WATER QUALITY STATUS REPORT ● REPORT NO. 77

CANYON CREEK
Madison and Teton Counties, Idaho
1987

Prepared by
Blaine Drewes

Pocatello Field Office
150 North Third Avenue
Pocatello, Idaho 83201

Department of Health & Welfare
Division of Environment
Boise, Idaho

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ABSTRACT

Canyon Creek was identified in the Agricultural Nonpoint Pollution Abatement Plans as a second priority stream segment for the reduction of agriculture related pollutants. A water quality study was conducted as a part of the planning process from November 26, 1986 to July 7, 1987. The objectives of the study were to: 1) observe the water quality impact that agricultural lands and tributaries have on Canyon Creek; 2) determine the water quality impact of Canyon Creek pollutants on the Teton River.

Due to lower than average winter precipitation rates and a cool dry spring, the runoff was much less than normal. Much of the water was retained in the soil and that which ran off flowed slowly with little erosive potential. One storm occurred on May 29, but was confined to the forest above the farmland.

Suspended sediment exceeded 100 mg/ l on only 5 of the 71 samples taken in the watershed. Three of these were directly related to spring runoff, one to loading from a tributary, and one to the above mentioned thunderstorm. Other parameters sampled showed a corresponding low concentration.

Tributaries which contributed the greatest amount of pollution were Spring Creek, Pony Creek, and Crooked Creek, all intermittent streams. Spring Creek had low suspended sediment concentrations, but was high in nitrates + nitrites, ortho-phosphates, and fecal coliform. This was due to range cattle and the breakdown of detritus. Pony and Crooked Creeks run through conventionally farmed land which is the major contributor of pollution in these streams.

Because of the low runoff and the lack of a storm event, it is impossible to determine the normal impact of agricultural pollution on Canyon Creek or the Teton River. Where was no major impact recorded on the Teton River by Canyon Creek as all pollutants were diluted by the greater flow of the Teton River.

INTRODUCTION

Canyon Creek originates in the Targhee National Forest of southwestern Teton County and southeastern Madison County, flowing north into the Teton River approximately 3 miles west of the Teton-Madison county line (Figures 1 and 2). The major tributaries of Canyon Creek are Spring Creek, Calamity Creek, Warm Creek, Wright Creek, Pony Creek, and Crooked Creek. Canyon Creek is a major tributary of the Teton River, which empties into the North Fork (Henry's Fork) of the Snake River. The Teton River (USB 234) has been identified as a second priority stream segment in the Nonpoint Source Pollution Abatement Plan.

The current designated uses of Canyon Creek and the Teton River are as a domestic and agricultural water supply, cold water biota, salmonid spawning, and primary and secondary contact recreation. The Teton River is designated as a Special Resource water by the Idaho water quality standards and are protected as such.

The Canyon Creek watershed containes approximately 78,480 acres. Of this amount 46,430 acres are private land, most of which are used for agricultural purposes (Table 1).

Table 1: Land Ownership and Use in the Canyon Creek Watershed (Acres)

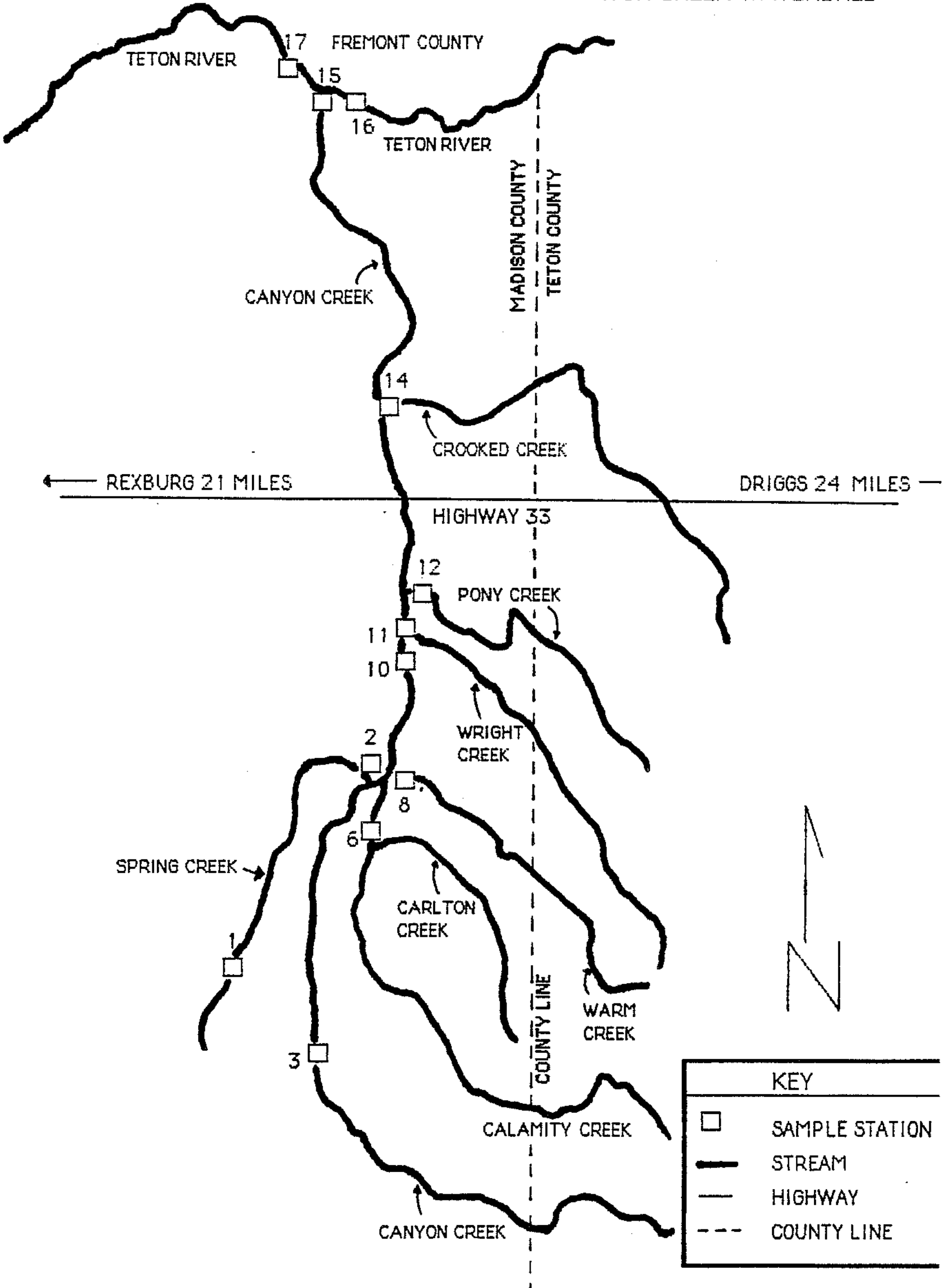
Federal Forest		28,870
US Bureau of Reclamation		1,180
State of Idaho		2,000
Private		46,430
Dry Cropland	30,600	
Irrigated Cropland	4,680	
Range and Woodland	11,150	

The 28,870 acres of forest land is located in the upper reaches of the watershed in the Targhee National Forest. State lands are adjacent to the Targhee National Forest. USBR lands are located near the mouth of Canyon Creek and were to be used for recreational access on the Teton Lake.

The watershed extends 17 miles southward from the mouth of Canyon Creek, and is 8 miles wide at its widest point. The watershed averages about 5 miles in width along its length. Elevations range from 8550 feet at the headwaters to 5100 feet at the confluence with the Teton River.

Figure 1. Canyon Creek Project Location

FIGURE 2: SAMPLING STATIONS IN THE CANYON CREEK WATERSHED



Topography of the area is generally characteristic of Eastern Idaho, with rolling hills and steep mountainous terrain. Cropland slopes range from 4-30%. Dry cropland rotations include grain-fallow, grain-grain-fallow, and annual cropping. Wheat and barley are the main crops although some operators include alfalfa-grass hay in their rotations. Irrigated cropland rotations include grain-potatoes, or grain-grain-potatoes. Irrigation systems include high pressure center pivots and wheel lines.

The climate of the Canyon Creek watershed is semi-arid with cool, moist winters and warm, dry summers. Annual precipitation ranges from 15 inches to greater than 26 inches at the higher elevations. Winter precipitation occurs mostly in the form of snow. Snow packs of 20 inches or more are common at higher elevations. The frost free growing season lasts from 85 days to about 40 days at higher elevations. The average air temperatures vary from 36 to 43 degrees F. The prevailing wind is out of the southwest and frequently reaches velocities in excess of 30 mph.

The USGS last checked Canyon Creek for discharge in 1977. The peak flow for that year was 378 cfs on April 8, and dropped to zero many times during the period from June 14 to September 7. The highest measured peak flow recorded was 694 cfs on June 8, 1975. The "dry" periods are due to an agricultural diversion of the water 0.25 miles downstream from the Green Canyon Hot Springs. During the irrigation months a large percentage or all of Canyon Creek water is diverted into the Canyon Creek Canal. The water is transported for use on cropland predominantly outside the Canyon Creek Watershed.

The soils in the Canyon Creek Watershed are highly erodible. The main soil types in the watershed are:

Ard silt loam, 4 to 12 percent slopes. Elevation is about 6100 ft. This soil is mainly used for nonirrigated barley and winter wheat. Surface runoff is medium, and the hazard of erosion is moderate.

Greys silt loam, 20 to 30 percent slope. Elevation ranges from 5700 to 7000 ft. This soil is used for wildlife habitat, recreation, and range. The slopes are too irregular and steep to be cultivated. Surface runoff is rapid, and the hazard of erosion is high.

Judkins extremely stony loam, 30 to 60 percent slopes. Elevation ranges from 5800 to 7000 ft. This soil is used for wildlife habitat. Surface runoff is rapid, and the hazard of erosion is high.

Rammel-Rock outcrop complex, 8 to 20 percent slopes. Elevation is 5200 to 7000 feet. This complex is on the canyon sides. The soil is used for range, recreation, and wildlife habitat. Surface runoff is medium, and the erosion hazard is moderate.

Rammel-Rock outcrop complex, 20 to 60 percent slopes. Elevation from 5200 to 7000 ft. This soil is similar to the Rammel-Rock outcrop complex, 8 to 20 percent except the runoff rate is very rapid and the erosion potential is high.

Ririe silt loam, 12 to 20 percent slopes. Elevation 5000 to 7000 feet. This soil is located on west and south facing dissected plateaus. This soil is used mainly for nonirrigated barley and wheat. Surface runoff is rapid, and the hazard of erosion is high (Madison SCD, 1987).

The purpose of this study was to determine if erosion from agricultural lands adversely affected the water quality of Canyon Creek. Because Canyon Creek is a major tributary of the Teton River, the effect of Canyon Creek pollution on the Teton River was also evaluated.

MATERIALS AND METHODS

Two subdrainages were identified in the Canyon Creek Watershed: 1. West Canyon Creek and 2. East Canyon Creek. The division runs down the middle of Canyon Creek to the mouth (Figure 2). These subdrainages are separated into two different project areas under the Idaho Agricultural Pollution Abatement Plan. The West Canyon Creek Subdrainage, with 20,000 acres of private land, is administered by the Madison Soil Conservation District while the East Canyon Creek Subdrainage, with 26,430 acres of private land is administered by the Teton Soil Conservation District. Only the West Canyon Creek drainage was funded for a planning project, but in order to accomplish the study objectives, both the east and west drainages were sampled.

SAMPLE STATIONS

Sampling stations were located on the tributaries at the forest boundary (if applicable), and at their mouths (Figure 2). The stations located in the West Canyon Creek Subdrainage, their name and STORET numbers were:

#	NAME	STORET No.
1	Spring Creek at Canyon Creek Road	2080497
2	Spring Creek at Mouth	2080498

These stations were used to determine the agricultural pollution impacts on Spring Creek. The upper station was located near the forest boundary; data served as baseline information. The station at the mouth would indicate the increase in agricultural pollutants from the forest boundary to the mouth. The lower station also indicated the amount of pollution entering Canyon Creek from the Spring Creek drainage.

Stations located in the East Canyon Creek Subdrainage, their name and STORET numbers were:

#	NAME	STORET No.
6	Calamity Creek at Canyon Creek Road	2080502
8	Warm Creek at Mouth	2080504
11	Wright Creek at Mouth	2080507
12	Pony Creek at Mouth	2080508
14	Crooked Creek at Mouth	2080510

These stations were all indicative of agricultural pollution with little or none of their flows originating on forest lands. Therefore, only one station at the mouth was deemed necessary. These stations were used to determine which drainages contributed the greatest amounts of agricultural pollution to Canyon Creek.

Stations located on Canyon Creek and the Teton River are:

#	NAME	STORET No.
3	Canyon Creek at Canyon Creek Road Upper Crossing	2080499
10	Canyon Creek at Canyon Creek Road Lower Crossing	2080506
15	Canyon Creek at Mouth	2080511
16	Teton River 0.1 miles above Canyon Creek	2080512
17	Teton River 0.2 miles below Canyon Creek	2080513

Station 3 was located at the forest boundary and served as a baseline information station. Canyon Creek at Canyon Creek Road- Lower Crossing was used to show the impacts of the perennial streams. Stations 15, 16, and 17 showed the impact of pollution in Canyon Creek on the Teton River.

Note that there are no stations numbered 4,5,7,9, or 13 as these were deleted prior to sampling.

PARAMETERS

Methods of sample collection, preservation, and analysis followed Standard Methods (APHA, 1985), and the National Handbook of Recommended Methods for Water Data Aquisition (USGS, 1977). Two one-liter water chemistry samples were collected from the center of the stream flow or from an area of complete water mixing. These were collected at 0.6 depth using a Bel-Art Products churn splitter. One sample was preserved with 2ml H_2SO_4 for nutrient analysis, and one sample was sent unpreserved for specific conductance, turbidity, and suspended sediment. These samples were analyzed by the Idaho Bureau of Laboratories, Boise branch.

Bacteriological samples were hand dipped at the same time as the chemistry samples were taken. Bacteriological samples were collected in sterile 500 ml nalgene bottles and analyzed by the Idaho Bureau of Laboratories, Pocatello branch. Parameters analyzed are shown in below.

Parameter	Units	STORET No.
Flow	cfs	00061
Suspended Sediment	mg/l	00530
Nutrients		
Total Ammonia (NH_3)	mg/l	00610
Total Nitrate + Nitrite (NO_2+NO_3)	mg/l	00630
Total Kjeldahl Nitrogen (TKN)	mg/l	00625
Total Phosphorus (TP)	mg/l	00665
Total ortho-phosphate (T o-p)	mg/l	70507
Dissolved ortho-phosphate (D o-p)	mg/l	00671
Bacteria		
Fecal Coliform	colonies /100 mls	31616

Parameter	Units	STORET No.
Bacteria		
Fecal Streptococcus	colonies /100 mls	31679

A sample schedule was established with the flexibility to respond to storm events. Samples were taken twice a month from mid-February to early July to provide information on water quality during the spring flows. In addition, one sample set was taken in November and in December to characterize ambient conditions at low flow.

Nutrient and sediment loads contributed during a one day period was based on the assumption that an individual sample was representative of the whole day.

Flow

Direct measurement of stream velocity was made with a Marsh McBirney Model 201 flow meter. Cross sections of the creeks were made by measuring the stream width to the nearest tenth of a foot, and measuring the water depth to the nearest tenth of a foot. Velocities were measured each foot at 0.6 depth. Determination of these two factors was not always possible. Flows in the Teton River were too rapid and could not be determined using the flow meter. The flows were estimated at the lower Teton River sampling station using the "orange peel " method. This method involves timing a floating object over a known length of the river. Depth measurements were made as above. Access to the upper Teton River station was denied, so flow was estimated by subtracting the flows at the mouth of Canyon Creek from the flows at the lower Teton River station.

Suspended sediment

Suspended sediment is one of the prime indicators of non-point agricultural pollution. Suspended sediment consists of soil particles that are entrained in the water column from three inches above stream bottom to the top of the column (Clark, 1985).

Nitrogen

Nitrogen is a primary plant nutrient and is applied in various forms to agricultural lands. This study looked at the four most common nitrogen compounds; Nitrate, Nitrite, Total Kjeldahl Nitrogen, and Ammonia. Because of the rapid interchangability of nitrate and nitrite, these compounds were analyzed together as nitrate+nitrite. Total Kjeldahl Nitrogen (TKN) method was used to determine the amount of organic nitrogen in the sample. The TKN method does not distinguish between organic and ammonia nitrogen compounds. An estimate of the amount of organic material in the sample can be made by subtracting the ammonia concentration from the TKN concentration.

Phosphorus

Phosphorus is another of the primary plant nutrients, and is usually the limiting nutrient factor for healthy plant growth in eastern Idaho. The most common of the uses is as a fertilizer, although some pest control sprays are phosphorus based. Three major forms of phosphorus were monitored during the study. These were total phosphorus, dissolved ortho-phosphate, and total ortho-phosphate. The total ortho-phosphate was analyzed due to problems with contamination of the dissolved ortho-phosphate on November 11, 1986, May 29, 1987, and June 16, 1987. Total phosphorus includes all forms of phosphorus present. Total ortho-phosphate and dissolved ortho-phosphate are those fractions which are dissolved in the water. Dissolved ortho-phosphate was filtered on site through a 0.45um filter. Total ortho-phosphate is filtered in the lab. Bauer (1987) states that comparison of total ortho-phosphate and dissolved ortho-phosphate results shows a greater amount of ortho-phosphate when it is lab filtered. This he attributes to the soil bound phosphorus becoming hydrolized in transit.

Bacteria

Two bacterial parameters were sampled during this study. The first, fecal coliform, is found in the intestines of warm blooded animals and is used as an indicator of fecal contamination of the water. Streptococcus, the second, is indicative of livestock contamination. Both bacteria types are reported in terms of number of colonies per 100 ml of sample. A ratio of the fecal coliform to streptococcus colonies can be used to determine the source of the contamination (Clark 1985b, 1986).

The segment of the Teton River of which Canyon Creek is a tributary (USB 234) is protected for primary contact recreation (Idaho Water Quality Standards, 1985). Under the bacterial standards the fecal coliform counts should not exceed 500/100ml at any one time; nor should the geometric mean exceed 50/100ml based on a minimum of 5 samples taken over a 30 day period. Since there was a maximum of three samples taken at any station during one month, the only standard which may be applied is the 500/100ml one time standard.

QUALITY ASSURANCE

Duplicate samples were collected each sampling date from Warm Creek at the mouth to measure precision. Chemical samples were divided with the churn splitter. Average relative ranges were calculated according to Bauer (1986).

Spiked field samples were used to determine accuracy. Laboratory supplied spikes were added to 900ml of sample water. Spiked samples were analyzed for suspended sediment, nitrate + nitrite, TKN, ammonia, total phosphorus, and dissolved ortho-phosphate. A different sampling site was selected for spiking each sampling run. Percent recovery is determined by subtracting the values of the unspiked samples from the spiked samples and comparing this figure with the known amount in the spike.

RESULTS AND DISCUSSION

FLOW

Canyon Creek is subject to wide variations of flow through the year. Spring snow melt increases the flow to high levels, at times exceeding 600 cfs. Water is diverted for irrigation during the summer months, and very little water reaches the Teton River. Discharge over the winter months is very predictable with flows from 10-20 cfs at the highway 33 bridge. Historical data provided by the USGS (Oct. 4, 1974 - Sept. 30, 1977) shows this flow regime clearly (Appendix 2). Flows for the winter months of November through March showed a three year high of 21 cfs and a three year low of 6.7 cfs with a mean of 11.7 cfs (n=454). Flows for the "meltoff" months of April through June had a high of 644 cfs, low of 0 cfs and a mean of 114 cfs (n=273). Note that the irrigation diversion was opened on June 2, 1977, skewing the data to the low end. If the data is deleted after June 2, 1977, the more accurate low and means would be 19 cfs and 136 cfs respectfully (n=244). The USGS data showed that in the months where Canyon Creek was diverted (July- September) the flow was never over 8 cfs. The high flow was 7.8 cfs, the low was 0 cfs and the mean was 1.30 cfs (n=214). Data from July 1-17, 1975 and July 1-9, 1976 were not used in the irrigation data as the diversion was not open.

Discharge measurements taken by IDHW-DOE personnel from November 26, 1986 to July 7, 1987 showed the pattern described above (Appendix 1). The station on Canyon Creek at Canyon Creek Road-Lower Crossing had flows below 21 cfs during the winter months. The spring runoff started in early April and continued until early May. Flows for that period ranged from 52 to 72.8 cfs. A storm on May 29 resulted in a flow of 69.1 cfs. The diversion was opened prior to the June 16 sampling date and is reflected in the low flows measured in June and July.

Flows for Canyon Creek and its tributaries were representative of the weather patterns observed. Spring thaw started in the lower reaches in early March and continued in the upper reaches until early May. The snowpack was light and the weather was cool and dry during this period. Weather records indicated this was one of the mildest winters on record with 54% of normal precipitation (pers. comm. Len Thompson, 1987). The mild temperatures, without a major storm, caused a slow runoff. Flow in the lower streams peaked much earlier than streams in the higher elevations. Some of the lower streams were dry before the upper stream flows peaked.

A thunderstorm occurred in the upper reaches of the Canyon Creek watershed May 29, but the rains were relatively light, the soil was dry, and most of the water was retained in the soil.

SUSPENDED SEDIMENT

Suspended sediment concentrations increased predictably during spring runoff and during the May 29 thunderstorm (Appendix 1). Because of the light snowpack, mild spring runoff, and the conditions of the area during the thunderstorm, only 5 of the 71 watershed samples analyzed showed suspended sediment concentrations over 100 mg/l. On those tributaries which had suspended sediment concentrations over 100 mg/l, field notes showed Pony Creek (March 2) and Crooked Creek (March 31) flowed through areas planted in spring barley which had not sprouted and had been planted using conventional methods. Elevated suspended sediment concentrations for Canyon Creek at the Mouth (March 31) were directly due to the influence of Crooked Creek. Canyon Creek at Canyon Creek Road-Lower Crossing (April 6) had range cattle in the creek upstream. Pony Creek (May 29) suspended sediment concentrations were due to the effects of the thunderstorm in the upper watershed forest.

Comparisons of the data from Canyon Creek at Canyon Creek - Lower

Crossing and Canyon Creek at Mouth, and Crooked Creek vs. Canyon Creek at Mouth show a drop in the amount of suspended sediment exported (Table 2). This is due, in part, to three large natural impoundments located just upstream from the mouth of Canyon Creek. The velocity of the water dropped rapidly upon entering these impoundments, dropping the sediment in the large ponds. The increase in load transport on May 29 was caused by a rise in the discharge caused by the thunderstorm. The sediment that had been "stored" in the impoundments during low flow were flushed into the Teton River.

Table 2. Suspended Sediment Export (Tons/ day) for Canyon Creek at Canyon Creek Road- Lower Crossing, Crooked Creek, and Canyon Creek at Mouth

Date	Ca. Cr. Lr. Cros.	Crk. Cr.	Ca. Cr. at Mth.
3/31/87	0.47	337	275
4/6/87	98.1	No Flow	30.9
4/14/87	3.92	No Flow	2.91
5/29/87	6.69	No Flow	10.4

$$\text{Tons/ day} = (\text{mg/l})*(0.0027)*(\text{cfs})$$

where mg/l is the concentration in milligrams/ liter, and cfs is the flow in cubic feet per second.

Suspended sediment impacts on the Teton River from Canyon Creek were minimumized because of the lower than average flows in Canyon Creek, three large natural impoundments in the lower reaches of Canyon Creek, natural vegetation buffers of over 100 ft. width on Canyon Creek and all tributaries except Pony and Crooked Creeks, and numerous beaver dams on Canyon Creek, Warm Creek, and Calamity Creek.

NUTRIENTS

Nitrogen

Nitrates, nitrites, and ammonia are considered inorganic nitrogen compounds. A concentration of total inorganic nitrogen of 0.3 mg/l is considered the limit for preventing the development of nuisance aquatic vegetation (Mackenthun, 1973). The data show that there were no significant concentrations of inorganic nitrogen in Canyon Creek (Figure 3). Spring Creek, Crooked Creek, Wright Creek and Pony Creek exceeded the recommendation in 45% of the samples taken at their mouths, but the inorganic nitrogen was diluted to below recommended levels in Canyon Creek. Ammonia standards were not exceeded at any time at any station (Idaho Water Quality Standards & Waste Water Requirements, Rev. March 1987).

TKN concentrations were low during the period of study. Those concentrations above 2 mg/l occurred during spring runoff and may represent a "flushing" of detritus which collected through the winter. There are no recommendations or standards for TKN.

Phosphorus

Total phosphorus concentrations exceeded the recommended criteria of 0.1 mg/l (Mackenthun,1973) in 28 of the 86 samples. The phosphorus loading from the tributaries above station 10 was insignificant as it was diluted to below recommended criteria on all but one occasion (Figure 4). The 0.97 mg/l reading on April 6 at this station was due to spring runoff from the fields located on the benches from Calamity Creek to station 10. The Wright Creek, Pony Creek, and Crooked Creek drainages had a much greater effect on Canyon Creek total phosphorus concentrations. On March 31, the total phosphorus concentration increased from <0.05 mg/l at station 10 to 1.95 mg/l at Canyon Creek at Mouth. This is due in part to the lack of buffer vegetation and the conventional tillage methods used along Crooked Creek.

Dissolved ortho-phosphate followed the pattern shown above for total phosphorus. The 0.025 mg/l recommendation (Mackenthun, 1973) was exceeded once at station 10 on April 6 but was exceeded 3 out of five samples taken at Canyon Creek at Mouth due to the influence of ortho-phosphate in Wright, Pony and Crooked Creeks.

BACTERIA

Bacterial standards were exceeded twice in 74 samples (Table 3). Both times this occurred on Spring Creek at Canyon Creek Road in an area used for range cattle and under low flow conditions. Spring Creek dried up before it reached Canyon Creek on both of these dates.

Figure 3. Nitrate + Nitrite Concentrations in Canyon Creek

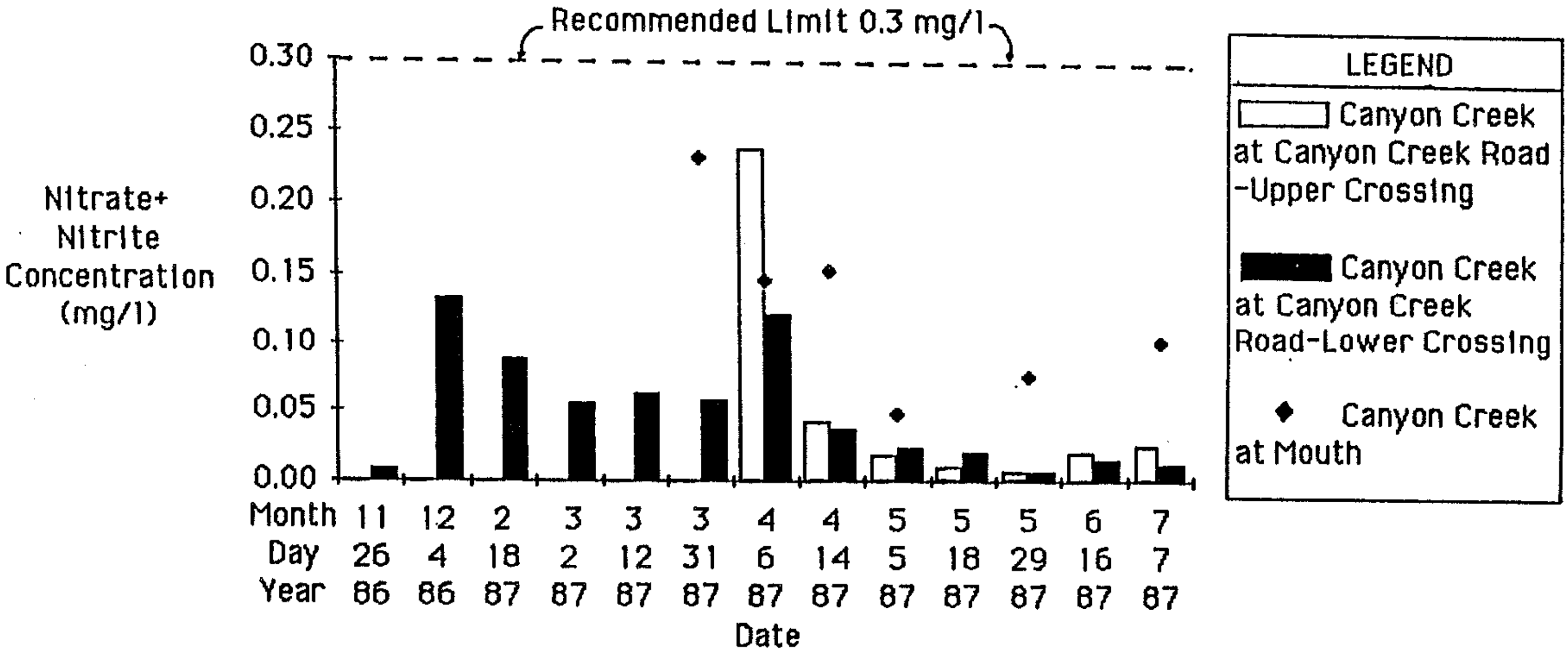
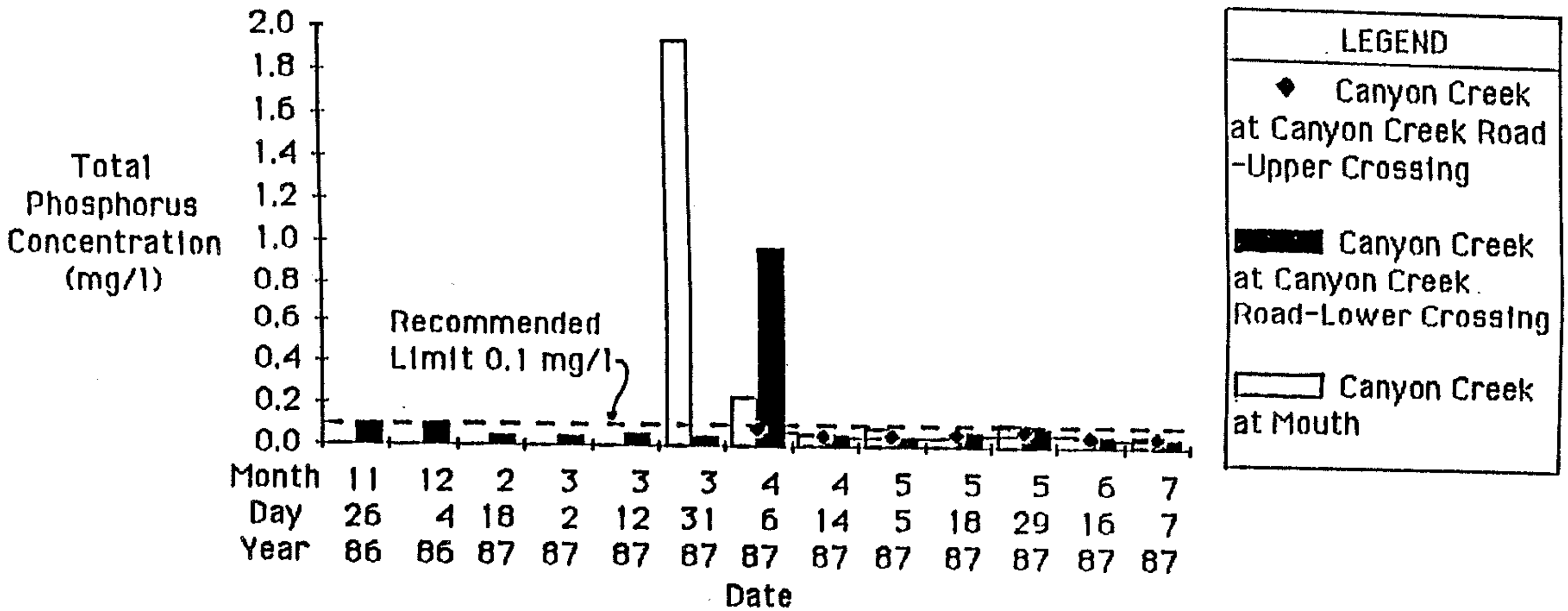


Figure 4. Total Phosphorus Concentrations in Canyon Creek



The fecal coliform/ streptococcus ratio indicated a strong livestock influence (Table 4). 11 of the 74 samples indicated mixed human-livestock influences and 3 of the 74 indicated human influences.

QUALITY ASSURANCE

Table 5 shows the average relative ranges as an estimate of precision. Table 6 shows accuracy (% recovery) and the 95% confidence intervals on spiked samples. Precision was excellent for total phosphorus, but precision for all other parameters were fair to poor. This may be due to the purity of the water used in the samples. The parameters tested for were near the laboratory detection limits, therefore even a small error would skew the data greatly.

There were not enough accuracy samples taken during the study to get a valid assessment of the accuracy. The accuracy samples from the Lower Blackfoot River study were added to the Canyon Creek study samples to increase the data base. The Blackfoot River samples were taken in the same manner as the Canyon Creek samples, and were analyzed at the same time. Even then, the recommended sample size of ten was not achieved. The accuracy of nitrate (103.8 ± 12.0) and ammonia (105.6± 11.1) were excellent, the TKN (109.4 ± 8.8) and total phosphorus (104.0 ± 3.5) were good, but the suspended sediment (81.0 ± 14.8) and dissolved ortho-phosphate (63.3 ± 18.5) were poor.

CONCLUSIONS AND RECOMMENDATIONS

Drought-like conditions and lack of a significant storm event severely limited the scope of the study. The cool, dry spring allowed a gradual snow melt which caused lower than normal runoff and flows. Pony and Spring Creeks, which local landowners said runs throughout the summer, dried up after spring runoff. Only Crooked, Pony, and Wright Creeks showed any indication of agricultural pollution.

Except for the one sampling date when Crooked Creek was running, Canyon Creek was not severely impacted by the pollutants in the tributaries.

The impact of Canyon Creek on the Teton River was minimal. Most of the time the quality of the Canyon Creek water was much better than the Teton River water.

Table 3. Fecal Coliform /Streptococcus Counts (Colonies /100ml)

	Station number											
Date	1	2	3	6	8	10	11	12	14	15	16	17
11/26/86				<10	<10	10						
				<10	<10	<10						
12/4/86						20	<10					
						40	10					
2/18/87		<10		<10	<10	<10	<10					
		10		<10	<10	20	<10					
3/2/87					<10	140	<10	<10				
					<10	40	90	1100				
3/12/87		<10			30	160	<10	<10				
		10			30	10	260	60				
3/31/87		<10		<10	30	10	<10		<10	<10		
		300		<10	<10	<10	30		8900	670		
4/6/87		<10	<10	10	40	20	<10			10	100	<10
		110	10	<10	30	20	<10			<10	850	960
4/14/87	<10	<10	<10	<10	<10	<10	<10			<10	<10	10
	<10	<10	20	<10	10	<10	<10			<10	<10	<10
5/5/87	<10		<10	<10	20	<10	<10			<10	<10	<10
	<10		<10	10	60	<10	20			10	<10	<10
5/18/87	370		<10	<10	20	40	<10					
	420		<10	30	380	100	40					
6/16/87	<u>1400</u>		20	390	60	80	20					
	90		10	80	120	100	20					
7/7/87	<u>770</u>		70	350	30		<10			<10	<10	<10
	610		140	210	360		30			<10	<10	10

<u>Underlined</u> counts exceed Idaho State water quality standards

Table 4. Fecal Coliform/ Streptococcus Ratios

Station Number

Date	1	2	3	6	8	10	11	12	14	15	16	17
11/26/86				N/A	N/A	N/A						
12/4/86						0.50	N/A					
2/18/87		N/A		N/A	N/A	N/A	N/A					
3/2/87					N/A	3.50	N/A	N/A				
3/12/87		N/A			1.00	*16.0*	N/A	N/A				
3/31/87		N/A		N/A	N/A	N/A	N/A		N/A	N/A		
4/6/87		N/A	N/A	N/A	1.33	1.00	N/A			N/A	N/A	N/A
4/14/87	N/A	N/A	N/A	N/A	N/A	N/A	N/A			N/A	N/A	N/A
5/5/87	N/A		N/A	N/A	0.33	N/A	N/A			N/A	N/A	N/A
5/18/87	0.88		N/A	N/A	0.05	0.40	N/A					
6/16/87	*15.6*		2.00	*4.88*	0.50	0.80	1.00					
7/7/87	1.26		0.50	1.67	0.80		N/A			N/A	N/A	N/A

Standard writing indicates livestock influences or insignificant (less than 10 colonies) values (Ratio 0.70 or less).

Underlined values indicate human-livestock mixed influences (Ratio 0.71 to 4.19).

Italisized values indicate human influences (Ratio 4.20 or greater).

N/A Ratio not applicable due to low fecal coliform or streptococcus plate counts.

Table 5. Precision of Split Samples for Warm Creek at Mouth

PARAMETER	N	RANGE (%)
Suspended Sediment	9	16.4
Nitrate+ Nitrite	10	26.4
Ammonia	10	34.2
Total Kjeldahl Nitrogen	10	12.6
Total Phosphorus	10	0.0
Dissolved ortho-phosphate	9	27.9

Table 6. Accuracy (% average recovery) and the 95% confidence interval for Canyon Creek and Tributaries

PARAMETER	N	AVE. % RECOVERY	95% CI
Suspended Sediment	7	81.0	±14.8
Nitrate+ Nitrite	9	103.8	±12.0
Ammonia	7	105.6	±11.1
Total Kjeldahl Nitrogen	7	109.4	±8.8
Total Phosphorus	9	104.0	±3.5
Dissolved ortho-phosphate	6	63.3	±18.5

It is recommended that the east and west sides of the watershed be combined into one study area under the administration of one Conservation District. This would solve any question which may arise over the status of the east side of the watershed. Secondly, it is recommended that a new study be conducted during a more normal water year to determine the impact the agricultural practices have in this watershed.

ACKNOWLEDGEMENTS

We wish to express our gratitude to those who made this report possible. Employees and board members of the Madison Soil Conservation District, and Len Thompson PhD who keeps the Rexburg weather records.

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APPENDIX 1

PLANNING STUDY DATA

1986-1987

Discharge (cfs), Suspended Sediment (mg/l), and Nutrients (mg/l) for Spring Creek at Canyon Creek Road (Station 1)

Date	Discharge	Suspended Sediment	NO_2+ NO_3-N	NH_3-N	TKN	TP-P	O-Phos.
4-14-87	1.5	12	1.12	0.017	0.22	0.10	0.063
5-5-87	0.7	8	1.36	0.027	0.23	0.08	0.057
5-18-87	0.5	20	1.34	0.041	0.51	0.14	
5-29-87	0.3	26	1.32	0.101	0.27	0.11	<u>0.054</u>
6-16-87	0.2	16	1.52	0.041	0.29	0.11	<u>0.059</u>
7-7-87	0.1	<2	1.81	0.075	0.20	<0.05	0.026
Mean Flow	0.55						

<u>Underlined</u> ortho-phosphate is Total ortho-phosphate; not field filtered

Discharge (cfs), Suspended Sediment (mg/l), and Nutrients (mg/l) for Spring Creek at Mouth (Station 2)

Date	Discharge	Suspended Sediment	NO_2+ NO_3-N	NH_3-N	TKN	TP-P	O-Phos.
2-18-87	1.5		0.038	0.087	1.53	0.80	1.28
3-12-87	1.5	22	0.546	0.150	0.87	0.42	0.260
3-31-87	0.2	26	1.20	0.349	1.50	0.45	0.226
4-6-87	2.9	68	0.922	0.063	0.63	0.30	0.102
4-14-87	0.4	12	0.956	0.022	0.41	0.19	0.072
5-29-87	0.1	8	0.040	0.066	0.22	0.11	<u>0.069</u>
Mean Flow	1.1						

<u>Underlined</u> ortho-phosphate is Total ortho-phosphate; not field filtered

Discharge (cfs), Suspended Sediment (mg/l), and Nutrients (mg/l) for Canyon Creek at Canyon Creek Road - Upper Crossing (Station 3)

Date	Discharge	Suspended Sediment	NO_2+ NO_3-N	NH_3-N	TKN	TP-P	O-Phos.
4-6-87	15.0	22	0.237	0.086	0.25	0.08	0.011
4-14-87	17.0	6	0.043	0.020	0.22	0.05	0.027
5-5-87	61.5	8	0.019	0.004	0.27	<0.05	0.025
5-18-87	39.7	12	0.010	0.029	0.28	0.06	
5-29-87	63.8	38	0.007	0.045	0.43	0.07	<u>0.012</u>
6-16-87	28.2	10	0.020	0.049	0.13	<0.05	<u>0.014</u>
7-7-87	9.3	2	0.026	0.046	0.11	<0.05	0.009
Mean Flow	33.5						

<u>Underlined</u> ortho-phosphate is Total ortho-phosphate; not field filtered

Discharge (cfs), Suspended Sediment (mg/1), and Nutrients (mg/1) for Calamity Creek at Canyon Creek Road (Station 6)

Date	Discharge	Suspended Sediment	NO_2+ NO_3-N	NH_3-N	TKN	TP-P	O-Phos.
11-26-86	1.0	<2	0.024	0.024	0.12	<0.1	0.013
2-18-87	6.6		0.136	0.071	<0.05	<0.05	0.013
3-31-87	6.8	36	0.131	0.040	0.28	0.09	0.023
4-6-87	4.7	34	0.135	0.032	0.24	0.11	<0.003
4-14-87	8.6	10	0.135	0.014	0.17	0.06	0.027
5-5-87	8.7	12	0.041	0.011	0.28	0.05	0.030
5-18-87	6.4	42	0.044	0.025	0.22	0.05	
5-29-87	10.9	20	0.039	0.074	0.40	0.06	0.006
6-16-87	7.6	12	0.020	0.064	0.28	0.05	0.014
7-7-87	4.0	2	0.030	0.058	0.14	0.05	0.006
Mean Flow	6.56						

Underlined ortho-phosphate is Total ortho-phosphate; not field filtered

Discharge (cfs), Suspended Sediment (mg/l), and Nutrients (mg/l) for Warm Creek at Mouth (Station 8)

Date	Discharge	Suspended Sediment	NO_2+ NO_3-N	NH_3-N	TKN	TP-P	O-Phos.
11-26-86	1.5	<2	0.027	0.027	0.10	<0.1	<0.001
2-18-87	2.4		0.021	0.037	0.19	<0.05	0.008
3-2-87	2.1	9	0.031	0.043	0.16	<0.05	0.007
3-12-87	3.8	9	0.007	0.053	0.13	<0.05	0.003
3-31-87	2.7	8	0.033	0.023	0.33	<0.05	0.002
4-6-87	3.1	14	0.024	0.027	0.15	<0.05	<0.003
4-14-87	4.2	5	0.015	0.018	0.27	<0.05	0.007
5-5-87	3.1	11	0.017	0.017	0.24	<0.05	0.014
5-18-87	3.1	10	0.067	0.025	0.11	<0.05	
5-29-87	6.4	20	0.037	0.036	0.25	<0.05	0.009
6-16-87	3.1	8	0.033	0.076	0.24	<0.05	<0.001
7-7-87	4.4	2	0.011	0.048	0.09	<0.05	<0.005
Mean Flow	3.33						

Underlined ortho-phosphate is Total ortho-phosphate; not field filtered

Discharge (cfs), Suspended Sediment (mg/1), and Nutrients (mg/1) for Canyon Creek at Canyon Creek Road- Lower Crossing (Station 10)

Date	Discharge	Suspended Sediment	NO_2+ NO_3-N	NH_3-N	TKN	TP-P	O-Phos.
11-26-86	7.3	<2	0.009	0.202	0.39	<0.1	<u>0.014</u>
12-4-76	7.3	4	0.133	0.029	0.08	<0.1	<u>0.002</u>
2-18-87	13.1		0.087	0.053	<0.05	<0.05	0.012
3-2-87	20.8	16	0.055	0.075	0.21	0.05	0.018
3-12-87	12.8	8	0.063	0.093	0.22	0.06	0.016
3-31-87	10.9	16	0.057	0.025	0.28	<0.05	0.006
4-6-87	67.9	536	0.121	0.068	2.15	0.97	0.022
4-14-87	52.0	14	0.037	0.015	0.22	0.06	0.008
5-5-87	72.8	20	0.023	0.031	0.29	0.05	0.026
5-18-87	13.5	16	0.020	0.029	0.20	0.07	
5-29-87	69.1	36	0.007	0.040	0.42	0.09	<u>0.033</u>
6-16-87	2.3	6	0.016	0.043	0.15	0.06	<u>0.028</u>
7-7-87	1.3	<2	0.012	0.061	0.14	0.05	0.017
Mean Flow	27.0						

<u>Underlined</u> ortho-phosphate is Total ortho-phosphate; not field filtered

Discharge (cfs), Suspended Sediment (mg/l), and Nutrients (mg/l) for
Wright Creek at Mouth (Station 11)

Date	Discharge	Suspended Sediment	NO_2+ NO_3-N	NH_3-N	TKN	TP-P	O-Phos.
12-4-86	1.5	8	0.191	0.014	0.11	0.1	0.030
2-18-87	3.5		0.339	0.057	6.46	0.26	0.030
3-2-87	1.0	42	0.328	0.026	0.74	0.29	0.045
3-12-87	0.9	66	0.204	0.153	0.60	0.28	0.105
3-31-87	1.2	26	0.225	0.020	0.26	0.12	0.042
4-6-87	0.7	34	0.208	0.023	0.32	0.12	0.004
4-14-87	0.7	6	0.237	0.015	0.23	0.07	0.038
5-5-87	3.4	12	0.070	<0.001	0.19	0.05	0.045
5-18-87	2.3	16	0.057	0.027	0.25	0.08	
5-29-87	16.9	74	0.040	0.040	0.39	0.12	0.031
6-16-87	2.9	22	0.022	0.047	0.14	0.07	0.030
7-7-87	2.6	6	0.031	0.041	0.13	0.07	0.025
Mean Flow	1.13						

Underlined ortho-phosphate is Total ortho-phosphate; not field filtered

Discharge (cfs), Suspended Sediment (mg/1), and Nutrients (mg/1) for Pony Creek at Mouth (Station 12)

Date	Discharge	Suspended Sediment	NO_2+ NO_3-N	NH_3-N	TKN	TP-P	O-Phos.
3-2-87	0.2	6,590	0.553	0.099	5.97	4.30	0.135
3-12-87	0.4	28	0.100	0.104	1.07	0.51	0.373
5-29-87	1.8	362	0.052	0.153	1.37	0.54	<u>0.132</u>
Mean Flow	0.8						

<u>Underlined</u> ortho-phosphate is Total ortho-phosphate; not field filtered

Table 12: Discharge (cfs), Suspended Sediment (mg/1), and Nutrients (mg/1) for Crooked Creek at Mouth (Station 14)

Date	Discharge	Suspended Sediment	NO_2+ NO_3-N	NH_3-N	TKN	TP-P	O-Phos.
3-31-87	2.4	52,150	0.371	0.281	65.5	29.8	1.04

Discharge (cfs), Suspended Sediment (mg/1), and Nutrients (mg/1) for Canyon Creek at Mouth (Station 15)

Date	Discharge	Suspended Sediment	NO_2+ NO_3-N	NH_3-N	TKN	TP-P	O-Phos.
3-31-87	120	852	0.230	0.051	3.05	1.95	0.062
4-6-87	250	46	0.144	0.036	0.57	0.24	0.005
4-14-87	43.0	16	0.152	0.024	0.24	0.06	0.069
5-5-87	67.8	16	0.048	0.015	0.29	0.09	0.042
5-29-87	74.1	52	0.074	0.058	0.33	0.11	<u>0.067</u>
7-7-87	4.7	<2	0.100	0.030	0.27	0.06	0.017
Mean Flow	93.3						

<u>Underlined</u> ortho-phosphate is Total ortho-phosphate; not field filtered

Discharge (cfs), Suspended Sediment (mg/l), and Nutrients (mg/l) for Teton River 0.1mi above Canyon Creek (Station 16)

Date	Discharge	Suspended Sediment	NO_2+ NO_3-N	NH_3-N	TKN	TP-P	O-Phos.
4-6-87	600	472	0.611	0.199	2.23	1.12	0.021
4-14-87	375	26	0.732	0.042	0.41	0.11	0.025
5-5-87	280	10	0.312	0.038	0.24	0.05	0.026
5-29-87	750	66	0.226	0.063	0.52	0.12	<u>0.018</u>
7-7-87	200	<2	0.358	0.066	0.39	<0.05	<0.005
Mean Flow	441						

<u>Underlined</u> ortho-phosphate is Total ortho-phosphate; not field filtered
Teton River flows are estimates (refer to text).

Discharge (cfs), Suspended Sediment (mg/l), and Nutrients (mg/l) for Teton River 0.2mi below Canyon Creek (Station 17)

Date	Discharge	Suspended Sediment	NO_2+ NO_3-N	NH_3-N	TKN	TP-P	O-Phos.
4-6-87	850	552	0.567	0.115	2.33	1.19	0.025
4-14-87	425	16	0.771	0.039	0.31	0.08	0.018
5-5-87	350	16	0.289	0.012	0.22	<0.05	0.030
5-29-87	825	72	0.233	0.073	0.59	0.18	0.018
7-7-87	200	2	0.368	0.173	0.33	<0.05	<0.005
Mean Flow	530						

Underlined ortho-phosphate is Total ortho-phosphate; not field filtered
Teton River flows are estimates (refer to text).

Appendix 2

U.S. GEOLOGICAL SURVEY FLOW DATA

1974-1977

1975 WY UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

13054600 CANYON CREEK AT HWY 33 NR NEWDALE ID PROCESS DATE: 15-AUG-86 10:37 EMW
LAT 435044 LONG 1112641 STATE 16 COUNTY 065 DATUM OF GAGE: DRAINAGE AREA: 79.9

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1974 TO SEPTEMBER 1975
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1.3	6.2	5.5	10	17	12	10	15	230	223	2.7	1.1
2	1.3	6.2	7.3	10	18	12	9.7	16	256	205	.70	.90
3	1.3	5.9	8.5	11	18	12	10	22	328	191	1.5	1.1
4	1.3	5.5	8.6	14	18	12	10	28	375	179	1.0	.80
5	1.3	5.1	13	17	15	12	10	23	368	157	.30	.90
6	1.3	5.5	17	18	13	13	11	20	468	135	.70	1.0
7	1.3	5.5	16	18	14	13	11	19	622	117	.70	1.2
8	1.3	5.5	16	17	14	12	10	20	644	104	.50	.80
9	1.3	6.2	16	15	15	12	9.8	20	482	86	.90	.90
10	1.3	6.6	16	12	15	11	9.7	20	358	73	.80	1.3
11	1.3	5.9	16	11	16	11	9.4	31	322	58	.70	1.5
12	1.3	5.5	16	11	16	11	10	43	339	45	.70	1.3
13	1.3	6.6	16	12	18	11	12	49	407	37	1.0	.80
14	1.5	6.3	15	12	17	10	13	71	446	32	1.0	1.3
15	1.5	5.9	15	13	16	10	15	113	512	28	1.5	1.0
16	1.5	5.9	15	15	14	12	15	154	521	26	1.0	1.2
17	1.5	5.2	15	17	12	11	15	192	446	16	1.0	1.4
18	1.6	6.1	15	18	12	11	15	205	444	5.7	1.1	1.6
19	1.5	6.2	14	19	14	12	15	215	374	3.2	1.0	1.8
20	8.2	6.3	14	20	16	13	16	150	323	3.0	1.3	1.8
21	13	6.7	14	18	13	11	15	109	389	5.1	.90	1.8
22	13	6.6	14	15	10	12	19	89	407	1.8	.90	2.3
23	13	6.0	12	15	10	10	19	76	388	1.1	.80	2.5
24	3.9	5.9	10	16	11	10	19	72	392	1.0	1.3	2.0
25	1.5	6.2	11	18	12	11	21	69	404	1.0	1.0	2.0
26	4.4	5.4	13	20	12	10	18	67	292	1.1	2.0	2.0
27	4.8	5.3	15	17	12	9.0	16	74	233	.90	.90	2.0
28	4.8	5.0	16	16	12	8.0	15	89	213	.80	1.3	2.0
29	4.8	5.0	12	15	---	10	15	100	214	.70	2.3	2.1
30	5.1	5.0	10	14	---	11	14	139	225	2.3	.70	2.3
31	6.2	---	10	15	---	10	---	177	---	7.8	1.2	---
TOTAL	108.7	175.2	411.9	469	400	345.0	407.6	2487	11422	1747.50	33.40	44.70
MEAN	3.51	5.84	13.3	15.1	14.3	11.1	13.6	80.2	381	56.4	1.08	1.49
MAX	13	6.7	17	20	18	13	21	215	644	223	2.7	2.5
MIN	1.3	5.0	5.5	10	10	8.0	9.4	15	213	.70	.30	.80

WTR YR 1975 TOTAL 18052.00 MEAN 49.5 MAX 644 MIN .30

1976 WY UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

13054600 CANYON CREEK AT HWY 33 NR NEWDALE ID PROCESS DATE: 15-AUG-86 10:37 EMW
LAT 435044 LONG 1112641 STATE 16 COUNTY 065 DATUM OF GAGE: DRAINAGE AREA: 79.9

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1.8	14	16	15	11	12	16	60	332	64	3.6	1.5
2	2.0	14	17	15	11	11	16	75	386	56	2.1	.43
3	2.0	16	18	14	12	11	16	89	399	51	2.5	1.1
4	2.0	16	17	14	12	10	18	140	419	43	4.2	.38
5	2.1	15	17	14	15	11	31	127	397	38	4.2	1.4
6	1.6	16	19	14	10	12	34	127	391	32	.53	1.2
7	1.6	16	21	14	11	12	35	138	384	23	.43	1.8
8	2.7	16	20	14	11	12	44	161	354	16	1.1	1.8
9	2.7	11	19	14	12	12	48	177	314	13	1.3	1.8
10	2.7	13	17	12	12	12	46	196	285	4.3	.65	1.9
11	2.7	12	17	12	12	12	55	252	305	1.2	1.5	1.8
12	2.9	11	18	13	12	12	73	256	231	.24	1.2	2.1
13	3.2	12	15	11	12	12	66	233	183	.30	1.6	2.1
14	4.5	13	14	12	12	12	56	264	143	.29	1.6	2.2
15	6.6	14	14	13	12	12	60	352	109	.44	2.3	2.1
16	6.6	15	15	13	12	12	60	332	107	.87	2.6	2.1
17	6.6	15	14	13	12	13	55	318	113	.82	.76	2.6
18	6.6	15	15	13	12	14	49	376	111	.76	1.0	2.8
19	7.6	13	15	12	12	16	49	447	110	1.5	2.0	1.9
20	7.0	12	15	11	11	13	53	445	126	.39	1.8	1.8
21	7.0	12	15	11	10	13	57	431	153	.27	.01	1.7
22	7.8	13	15	11	11	14	51	399	142	.49	.84	1.8
23	7.9	14	15	12	12	15	51	406	122	1.9	2.1	1.9
24	6.7	15	15	12	12	14	56	438	91	.89	2.4	1.9
25	6.3	15	15	12	13	16	67	382	81	.88	1.1	1.9
26	8.8	14	15	11	12	14	65	371	73	.80	2.1	1.9
27	8.5	15	15	11	12	14	67	369	65	.00	2.1	2.4
28	8.9	16	13	12	12	14	60	397	57	.22	2.1	2.6
29	15	16	14	12	12	13	53	419	57	.60	2.1	2.3
30	15	15	15	12	---	13	46	406	61	1.4	2.1	4.0
31	15	---	14	12	---	14	---	354	---	2.2	1.9	---
TOTAL	182.4	424	494	391	342	397	1453	8937	6101	356.76	55.82	57.21
MEAN	5.88	14.1	15.9	12.6	11.8	12.8	48.4	288	203	11.5	1.80	1.91
MAX	15	16	21	15	15	16	73	447	419	64	4.2	4.0
MIN	1.6	11	13	11	10	10	16	60	57	.00	.01	.38

CAL YR 1975 TOTAL 18456.60 MEAN 50.6 MAX 644 MIN .30
WTR YR 1976 TOTAL 19191.19 MEAN 52.4 MAX 447 MIN .00

13054600 CANYON CREEK AT HWY 33 NR NEWDALE ID PROCESS DATE: 15-AUG-86 10:37 EMW
LAT 435044 LONG 1112641 STATE 16 COUNTY 065 DATUM OF GAGE: DRAINAGE AREA: 79.9

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	8.5	12	11	8.4	11	10	12	44	19	.03	.13	.00
2	9.6	12	12	8.2	12	10	11	40	6.9	.04	.13	.00
3	22	12	11	8.0	12	10	10	44	13	.01	.00	.00
4	17	12	10	8.0	10	9.5	13	39	8.8	.00	.00	.00
5	13	11	9.5	7.0	10	9.4	18	33	6.5	.01	.18	.00
6	15	11	9.0	6.0	10	9.4	31	31	4.1	.00	.21	.23
7	16	11	8.5	5.8	10	9.8	44	34	2.2	.02	.28	.00
8	16	11	11	5.6	10	9.9	125	37	2.0	.01	.36	.22
9	14	11	10	5.0	10	10	81	39	.02	.01	.03	.05
10	14	11	9.0	6.0	10	10	39	44	.04	.00	.16	.69
11	14	10	9.5	7.0	10	9.5	33	40	.09	.00	.06	.87
12	14	8.0	10	8.0	11	9.4	31	35	.21	.00	.36	.87
13	14	6.0	10	8.5	11	9.6	29	35	.13	.00	.07	.76
14	14	6.5	9.5	9.0	11	9.6	33	37	.00	.00	.22	.51
15	14	8.0	9.2	9.2	11	10	26	43	.03	.00	.16	.52
16	14	9.0	8.9	9.4	11	11	28	43	.40	.00	.00	.13
17	14	10	9.4	9.6	11	10	36	47	.32	.00	.09	.20
18	13	10	10	9.6	11	10	26	41	.33	.00	.00	.20
19	12	9.5	10	10	11	10	24	42	.88	.00	.00	.24
20	12	9.0	9.6	11	11	12	24	39	.08	.00	.02	.24
21	12	7.0	9.5	11	11	11	26	39	.00	.00	.00	.44
22	12	10	9.0	10	11	11	29	46	.00	.00	.11	1.4
23	14	8.0	8.8	11	11	18	34	55	.00	.00	.10	1.6
24	13	9.0	8.6	11	10	16	41	58	.04	.00	.24	1.8
25	13	10	8.4	9.0	10	12	43	50	.10	.00	.17	1.8
26	13	6.0	9.0	7.5	10	10	43	40	.01	.00	.38	1.9
27	12	3.0	9.5	8.5	10	11	48	25	.05	.00	.55	2.1
28	12	3.5	10	9.0	10	12	46	30	.02	.12	.62	2.1
29	12	4.5	10	9.5	---	11	41	27	.00	.04	.05	2.2
30	13	7.0	9.5	10	---	10	41	23	.00	.02	.16	4.3
31	12	---	8.0	10	---	10	---	16	---	.00	.00	---
TOTAL	418.1	268.0	297.4	265.8	297	331.1	1066	1196	65.25	.31	4.84	25.37
MEAN	13.5	8.93	9.59	8.57	10.6	10.7	35.5	38.6	2.17	.01	.16	.85
MAX	22	12	12	11	12	18	125	58	19	.12	.62	4.3
MIN	8.5	3.0	8.0	5.0	10	9.4	10	16	.00	.00	.00	.00

CAL YR 1976 TOTAL 19074.29 MEAN 52.1 MAX 447 MIN .00
WTR YR 1977 TOTAL 4235.17 MEAN 11.6 MAX 125 MIN .00