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REPORT ON THE FEASIBILITY OF PROVIDING INSTREAM FLOW IN THE LA BARGE CREEK INSTREAM FLOW SEGMENT NO. 1 TEMPORARY FILING NO. 27 3/146

August, 1993

Prepared For:

Wyoming Water Development Commission
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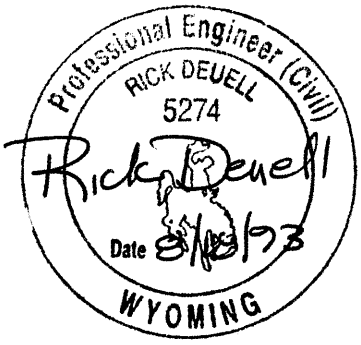

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REPORT ON THE FEASIBILITY OF PROVIDING INSTREAM FLOW IN LA BARGE CREEK INSTREAM FLOW SEGMENT NO. 1 TEMPORARY FILING NO. 27 3/146

Wyoming Water Development Commission
October, 1992

I. SUMMARY

The Wyoming Water Development Commission (WWDC) is required by W.S. 41-3-1004 (a) to determine the feasibility of providing various amounts of unappropriated direct flow of water for instream uses within stream segments requested by the Wyoming Game and Fish Department (WGFD). For La Barge Creek, WWDC contracted with Western Water Consultants, Inc. (WWC) of Laramie, Wyoming to prepare the technical study. WGFD has requested a direct flow water right for purposes of providing instream flow for fisheries in a segment of La Barge Creek. The amount of the flow requested is 17 cubic feet per second (cfs) for one period of the year: October 1 through March 31; and 25 cfs for each of two periods of the year: April 1 through June 30, and July 1 through September 30. The segment is called the La Barge Creek Instream Flow Segment Number 1 and is defined by an upstream point located at the confluence of La Barge Creek and Turkey Creek in Section 24, Township 28 North, Range 116 West and a downstream point located at the U.S. Forest Service boundary in Section 1, Township 27 North, Range 116 West, all in Lincoln County, Wyoming. The segment has a stream length of 3.3 miles and its location is shown on Figure 1.

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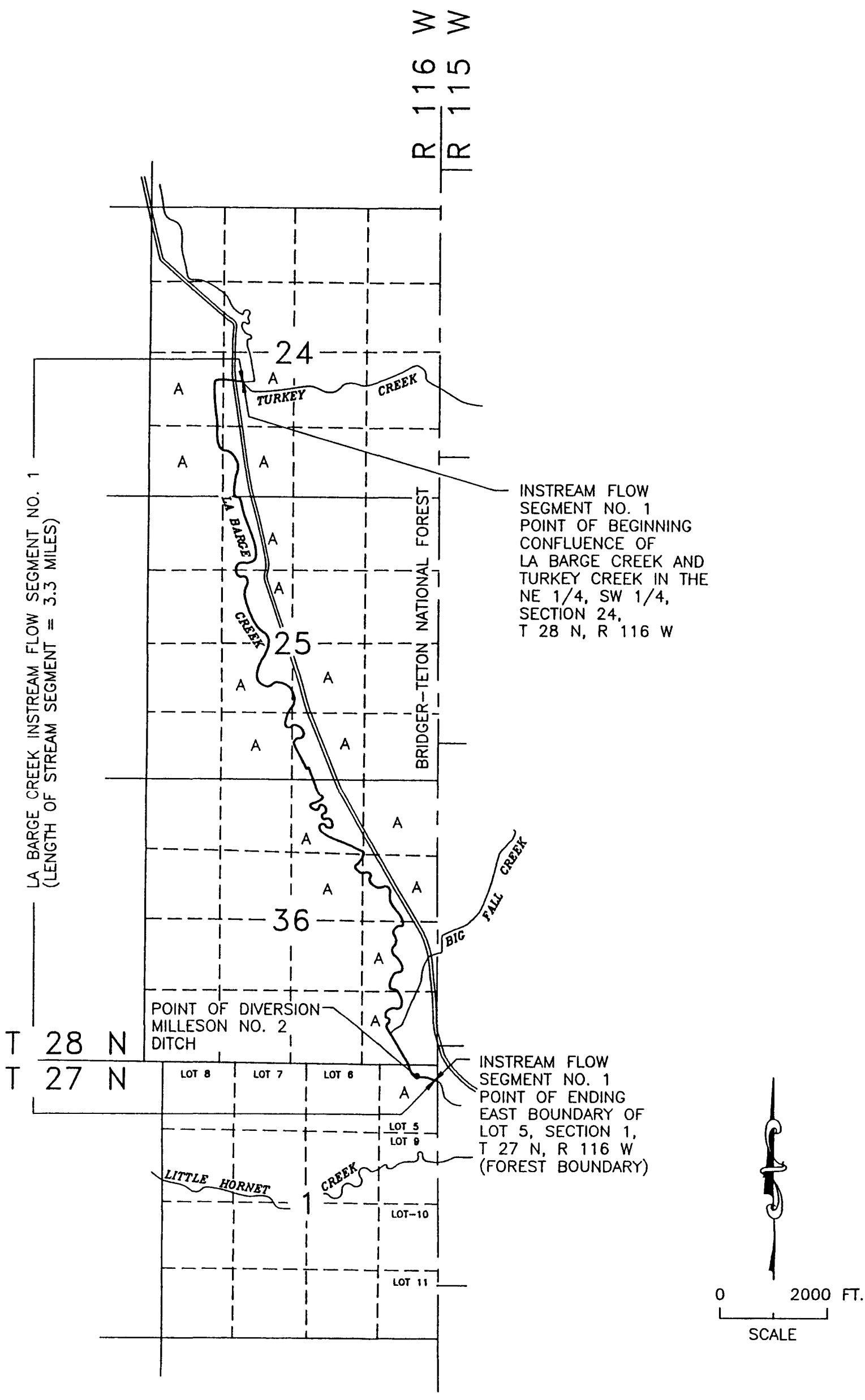

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FIGURE 1

LA BARGE CREEK
INSTREAM FLOW SEGMENT NO. 1

Western Water Consultants, Inc.

Mean monthly flow, dry year flow, and daily flow exceedence analyses were conducted without consideration of adjudicated and unadjudicated diversion rights because the amounts are insignificant to the analysis. The mean monthly flow analysis shows that on the average for La Barge Creek at the lower end of the proposed Instream Flow Segment No. 1, the requested flow of 17 cfs for the period of October 1 through March 31 is available for all the months except December when the average flow is 15.3 cfs, and the flow of 25 cfs requested for the periods of April 1 through June 30 and July 1 through September 30 is available. Daily flow exceedance analysis indicates that the requested flow of 17 cfs for the period of October 1 through March 31 is available 50% of the time, the requested flow of 25 cfs for the period of April 1 through June 30 is available 96% of the time, and the requested flow of 25 cfs for the period of July 1 through September 30 is available 98% of the time.

II. WATER RIGHTS

II. WATER RIGHTS

Water rights upstream of the downstream end of the instream flow section are presented in Table 1. There is only one adjudicated diversion right appropriated for the La Barge G.S. Pipeline (Permit No. 21216) for 0.02 cfs for domestic purposes. Due to its amount it was no considered in the analysis for the instream flow segment.

There are three unadjudicated rights, two of which have expired due to noncompletion of the facility and one right for the La Barge Scaler Cabin Pipeline (Permit No. 20807) for 0.016 cfs for domestic purposes. The diversions requested under these permits are all small and were not considered in the analysis for the instream flow segment.

TABLE 1

LISTING OF WATER RIGHTS ON LA BARGE CREEK

Upstream of the Downstream End of
Instream Flow Segment No. 1

Permit Number	Proof Number	Facility	Source	Priority Date Mo	Day	Year	Amount (cfs)	Acres	Use*	Status	Diversion Location Sec.	Twn.	Rng.	**
DIRECT FLOW														
14246		Milleson No. 1	Big Fall Creek	7	20	1916	0.08	5.9	1	Exp.	1	27	116	IN
14247		Milleson No. 2	La Barge Creek	7	17	1916	0.77	53.9	1	Exp.	1	27	116	IN
20807	---	LaBarge Scaler Cabin Pipeline	Scaler Cabin Spring	7	5	1951	0.016	---	2	Unadj.	10	28	116	A
21216	25245	LaBarge G.S. Pipeline	LaBarge G.S. Spring	6	5	1953	0.02	---	2	Adj.	7	29	116	IN

NOTE: * Use Description
1=Irrigation, based on 1 cfs/70 acres
2=Domestic
3=Stock
4=Industrial

** A-Indicates diversion is above upper end of proposed Instream Flow Segment

IN-Indicates diversion is within proposed Instream Flow Segment

III. STREAMFLOW RECORDS

III. STREAMFLOW RECORDS

Gaging stations on La Barge Creek and on similar drainage basins in the Wyoming Range are shown on Figure 2. Gaging stations considered for the analysis of flows on La Barge Creek are listed below.

1. La Barge Creek near La Barge, Wyoming; Station Number 092090.00; 1932-1939.

2. La Barge Creek near Viola, Wyoming; Station Number 092085.00; 1913-1917, 1941-1949.

3. La Barge Creek above Viola, Wyoming; Station Number 092084.00; 1983-1984, 1985-1991 irrigation season by SEO.

4. La Barge Creek near La Barge Meadows, Wyoming; Station Number 092080.00; 1941-1942, 1951-1981.

5a. North Horse Creek at Sherman Ranger Station, Wyoming; Station Number 091895.00; 1956-1974.

5b. North Horse Creek above Sherman Ranger Station, Wyoming; Station Number 091894.95; 1983-1984, 1985-1991 irrigation season by SEO.

The records for the two stations, 091894.95 and 091895.00, on North Horse Creek were combined into a single record due to the closeness of the gage sites. The drainage areas are 42.80 and 43.00 square miles, so any differences in flow rates are insignificant.

The mean monthly flow records for the gages utilized in the hydrologic analysis are included in this report. Flow records for 1983-1991 for LaBarge Creek above Viola and North Horse Creek are presented in Table 2. Table 3 presents the mean monthly flow record for North Horse Creek for the years 1955-1984 (the period for which records are available for the entire year) with statistical information shown at the bottom.

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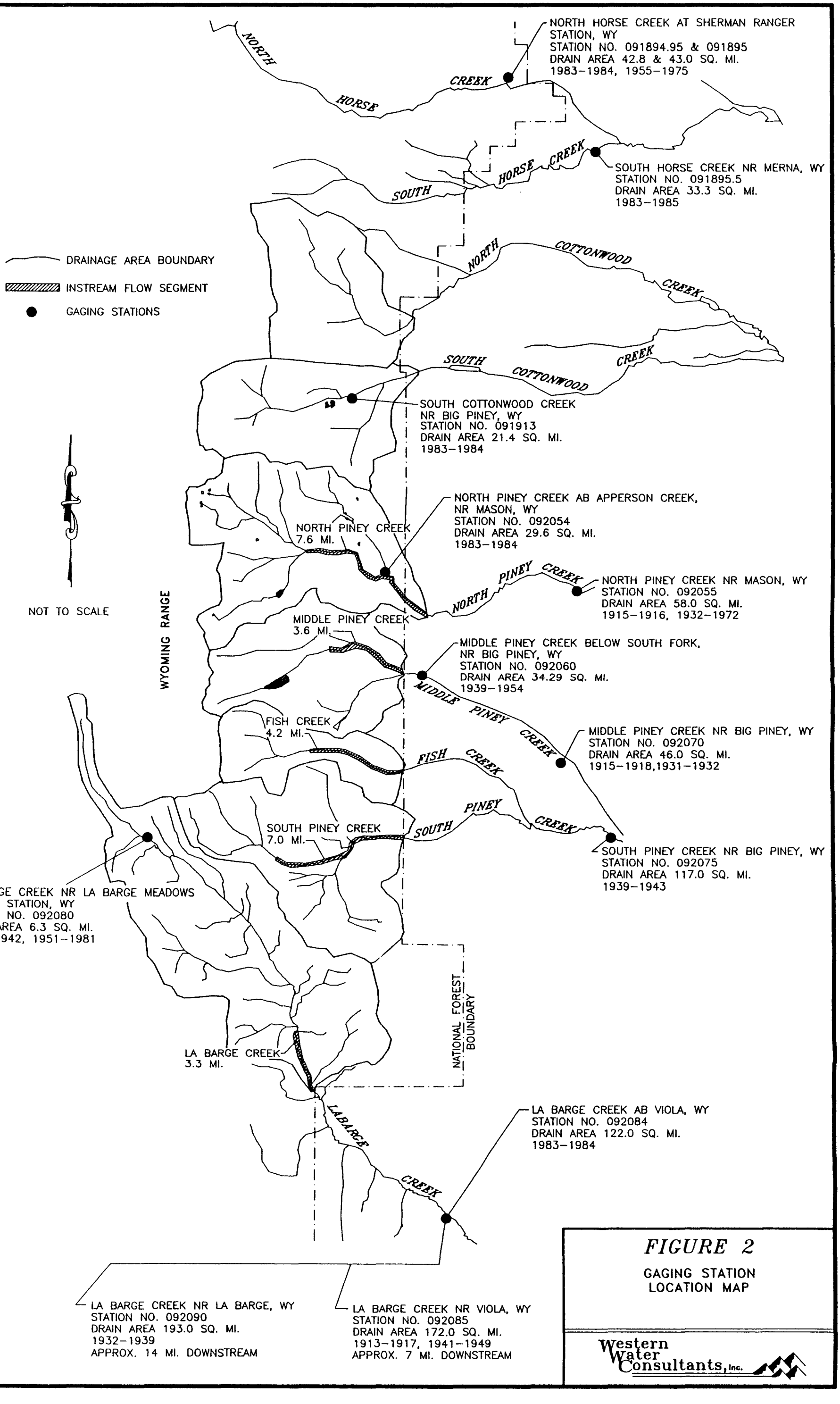


FIGURE 2

GAGING STATION
LOCATION MAP

Western Water Consultants, Inc.

TABLE 2

MEAN MONTHLY STREAMFLOW DATA FOR GAGING STATIONS NEAR LA BARGE CREEK

Units are cfs except for annual flow which is in acre-feet

North Horse Creek at Sherman Ranger Station, WY
Station No. 091894.95, Drainage Area = 42.85 sq mi

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Annual (AF)
1983	26.6	17.0	9.0	8.7	7.6	9.0	14.2	169.0	469.0	109.0	21.5	9.9	52469
1984	14.0	16.3	10.1	9.0	7.3	6.3	14.2	195.0	423.0	115.0	23.2	14.3	51152
1985									173.0	27.9	7.9	7.9	
1986								233.0	747.0	100.0	11.0	8.9	
1987								312.0	67.5	21.0	11.5	8.0	
1988								320.0	171.0	16.4	3.1	2.6	
1989								288.0	349.0	42.8	7.3	4.1	
1990								143.0	254.0	25.3	5.2	4.6	
1991								191.4	379.9	36.8	9.4	5.6	
Mean	20.3	16.6	9.5	8.9	7.4	7.7	14.2	231.4	337.0	54.9	11.1	7.3	

La Barge Creek above Viola, WY
Station No. 092084, Drainage Area = 121.6 sq mi

	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Annual (AF)
1983	69.2	46.8	40.2	43.9	41.8	44.8	54.5	259.0	540.0	226.0	104.0	79.6	93616
1984	69.9	60.3	44.8	41.0	34.3	39.3	68.4	426.0	399.0	164.0	89.7	73.5	91463
1985								303.0		81.3	48.4	53.0	
1986							196.0					92.0	
1987							167.0	228.0	122.0	80.4	59.4	49.5	
1988								251.3	164.5	69.1	47.2	43.0	
1989	47.0	47.0							162.0	89.0	51.0		
1990							156.6	176.9	200.1	98.2	56.2	50.6	
1991								146.8	243.8	92.3	56.1	50.5	
Mean	62.0	51.4	42.5	42.5	38.1	42.1	128.5	255.9	261.6	112.5	64.0	61.5	

TABLE 3

NORTH HORSE CREEK AT SHERMAN RANGER STATION
Station No. 091894.95 and 091895.00, USGS Data
Average Monthly Flow (cfs)

YEAR	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	TOTAL(AF
1955	4.75	3.46	3.50	3.50	3.50	6.00	16.00	226.97	241.27	34.48	8.83	4.20	33669
1956	5.07	5.05	4.50	4.00	5.00	6.00	77.55	491.42	539.50	46.77	7.58	4.77	72351
1957	4.83	4.81	4.50	4.00	3.80	3.93	16.13	205.10	490.20	89.06	3.49	6.85	50397
1958	4.59	3.10	2.50	2.50	3.00	4.00	8.00	369.65	227.53	22.94	7.72	3.93	40049
1959	3.13	6.07	4.48	3.00	3.46	5.81	25.00	108.13	457.60	35.23	9.03	7.41	40090
1960	12.43	4.58	4.25	4.01	3.50	5.53	25.71	181.97	233.57	24.28	6.39	4.36	30849
1961	6.96	6.11	4.69	4.00	4.30	5.23	18.33	264.77	141.30	12.46	7.45	17.45	29928
1962	14.19	15.00	8.00	8.65	8.07	7.00	45.67	345.87	381.73	51.58	10.90	5.85	54556
1963	6.83	4.54	4.21	4.74	4.93	5.52	10.95	258.29	306.27	38.13	8.49	12.21	40204
1964	5.16	3.31	3.11	2.83	2.86	3.97	5.97	196.25	436.87	85.35	12.47	5.68	46058
1965	4.17	4.97	4.57	4.82	5.49	4.06	14.69	200.74	579.53	163.97	25.68	15.16	61949
1966	9.36	6.37	7.02	6.63	5.79	12.00	44.73	368.55	171.37	24.24	5.81	7.28	40655
1967	4.16	4.93	4.71	4.32	3.11	2.84	6.80	174.23	561.03	125.32	14.61	7.83	55023
1968	7.67	7.00	7.53	8.14	8.17	7.50	6.29	143.00	420.87	54.81	20.19	10.24	42214
1969	9.06	7.61	6.13	5.35	4.68	4.82	37.61	421.32	178.53	35.74	9.10	5.70	44135
1970	7.75	7.32	5.64	2.71	4.19	5.71	9.95	242.87	519.57	67.48	11.09	9.64	53857
1971	7.17	7.51	4.55	5.15	5.95	6.60	13.44	354.35	809.47	159.39	24.84	9.53	84870
1972	13.04	8.63	6.13	6.19	6.20	6.75	22.81	317.32	770.70	125.39	20.26	13.11	79309
1973	15.39	10.04	8.38	5.80	4.38	4.55	7.33	292.35	288.10	34.16	10.41	11.29	41907
1974	7.90	7.84	5.96	4.61	4.80	4.95	30.30	321.71	650.80	75.97	13.20	6.48	68351
1983	26.55	17.03	9.00	8.67	7.56	8.95	14.23	169.23	469.30	108.74	21.46	9.88	52475
1984	14.05	16.30	10.08	8.98	7.41	6.28	14.21	195.06	422.53	114.55	23.23	14.27	51119
#RECORDS	22	22	22	22	22	22	22	22	22	22	22	22	22
MEAN	8.83	7.34	5.61	5.12	5.01	5.82	21.44	265.87	422.62	69.55	12.83	8.78	50637
STD DEV	5.27	3.90	1.94	1.96	1.61	1.91	16.84	95.75	183.37	44.64	6.54	3.75	14626
MIN	3.13	3.10	2.50	2.50	2.86	2.84	5.97	108.13	141.30	12.46	3.49	3.93	29928
MAX	26.55	17.03	10.08	8.98	8.17	12.00	77.55	491.42	809.47	163.97	25.68	17.45	84870

IV. HYDROLOGY

IV. HYDROLOGY

A hydrologic analysis was conducted to estimate the flows at the downstream end of the proposed instream flow segment. The most reliable information to utilize is actual streamflow records for the stream being studied. For La Barge Creek this includes data collected at four gaging stations. For this analysis the first step was to examine the gaging station records.

The four gaging stations on La Barge Creek are:

TABLE 4
GAGING STATIONS ON LA BARGE CREEK

Station Number	Station Name	Drainage Area (Sq. Miles)	Period of Record
092090.00	La Barge Creek near La Barge	193.00	1932-1939
092085.00	La Barge Creek near Viola	172.00	1913-1917 1941-1949
092084.00	La Barge Creek above Viola	122.00	1983-1991
092080.00	La Barge Creek Nr. La Barge Meadows	6.30	1941-1942 1951-1981

Instream Flow Segment No. 1 on La Barge Creek is between Stations 092084.00 and 092080.00. Since the gaging stations below Viola (092090.00 and 092085.00) are not as close to the instream flow segment, do not have long periods of record, and are influenced by diversions for irrigation, they were eliminated from consideration. Station 092080.00 has a long period of record and is above any diversion, however, it has a very small drainage area (6.30 Sq. Mi.) compared to the instream flow segment (64.0 Sq. Mi.) and its period of record does not overlap other gaging stations. These problems make the records of limited value in

determining flows at the instream flow segment. This leaves station 092084.00 as the best predictor for flows at the instream flow segment.

Station 092084.00 is approximately 9 miles downstream from the instream flow segment. It is believed to be a good predictor of flows at the instream flow segment because there are no tributaries between the instream flow segment and the gaging station which contribute significantly to base flow. The difficulty with this gaging station is that the period of record is limited, especially for the winter months. Therefore, each month is treated differently depending on the amount of data available for that month.

For the months of May through September the records are reasonably complete from 1983 through 1991. This gives nine years of data which, if adjusted for the difference in drainage area and to long term trends, should yield a good predictor for flows at the downstream end of the instream flow segment. For the other months only 1983 and 1984 records are available. This short record period is much less reliable.

For the area adjustment, the Handbook of Applied Hydrology, Chow (1964), states the basin discharge can be related to some exponential of the drainage area. Typically the exponent ranges from 0.5 to 1.0. Cudworth (1989) states that an exponent of 0.5 should be utilized for short durations (less than 60 days). For La Barge Creek, an exponent of 0.5 was felt, to be appropriate for monthly analysis based on this information and the experience of the investigation. There are many large springs in the upper end of the basin which contribute to streamflow substantially more than the drainage area in the lower portions of the basin. Therefore the area adjustment for the gaging station to the instream flow segment yields:

$$\text{Adjustment Factor} = \frac{(64 \text{ Sq. Mi.})^{0.5}}{(122 \text{ Sq. Mi.})^{0.5}} = 0.72$$

The flow at the downstream end of the instream flow segment is typically 72% of the flow at the gaging station.

In order to determine how the flows during 1983-1991 compare with the long term average, that period was compared with a long-term average by two methods. First the only long term record for a Wyoming Range stream which overlaps this period is for the North Horse Creek station, so the La Barge Creek flows are compared to the recorded flows at that station. Second, the flow contribution from the Wyoming Range was calculated by subtracting the flow in the Green River at Warren Bridge (Station 091885.00) and the flow in the New Fork River near Big Piney (Station 092050.00) from the flow in the Green River near La Barge (Station 092094.00). This is represented as:

Wyoming Range Flow = Sta. 092094.00 - Sta. 092050.00 - Sta. 091885.00

These two methods yield the following adjustments:

TABLE 5
RATIO OF 1983-1991 FLOWS TO LONG TERM TRENDS

Month	N. Horse Ck.	Green River
Oct.*	2.3	2.2
Nov.*	1.8	1.9
Dec.*	2.4	2.0
Jan.*	2.5	1.2
Feb.*	2.0	1.3
Mar.*	1.7	1.2
Apr.*	0.42	1.3
May	0.88(0.79*)	1.9(0.87*)
Jun.	0.85	1.0
Jul.	0.88	1.0
Aug.	0.96	1.2
Sep.	0.90	1.1

* The 1983-1991 period only includes 1983 and 1984 for these data.

For adjustment of flow records to long term values, the Green River adjustment factors are believed to be more appropriate for the months of October through April. The period of record is longer and is less susceptible to abnormalities that may occur for one drainage. However, for the summer months there are irrigation withdrawals and return flow delays which make the Green River adjustment suspect. Therefore the North Horse Creek adjustment is utilized for the months of May through September.

The average monthly flows calculated from the gaging records adjusted for drainage area and period of record are:

TABLE 6

ADJUSTMENT OF GAGING STATION RECORDS

Month	Gage 092084.00 Average (cfs)	Area Adjustment	Long Term Adjustment	Estimated Flow at Instream Flow segment (cfs)
Oct.	69.6	0.72	1/2.2	22.8
Nov.	53.6	0.72	1/1.9	20.3
Dec.	42.5	0.72	1/2.0	15.3
Jan.	42.5	0.72	1/1.2	25.5
Feb.	38.1	0.72	1/1.3	21.1
Mar.	42.1	0.72	1/1.2	23.3
Apr.	128.5	0.72	1/1.3	71.2
May	255.9	0.72	1/0.88	209.4
Jun.	261.6	0.72	1/0.85	221.6
Jul.	112.5	0.72	1/0.88	92.0
Aug.	64.0	0.72	1/0.96	48.0
Sep.	61.5	0.72	1/0.90	49.2

Using these estimated average monthly flows, a long term record was generated using the long term record at North Horse Creek. Individual monthly flows were generated for La Barge Creek by adjusting the North Horse Creek monthly flows by the ratio of the LaBarge Creek long

term average flow to the North Horse Creek average flow. As can be seen, the predicted flow drops dramatically from October to September. This is the result of using two different methods for different periods of the year. Since there is considerably more data for September this is a much more reliable prediction. October average flows are most likely higher than presented by this analysis so the analysis is considered conservative (under predict average flow).

V. MEAN MONTHLY FLOW ANALYSIS

V. MEAN MONTHLY FLOW ANALYSIS

The mean monthly generated flows for the downstream end of the instream flow segment are presented in Table 7. At the bottom of the table, 22-year mean flows are shown along with the standard deviation, minimum and maximum flows. Figure 3 graphically compares the natural and available mean monthly flows to the requested flows.

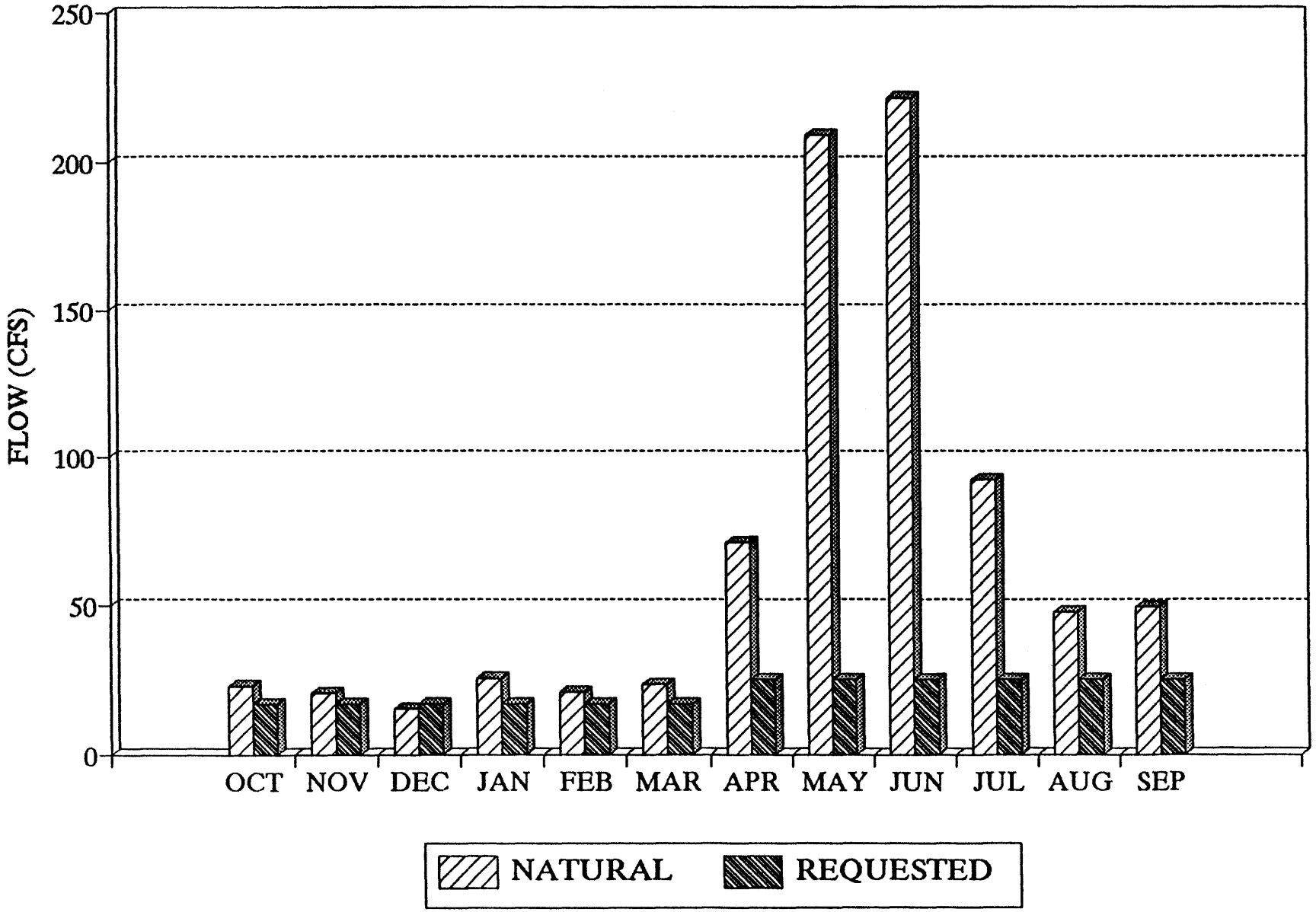
For the period of October 1 through March 31, the requested flow of 17 cfs is available, on average, for all months except December when the average flow is 15.3 cfs. The requested flow of 25 cfs for the periods of April 1 through June 30 and July 1 through September 30 is always available on average.

TABLE 7

LA BARGE CREEK AT INSTREAM FLOW SEGMENT
Generated Flows at Downstream End
Average Monthly Flows (cfs)

YEAR	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	TOTAL(AF)
1955	12.27	9.58	9.55	17.44	14.74	24.02	53.13	178.76	126.51	45.61	33.04	23.54	16737
1956	13.09	13.99	12.27	19.93	21.06	24.02	257.54	387.04	282.89	61.87	28.36	26.73	34968
1957	12.47	13.32	12.27	19.93	16.00	15.73	53.57	161.54	257.04	117.81	13.06	38.38	22254
1958	11.85	8.59	6.82	12.46	12.63	16.01	26.57	291.14	119.30	30.34	28.88	22.02	17971
1959	8.08	16.81	12.22	14.95	14.57	23.26	83.02	85.16	239.94	46.60	33.78	41.52	18793
1960	32.10	12.69	11.59	19.98	14.74	22.14	85.38	143.32	122.47	32.12	23.91	24.43	16601
1961	17.97	16.92	12.79	19.93	18.11	20.94	60.87	208.53	74.09	16.48	27.87	97.78	18277
1962	36.64	41.55	21.82	43.10	33.99	28.02	151.67	272.41	200.16	68.23	40.78	32.78	29393
1963	17.64	12.58	11.48	23.62	20.76	22.10	36.36	203.43	160.59	50.44	31.76	68.42	19902
1964	13.32	9.17	8.48	14.10	12.05	15.89	19.83	154.57	229.07	112.90	46.65	31.83	20389
1965	10.77	13.77	12.46	24.01	23.12	16.25	48.78	158.10	303.88	216.90	96.07	84.95	31746
1966	24.17	17.64	19.15	33.03	24.39	48.04	148.54	290.27	89.86	32.06	21.74	40.79	22973
1967	10.74	13.66	12.85	21.52	13.10	11.37	22.58	137.22	294.17	165.77	54.66	43.88	25012
1968	19.80	19.39	20.54	40.56	34.41	30.03	20.89	112.63	220.68	72.50	75.54	57.38	21700
1969	23.39	21.08	16.72	26.65	19.71	19.30	124.90	331.83	93.61	47.28	34.05	31.94	24284
1970	20.01	20.28	15.38	13.50	17.65	22.86	33.04	191.28	272.44	89.26	41.49	54.02	24205
1971	18.51	20.80	12.41	25.66	25.06	26.42	44.63	279.09	424.44	210.84	92.93	53.40	37660
1972	33.67	23.91	16.72	30.84	26.11	27.02	75.75	249.92	404.12	165.86	75.80	73.46	36370
1973	39.74	27.81	22.85	28.90	18.45	18.22	24.34	230.25	151.06	45.19	38.95	63.27	21708
1974	20.40	21.72	16.25	22.97	20.22	19.82	100.62	253.38	341.25	100.49	49.38	36.31	31023
1983	68.55	47.17	24.55	43.20	31.84	35.83	47.26	133.29	246.08	143.84	80.29	55.36	28852
1984	36.28	45.15	27.49	44.74	31.21	25.14	47.19	153.63	221.55	151.53	86.91	79.96	28987
#RECORDS	22	22	22	22	22	22	22	22	22	22	22	22	22
MEAN	22.8	20.3	15.3	25.5	21.1	23.3	71.2	209.4	221.6	92.0	48.0	49.2	24991
STD DEV	13.62	10.80	5.30	9.75	6.79	7.64	55.91	75.41	96.15	59.05	24.47	21.01	6305
MIN	8.08	8.59	6.82	12.46	12.05	11.37	19.83	85.16	74.09	16.48	13.06	22.02	16601
MAX	68.55	47.17	27.49	44.74	34.41	48.04	257.54	387.04	424.44	216.90	96.07	97.78	37660
REQUESTED	17	17	17	17	17	17	25	25	25	25	25	25	

FIGURE 3: LA BARGE CREEK
AVERAGE MONTHLY AND REQUESTED FLOWS



VI. DRY YEAR FLOW ANALYSIS

VI. DRY YEAR FLOW ANALYSIS

The ranking, in ascending order, of the estimated flows for the proposed instream flow segment are presented in Table 8. The table presents the flows ranked by yearly flow in acre-feet and ranked by flow during each instream flow period. Requested flows are compared to those available in the driest year on record determined by total annual flow.

To provide additional insight to low flows, the requested flows are compared to those available during the average of the lowest three years by instream flow period. This second procedure was utilized because the lowest flow period on record does not necessarily correspond to the lowest year by total annual flow. Yearly flow volumes are dominated by the peak runoff months of May and June, therefore the driest years by annual volume are the ones with the lowest flows during these months. Comparison of annual flow volumes does not necessarily give an indication of what occurs during the summer or winter months which are important when considering fisheries. Examination of flows by periods gives a better indication of what can be expected as low flows during those periods. Because examination of short periods is more vulnerable to spurious data an average of the three lowest years is utilized.

Using annual total flow, the driest year on record for the generated flows is 1960. A summary of data for that year is presented in Table 9.

TABLE 8

RANKING OF FLOWS IN ASCENDING ORDER
La Barge Creek at Downstream
End of Instream Flow Segment
Annual and Period Flow in Acre-Feet

COMPLETE YEAR		OCT 1 - MAR 31		APR 1 - JUN 30		JUL 1 - SEP 30	
Year	Acre-Feet	Year	Acre-Feet	Year	Acre-Feet	Year	Acre-Feet
1960	16601	1958	2073	1961	10513	1960	2470
1955	16737	1964	2218	1960	10678	1958	2497
1958	17971	1967	2527	1968	10739	1966	2892
1961	18277	1955	2662	1955	10931	1955	3144
1959	18793	1957	2720	1963	12215	1969	3479
1963	19902	1959	2726	1964	12258	1956	3599
1964	20389	1965	3029	1959	12329	1959	3738
1968	21700	1956	3158	1973	12400	1961	4308
1973	21708	1961	3235	1984	12825	1962	4363
1957	22254	1963	3278	1983	12932	1973	4506
1966	22973	1970	3327	1958	13401	1963	4601
1970	24205	1960	3453	1967	13757	1957	5208
1969	24284	1974	3680	1957	14326	1970	5674
1967	25012	1969	3852	1970	15094	1974	5736
1983	28852	1971	3899	1965	15481	1964	5901
1984	28987	1973	4752	1966	16150	1968	6311
1962	29393	1972	4804	1969	16842	1967	8150
1974	31023	1968	4984	1962	18999	1983	8609
1965	31746	1966	5068	1974	21111	1972	9695
1956	34968	1962	6215	1972	22143	1984	9790
1972	36370	1984	6372	1971	22724	1971	11019
1971	37660	1983	7643	1956	28211	1965	12251

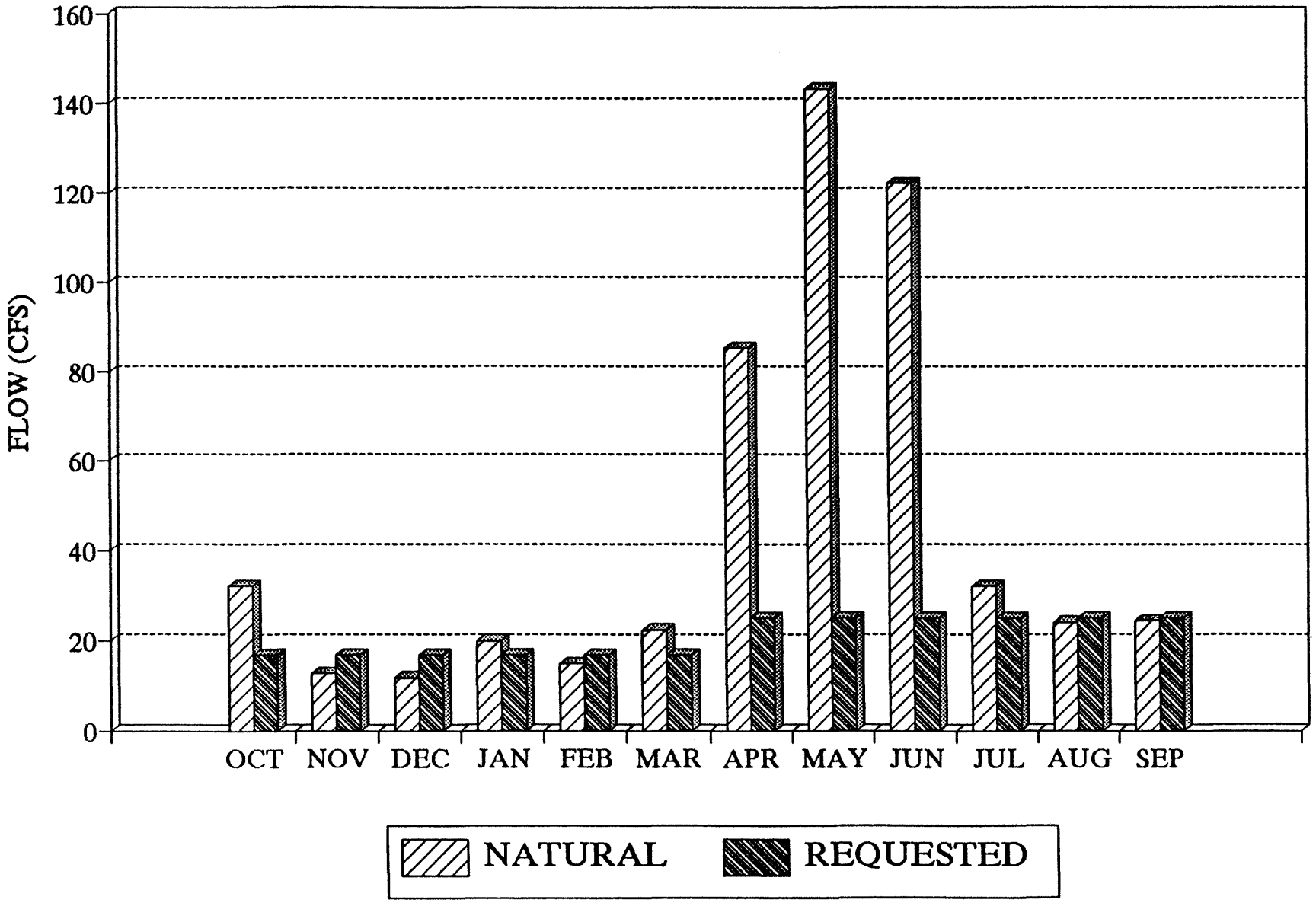
TABLE 9
COMPARISON OF MONTHLY FLOW DURING DRIEST YEAR ON RECORD (1960) AND REQUESTED LABARGE CREEK AT DOWNSTREAM END OF INSTREAM FLOW SEGMENT

Month	Mean Monthly Flow (1960) (cfs)	Requested Flow (cfs)	Shortfall (cfs)	Shortfall (AF)
October	32.1	17	—	—
November	12.7	17	4.3	256
December	11.6	17	5.4	332
January	20.0	17	—	—
February	14.7	17	2.3	128
March	22.1	17	—	—
April	85.4	25	—	—
May	143.3	25	—	—
June	122.5	25	—	—
July	32.1	25	—	—
August	24.0	25	1.0	61
September	24.4	25	0.6	36
			TOTAL	813
		Total July 1 - Sept. 30		97

Shortages occur during the late summer, fall, and winter months. A bar graph comparing the 1960 monthly flows to the requested flows is presented in Figure 4.

Using the three lowest flow years by instream flow period, results in different years being utilized. This procedure also removes the aberration of the high flow in September during the driest year. By period, the three driest years are:

FIGURE 4: LA BARGE CREEK
DRIEST YEAR(1960)AND REQUESTED FLOWS



October 1 - March 31	1958, 1964, 1967
April 1 - June 30	1961, 1960, 1968
July 1 - September 30	1960, 1958, 1966

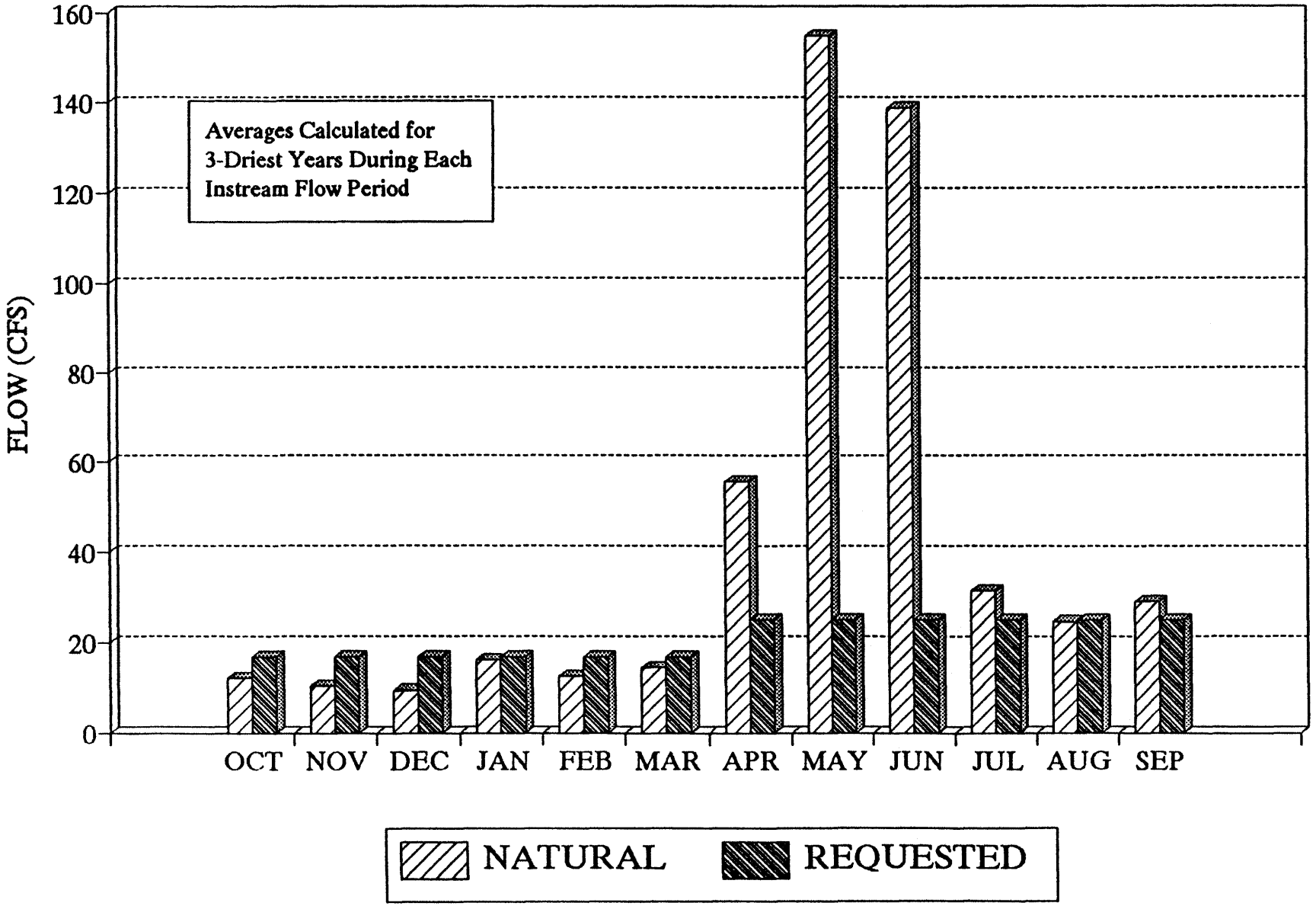
Averages of the monthly flows for the three driest years by period are presented in Table 10.

TABLE 10
COMPARISON OF REQUESTED FLOWS AND AVERAGE OF 3 DRIEST YEARS BY PERIOD - LABARGE CREEK - DOWNSTREAM END OF INSTREAM FLOW SEGMENT

Month	3-Year Natural Mean Monthly Flow (cfs)	Requested Flow (cfs)	Average Shortfall (cfs)	Avg. Volume Shortfall (AF)
October	12	17	5	307
November	10.5	17	6.5	387
December	9.4	17	7.6	467
January	16	17	1	61
February	12.6	17	4.4	244
March	14.4	17	2.6	160
April	55.7	25	—	—
May	154.83	25	—	—
June	139.1	25	—	—
July	31.5	25	—	—
August	24.8	25	0.2	12
September	29.1	25	—	—
			TOTAL	1638
		Total July 1 - Sept. 30		12

The months of October through March depict a deficit in meeting the requested flow while for the remaining months the requested flow is met except for the month of August which has a deficit of 0.2 cfs or 12 acre-feet. Figure 5 is a bar graph relating the average of the three lowest years by period to the requested flow.

FIGURE 5: LA BARGE CREEK
3-DRIEST YEAR AVG. AND REQUESTED FLOWS



VII. DAILY FLOW EXCEEDANCE ANALYSIS

VII. DAILY FLOW EXCEEDENCE ANALYSIS

The WGFD considers that an instream flow request is "feasible" if, during the late summer period (July 1- September 30) the requested flow is available 50% of the time. Therefore a daily flow duration analysis was conducted. The daily flow duration analysis included all three instream flow periods. There are only short-term flow records for La Barge Creek. To be meaningful, a daily flow duration curve should be constructed using long-term records. Searcy (1955) presents a method for constructing long-term daily flow duration curves from short-term records if there is an index stream with overlapping records. North Horse Creek meets these criteria and was utilized as the index stream.

To perform this analysis, daily flow duration tables were obtained from the Wyoming Water Resources Center for North Horse Creek for its entire record and were constructed using daily flow records from the USGS Water Resources Data for La Barge Creek 1983-1984 and North Horse Creek 1983-1984. These tables and data were obtained for all three instream flow periods. From this information, long term daily flow duration curves were constructed for La Barge Creek at the site of the gaging station on that stream. Because 1983 and 1984 represent a limited data set, extreme high and low flows were not part of the data set, therefore only the center portion of the curve could be developed. For completeness, the curves were extended using the same shape as the long-term North Horse Creek daily flow duration-curve as discussed in Chow (1964).

The daily flow duration curves were developed using the data for the gaging station on La Barge Creek above Viola which is downstream of the instream flow segment. Therefore the curves were adjusted to the upstream location. Since the area under the daily flow duration

curve is the average volume of flow for the period, the curves were adjusted by maintaining the same slope but shifting them up or down (retaining the same shape) according to the volume under the curve. To accomplish this, the volume for the downstream end of the instream flow segment was estimated for each instream flow period using the average monthly flows previously developed. The daily flow duration curves are presented on Figures 6 through 8.

There were no water right diversions above the instream flow segment which were considered significant to this analysis. Therefore the flows considered are only those generated. From the daily flow duration curves a summary of exceedence values is presented in Table 11.

TABLE 11
Daily Flow Exceedence Summary
La Barge Creek at Downstream End of Instream Flow Segment

Period	Requested Instream Flow (cfs)	WGFD Exceedence Criteria (% Time)	Exceedence During Period of Record (% Time)
Oct. 1 - Mar. 31	17	N/A	50%
Apr. 1 - Jun. 30	25	N/A	96%
Jul. 1 - Sep. 30	25	50%	98%

FIGURE 6: LA BARGE CREEK
DAILY FLOW DURATION CURVES OCT1 - MAR31

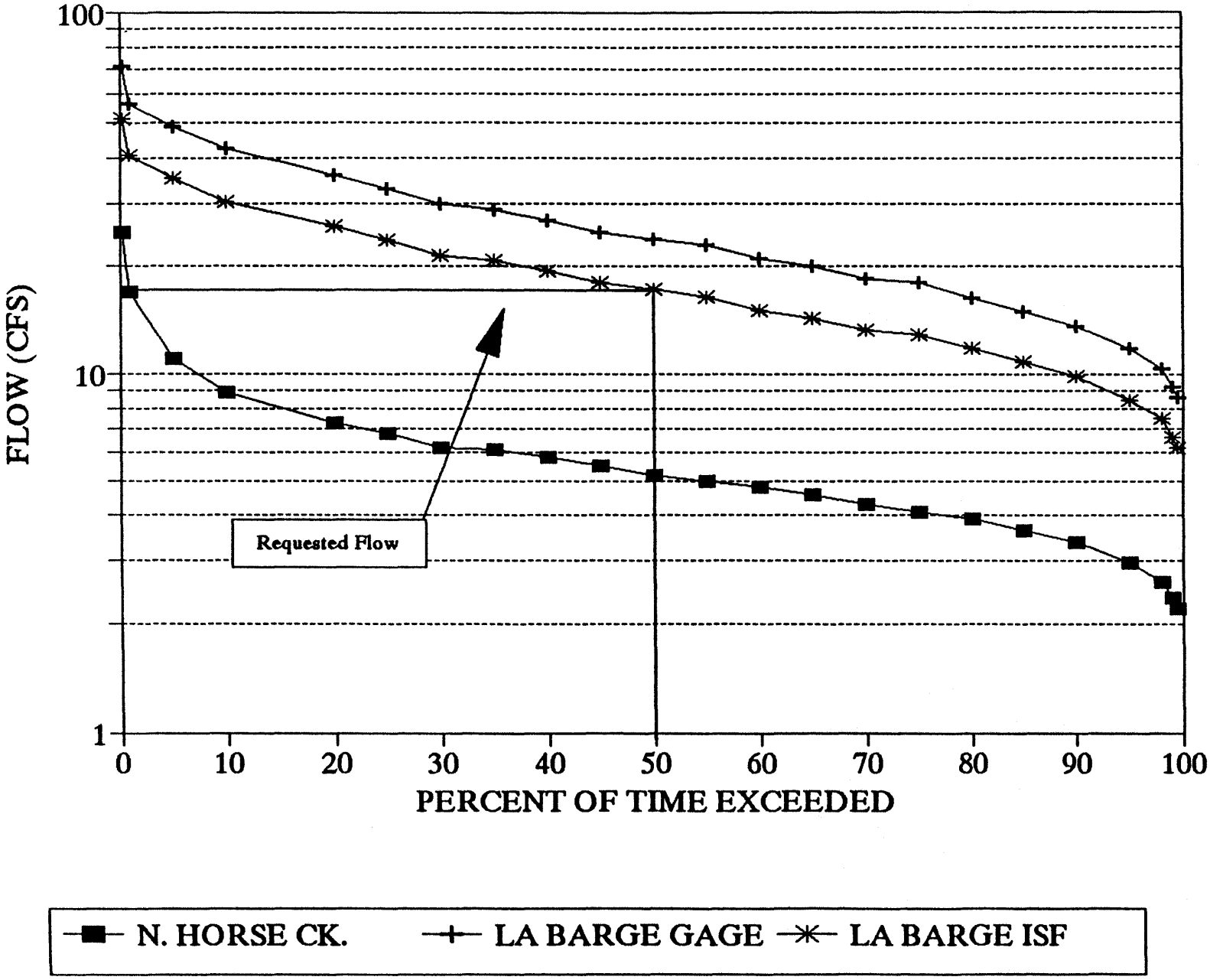


FIGURE 7: LA BARGE CREEK
DAILY FLOW DURATION CURVES APR1 - JUN30

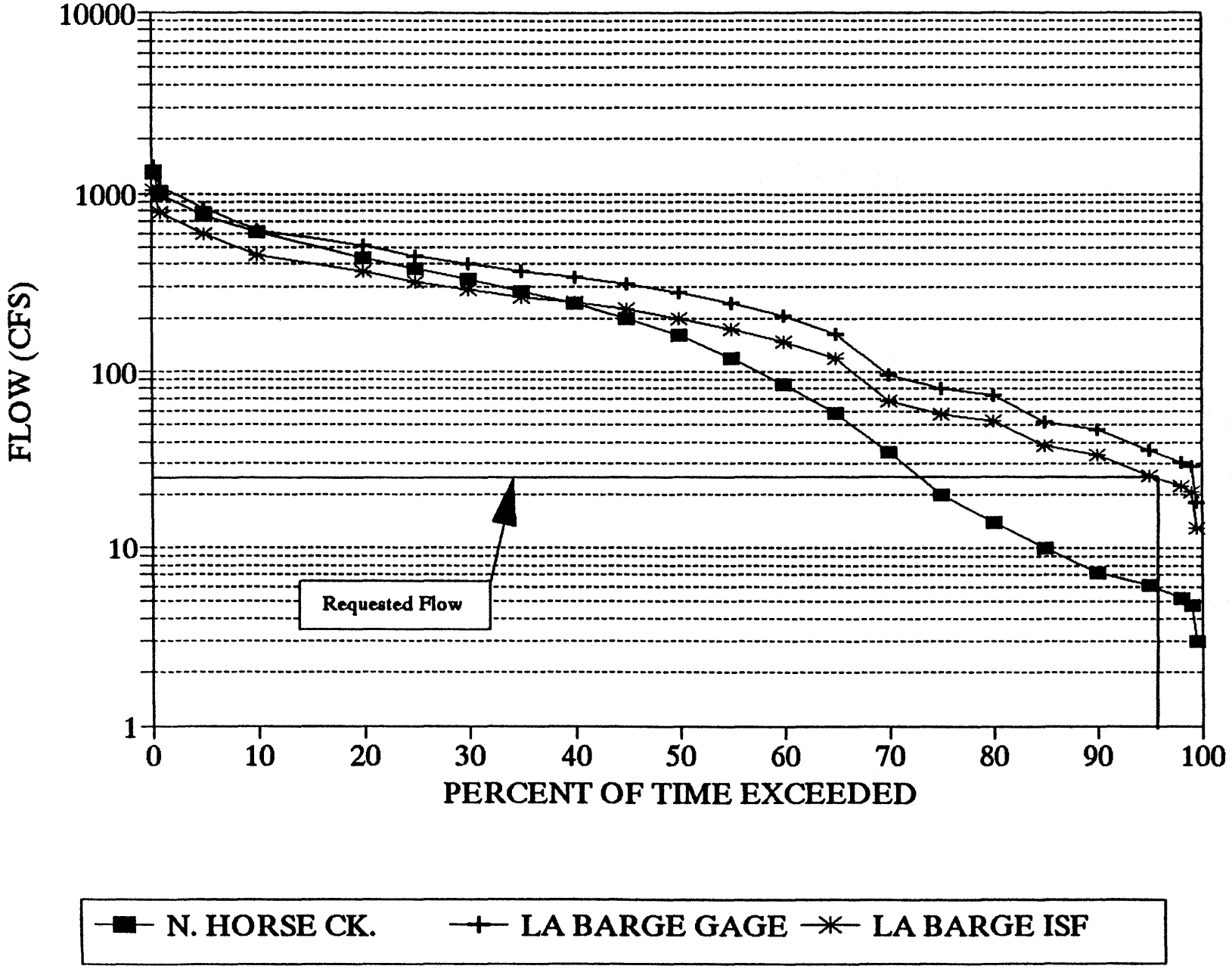
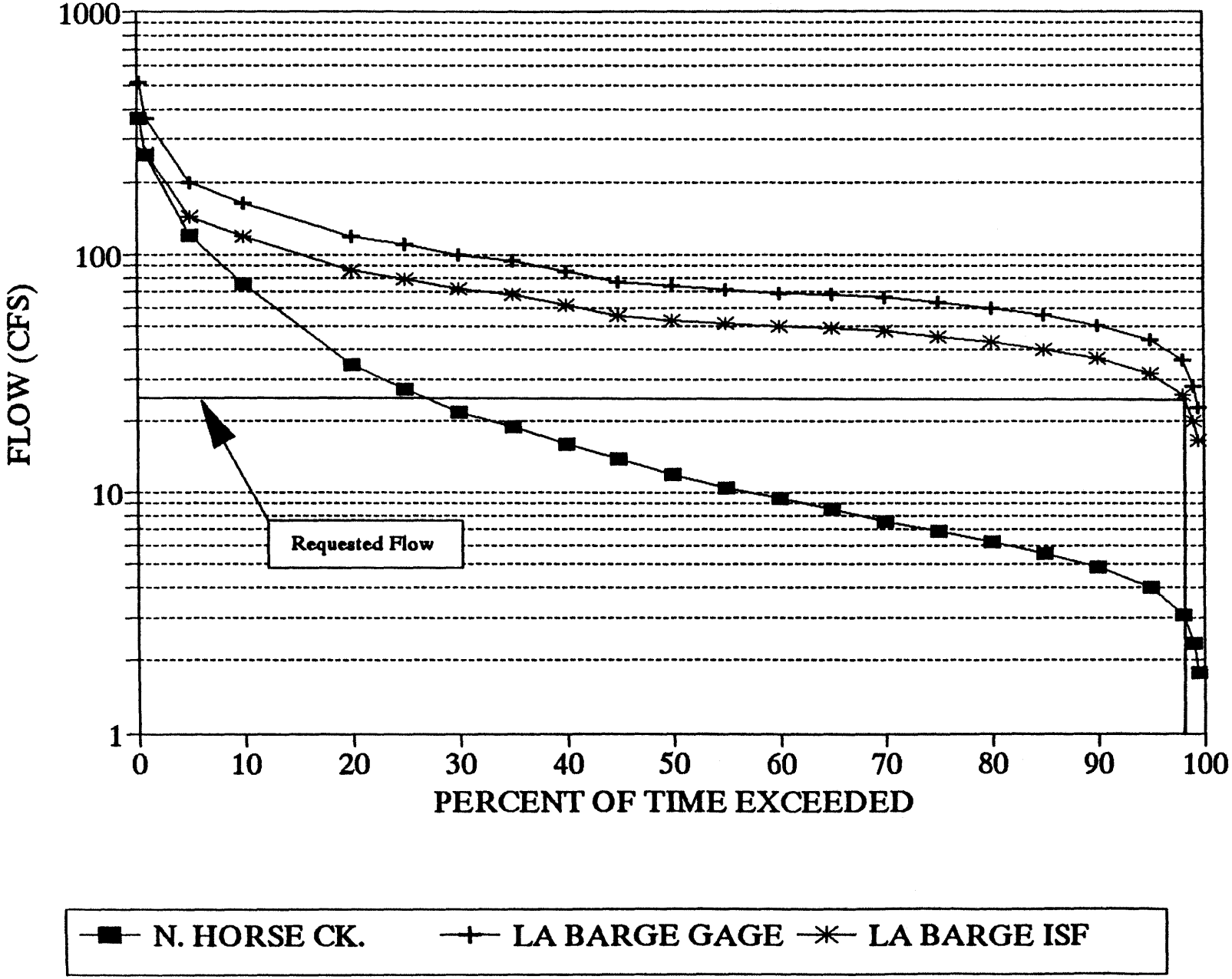


FIGURE 8: LA BARGE CREEK
DAILY FLOW DURATION CURVES JUL1 - SEP31



VIII. CONCLUSIONS

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The mean monthly flow analysis indicates that in an average year the flow request is met by direct flow with the exception of December when it is short by less than 2 cfs, for the entire year. During extremely dry years, direct flow may not meet the requested flow in the winter months or in the late summer months of July and September. Exceedence analysis shows that during the October 1 - March 31 period, the requested flow of 17 cfs is available or exceeded 50% of the time. For the two periods with a requested flow of 25 cfs, the requested flow is available or exceeded 96% of the time for the April 1 - June 30 period and 98% of the time for the July 1 - September 30 period.

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REFERENCES

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APPENDIX A

WYOMING GAME AND FISH REPORT
AND
APPLICATION TO STATE ENGINEER
TF NO. 27 3/146

WYOMING GAME AND FISH DEPARTMENT

FISH DIVISION

ADMINISTRATIVE REPORT

TITLE: LaBarge Creek Instream Flow Report

PROJECT: IF-4090-07-8805

AUTHOR: William H. Bradshaw

DATE: November 1990

INTRODUCTION

Studies were conducted to obtain instream flow information from a segment of LaBarge Creek northwest of LaBarge, Wyoming. These studies were designed to provide the basis for determining instream flows which would maintain or improve the existing fishery in the candidate section of LaBarge Creek. Results of these studies apply to the stream segment extending upstream from the U.S. Forest Service boundary in Section 1, Range 116 West, Township 27 North, to the confluence of LaBarge Creek and Turkey Creek in Section 24, Range 116 West, Township 28 North. This stream section is 3.3 miles long.

This section of LaBarge Creek is designated by the Wyoming Game and Fish Department (WGFD) as a Class 3 trout stream. Class 3 streams generally support regionally important fisheries. The stream is managed under the basic yield concept for rainbow trout and is stocked with rainbow trout during spring and summer months. Some recruitment from tributary streams also contributes to the fishery during the same time period. Other species present include brook trout, brown trout, cutthroat trout and mountain whitefish. This section of LaBarge Creek provides significant recreational fisheries opportunities for both resident and non-resident anglers (R. Remmick, WGFD, personal communication), and is highly accessible through public lands. For these reasons, this segment of the stream is considered a critical segment.

The management goal of the WGFD is to maintain or improve the existing stream fishery in LaBarge Creek. Three time periods are considered critical for realizing this goal. October 1 to March 31 is considered critical because this is a time period when low flows can cause degradation of hydraulic characteristics necessary for trout survival, fish passage and aquatic insect production. April 1 to June 30 is a critical period for maintaining physical habitat for juvenile rainbow trout; and from July 1 to September 30 it is critical to maintain flows adequate for adult trout production.

To address the management goal, objectives of this study were to determine instream flows necessary to 1) maintain or improve winter hydraulic characteristics for trout survival, fish passage and aquatic insect production, 2) maintain physical habitat for juvenile rainbow trout, and 3) maintain or improve adult trout production during the late summer months.

METHODS

Data for these studies were collected from a site located approximately 1/4 mile below the confluence of LaBarge and Turkey Creeks, in Section 24, Range 116 West, Township 28 North (Figure 1). These studies were conducted between June and August 1988 within a 483 foot long study site that contained trout habitat typical of that found throughout the candidate section of LaBarge Creek. Data were collected after peak runoff from a range of discharge rates (Table 1).

Table 1. Dates and discharge rates when instream flow data were collected from LaBarge Creek during 1988.

Date	Discharge Cubic Feet Per Second (cfs)
06-10-88	142
07-02-88	54
08-28-88	22

The Habitat Retention method (Nehring 1979, Annear and Conder 1984) was used to identify a maintenance flow. A maintenance flow is defined as a continuous flow needed to maintain minimum hydraulic criteria at riffle areas in a stream segment. Based on the extensive research of Annear and Conder (1984), the maintenance flow is further defined as the discharge at which two of three hydraulic criteria are met for all riffles in the study area (Table 2). Meeting these criteria provides passage for all life stages of trout between different habitat types and maintains survival of trout and aquatic macroinvertebrates at all times of year.

Data were collected from transects placed across three riffles within the study area and analyzed using the IFG-1 computer program (Milhous 1978). Instream flow recommendations derived from this method are applicable throughout the year except when higher instream flows are required to meet other fishery management purposes.

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

Category	Criteria
Average Depth (ft)	Top width[1] X 0.01
Average Velocity (ft per sec)	1.00
Wetted Perimeter (percent)[2]	60

1 - At average daily flow
2 - Compared to wetted perimeter at bankfull conditions

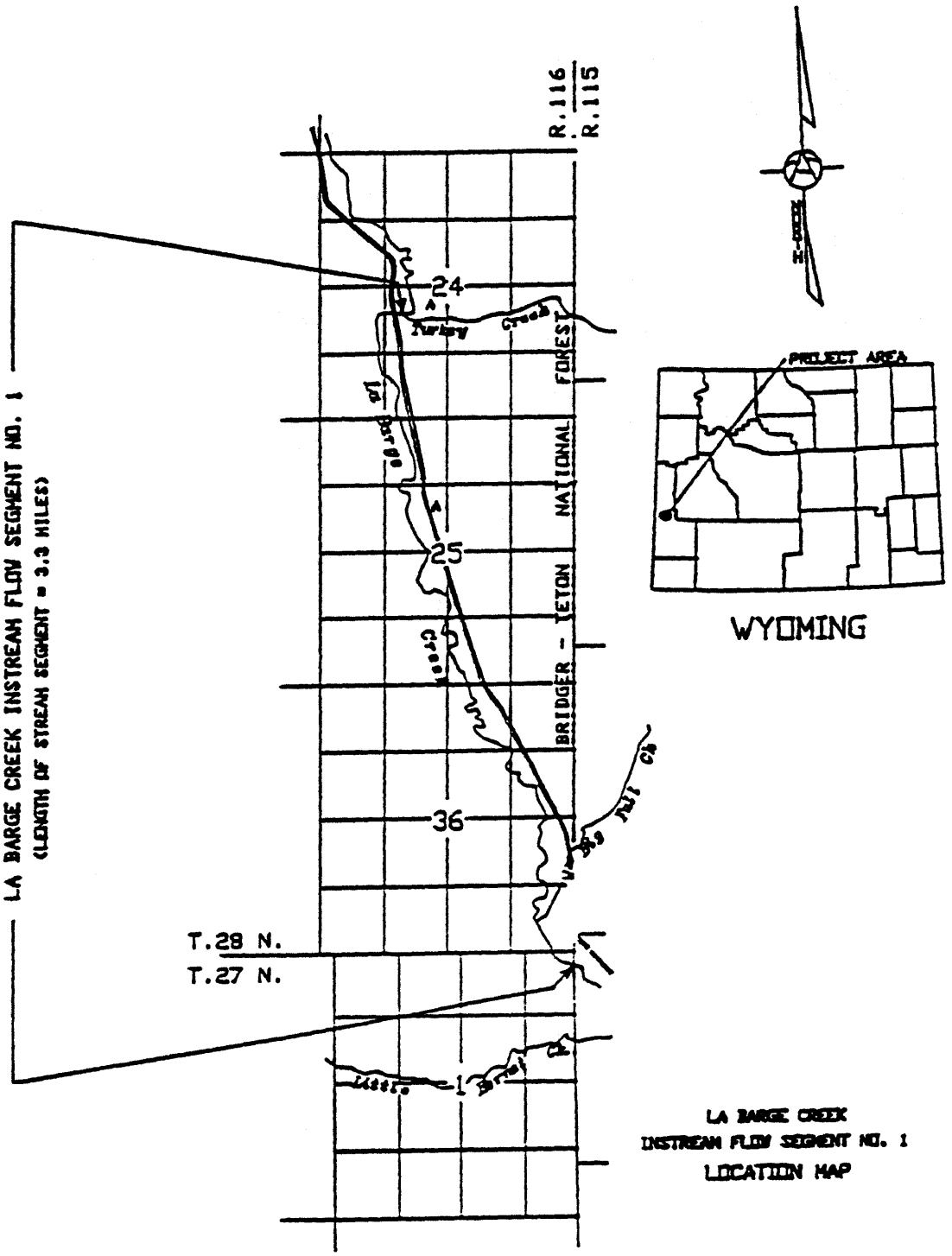
LA BARGE CREEK INSTREAM FLOW SEGMENT NO. 1
(LENGTH OF STREAM SEGMENT = 3.3 MILES)
R.116
R.115
24
25
36
1
T.28 N.
T.27 N.
BRIDGER - TETON NATIONAL FOREST
PROJECT AREA
WYOMING
LA BARGE CREEK
INSTREAM FLOW SEGMENT NO. 1
LOCATION MAP

Figure 1

A physical habitat simulation model (PHABSIM) developed by the Instream Flow Service Group of the U.S. Fish and Wildlife Service (Bovee and Milhous 1978) was used to examine incremental changes in the amount of physical habitat available for rainbow trout juveniles at various discharge rates. This model is generally regarded as state-of-the-art technology and is the most commonly used method in North America for quantifying changes in physical habitat with changes in discharge (Reiser et al. 1989).

The amount of physical habitat available at a given discharge is expressed in terms of weighted usable area (WUA) and reflects the composite suitability of depth, velocity and substrate at a given flow. Depth, velocity and substrate data were collected from seven transects in accordance with guidelines given by Bovee and Milhous (1978).

In order to perpetuate this fishery, it is important to maintain suitable habitat for juveniles that are stocked into LaBarge Creek by the WGFD or that recruit naturally to LaBarge Creek as tributary flows drop during the summer. Maintenance of suitable physical habitat for this life stage is a critical part of ensuring adequate recruitment to this fishery. The WUA for rainbow trout juveniles was simulated for flows ranging from 5 to 200 cfs using calibration and modeling techniques outlined in Milhous (1984) and Milhous et al. (1984).

Physical habitat for adult rainbow trout was considered adequate for their survival at flows recommended for juveniles. Simulation of physical habitat for spawning was not done because very little spawning habitat was found within the instream flow segment.

The Habitat Quality Index (HQI) developed by the Wyoming Game and Fish Department (Binns and Eiserman 1979) was used to estimate potential changes in trout production over a range of late summer flow conditions. The model incorporates seven attributes that address chemical, physical and biological components of trout habitat. Results are expressed in habitat units (HU), with one HU defined as the amount of habitat quality which will support 1 pound of trout. This model was developed by the WGFD after several years of testing and model refinement. The HQI has been reliably used on many Wyoming streams to assess habitat unit gains or losses associated with projects that modify instream flow regimes.

By measuring habitat attributes at various flow events as if associated habitat features were typical of late summer flow conditions (Conder and Annear 1987), HU estimates were made for hypothetical summer flows ranging from 5 to 125 cfs. To better define the potential impact of these other late summer flow levels on trout production, some attributes were derived mathematically for flows other than those which were measured. Results of the HQI model apply to the time of year that determines trout production. For LaBarge Creek this period is from July 1 to September 30.

RESULTS AND DISCUSSION

The Habitat Retention method was developed to identify a flow that would maintain existing survival rates of trout, provide passage for trout between different habitat types in streams, and maintain survival rates of aquatic insects in riffle areas. Maintenance of these features is important year round except when higher flows are needed at specific times to meet other requirements.

Results from the Habitat Retention model showed that flows of 17, 3 and 15 cfs are necessary to maintain aquatic insect production and fish passage at riffles 1, 2 and 3 respectively (Table 3). 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. Based on this criteria, the maintenance flow for this segment of LaBarge Creek is 17 cfs.

Table 3. Results from IFG-1 modeling at the LaBarge Creek study site.

Discharge (cfs)	Average Depth (ft)	Average Velocity (ft/sec)	Wetted Perimeter
		Riffle 1	
3.6	0.19	1.00[1]	18.8
6.7	0.25	1.18	22.5
10.8	0.30	1.33	26.7
16.8[2]	0.36[1]	1.47	31.4
21.9	0.43	1.58	32.2
30.6	0.53	1.75	33.0
39.9	0.62	1.92	33.6
54.3	0.74	2.16	34.4
77.2	0.88	2.48	35.5
87.7	0.94	2.61	35.8
110.1	1.06	2.88	36.6
141.6	1.19	3.21	37.4
248.4	1.29	4.01	48.5[1]
567.4	1.44	4.86	80.8
		Riffle 2	
0.7	0.11	1.00[1]	5.1
2.6	0.22[1]	1.06	8.9
3.5	0.27	1.24	10.6
8.0	0.41	1.54	12.7
14.9	0.54	1.91	14.7
23.3	0.65	2.22	16.7
36.8	0.82	2.59	18.0
49.0	0.92	2.87	19.5
71.1	1.04	3.26	22.0
93.5	1.14	3.56	24.1
119.5	1.11	3.82	29.5
133.2	1.14	3.91	31.2[1]
201.6	1.32	4.25	37.5
310.1	1.50	4.59	47.1
567.4	2.21	5.17	52.0

Table 3. (continued)

Discharge (cfs)	Average Depth (ft)	Average Velocity (ft/sec)	Wetted Perimeter
		Riffle 3	
0.9	0.14	0.30	22.9
2.4	0.20	0.42	28.8
3.9	0.25	0.51	30.5[1]
5.1	0.28	0.58	31.8
9.2	0.37	0.77	33.2
15.3[2]	0.42	1.00[1]	37.3
17.4	0.44[1]	1.05	37.8
22.7	0.49	1.21	39.2
34.9	0.57	1.50	41.5
51.0	0.66	1.84	42.6
87.7	0.81	2.47	44.8
145 6	0.95	3.28	48.0
231.2	1.15	4.26	48.8
340.6	1.33	5.33	49.5
567.4	1.60	7.21	50.8

1 - Hydraulic criteria from Table 2 met
2 - Flow meets two of three criteria for individual transect

Natural mortality that occurs during the winter can often be a significant factor limiting a trout population. Kurtz (1980) found that the loss of winter habitat due to low flow conditions was an important factor affecting mortality rates of trout in the upper Green River, with mortality approaching 90% during some years. Needham et al. (1945) documented average overwinter brown trout mortality of 60% and extremes as high as 80% 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 as the primary causes of winter trout mortality.

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) and dilute and prevent snow bank collapses and ice dam formation respectively. Because any reduction of natural winter stream flows would increase trout mortality and effectively reduce the number of fish that the stream could support, maintenance of natural flows is considered critical. As a consequence, 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 up to the maintenance flow. For LaBarge Creek, the maintenance flow is 17 cfs.

Stream flow data are unavailable for this section of LaBarge Creek and it is possible that the discharge of 17 cfs identified by the Habitat Retention method may not be present at times during the winter. Because the existing fishery is adapted to natural flow patterns, occasional periods of shortfall during the winter do not

imply the need for storage. Instead, they illustrate the need to maintain all natural winter streamflows, up to 17 cfs, in order to maintain existing survival rates of trout populations.

Results from the PHABSIM analysis show that a flow of 25 cfs will maintain 99% of the physical habitat for rainbow trout juveniles but at lower flows, physical habitat is reduced (Figure 2). A flow of 20 cfs will maintain 95% of the physical habitat and at 15 cfs about 90% of the physical habitat is maintained. Reductions in physical habitat are rapid below 15 cfs. Under natural conditions, flows are often in excess of 25 cfs from April 1 to July 31. When this occurs, physical habitat for juvenile rainbow trout will be less than optimum, especially when flows exceed 50 cfs.

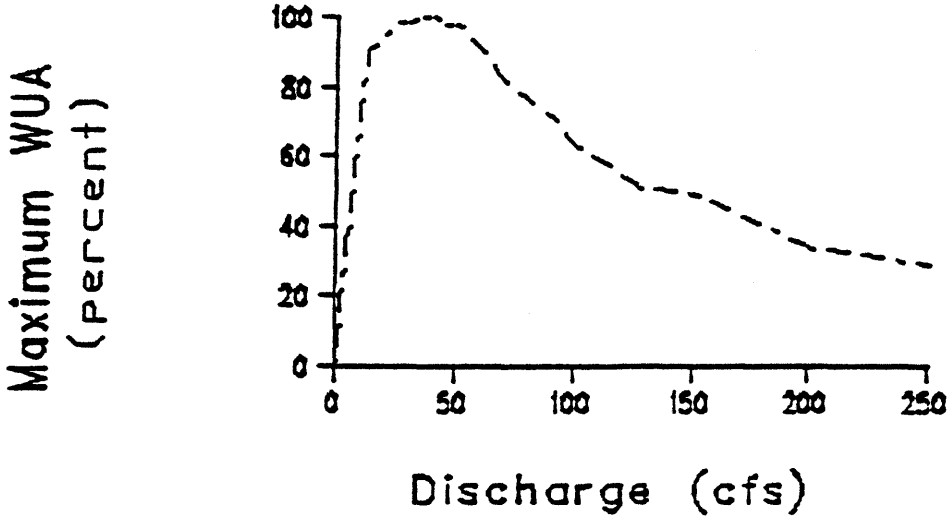

Figure 2. Percent of maximum weighted usable area (MUA) for rainbow trout juveniles at the LaBarge Creek study site as a function of discharge.

Because the existing fishery is maintained by juvenile trout stocked by the WGFD or that drift into LaBarge Creek from tributaries, it is important to maintain or improve physical habitat for juvenile rainbow. Instream flow recommendations were developed for the time of year when juveniles are stocked or recruit to the instream flow segment. This time period was defined as the period from April 1 to June 30. The current fishery management objectives for this section of LaBarge Creek are to maintain or improve physical habitat for juvenile rainbow trout and meet or exceed the hydraulic criteria addressed by the Habitat Retention method. In this situation, a flow of 25 cfs is the minimum amount necessary to accomplish these objectives.

Results from the HQI model indicate that under existing average late summer conditions, this segment of LaBarge Creek supports approximately 55 trout Habitat Units per acre (Figure 3). A flow of 25 cfs is the minimum flow that will maintain this existing level of HU's. At lower flows, trout habitat units would be reduced by approximately 15% or more. Fishery management objectives for the late summer are to

maintain the existing number of habitat units, and meet or exceed the hydraulic criteria addressed by the Habitat Retention method. A flow of 25 cfs is the minimum streamflow which will accomplish these objectives for the period from July 1 through September 30.

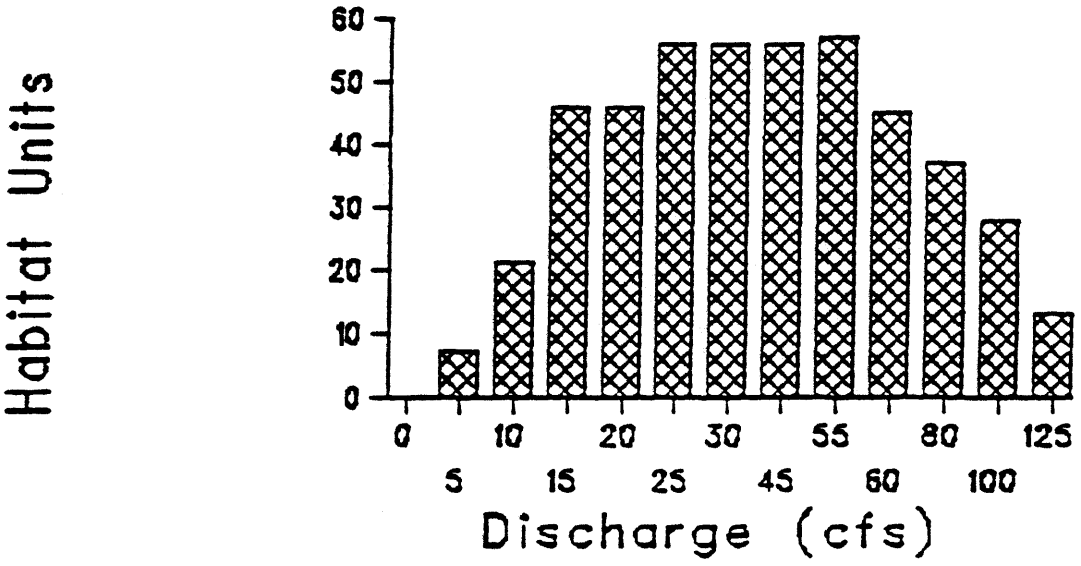

Figure 3. Adult trout habitat units (HU) as a function of discharge at the LaBarge Creek study site.

SUMMARY

The instream flow regime in Table 4 is based on results from the Habitat Retention, HQI and PHABSIM models, and displays the minimum stream flows needed to maintain or improve existing trout production levels in a section of LaBarge Creek at critical times of year. This stream section extends for a distance of 3.3 miles; from the U.S. Forest Service boundary in Section 1, Range 116 West, Township 27 North, upstream to the confluence of LaBarge Creek and Turkey Creek in Section 24, Range 116 West, Township 28 North.

Table 4. Summary of instream flow recommendations for LaBarge Creek northwest of LaBarge.

Time Period	Instream Flow Recommendation (cfs)
October 1 to March 31	17*
April 1 to June 30	25
July 1 to September 30	25

* - To maintain existing natural flows

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Form S.W. 1
Rev. 9-68

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 _____ day of _____ A.D. 19 ____ at _____ o'clock _____ M.

_____
State Engineer

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

Fee Paid $_____ Map Filed _____

WATER DIVISION NO. _____ DISTRICT NO. _____ Temp. Filing No. _____

PERMIT NO. _____

NAME OF FACILITY LaBarge Creek Instream Flow Segment No. 1

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

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

2. Name & address of agent to receive correspondence and notices Wyoming Game & Fish Dept., 5400 Bishop Blvd., Cheyenne, WY 82002

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 LaBarge Creek, a tributary of the Green River

5. The point of diversion of the proposed works is located segment of the instream flow is from the confluence of Labarge Creek and Turkey Creek and flows in NE1/4 SW1/4 corner of Section 24 T. 28 N., R. 116 W., and to the east line of lot 5 of Section 1 T. 27 N., R. 116 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 Federally owned.

7. The carrying capacity of the ditch, canal, pipeline or other facility at the point of diversion is see remarks cubic feet per second.

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 application of water to the beneficial uses stated in this application is 30 days from issue

Permit No. _____ Page No. _____
(Leave blank)

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.

Township	Range	Sec.	NE¼				NW¼				SW¼				SE¼				TOTALS
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
28N	116W	24									X	X	X	X					
		25					X			X	X			X		X	X		
		36	X	X	X	X									X			X	
27N	116W	1	X Lots 3																

Number of acres to receive original supply _____

Number of acres to receive supplemental supply _____

Total number of acres to be irrigated _____

REMARKS

Based on the results of a study conducted in 1988 by The Wyoming Game & Fish Dept:

MONTH	FLOW(cfs)
October	17
November	17
December	17
January	17
February	17
March	17
April	25
May	25
June	25
July	25
August	25
September	25

Based on the results of a study conducted in 1988 by the Wyoming Game and Fish Department, a flow right of 17 cfs is requested from October 1 to March 31 to ensure hydraulic conditions needed to maintain or improve existing levels of trout survival, fish passage and insect production. A flow of 25 cfs is requested from April 1 to June 30 to maintain existing levels of habitat for juvenile trout that recruit from tributaries. A flow of 25 cfs if requested from July 1 to September 30 to maintain or improve existing levels of adult trout production.

Length of stream segment - 3.3 miles

Intervening ditches - see map

Gages are located at substantial distances from the upstream and downstream ends of the instream flow segment. If additional information is needed, a gage will be installed at or near the downstream end 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.

M A Lucas
Signature of Applicant or Agent

12/17/90
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. _____

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.

Amounts of Instream Flow requested at
the downstream end of stream segment No. 1

MONTH	FLOW (cfs)
October	17
November	17
December	17
January	17
February	17
March	17
April	25
May	25
June	25
July	25
August	25
September	25

Based on the results of a study conducted in 1988 by the Wyoming Game and Fish Department.

Stream gages are located at substantial distances from the upstream and the downstream ends of the instream flow segment. If additional information is required, a gage will be installed at or near the downstream end of the instream flow segment.

OWNERSHIP LEGEND

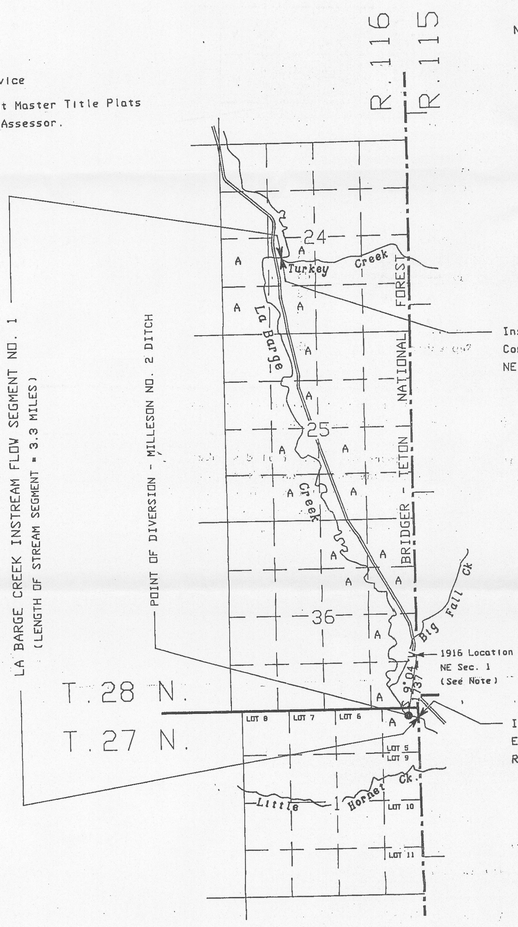
A - Federal Govt. / U.S. Forest Service

Ownership from Bureau of Land Management Master Title Plats and from records of the Lincoln County Assessor.

NORTH

2000 1000 0 2000 4000

SCALE 1" = 2000'



NOTE: Record Tie to the headgate for the Milleson No. 2 Ditch is from Map To Accompany Application dated 1916. In 1942, a resurvey of this township was approved by the GLO. Apparently the NE corner of Section 1 was shifted from the 1916 location. Headgate location is thus erroneously recorded as being in the SE 1/4, NE 1/4 of Section 1, but is actually located in Lot 5 (NE 1/4, NE 1/4) of Section 1, T.28 N., R.116 W., Independent Resurvey.

Instream Flow Segment No. 1 - Point of Beginning
Confluence of La Barge Creek and Turkey Creek in the NE 1/4, SW 1/4, Section 24, T.28 N., R.116 W.

Instream Flow Segment No. 1 - Point of Ending
East Boundary of Lot 5, Section 1, T.27 N., R.116 W. (Forest Boundary)

CERTIFICATE OF SURVEYOR

STATE OF WYOMING)
COUNTY OF LARAMIE) ss

I, Becky J. Braman, a Professional Land Surveyor in the State of Wyoming do hereby certify that this map has been prepared from the U.S. Geological Survey Topographic Quadrangles, the Bureau of Land Management Surface Management Quadrangles and GLO Plats and Wyoming State Engineer's water right records and that it correctly represents the location of the creek and the lands that it flows through to the best of my belief and knowledge.

Professional Land Surveyor BECKY J. BRAMAN 3881 WYOMING

Becky J. Braman
Becky J. Braman, P.L.S. 3881
Dated March 25, 1991

TABLE OF INTERVENING PERMITS

MILLESON NO. 2 DITCH

Unadjudicated

Expired Permit No. 14247 Priority 07-17-1916 0.77 cfs 53.9 Acres

MAP
TO ACCOMPANY
APPLICATION FOR
LA BARGE CREEK
INSTREAM FLOW SEGMENT NO. 1

APPLICANT:

WYOMING WATER DEVELOPMENT COMMISSION
HERSCHLER BUILDING
CHEYENNE, WYOMING 82002

APPROVED _____

STATE ENGINEER

STATES VEST WATER RESOURCES CORPORATION
INTERMOUNTAIN PROFESSIONAL SERVICES, INC.
CHEYENNE, WYOMING

Amended per State Engineer's Office 1-10-91