WYOMING GAME AND FISH DEPARTMENT

FISH DIVISION

ADMINISTRATIVE REPORT

TITLE: North Piney Creek Instream Flow Report

PROJECT: IF-4090-07-8807

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INTRODUCTION

Studies were conducted to obtain instream flow information from a segment of North Piney Creek west of Big Piney, 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 North Piney Creek. Results of these studies apply to the stream segment extending upstream from Bureau of Land Management lands in Section 30, Range 114 West, Township 31 North, to the point where North Piney Creek crosses the west boundary of Section 16, Range 115 West, Township 31 North. This stream section is 7.6 miles long.

This section of North Piney 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 species concept for Colorado River cutthroat trout. Brook trout are also present in this stream segment. This section of North Piney Creek supports significant recreational fisheries opportunities for both resident and non-resident anglers (R. Remmick, personal communication), and is highly accessible through public lands.

Colorado River cutthroat trout were historically distributed throughout the Green River drainage but are currently found only in headwater streams. The U.S. Fish and Wildlife Service (USFWS) considers the Colorado River cutthroat trout a Category 2 taxa which may be appropriate for Federal listing as threatened or endangered (USFWS 1985). The Wyoming Game and Fish Department considers this trout to be a "sensitive" species which requires special attention to prevent population reductions to threatened or endangered levels (WGFD 1987). The Comprehensive Management and Enhancement Plan for Colorado River Cutthroat Trout in Wyoming (WGFD 1987) provides a framework for management of Colorado River cutthroat trout populations and includes the need to obtain adequate instream flow protection for streams inhabited by this species. For these reasons, this stream segment is considered a critical reach.

The management goal of the WGFD is to maintain or improve the existing stream fishery in North Piney Creek. Three time periods are considered critical for realizing this goal. October 1 to May 14 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. May 15 to June 30 is a critical period for maintaining spawning habitat for Colorado River cutthroat trout; and from July 1 to September 30 it is critical to provide flows adequate for maintaining existing levels of adult trout production.

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

METHODS

Data for these studies were collected from a site located just below the confluence of North Piney Creek and Apperson Creek in the SE1/4, NW1/4 of Section 24, Range 115 West, Township 31 North (Figure 1). These studies were conducted between June and August 1988 within a 218 foot long study site that contained trout habitat typical of that found throughout the candidate section of North Piney Creek. Data were collected from a range of discharge rates after peak runoff (Table 1).

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

Date	Discharge Cubic Feet Per Second (cfs)
06-09-88	215
07-04-88	72
08-24-88	28

The Habitat Retention method (Nehring 1979) 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 extensive research by Annear and Conder (1984), the maintenance flow is specifically 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 two riffles within the study area and analyzed using the IFG-1 computer program (Milhous 1978). Instream flow recommendations derived from this method are applicable to all times of year except when higher instream flows are required to meet other fishery management purposes.

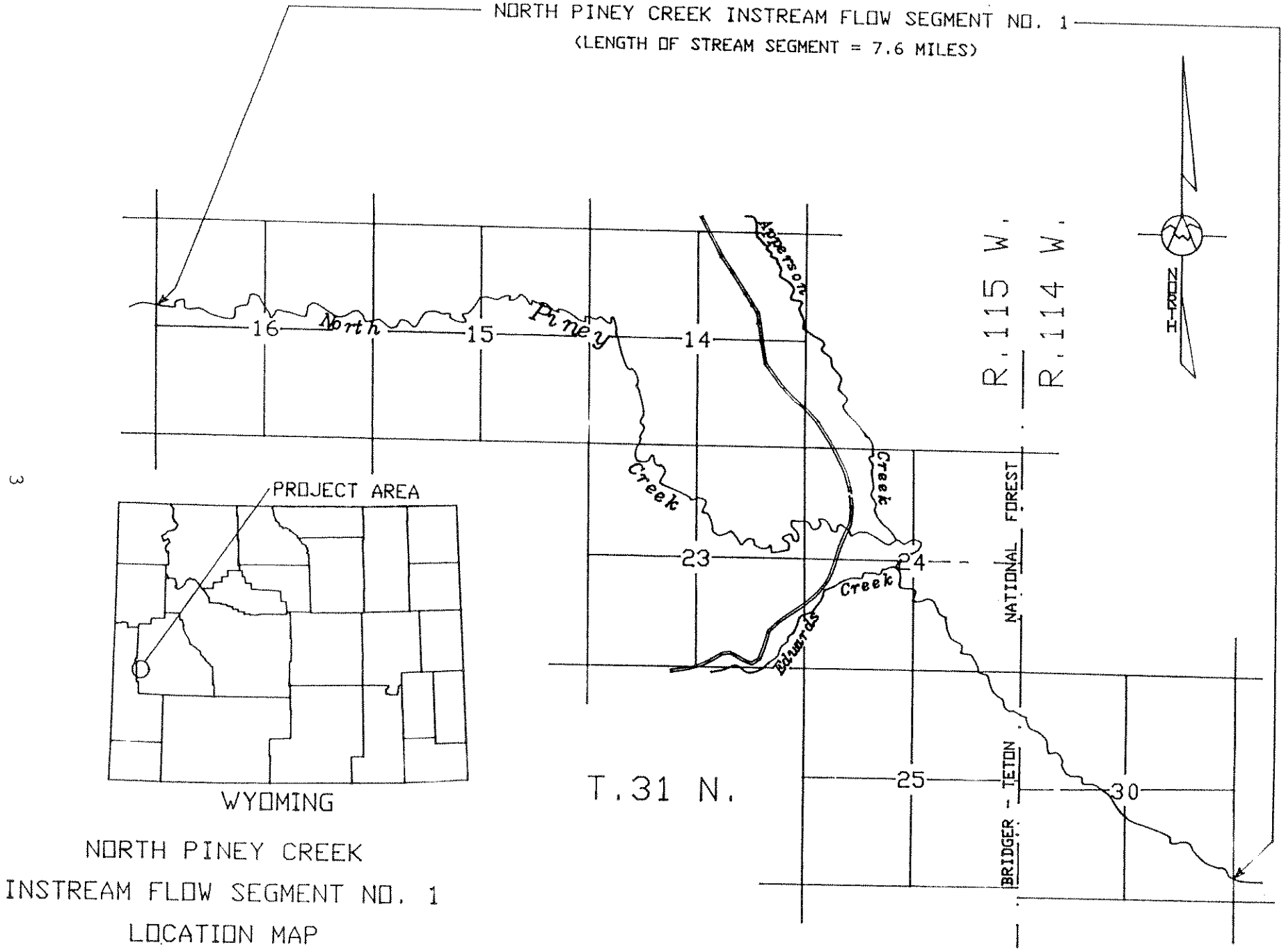

Figure 1. Location of instream flow filing reach on North Piney Creek.

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

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 cutthroat trout spawning 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 six transects in accordance with guidelines given by Bovee and Milhous (1978). Using calibration and modeling techniques outlined in Milhous (1984) and Milhous et al. (1984), the WUA for cutthroat trout spawning was simulated for flows ranging from 15 to 200 cfs.

The Habitat Quality Index (HQI) model (Binns and Eiserman 1979) was used to estimate the number of habitat units (HU) that the stream supports under average stream flow conditions, as well as to evaluate the effect of other late summer flow patterns on HU's. One habitat unit is defined as the amount of habitat quality capable of supporting 1 pound of trout. The results of the HQI model apply to the time of year that determines trout production. For North Piney Creek this period is from July 1 to September 30.

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 15 to 150 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 from the HQI model were used to identify the flow needed to maintain existing levels of trout production between July 1 and September 30.

RESULTS AND DISCUSSION

The Habitat Retention method was developed to identify a flow that would maintain survival rates of aquatic insects in riffle areas, maintain existing survival rates of trout, and provide passage for trout between different habitat types in streams during the winter. 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 show that flows of 20 and 25 cfs are necessary to maintain aquatic insect production and fish passage at riffles 1 and 2 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. For this segment of North Piney Creek, this stream flow is 25 cfs.

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

Average Depth (ft)	Average Velocity (ft/sec)	Wetted Perimeter (ft)	Discharge (cfs)
	Riffle # 1		
1.75	1.73	73.4	218
1.50	1.56	71.1	164
1.33	1.44	69.6	131
1.17	1.32	67.4	103
1.02	1.21	64.2	78
0.91	1.12	58.4	59
0.85	1.07	48.3[1]	44
0.91	1.12	32.8	33
0.75	1.00[1]	27.8	20[2]
0.59[1]	0.95	27.2	18
	Riffle # 2		
1.31	4.28	69.3	388
1.35	4.33	54.1	312
1.21	4.03	52.0	250
0.98	3.52	48.4	166
0.83	3.14	46.0	119
0.66	2.72	43.7	79
0.58	2.48	41.4[1]	59
0.41[1]	1.97	31.5	25[2]
0.15	1.00[1]	22.1	4

1 - Minimum hydraulic criteria from Table 2 met
2 - Discharge at which 2 of 3 hydraulic criteria are met

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 May 14 is to protect all available natural stream flows in the instream flow segment up to the maintenance flow. For North Piney Creek, the maintenance flow is 25 cfs.

Stream flow data are unavailable for this section of North Piney Creek and it is possible that the discharge of 25 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 25 cfs, in order to maintain existing survival rates of trout populations.

Current management objectives are aimed at maintaining or improving populations of Colorado River cutthroat trout (WGFD 1984, WGFD 1987). This segment of North Piney Creek is managed for wild cutthroat trout and is dependent on spawning and egg survival for perpetuation of the fishery. Colorado River cutthroat trout spawn in the spring, during or shortly after peak runoff, and their eggs incubate until early to mid-summer. Results from the PHABSIM model were used to determine flows necessary to maintain or improve Colorado River cutthroat trout reproductive success by maintaining spawning habitat from May 15 to June 30.

Results from the PHABSIM analysis show that a flow of 35 cfs will maintain 100% of the maximum amount of physical habitat available for cutthroat trout spawning (Figure 2). Rapid reductions in physical habitat available for spawning occur at flows below 35 cfs, and above 45 cfs. Because Colorado River cutthroat trout are considered a "sensitive" species by the WGFD and their perpetuation in North Piney Creek is dependent upon natural reproduction, it is important to maximize spawning opportunities. To accomplish the current fishery management objective of maintaining or improving reproductive success for Colorado River cutthroat trout, and at the same time, protecting the habitat features addressed by the Habitat Retention method, a flow of 35 cfs is recommended for the period from May 15 to June 30.

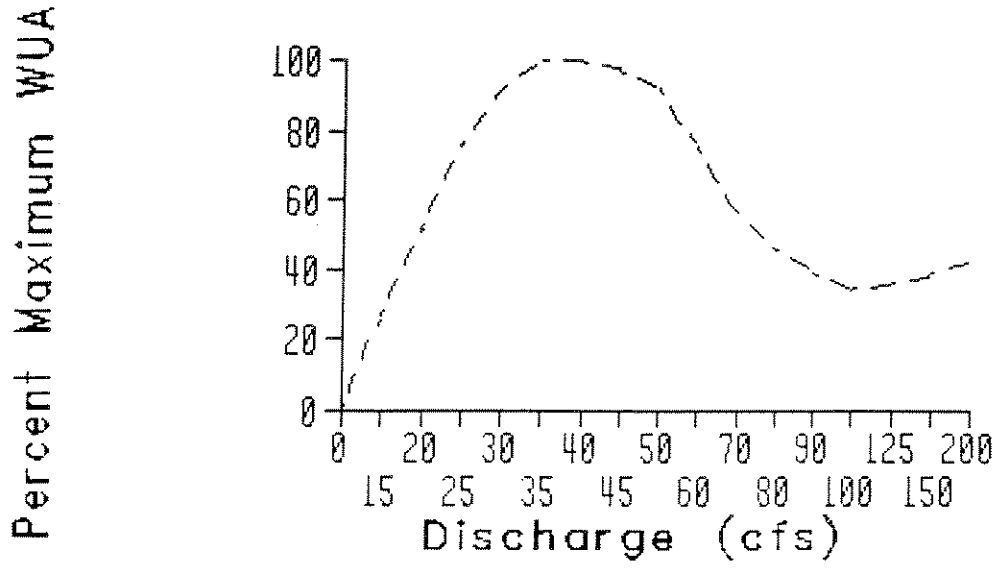

Figure 2. Percent of maximum weighted usable area (WUA) for cutthroat trout spawning at the North Piney Creek study site as a function of discharge.

Results from the HQI model indicate that under existing average late summer conditions, this segment of North Piney Creek supports approximately 65 trout Habitat Units (Figure 3). Results from this analysis indicate that 40 cfs is the minimum streamflow that will maintain this existing level of HU's. At lower flows, trout habitat units would be reduced by approximately 30% 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. In order to accomplish these objectives a flow of 40 cfs is recommended for the period from July 1 through September 30.

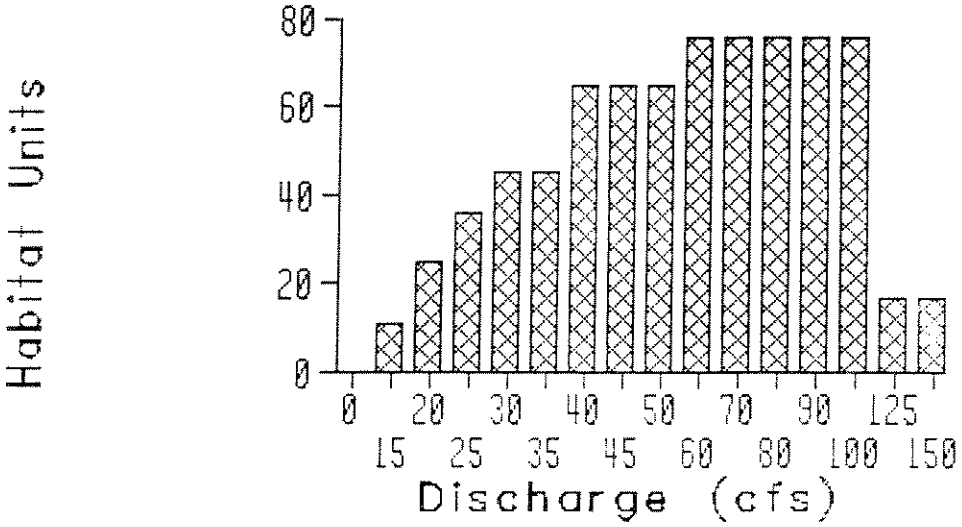

Figure 3. Adult trout habitat units (HU) as a function of discharge at the North Piney Creek study site.

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 North Piney Creek at critical times of year. This stream section extends for a distance of 7.6 miles; from Bureau of Land Management lands in Section 30, Range 114 West, Township 31 North, to the point where North Piney Creek crosses the west boundary of Section 16, Range 115 West, Township 31 North.

Table 4. Summary of instream flow recommendations for North Piney Creek west of Daniel.

Time Period	Instream Flow Recommendation (cfs)
October 1 to May 14	25 *
May 15 to June 30	35
July 1 to September 30	40

* - To maintain existing natural flows

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