)
DISCONTINUED - SEPTEMBER 1972

CLASS	SIZE*	TOTAL	ACCUM	PERCENT	SIZE/DA	SIZE/MEAN
1	10.0	0.	1302.	100.00	.04	.14
2	15.0	0.	1302.	100.00	.06	.21
3	20.0	0.	1302.	100.00	.08	.28
4	25.0	0.	1302.	100.00	.10	.35
5	30.0	32.	1302.	100.00	.12	.42
6	40.0	242.	1270.	97.54	.16	.56
7 (43.6 / 90.9)	50.0	624.	1028.	78.96	.20	.70
8	75.0	242.	404.	31.03	.30	1.05
9	100.0	129.	162.	12.44	.40	1.40
10	150.0	16.	33.	2.53	.61	2.11
11	200.0	10.	17.	1.31	.81	2.81
12	250.0	7.	7.	.54	1.01	3.51
13	300.0	0.	0.	0.00	1.21	4.21
14	400.0	0.	0.	0.00	1.62	5.62
15	500.0	0.	0.	0.00	2.02	7.02
16	750.0	0.	0.	0.00	3.04	10.53
17	1000.0	0.	0.	0.00	4.05	14.04

* Each class size represents the lower limit of the flow range in cfs.

Table 11. Daily flow duration statistics for the month of October during the period of record at Gage 062710.

(From Wyoming Water Research Center DURCUR Program)

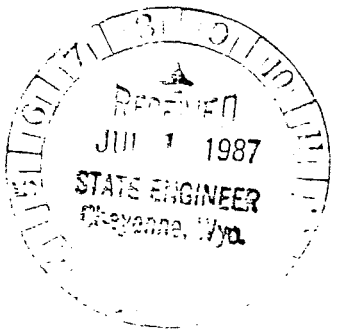
Appendix A

Tensleep Creek Instream Flow Report by
Wyoming Game and Fish Department

WYOMING GAME AND FISH DEPARTMENT

FISH DIVISION

ADMINISTRATIVE REPORT



TITLE: Tensleep Creek Instream Flow Report

PROJECT: IF-2286-09-8601

AUTHOR: Thomas C. Annear

DATE: February, 1987

Studies were begun in August 1985 and continued through the 1986 field season to obtain instream flow information from a portion of Tensleep Creek. The studies were designed to provide results which could be used to determine instream flow needs for trout as well as to evaluate potential flow-related impacts which could result from the proposed Federal Energy Regulatory Commission (FERC) project at this site. All data except existing fish population data have been collected. Data to document the nature of the existing fishery will be collected over the next 2-3 years or until the project is built.

METHODS

All of the field data used in this study were collected from a 315 foot long study site located about 1/4 mile upstream from the mouth of Leigh Creek at R87W, T48N, S34, SW1/4. This site contained a combination of pool and riffle habitat for trout that was representative of trout habitat features found throughout this portion of the stream. Results and recommendations apply to a portion of the stream extending from a downstream boundary at the west section line of section 4, R87W, T47N upstream to the confluence of East and West Tensleep Creeks in R86W, T48N, S6, SW1/4.

A physical habitat simulation model (PHABSIM) developed by the Instream Flow Service Group of the Fish and Wildlife Service (Bovee and Milhous 1978) was used to identify incremental changes in the amount of physical habitat for rainbow trout with changes in flow. Data were collected at seven transects which were placed across each habitat type within the study segment. Velocities and depths were measured at 1 to 2 foot intervals across each transect during three different flow events (Table 1). These data permitted accurate simulation of physical habitat over a range of flows between 20 and 435 cfs.

T.F. No. 26 5/157

The PHABSIM model can be used to quantify habitat changes for a variety of species and up to five live stages of fish. For the above-defined stream segment, analyses were made of habitat changes for rainbow trout adult, juvenile and fry life stages (combined). The model was used for rainbow trout since the stream is dominated by this species. Recommendations were not provided for spawning and incubation useable area because analyses showed very limited amounts of useable area for spawning over the entire range of flo s.

Table 1. Dates and discharges when instream flow data were collected on Tensleep Creek.

Date	Discharge (cfs)	PHABSIM	HQI
08-06-85	39	-	X
07-02-86	174	X	X
07-22-86	70	X	X
09-09-86	50	X	X

Most of the recruitment to this fishery is assumed to come from upstream tributaries to Tensleep Creek and fish stocked by the Department.

The Habitat Retention method (Nehring 1979) was used to identify a flow for maintaining adequate levels of aquatic insect production and fish passage through riffle areas. Data from single transects placed across four riffles within the study area were analyzed in the IFG-1 computer program (Milhous 1978). Flow data were collected on the same dates as the PHABSIM data were collected (Table 1). The flow recommendation for this method was determined by identifying the discharge at which two of the three hydraulic criteria in Table 2 were met at all riffle cross-sections.

Table 2. Hydraulic criteria used to obtain an instream flow recommendation using the Habitat Retention method for Tensleep Creek.

Category	Criteria
Average Depth (ft)	Top Width * 0.01
Average Velocity (ft per sec)	1.00
Wetted Perimeter (percent)*	60

* - Compared to wetted perimeter at bank full conditions.

The Habitat Quality Index (HQI) developed by the Wyoming Game and Fish Department (Binns and Eiserman 1978) was used to estimate potential changes in trout standing crops under various levels of late summer flow conditions. This model incorporates seven attributes that address chemical, physical as well as biological components of trout habitat. Results are expressed in habitat units (HU) per acre. The estimates derived from this model are based on and apply only to late summer flow conditions. By measuring habitat attributes at various flow events as if associated habitat features were typical of late summer flow conditions, HU estimates can be made for a range of theoretical late summer flows.

Results from the Habitat Retention, HQI and PHABSIM (adult, juvenile and fry life stages) models were combined to identify the flow needed to maintain existing levels of trout production throughout the year. Natural undepleted flows during this time period (primarily October to April) that are less than the recommended discharge will maintain trout survival at its current level since the existing trout population has evolved under these conditions. The results presented here are useful to illustrate the critical nature of those flows for trout survival.

RESULTS

Results from the habitat retention model showed that flows of 7,9,18 and 22 cfs are necessary to maintain aquatic insect production and fish passage at the four riffles in the study area (Appendix A). The maintenance flow derived from this method is defined as the flow at which two of the three hydraulic criteria are met for all riffles in the study site; which in this case is 22 cfs.

Results from the PHABSIM analysis for adult, juvenile and fry rainbow trout showed that useable area in the stream is maximized at 40 cfs for the range of flows considered (Figure 1). The average percent of useable area for these three life stages decreases from 14 percent at 40 cfs to 21 percent at 22 cfs. At flows less than 20 cfs, useable area for rainbow trout decreases rapidly.

August and September stream flows usually approximate the 39 cfs flow that was measured on August 6, 1985 (Table 1). Therefore, the management objective for this stream segment is to maintain approximately 135 HU's per acre - the number which were determined to presently exist in the study area (Figure 2). To better define the potential habitat quality and standing crop of trout at flows less than 39 cfs, data for an HQI at 22 cfs were simulated and run through the model. The results from this analysis indicate that trout habitat units would decrease to about 105 HU's per acre.

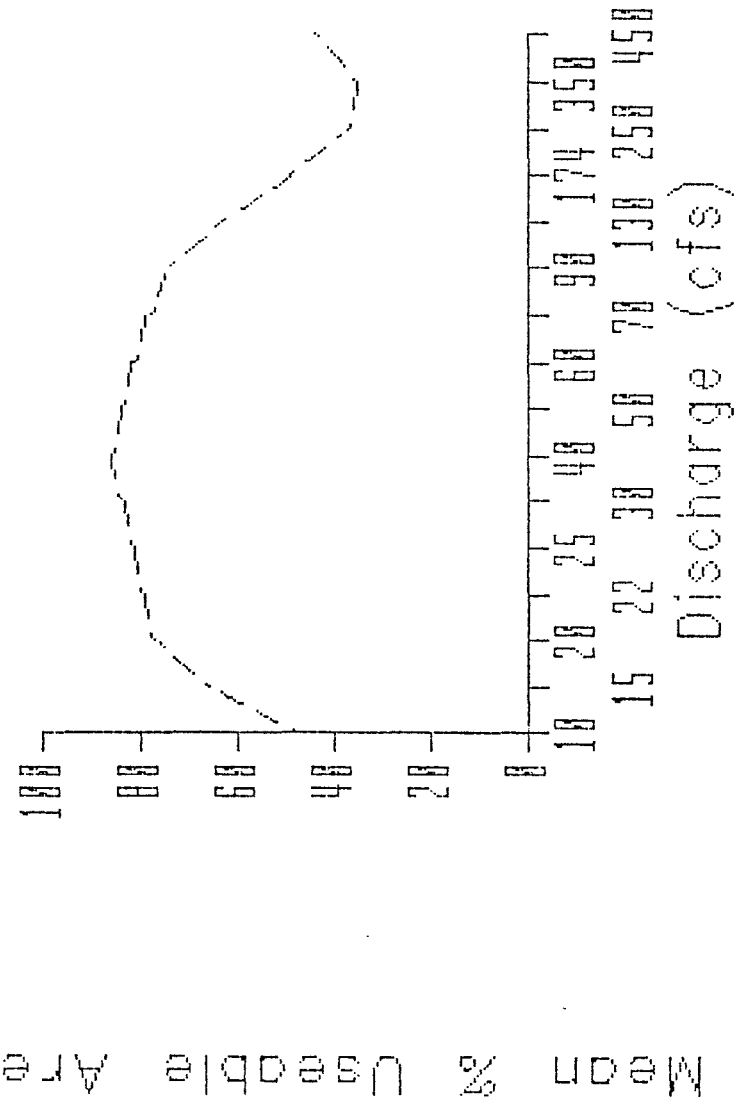


Figure 1. Change in mean percent useable area for adult, juvenile and fry rainbow trout with incremental changes in stream flow.

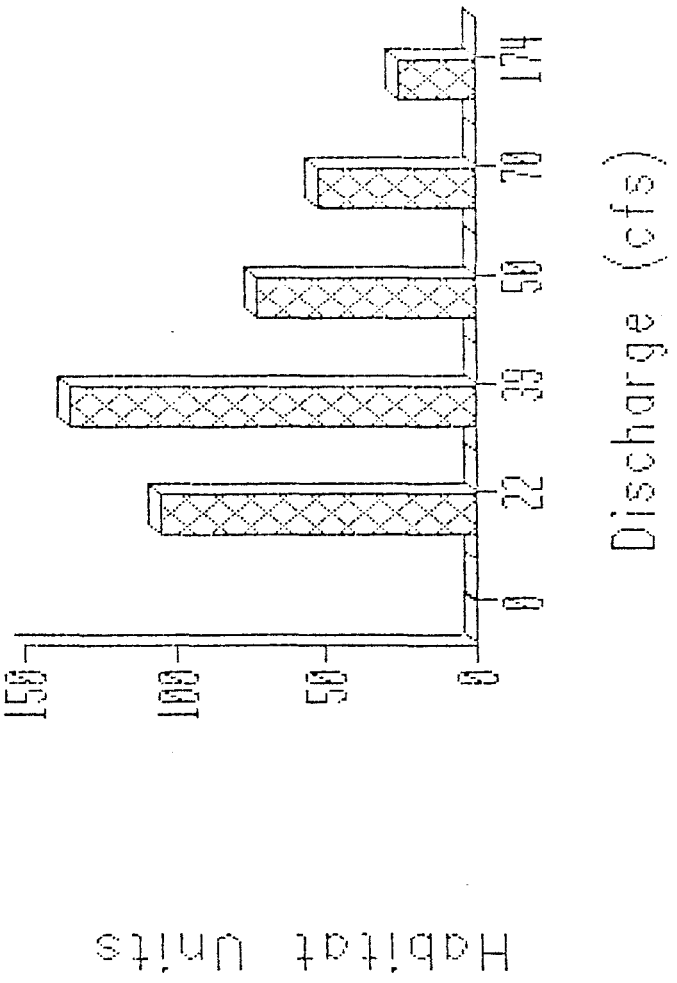


Figure 2. Estimated numbers of trout habitat units at five different flows.

This decrease in HU's is generally supported by the results from the PHABSIM model. If July to September flows were to be increased above existing levels, trout densities would similarly decrease from current levels.

On this basis an instream flow of at least 22 cfs between July 1 and September 30 is recommended to maintain existing levels of trout production.

It is a well documented fact that substantial mortality of wild trout occurs in the winter, particularly in relatively high elevation streams like those found throughout Wyoming. Needham et. al (1945) documented overwinter losses of brown trout ranging up to 85 percent and averaging over 60 percent in a California stream. Butler (1979) reported significant trout and aquatic insect losses caused by anchor ice formation. Reimers (1957) considered anchor ice, collapsing snow banks and fluctuating flows resulting from the periodic formation and breakup of ice dams to be the primary causes of trout winter mortality. These studies were all conducted on unregulated streams and illustrate the severe conditions that trout are exposed to naturally during the winter. The causes of winter mortality discussed above are all greatly influenced by the quantity of winter flow in terms of its ability to minimize anchor ice formation (increased velocity and temperature loading). Higher flows also serve to dilute and prevent snow bank collapses and ice dam formation respectively. Any reduction of natural winter stream flows would increase trout mortality and effectively reduce the number of fish that the stream could support. The fishery management objective for the time period from October 1 to March 31 is to protect all available natural stream flows in the instream flow segment.

The Habitat Retention method was developed to identify a flow that would maintain aquatic insects in riffle areas and provide passage for trout between different habitat types in the stream. Maintenance of these features is as important during the winter as it is during the summer and, as a consequence, the recommendation derived from this method (22 cfs) is applied to the period between October 1 and March 31.

Preliminary analyses indicate that the recommended winter instream flow is seldom found in the portion of Tensleep Creek addressed by these studies. Since Tensleep Creek supports an excellent fishery with these flow conditions, this does not indicate a need for storage to provide the recommended flow. Instead it shows that the entire available natural flow is needed throughout the winter to maintain trout survival at its present level.

Results from the PHABSIM model show that the amount of useable area in the study area for spawning rainbow trout is extremely limited (Table 3). This is due primarily to the very limited amount of spawning gravels and excessive flow conditions experienced during spring runoff (high velocities) in this portion of the stream. Any reduction in flows during spring runoff (whenever flows exceed about 130 cfs) would increase the useable area for spawning somewhat. The majority of the trout recruitment to this portion of the stream undoubtedly originates in upstream tributaries and from Game and Fish Department hatchery plants. Subsequently an instream flow right to enhance natural reproduction in this part of the stream cannot be justified. An instream flow to maintain motile life stages (adult, juvenile and fry), however, is still needed during this time. This recommendation is derived from the Habitat Retention and PHABSIM model results and is the same recommendation as applied to all other times of year (22 cfs).

Table 3. Comparison of weighted useable area for rainbow trout spawning with total surface area in the study area.

Discharge (cfs)	Fry WUA (sq ft)	Total Area (sq ft)
10	0	31383
15	0	32896
20	2	34378
22	3	34782
25	8	35183
30	24	35760
40	60	36793
50	67	37509
60	79	38097
70	95	38667
90	139	39902
130	194	42431
174	165	44049
250	64	45944
350	8	47541
450	0	48008

CONCLUSIONS

Based on the analyses and results contained in this report, a year round instream flow recommendation of 22 cfs applies to approximately 8.0 miles of Tensleep Creek on National Forest lands upstream from the western section line of section 4, T47N, R87W to the confluence of East and West Tensleep Creeks in R86W, T48N, S6, SW1/4 (Table 4.)

Table 4. Summary of instream flow recommendations for Tensleep Creek.

Time Period	Instream Flow Recommendation (cfs)
July 1 to September 30	22*
October 1 to September 31	22**
April 1 to June 30	22**

* - Feasibility determined by availability at least 50 percent of this time period

** - To maintain existing natural flows up to the specified amount

LITERATURE CITED

Bovee, K. and R. Milhous. 1978. Hydraulic simulation in instream flow studies: theory and technique. Instream Flow Information Paper 5. FWS/OBS 78/33. Cooperative Instream Flow Service Group, U.S. Fish and Wildlife Service. Fort Collins CO.

Binns, N. and F. Eiserman. 1979. Quantification of fluvial trout habitat in Wyoming. Trans Amer Fish Soc. 108 (3): 215-228.

Butler, R. 1979. Anchor ice, its formation and effects on aquatic life. Science in Agriculture, Vol XXVI, Number 2, Winter, 1979.

Milhous, R. 1978. A computer program for the determination of average hydraulic and shape parameters of a stream cross section. Washington State Dept of Ecol. Olympia, WA.

Needham, P., J. Moffett, and D. Slater. 1945. Fluctuations in wild brown trout populations in Convict Creek, California. J Wildl Mgmt. 9(1): 9-25.

Nehring, R. 1979. Evaluation of instream flow methods and determination of water quantity needs for streams in the state of Colorado. Colo Div Wildl. Fort Collins, CO. 144p.

Reimers, N. 1957. Some aspects of the relation between stream foods and trout survival. Calif Fish and Game. 43(1): 43-69.

APPENDIX A

Table 5. Results from Habitat Retention method for riffle 1.

Disch*	Avg Dep*	Avg Vel*	Wet Per*
4.8	0.4	0.35	54.6
6.8	0.45	0.39	60.1
10.3	0.57	0.46	69.9
16.1	0.69	0.57	73.7
23.8	0.81	0.69	76.4
30.2	0.88	0.78	79.3
33.9	0.9	0.82	82.3
42.3	0.98	0.92	83.8
48.9	1.04	0.99	85.5
51.1	1.05	1.02	88.5

* - Discharge (cfs)
Average Depth (ft)
Average Velocity (ft per sec)
Wetted Perimeter (percent of bank full)

Table 6. Results from Habitat Retention method for riffle 2.

Disch	Avg Dep	Avg Vel	Wet Per
0.34	0.42	0.12	13.1
4.8	0.55	0.47	36.7
14.6	0.67	0.75	57.4
17.8	0.7	0.79	59.9
20.8	0.74	0.86	64.2
28.7	0.83	0.98	69.7
30.3	0.87	0.99	71.8
35.1	0.9	1.06	72.3
38.7	0.93	1.11	73.7
46.7	1.01	1.21	75.9

Table 7. Results from Habitat Retention method for riffle 3.

Disch	Avg Dep	Avg Vel	Wet Per
3.2	0.52	0.37	39.8
6.1	0.61	0.48	50.1
9.1	0.64	0.56	59.5
9.3	0.65	0.57	60.1
13.1	0.73	0.66	65.2
16.4	0.81	0.73	67.1
20.4	0.91	0.81	68.6
25.2	0.98	0.89	69.9
31.5	1.06	0.99	72.1
33.8	1.09	1.04	72.9

Table 8. Results from Habitat Retention method for riffle 4.

Disch	Avg Dep	Avg Vel	Wet Per
1.8	0.44	0.22	35.3
3.1	0.51	0.31	38.2
4.8	0.57	0.41	41.2
7.3	0.62	0.52	44.7
10.7	0.67	0.65	48.2
15.1	0.73	0.81	51.5
20.8	0.72	0.95	59.2
21.5	0.72	0.97	59.9
23.2	0.73	0.99	67.2
32.1	0.75	1.19	69.8

Appendix B

Correspondence from Tensleep Hydropower Project

Attorney at Law
Rocky Mountain Plaza, Suite 401
2020 Carey Avenue
Cheyenne, Wyoming 82001

307-635-3095

August 11, 1987

Gordon W. Fassett
State Engineer
Herschler Building
Cheyenne, Wyoming 82002

re: Tensleep Hydropower, Inc.
Temporary Filing 25 4/374

Dear Mr. Fassett:

On October 23, 1985, Ten Sleep Hydropower, Inc., submitted an application for a permit to divert 72 c.f.s. from Ten Sleep Creek for power generation. Included in that application were the following "Remarks":

> "The applicant is currently working with the State Fish and Game Department, the U.S. Fish and Wildlife Service, and the U.S. Forest Service to establish a minimum by-pass flow to insure the protection of fish, wildlife and habitat in the project area. All project designs will also be required to meet their approval prior to the issuance of the F.E.R.C. license and the special use permit. The proposed project will be non-consumptive in nature and will serve a benificial purpose."

The "minimum by-pass flow" that will "insure the protection of fish, wildlife and habitat in the project area" has now been established and agreed upon. That agreement is embodied in the enclosed Attachment A which were included as amendments to the F.E.R.C. License Application and are to be included in any other License granted for the Tensleep Hydropower Project.

Request is hereby made that Attachment A be made a part of the Tensleep Hydropower, Inc.'s temporary filing 25 4/374 and be included as Permit Conditions in any permit granted by the State Engineer to Tensleep Hydropower Inc., for the Tensleep Hydropower project.

Tensleep Hydropower, Inc. is aware that Wyoming Water Development Commission has, at the request of the Wyoming Game and Fish Department, submitted Temporary Filing No. 26 5/157 to the State Engineer. That application requests that a year around minumum streamflow of 22.0 c.f.s. be established on a 7.95 stream mile segment of Tensleep Creek starting at the upstream diversion point for the Tensleep Hydropower Project and ending at the point of discharge by that project back into Tensleep Creek.

We recognize that the 22 c.f.s. that will be bypassed through Tensleep's diversion works can be used to fulfill the instream flow requirements of temporary filing No. 26 5/157, and do not object to issuance of that permit.

Sincerely,

Thomas E. Cahill

TEC/sp

cc: Mike Stone
Jeff Bert
Jay Bingham
Frank Trelease

enclosures

ATTACHMENT A

The Applicant hereby submits the following articles to be included as amendments to the License Application ~~and~~ or as Articles in any License granted.

Article 1. Licensee shall discharge from the Ten Sleep Creek Water Power Project, a continuous minimum flow of 22.5 cubic feet per second, as measured immediately downstream from the Project Diversion, or inflow to the reservoir, whichever is less for the protection and enhancement of fish and wildlife resources in Ten Sleep Creek.

Article 2. Licensee shall, after consultation with Wyoming Game and Fish Department, U.S. Fish and Wildlife Service and Bighorn National Forest, prepare plans and implementation schedules for pre- and post-construction studies to determine the effects of the flow releases required by Article 1 and any unforeseen impacts on the populations of rainbow trout and brown trout in Ten Sleep Creek between one mile above the diversion point and one mile below the powerhouse. Within two months from the date of issuance of this order, Licensee shall file the study plan with the Commission for approval, with copies to the agencies consulted. The Commission reserves the right to require modifications to the study plan. Licensee shall fund and the Wyoming Game and Fish Department may conduct the studies as approved by the Commission. Licensee shall submit progress reports annually to the Commission and agencies consulted. Within 60 days after completing the studies, Licensee shall file with the Commission for approval, with copies to the agencies consulted, its recommendations for mitigation measures that are necessary to ensure maintenance and protection of the fishery resources in Ten Sleep Creek. Documentation of agency consultation on the recommendations shall be included in the filing.

Article 3. Licensee shall construct and operate stream flow gages as required by standard license Article _____ in the Ten Sleep Creek immediately above reservoir pool in a manner to allow continuous monitoring of the flows of Ten Sleep Creek. Further, Licensee shall annually make available to the Wyoming Game and Fish Department, U.S. Fish and Wildlife Service and the U.S. Forest Service the record of flows obtained from the gage.

Article 4. Licensee shall, within six months following issuance of this license, file for Commission approval functional design drawings of the fish screen, fish bypass facility, upstream fish passage facility and automatic flow bypass facility for the diversion intake of the Ten Sleep Water Power Project, prepared after consultation with and approval from the Wyoming Game and Fish Department, U.S. Fish and Wildlife Service and U.S. Forest Service. Functional design drawings shall include data on water velocities through fish bypass facility, fish screens and upstream fish passage facility, and shall represent construction plans/requirements for the project. Within two months of completion of construction, Licensee shall file as-built drawings with the Commission. Documentation of agency consultation on the designs shall be included in the filing.

Article 5. Licensee shall, within the guidelines set forth in "Raptor Protection in Powerlines - The State of the Art - 1981," Raptor Research Report #4, Raptor Research Foundation, Inc., 1981, develop a detailed design plan of project transmission line construction or reconstruction (upgrade) to protect bald eagles and other raptors. Licensee shall, within two months of the date of issuance of this license, file with the Commission the design plan, along with comments on the design from the Wyoming Game and Fish Department, U.S. Fish and Wildlife Service and the U.S. Forest Service. The Commission reserves the right to require modifications to the design of the transmission line to protect the bald eagle and other raptors.

Article 6. Licensee shall, within one year from the date of issuance of this order and after consultation with the Wyoming Game and Fish Department, Wyoming Department of Environmental Quality, Environmental Protection Agency, U.S. Fish and Wildlife Service and U.S. Forest Service, prepare a plan to (a) control erosion; (b) revegetate disturbed areas; (c) minimize introduction to Ten Sleep Creek of sediments and any potential toxic substances resulting from dredging, construction and operating project facilities; and (d) adequately dispose of spoil resulting from project construction. The plans shall include an implementation schedule, monitoring and maintenance programs for project construction and operation and evidence of agency consultations. The plan shall be filed with the Commission, Wyoming Game and Fish Department and the Environmental Protection Agency for their approval within one year from date of issuance of license, and sixty days prior to any contracting for ground-disturbing activity. The Commission reserves the right to require changes in the plan.

Article 7. Licensee shall, prior to construction, provide surety in the amount of $100,000 to be held in escrow in favor of the Wyoming Game and Fish Department. These funds shall be made readily accessible so that necessary corrective measures may be taken by the Wyoming Game and Fish Department in the event that adverse impacts occur to the stream as a result of construction for this project which were not addressed in the other articles. Upon completion of project construction and agreement with the Wyoming Game and Fish Department, any remaining surety will be released from escrow and returned to the Licensee.

Appendix C

Permit Application for Tensleep Instream Flow Segment No. 1

THE STATE OF WYOMING

MIKE SULLIVAN
GOVERNOR

Game and Fish Department

BILL MORRIS
DIRECTOR

June 29, 1987

Mr. Michael Purcell, Director
Wyoming Water Development Commission
Herschler Building
Cheyenne, Wyoming 82002

Dear Mr. Purcell:

Enclosed find the completed instream flow right application for a 7.95 mile segment of Tensleep Creek in Washakie County. A direct flow right of 22 cfs from October 1 to September 30 is requested.

For purposes of determining the availability of unappropriated water in this stream reach, you may wish to refer to a hydrology analysis conducted by Bingham Engineering, Inc. for their FERC application at this site. This report may be attached to their application for a water right in the State Engineer's Office. It may also be obtained by contacting Mr. Jeff Burt, 165 Wright Brothers Drive, Salt Lake City, Utah 84116; phone (801) 532-2520.

Please note that we do not feel that storage is necessary to provide a continuous, adequate flow between October 1 and April 30 even though flows equal to those requested in this application may not naturally be available on occasion during this period. Refer to previous letters regarding instream flow applications for the Clarks Fork and Middle Fork to assist you in determining the feasibility of this application.

If you have any questions regarding this application, please do not hesitate to contact my office.

Sincerely,

Bill Morris
Director

BM/TA/kw
Enclosures

Headquarters: 5400 Bishop Boulevard, Cheyenne, Wyoming 82002

Form S.W. 1
Rev. 10-85

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER

APPLICATION FOR PERMIT TO APPROPRIATE SURFACE WATER

THIS SECTION IS NOT TO BE FILLED IN BY APPLICANT

Filing/Priority Date

THE STATE OF WYOMING, STATE ENGINEER'S OFFICE } SS.

This instrument was received and filed for record on the 2 day of July, A.D. 19 87, at 4:00 o'clock P. M.

Frank J. Trelease
FRANK J. TRELEASE, Assistant State Engineer

Recorded in Book _____ of Ditch Permits, on Page _____.

Fee Paid $ 25.00. Map Filed E

WATER DIVISION NO. 3 DISTRICT NO. 6 Temp. Filing No. 26 5/157

PERMIT NO. _____

NAME OF FACILITY Tensleep Creek - Instream Flow Segment 1

1. Name(s), mailing address and phone no. of applicant(s) is/are Wyoming Water Development Commission, Herschler Building, Cheyenne, Wyoming, 82002, telephone 307-777-7626

(If more than one applicant, designate one to act as Agent for the others)

2. Name & address of agent to receive correspondence and notices Francis Petera, Wyoming Game & Fish, Cheyenne, Wyo., Michael Purcell, Wyo Water Development Comm., Herschler Bldg., Cheyenne

3. (a) The use to which the water is to be applied is Instream Flow

(b) If more than one beneficial use of water is applied for, the location and ownership of the point of use must be shown in item 10 of the application and the details of the facilities used to divert and convey the appropriation must be shown on the map in sufficient detail to allow the State Engineer to establish the amount of appropriation. In multiple use applications, stock and domestic purposes are limited to 0.056 cubic feet per second.

4. The source of the proposed appropriation is Tensleep Creek, tributary of Nowood River

5. The instream flow segment extends from the confluence of East and West Tensleep Creeks in ~~from the~~ Lot 23 ~~XXXX~~ of Section 6 T. 48 N., R. 86 W., ~~XXXXXX~~ downstream t the West Sec. line of Lot 4 of Section 4 T. 47 N., R. 87 W.

6. Are any of the lands crossed by the proposed facility owned by the State or Federal Government? If so, describe lands and indicate whether State or Federally owned.

All lands crossed by this instream flow segment are owned by the U. S. Dept. of Agriculture, U. S. Forest Service

7. The carrying capacity of the ditch, canal, pipeline or other facility at the point of ~~XXXXXXX~~ down stream the reach is 22 cubic feet per second. (See Remarks)

8. The accompanying map is prepared in accordance with the State Engineer's Manual of Regulations and Instructions for filing applications and is hereby declared a part of this application. The State Engineer may require the filing of detailed construction plans.

9. The estimated time required for the commencement of work is 30 days, for completion of construction is 30 days, and to complete the applicaton of water to the beneficial uses stated in this application is 30 days.

10. The land to be irrigated under this permit is described in the following tabulation. (Give irrigable acreage in each 40-acre subdivision. Designate ownership of land, Federal, State or private. If private, list names of owners and land owned separately.) If application is for stock, domestic, or for purposes other than irrigation, indicate point of use by 40-acre subdivision and owner.

			NE ¼				NW ¼				SW ¼				SE ¼				
Township	Range	Sec.	NE ¼	NW ¼	SW ¼	SE ¼	NE ¼	NW ¼	SW ¼	SE ¼	NE ¼	NW ¼	SW ¼	SE ¼	NE ¼	NW ¼	SW ¼	SE ¼	TOTALS
48	86	6											Lot 23						
48	86	7						Lot 6	Lot 7&8			Lot 9	Lot 12						
48	86	18						Lot 5	Lot 8			Lot 9&10	Lot 11						
48	87	13																Lot 8	
48	87	24	Lot 1	X	X					X	X	X	X						
48	87	23																X	
48	87	26	X	X	X					X	X	X	X						
48	87	27																X	
48	87	34	X	X			X		X	X		X							
48	87	33											Lot 2	Lot 3	X		Lot 4	Lot 5	
47	87	4						X											

Number of acres to receive original supply _____

Number of acres to receive supplemental supply _____

Total number of acres to be irrigated _____

MONTHLY INSTREAM FLOW REQUESTED

MONTH	Flow (cfs)
October	22
November	22
December	22
January	22
February	22
March	22
April	22
May	22
June	22
July	22
August	22
September	22

REMARKS

Based on the results of a study conducted by the Game and Fish Department (attached) a flow of 22 cfs is requested from October 1 to September 30 to maintain or improve the fishery in the identified stream segment. The intent of this filing is to insure that the specified flow reaches the most downstream point of the instream flow segment. Flows at the upstream end of the segment may naturally be less than the specified flow on occassion. At those times the existing flows in their entirety, plus natural stream gains throughout the segment, are needed to maintain the fishery as provided by W. S. 41-3-1001.

Length of stream segment = 7.95 stream miles

Intervening ditches = None

Location of instream flow control gage. A control gage will be installed on U.S.F.S. property in Section 7, T 48 N., R 86 W. by Bingham Engineering, Inc. in conjunction with construction of a hydroelectric facility. If this project should for any reason not be built, and if a control gage is needed, one will be installed on U.S.F.S. property within 1/2 mile of the downstream point of the instream flow segment.

Under penalties of perjury, I declare that I have examined this application and to the best of my knowledge and belief it is true, correct and complete.

Signature of Applicant or Agent

7/2/87
Date

THE STATE OF WYOMING,
STATE ENGINEER'S OFFICE } SS.

THIS IS TO CERTIFY that I have examined the foregoing application and do hereby grant the same subject to the following limitations and conditions:

This permit grants only the right to use the water available in the stream after all prior rights are satisfied.

The time for commencement of construction work shall terminate on _____.

The time for completing the work shall terminate on December 31, 19_____.

The time for completing the application of water to beneficial use shall terminate on December 31, 19_____, and final proof of appropriation shall be made within 5 years thereafter.

Witness my hand this _____ day of _____, A.D. 19_____.

_____
State Engineer

Permit No. _____ C-4 Page No. _____ (Leave Blank)

PERMIT NO. _____

PERMIT STATUS

Priority Date _____ Approval Date _____

NOTICE

A Manual of Regulations and Instructions for filing applications will be furnished by the State Engineer's Office upon request. By carefully complying with the instructions contained in the Manual, much trouble and delay will be saved by the applicant, the professional engineer or land surveyor, and the State Engineer's Office.

This application must be accompanied by maps in duplicate, prepared in accordance with the Manual and by a filing fee of ten dollars ($10.00) for stock and/or household domestic use and twenty-five dollars ($25.00) for all other uses including temporary and miscellaneous.

Applications returned for corrections must be resubmitted to the State Engineer within 90 days with the corrections properly made; otherwise the filing will be cancelled.

This application, when approved, does not constitute a complete water right. It is your authority to begin construction work, which must be commenced within the time allowed in the permit.

All appropriations for irrigation are limited to 1 cubic foot per second of time for each 70 acres of land irrigated, except as provided in Section 41-4-320, Wyo. Statutes, 1977. Appropriations for other uses are limited to the amount of water beneficially used in accordance with the terms of this permit.

Notice of commencement of work, completion of the work, and of application of the water to the beneficial uses described in the permit, must be filed in the State Engineer's Office before the expiration of the time allowed in the permit.

If extensions of time beyond the time limits set forth in the permit are required, requests for same must be in writing, stating why the additional time is required, and must be received in the State Engineer's Office before the expiration of the time allowed in the permit.

To perfect your water right, your Water Division Superintendent, or his authorized representative, will contact you after you have submitted notice to the State Engineer stating you have applied the water to the beneficial uses described in your permit. After execution of the proof, it will be considered by the State Board of Control, and, if found to be satisfactory, the Board will issue to you a Certificate of Appropriation which will constitute a completed water right.

The granting of a permit does not constitute the granting of a right-of-way. If any right-of-way is necessary in connection with the application it should be understood that this responsibility is the applicant's.