WATER QUALITY STATUS REPORT NO. 88

DEEP CREEK
Latah County, Idaho
1988

Idaho Department of Health and Welfare
Division of Environmental Quality
Water Quality Bureau
Boise, Idaho

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ABSTRACT

The Latah Soil and Water Conservation District (SWCD) applied for an Idaho Agriculture Nonpoint Source Pollution Abatement planning grant with the Idaho Division of Environmental Quality (DEQ) in November of 1986. Deep Creek had been identified by the DEQ and SWCD as a first priority stream segment in the Nonpoint Source Pollution Abatement program. Current designated uses as presented in the Idaho Water Quality Standards and Wastewater Treatment Requirements for Deep Creek are as a domestic and agricultural water supply, primary and secondary contact recreation, as well as cold water biota.

A water quality study was conducted from February 8, 1987 to August 10, 1988. The objectives of the study were to: 1) determine water quality in various reaches and subwatersheds; 2) document the effects of snowmelt and storm event runoff on the water quality of Deep Creek.

Deep Creek is about ten miles long and flows to the south from the Mary Minerva McCrosky State Park eventually joining the Palouse River approximately two miles west of Potlatch, Idaho. Elevations range from 2500 feet at the mouth to over 4300 feet at the summit of Mission Mountain. Approximately 24,190 acres are included in the watershed with 77% in private ownership, 12% held by the State of Idaho, and 11% federally managed. Fifty farming operations have divided the private lands into the following uses: 9040 acres (48%) of cropland, 1580 acres (8%) of hay and pasture, 7580 acres (41%) of woodland, and 470 acres (3%) of other uses. The state and federal lands are all woodland. Lower Deep Creek is a low gradient stream with a sand and gravel streambed and has a moderately entrenched channel.

The designated beneficial uses are adversely affected by pollutants from nonpoint sources. Primary pollutants are suspended sediment, ammonia, nitrite and nitrate, total Kjeldahl nitrogen, total phosphorus, fecal coliform and fecal streptococcus bacteria. The majority of sediment and nutrient transport occurs during the spring snowmelt period. Cattle are the likely source of bacterial contamination in stream reaches below station S-3. Agricultural practices affecting stations S-3, S-4, S-5, S-6, have increased nitrogen and phosphorus concentrations.

Cultural alteration of riparian vegetation and streambanks has caused streambank instability. The result is an increase in channel erosion and sediment transport, decreases in streamflow during the base flow period, and a decrease in fish habitat diversity.

An Agricultural Nonpoint Source Pollution Abatement Program targeted to implement Best Management Practices should mitigate some of the impacts of agriculture on water quality in Deep Creek. An implementation plan submitted by the Latah SWCD should emphasize the following actions: 1) Use of appropriate conservation practices to reduce soil erosion from critical acreages; 2) implement methods to reduce excessive phosphorus and nitrogen loads to Deep Creek from dryland agriculture and livestock sources; 3) mitigate bacterial sources affecting the water quality of Deep Creek; 4) stabilize eroded streambanks within the watershed; 5) enhance and increase the vegetative diversity of riparian areas; and 6) sample domestic wells downstream of station S-3 to determine nitrate concentrations.

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INTRODUCTION

The Latah Soil and Water Conservation District (SWCD) applied for an Idaho Agriculture Nonpoint Source Pollution Abatement planning grant with the Idaho Division of Environmental Quality (DEQ) in November of 1986. Deep Creek had been identified by the DEQ and SWCD as a first priority stream segment in the Nonpoint Source Pollution Abatement program. The planning grant process was designed to determine the suitability of the Deep Creek watershed for implementation caused by agricultural practices. Part of the planning process included a water quality monitoring study of Deep Creek during the period of February 8, 1987 to August 10, 1988.

Current designated benefical uses of Deep Creek are as a domestic and agricultural water supply, primary and secondary contact recreation, as well as cold water biota.

Purpose

The Deep Creek subwatershed is part of the Palouse River watershed, which has been identified as a First Priority Stream Segment (No.CB-170) through the Idaho Agriculture Pollution Abatement process. As such, it is considered to have significant water quality impacts which may be attributable to agricultural practices.

The Latah Soil & Water Conservation District submitted a preapplication for planning in the Deep Creek watershed. The Lewiston Field Office of the Division of Environmental Quality conducted a water quality study in anticipation of future planning and implementation of conservation practices in the watershed.

Background

Deep Creek watershed is located in the northwest corner of Latah County. Excellent road access is provided by U. S. Highway 95 which traverses the eastern edge of the watershed. The creek is about ten miles long and flows to the south from the Mary Minerva McCrosky State Park eventually joining the Palouse River approximately two miles west of Potlatch, Idaho. Elevations range from 2500 feet at the mouth to over 4300 feet at the summit of Mission Mountain. Approximately 24,190 acres are included in the watershed with 77% in private ownership, 12% held by the State of Idaho, and 11% federally managed.

Fifty farming operations have divided the private lands into the following uses: 9040 acres (48%) of cropland, 1580 acres (8%) of hay and pasture, 7580 acres (41%) of woodland, and 470 acres (3%) of other uses. The state and federal lands are all woodland. The watershed soils can be divided into three groups: nearly level silt loam soils on valley floors, moderately steep silt loams on uplands, and very steep loams on canyons and mountains.

Stream Classification

Deep Creek is classified as a C4 stream type using Rosgen's (1986) morphological stream classification. The C4 stream type applies to the lower four miles of the stream from station S-3 downstream to the mouth. The C4 stream type is characterized by a gradient of about 1.0 percent, sinuosity of 2.5, width to depth ratio greater than 5, a sand bed with mixtures of gravel and silt, a moderately entrenched channel with slight valley confinement, and low flood terraces of fine textured alluvium.

Additional stream sub-type modifiers include the following: 1) organic debris, D-2, which is infrequent and of small floatable size; 2) riparian vegetation, V-5, which is predominately grass; 3) stream size, S-5, at bankfull width which is 40 feet; and 4) flow regimen, S-1, which is seasonally subterranean with streamflow dominated by snowmelt runoff. Depositional features include point bar formation, B-2, with regular meander, M-1.

Study Objectives

Deep Creek is similar to other Palouse River tributaries. The majority of stream flow is generated through the accumulation of a winter snowpack and the resulting spring runoff. The stream is apparently intermittent over much of its length during the summer/fall season.

The objectives of the study were to: 1) determine water quality in various reaches and subwatersheds; 2) document the effects of snowmelt and storm event runoff on the water quality of Deep Creek.

METHODS

Sample Stations

Six sample sites were chosen to divide the watershed according to predominant land usage (Figure 1). STORET (Storage and Retrieval computer data system) descriptions are listed in Table 1.

Station 1, S-1, is located on the Middle Fork at a county bridge crossing, approximately 1 mile above its confluence with the East Fork. The woodlands above the station are 50% privately owned and 50% State owned. There is some logging activity on the private timber lands. Station map coordinates are SE 1/4, NW 1/4, Sec.2, T42N, R5W on USGS 15' topographic map.

Station 2, S-2, is located on the West Fork at a county road crossing. Approximately 4 square miles of federally owned timber land lies above the station and the land is covered in second growth timber. Map coordinates are SE 1/4, SW 1/4, Sec. 35., T43N, R5W.

Station 3, S-3, is located on Deep Creek below the confluence of the three headwater streams at a county road bridge crossing. Mixed land use above this site is timber, dryland cropping, and hay/pasture. Map coordinates are NW 1/4, SW1/4, Sec. 11, T42N, R5W.

Station 4, S-4, is located two miles above the mouth on Deep Creek. It is located above a county bridge crossing, 1/4 mile west of Highway 95. The station delineates the contribution of water quality constituents from the central corridor of Deep Creek. The majority of dryland agriculture occurs in this area. Map coordinates are NW 1/4, NW 1/4, Sec. 26, T42N, R5W.

Station 5, S-5, monitors a tributary that drains 5 square miles of cultivated cropland. The station is located below a small bridge that accesses a homestead in the NE 1/4, NE 1/4, Sec. 35, T42N, R5W.

Station 6, S-6, is located near the mouth of Deep Creek about 1,500 feet upstream from its confluence with the Palouse River. The station is located below the Highway 95 bridge in the NW 1/4, NW 1/4, Sec. 2, T41N, R5W.

FIGURE 1: MAP OF DEEP CREEK WATER QUALITY MONITORING STATIONS DURING 1987-1988

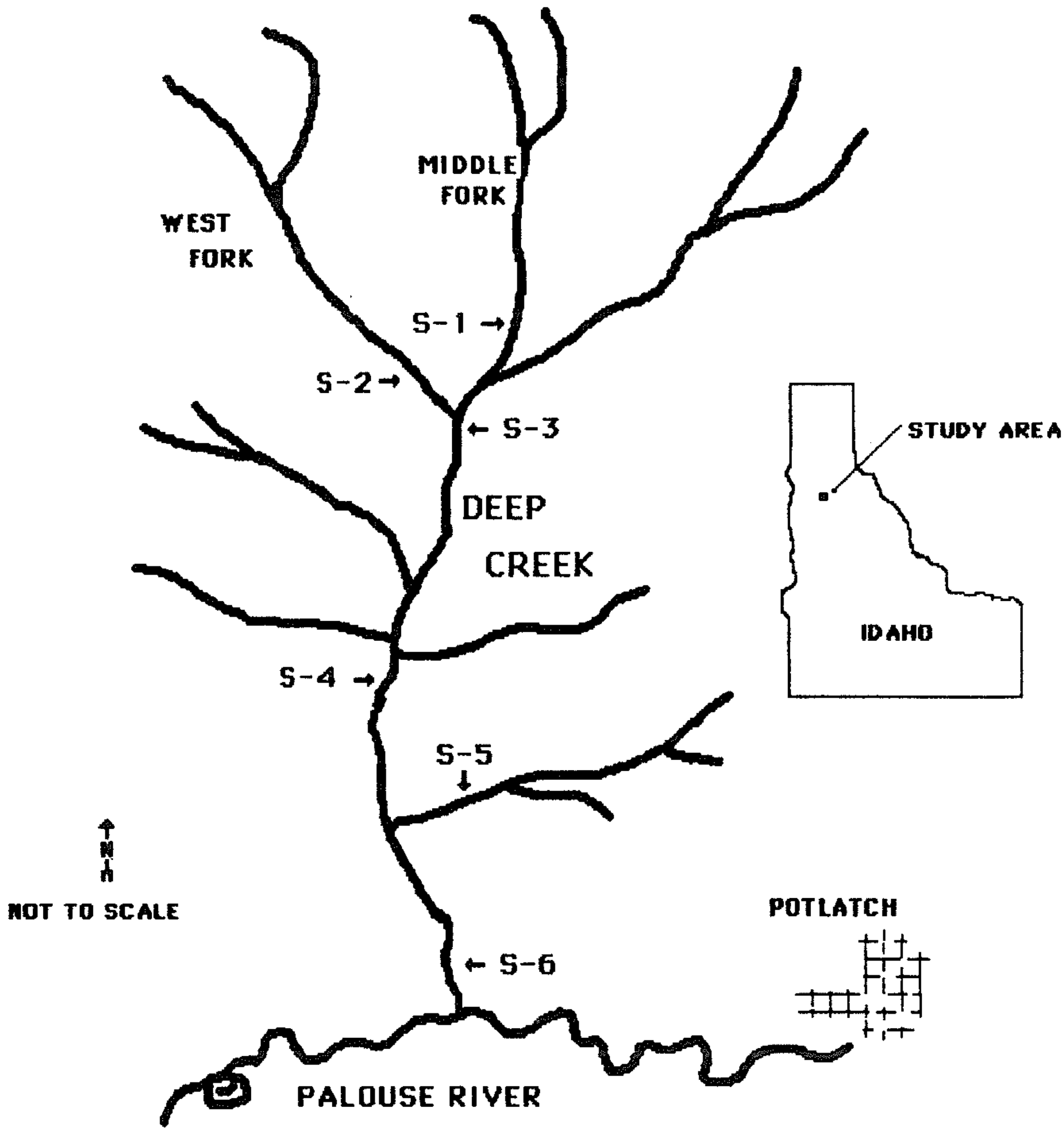


TABLE 1: List of Deep Creek monitoring stations, Latah County, Idaho

Station	Description	Latitude/Longitude	River Mile	Elevation	Storet Numbers
S-1	West Fork Deep Creek	47°01'08"/ 116°55'50"	324.3/59.5/133.2 5.9/1.1	2650'	2020318
S-2	Middle Fork Deep Creek	47°00'50"/ 116°54'40"	324.3/59.5/133.2 6.3/0.8	2630'	2020317
S-3	Deep Cr. 4 miles from mouth	47°00'00"/ 116°55'20"	324.3/59.5/133.2 5.5	2600'	2020323
S-4	Deep Cr. 2 miles from mouth	46°57'40"/ 116°56'02"	324.3/59.5/133.2 2.0	2523'	2020320
S-5	Tributary 1/2 mi. E. Hwy US 95	46°56'48"/ 116°55'10"	324.3/59.5/133.2 1.5/0.7	2590'	2020321
S-6	Deep Creek near mouth	46°55'40"/ 116°55'20"	324.3/59.5/133.2 0.5	2483'	2020322

Sampling Frequency

The study was designed to monitor water quality during spring and storm runoff events when the maximum influx of nutrients and suspended sediment typically occurs. These peak events usually occur in the spring from rain on snow events.

A sample schedule was established that provided flexibility to respond to storm events as they occurred. Intermediate data were gathered approximately every two weeks to provide information on water quality "normal" spring flows. Two additional samples were taken in the late spring to characterize ambient conditions at low flows. Thirteen sample sets were taken.

Parameters

Agricultural practices may contribute substantially to the sedimentation and nutrient loading of Deep Creek and subsequently to the Palouse River. Some of the sample parameters provide an indication of nutrients typically leached from farm fields. Other parameters are general indicators of water quality which highlight changes in designated beneficial uses of a particular stream segment (Table 2).

Total contribution of solute loads for a single day was determined by assuming that a grab sample was representative of a 24 hour period. Different subwatersheds or stations were compared to each other by using only those data collected on the same day at each station. Thus, data from the same climatological events could be compared.

Discharge

The mid-point method to determine stream discharge was used in this study as described by the U. S. Geological Survey (U.S.G.S., 1977). The total instantaneous stream discharge is calculated from the cross-sectional area of the stream and the stream velocity.

Direct measurement of velocity and depth was made with a Marsh McBirney, Model 201, current meter and wading rod. During high flow a sounding reel, bridge board, and Model 201 meter were used to measure velocity and depth from bridges.

Table 2. Sample parameters for Deep Creek water quality study.

Parameter	**Units**	**STORET***
Stream Discharge	cfs	00061
Water Temperature	°C	00010
pH	S.U.	00400
Conductivity	µmho/cm	00665
Suspended Sediments	mg/l	80154
Total phosphorus (T-P)	mg/l	00665
Dissolved orthophosphate (DOP)	mg/l	00671
Total Kjeldahl nitrogen (TKN)	mg/l	00625
Nitrate + Nitrite (NO2+NO3)	mg/l	00630
Fecal coliform	#/100 ml	31616
Fecal streptococcus	#/100 ml	31679

pH

The pH of water is a measure of its hydrogen ion concentration. Many chemical reactions are affected by the pH. On-site pH measurements were obtained with a Corning, Model #103, pH meter.

Conductivity and Temperature

Conductivity is a numerical expression of the ability of a water sample to carry an electrical current. It is dependent on the total concentrations of the total dissolved solids and salts in the water (APHA, 1985). Conductivity and temperature measurements were taken with a YSI, Model 33, SCT meter. Conductivity was corrected to 25 degrees centigrade.

Suspended Sediment

Suspended sediment concentrations are one of the primary indicators of nonpoint source pollution. Suspended sediment consists of soil particles that are entrained in the water column from three inches above the stream bottom to the top of the water column (Clark, 1985).

Nitrogen

Total organic nitrogen concentrations were determined by the Total Kjeldahl Nitrogen (TKN) process, which does not distinguish between organic and ammonia nitrogen compounds. The organic fraction may be estimated by subtracting the ammonia concentration from the TKN concentration. The inorganic nitrogen fraction includes the ammonia and nitrite + nitrate concentrations. All samples analyzed for the nitrogen fractions were preserved with 2 ml. of sulfuric acid and shipped on ice to the Idaho State Bureau of Laboratories for analysis.

Phosphorus

The major forms of phosphorus monitored during the study were total phosphorus (TP) and dissolved orthophosphate (DOP). Total phosphorus includes all the forms of phosphorus present in the sample. Dissolved orthophosphate is the dissolved fraction, and is the form most readily available for biological processes.

Total phosphorus samples were preserved with 2 ml. of concentrated sulfuric acid. The samples analyzed for dissolved orthosphosphate were filtered on site through a 0.45 um prewashed membrane filter and sent on ice to the State laboratory in Boise for analysis.

Bacteria

Samples for bacterial analysis were collected in sterile, 250 mg. bottles. The samples were refrigerated for analysis by the North Central District Health Department Laboratory in Lewiston.

Quality Assurance

The project served as part of a series of quality assurance checks by DEQ on precision of sampling procedures. Duplicate samples were collected from stations S-6 on different dates. The methods used to estimate the average relative range for precision followed (Bauer, 1986).

RESULTS AND DISCUSSION

Discharge

The Deep Creek drainage is subject to annual discharge extremes. Stream flows at the mouth (S-6) during the two year study period ranged from 0 to 164 cubic feet per second (CFS). Our measured maximum flow of 164 CFS on March 3, 1987 is only 19% of the two year discharge reoccurrence interval and 11% of the ten interval of 866 and 1550 CFS, respectively (USGS 1980). Several factors contributed to the small amount of stream flow originating from the watershed. Primarily, precipitation was 70% of normal for both winter periods (October through April) in 1986-7 and 1987-8 (Table 3). The spring snowmelt occurring in February and March of both 1987 and 1986 from rain on snow events. The snowmelt period lasted about a month to six weeks. These relatively slow melt conditions did not produce an extreme peak in the hydrograph. Also, a large portion of the precipitation that fell infiltrated into the ground due to low soil moisture conditions.

TABLE 3: MONTHLY PRECIPITATION (INCHES) AND PRECIPITATION FOR OCTOBER THROUGH APRIL DURING DEEP CREEK STUDY
(DATA RECORDED AT POTLATCH, IDAHO)

MONTHLY PRECIPITATION

PERIOD	MONTH												ANNUAL PRECIP.	% OF NORMAL
	J	F	M	A	M	J	J	A	S	O	N	D		
1921-87	3.43	2.39	2.14	1.96	2.07	1.86	0.76	1.07	1.14	1.86	2.74	3.57	25.01	-
1986	3.14	4.00	2.14	2.18	2.59	0.49	1.13	1.00	2.83	0.73	3.75	1.39	25.37	101
1987	2.01	1.88	2.68	1.07	2.21	1.54	1.86	0.57	0.02	0.00	1.33	2.83	18.00	72
1988	2.58	1.54	2.94	2.36	2.24	2.25	1.16	0.10	2.37	0.61	4.52	1.38	24.05	96

PERCENT OF NORMAL PRECIPITATION FOR OCTOBER THROUGH APRIL

PERIOD		ANNUAL PRECIP.	% OF NORMAL
1921-87		19.23	-
1986-87	(DATA FROM ABOVE TABLE)	13.51	70
1987-88		13.58	70

The lower two miles of Deep Creek lacked surface flow from S-4 downstream to S-6 during the summer-fall period. Although tributaries (S-1, S-2) in the forested upper watershed were producing surface flows during the summer-fall period, flowing water was not evident in the stream reaches downstream of S-4.

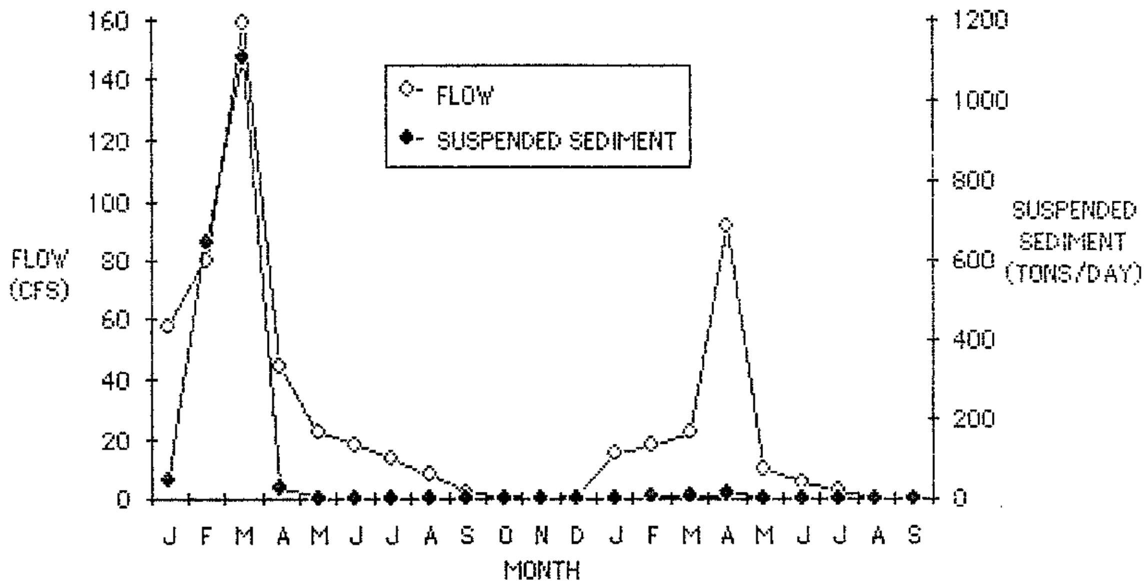
The modification of riparian vegetation and streambanks from agricultural practices have probably reduced the groundwater level and dewatered the channel from S-3 downstream to the mouth. Bohn (1987) found dry stream channels with severely degraded riparian vegetation to resume surface flow when riparian conditions improved.

Suspended Sediment

Suspended sediment discharge of Deep Creek at S-4 ranged from 0.1 to 1113.8 tons per day for corresponding stream flows of 6.5 and 150.0 CFS (Figure 2). Suspended sediment (SS) concentrations increased from upstream to downstream sampling stations as expected. For example, on 2-10-88 upstream stations S-1 and S-2 both had SS concentrations of 2 mg/l with a combined flow of 6.7 CFS, while S-6, at the mouth of Deep Creek, had SS concentration of 206 mg/l and a stream flow of 21.0 CFS. These SS concentrations equal 0.036 and 11.680 tons/day SS discharge for S-1 plus S-2 and S-6 respectively. Other SS samples collected during the hydrograph show a similar trend. The difference in sediment loading between upstream and downstream stations can be attributed primarily to agricultural practices in the lower watershed.

Examination of land use practices, channel condition, and water quality data indicate that agricultural practices are the primary cause of water quality degradation in the watershed. Station S-3 monitors fifty-four percent of Deep Creek's watershed area (Figure 1). The subwatershed is forested land currently with a low level of timber harvest. Forested stream reaches above S-3 had lower SS concentrations (as indicated above for 2-10-88), greater channel stability, and a more diverse riparian community with a greater woody vegetation component than stream reaches below S-3. Agriculture is the dominant land use from S-3 to S-6. Agriculturally influenced stream reaches below S-3 have channel stability problems resulting from stream bank modification and riparian vegetation alteration.

FIGURE 2 : DEEP CREEK (S-4) INSTANTANEOUS STREAM FLOW (CFS) AND SUSPENDED SEDIMENT DISCHARGE (TONS/DAY) RELATIONSHIP FOR 1987-1988 (SOME VALUES ESTIMATED SEE APPENDIX A)



Eroding stream banks and channel migration are common. The channel has little hydraulic control due to the lack of large organic debris or large substrate. The riparian community is now comprised solely of exotic reed canary grass along many stream reaches. Crop cultivation adjacent to the stream and intensive livestock grazing of the stream banks limit riparian succession and recovery. In addition to agricultural surface erosion, unstable eroding stream banks are probably a major contributor to total sediment loading. During the study, stream flows increased an average of 37% through the agricultural stream reach of S-3 to S-6 while suspended sediment concentration increased an average of 76% through the same reach. The estimated suspended sediment discharge of Deep Creek during the peak flow period may be as high as 6400 tons/day for two year flow events and 11,500 tons/day for ten-year flow events.

Nitrogen

Cultural addition of nitrogen may enrich aquatic communities by increasing primary production. In most cases undesirable conditions result. Toxic algae blooms and the threat to human health are a documented result of nitrogen increases. Our data indicate that agricultural practices in the Deep Creek watershed have increased surface water concentrations of nitrogen.

Table 4 displays an increase in ammonia, nitrite and nitrate, and total Kjeldahl nitrogen from upstream forested tributaries (S-1, S-2) to downstream agricultural influenced water quality monitored at S-3, S-4, and S-6. Tributary S-5 used extensively for dryland agriculture had the highest mean nitrite and nitrate, concentration of 8.7 mg/l. Mean concentration of nitrite and nitrate in the mainstem (S-3, S-4, S-6) of Deep Creek was 4.821 mg/l.

Bacteria

Fecal coliform (FC) and fecal streptococcus (FS) bacteria are used as indicators of bacterial water pollution because of their presence in the intestinal tract of warm blooded animals. Although these bacteria are not ordinarily considered disease causing organisms, other pathogens associated with them in the intestine may cause illness. The ratio of fecal coliform to fecal strep greater than 0.7 is generally accepted as an indicator of fecal contamination from livestock.

TABLE 4: RANGE AND MEAN OF NITROGEN SPECIES (MG/L) FOR DEEP CREEK STATIONS DURING 1987 AND 1988
(n varies see APPENDIX A)

STATION		NH3	NO2+NO3	TKN
S-1 Headwaters (Forest land)	RANGE	0.006-0.080	0.028-0.333	0.02-1.46
	MEAN	0.040	0.170	0.34
S-2 Headwaters (Forest land)	RANGE	0.007-0.081	0.016-1.480	0.01-0.48
	MEAN	0.037	0.473	0.24
S-3 Mainstem (Ag land)	RANGE	0.027-0.567	0.282-9.110	0.26-29.00
	MEAN	0.270	5.490	4.33
S-4 Mainstem (Ag land)	RANGE	0.014-0.346	1.380-23.700	0.30-7.02
	MEAN	0.084	5.644	1.70
S-5 Tributary (Ag land)	RANGE	0.080-0.651	0.290-17.100	1.01-5.86
	MEAN	0.288	8.727	2.03
S-6 Mouth (Ag land)	RANGE	0.004-0.367	0.490-12.600	0.30-1.50
	MEAN	0.088	3.330	0.76

Stations S-3, S-4, and S-6 downstream of S-1 and S-2 have significantly higher counts of fecal bacteria (Table 5). During the study FC/FS geometric mean ratios were greater than 0.7 of all stations except S-4 indicating that the livestock in the riparian areas are degrading water quality. State water quality standards were exceeded for secondary contact recreation at Station S-3 and at the mouth, S-6, on 3/3/87 amd 3/23/87, respectively.

Phosphorus

Phosphorus is usually the limiting factor of primary production in aquatic systems. Phosphorus enrichment of streams and lakes from cultural activities can produce changes in plankton populations and macrophyte communities. For example, undesirable increases in numbers and change in community structure may increase the eutrophication rate of natural waters. Recommended total phosphorus concentration for streams is 0.1 mg/l and for streams that feed lakes the recommended standard is 0.05 mg/l (US EPA, 1973). Mean total phosphorus concentration exceeded the recommended standard of 0.1 mg/l at all Deep Creek stations. TP concentrations ranged from 0.5 to 9.77 mg/l with S-3 having the highest mean concentration of 1.58 mg/l. Although TP concentrations were higher at the agricultural influenced water quality monitoring stations (S-3, S-4, S-5, and S-6), mean concentration measured at the mouth (S-6) was lowest of these stations, 0.27 mg/l (Table 6).

Dissolved orthophosphate (DOP) is the form of phosphorus which is most available for biological processes (Clark 1986). DOP concentrations ranged from 0.001 to 0.161 mg/l with S-5 having the highest mean DOP concentration of 0.099 mg/l. DOP concentrations increased downstream with the highest mean concentration, 0.040 mg/l, recorded at the mouth, S-6.

pH, Conductivity,and Temperature

We did not measure any pH values that exceeded the EPA (1986) criteria range of 6.5-9.0 for freshwater aquatic life. Mean pH at the mouth of Deep Creek, S-6, was 7.3.

TABLE 5: BACTERIOLOGICAL DATA (COLONIES/100ML) FOR DEEP CREEK STUDY DURING 1987 AND 1988

STATION	n	FECAL COLIFORM MINIMUM	FECAL COLIFORM MAXIMUM	GEOMETRIC MEAN	FECAL STREPTOCOCCUS MINIMUM	FECAL STREPTOCOCCUS MAXIMUM	GEOMETRIC MEAN	RATIO FC:FS
S-1	6	2	100	18	2	146	24	0.75
S-2	5	2	229	27	5	99	30	0.90
S-3	6	62	2200	316	22	1900	205	1.54
S-4	6	2	600	57	2	2200	92	0.62
S-5	5	46	700	137	57	2000	86	1.59
S-6	6	73	1100	176	10	3800	144	1.22

TABLE 6 : RANGE AND MEAN OF TOTAL PHOSPHOROUS AND DISSOLVED ORTHOPHOSPHATE CONCENTRATIONS (MG/L) FOR DEEP CREEK DURING 1987 AND 1988
(n varies see APPENDIX A)

STATION		TOTAL PHOSPHOROUS	DISSOLVED ORTHOPHOSPHATE
S-1 Headwaters (forest land)	RANGE	0.05-0.80	0.001-0.056
	MEAN	0.17	0.021
S-2 Headwaters (forest land)	RANGE	0.05-0.29	0.007-0.068
	MEAN	0.11	0.020
S-3 Mainstem (Ag land)	RANGE	0.08-9.77	0.018-0.059
	MEAN	1.58	0.036
S-4 Mainstem (Ag land)	RANGE	0.09-3.45	0.012-0.076
	MEAN	0.71	0.033
S-5 Tributary (Ag land)	RANGE	0.18-2.29	0.029-0.161
	MEAN	0.70	0.099
S-6 Mouth (Ag land)	RANGE	0.05-1.00	0.007-0.088
	MEAN	0.27	0.040

Mean conductivity increased from upstream to downstream stations. Mean conductivity values for the upper forested stations (S-1 and S-2) were 54 µhmos/cm while downstream in the agricultural stream reaches (S-3,S-4, S-6) mean conductivity was 158 µhmos. Tributary S-5 had the highest mean conductivity of any station, 240 µhmos/cm.

Highest measured water temperature was 11.0° C recorded at stations S-4 and S-6 on 6/1/88. Although temperature probably exceeds 11.0° C in June and July of most years, lower Deep Creek is dry during August when maximum stream temperatures are usually recorded.

CONCLUSIONS

1) Designated beneficial uses for Deep Creek, as defined by Idaho Water Quality Standards and Wastewater Treatment Requirements, are adversely affected by pollutants from nonpoint sources in the watershed. Primary pollutants are suspended sediment, ammonia, nitrite and nitrate, total Kjeldahl nitrogen, total phosphorus, fecal coliform and fecal streptococcus bacteria.

2) The majority of sediment and nutrient transport occurs during the spring snowmelt period.

3) Livestock are the likely source of bacterial contamination in stream reaches below S-3.

4) Agricultural practices affecting stations S-3, S-4, S-5, S-6, have increased nitrogen and phosphorus concentrations.

5) Cultural alteration of riparian vegetation and streambanks has caused streambank instability. The result is an increase in channel erosion and sediment transport, decreases in streamflow during the base flow period, and a decrease in fish habitat diversity.

RECOMMENDATIONS

1) An Agricultural Nonpoint Source Pollution Abatement Program targeted to implement Best Management Practices should mitigate some of the impacts of agriculture on water quality on Deep Creek.

2) An implementation plan submitted by the Latah SWCD should emphasize.

   A) Reduction of soil erosion from critical acreages.

   B) Reduction of the excessive phosphorus and nitrogen loads from dryland agriculture and livestock.

   C) Mitigation of bacterial sources close to the streams of Deep Creek.

   D) Stabilization of eroded banks.

   E) Enhance and increase diversity of riparian areas.

3) Domestic wells downstream of S-3 should be sampled to determine nitrate concentrations.

ACKNOWLEDGEMENTS

Ray Latham collected the field data during 1986. Kerby Cole assisted with field work during 1987. The Idaho Department of Health and Welfare, Bureau of Laboratories conducted the laboratory analysis. Cecilia Dale assisted with data processing and editorial review. Bill Clark and Irene Nautch provided helpful technical and editorial assistance.

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U.S. Geological Survey, 1980. Using channel geometry to estimate flood flows at ungaged sites in Idaho. Water-Resources Investigations 80-32. Boise, Idaho.

APPENDIX A-DATA

STATION	DATE	TEMP.	FLOW	COND. µhmos	pH	NH3	NO2+ NO3	TKN	TOTAL P	D.ORTHO P	S.S.	S.S.
S-1		°C	CFS	@25°C	S.U.	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ton/day
	2/5/87	3.0	8.0	48	6.7	-	0.333	0.31	0.14	-	38	0.821
	2/9/87	-	16.0	-	-	0.013	0.280	0.29	0.11	-	-	
	2/16/87	-	32.0	-	-	0.042	0.209	0.34	0.09	-	-	
	2/23/87	-	7.6	-	-	0.042	0.111	0.37	0.08	-	4	0.082
	3/2/87	-	54.0	-	-	0.080	0.162	1.46	0.80	-	892	130.054
	3/3/87	12.0	56.5	43	6.8	0.049	0.221	0.57	0.33	0.007	106	16.170
	3/9/87	-	27.0	-	-	0.024	0.064	0.23	0.07	-	-	
	3/16/87	-	56.5	-	-	0.025	0.029	0.16	0.06	-	10	1.526
**	3/23/87	4.0	6.3	42	6.8	0.008	0.028	0.16	0.07	0.044	9	0.153
	11/10/87	-	0.1	-	-	-	-	-	-	-	-	
	2/10/88	2.0	1.4	50	6.8	0.027	0.310	0.02	0.32	0.001	2	0.008
	2/22/88	5.0	1.5	48	6.9	0.011	0.259	0.04	0.05	0.001	6	0.024
	4/4/88	4.0	26.1	33	7.1	0.035	0.079	0.24	0.07	0.056	34	2.396
	6/1/88	9.0	1.5	58	7.8	0.006	0.129	0.23	0.05	0.018	2	0.008
	8/10/88	-	0.1	-	-	-	-	-	-	-	-	

** denotes average of duplicate samples
- denotes parameter not measured
D. means dissolved
S.S. means suspended sediment

STATION	DATE	TEMP.	FLOW	COND. µhmos	pH	NH3	NO2+ NO3	TKN	TOTAL P	D.ORTHO P	S.S.	S.S.
S-2		°C	CFS	@25°C	S.U.	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ton/day
	2/5/87	5.0	2.0	77	6.6	-	1.400	0.28	0.10	-	48	0.259
	2/16/87	-	-	-	-	0.050	1.480	0.32	0.12	-	22	
	2/23/87	-	-	-	-	0.017	0.129	0.12	0.05	0.012	4	
	3/2/87	-	-	-	-	0.081	0.534	0.62	0.29	-	122	
	3/3/87	10.0	4.5	48	6.8	0.081	0.553	0.48	0.21	0.007	128	1.553
	3/9/87	-	-	-	-	0.019	0.100	0.16	0.05	-	-	
	3/16/87	-	-	-	-	0.023	0.078	0.13	0.05	-	8	
	11/10/87	-	0.1	-	-	-	-	-	-	-	-	
	2/10/88	2.0	5.3	106	6.8	0.031	0.139	0.01	0.18	0.007	2	0.029
	2/22/88	4.0	4.0	42	6.7	0.007	0.502	0.09	0.06	0.009	6	0.065
	4/4/88	4.0	13.2	58	7.2	0.049	0.273	0.22	0.05	0.680	2	0.071
	6/1/88	10.0	2.5	42	7.2	0.016	0.016	0.24	0.05	0.017	2	0.014
	10/8/88	-	0.2	-	-	-	-	-	-	-	-	

STATION	DATE	TEMP.	FLOW	COND. µhmos	pH	NH3	NO2+ NO3	TKN	TOTAL P	D.ORTHO P	S.S.	S.S.
S-3		°C	CFS	@25°C	S.U.	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ton/day
	2/5/87	5.0	21.0	116	6.7	-	7.670	9.91	4.80	-	6720	381.024
	2/16/87	-	-	-	-	0.567	1.770	2.10	0.86	-	-	
	2/23/87	-	-	-	-	0.085	8.880	0.91	0.20	-	60	
	3/2/87	-	-	-	-	1.220	8.110	29.00	9.77	-	15120	
**	3/3/87	9.0	137.5	174	7.0	0.127	9.110	3.33	1.47	0.029	6220	2309.175
	3/9/87	-	-	-	-	0.349	8.020	2.62	0.45	-	-	
	3/16/87	-	-	-	-	0.178	5.150	1.26	0.32	-	80	
	3/23/87	8.0	1.0	193	7.2	0.051	5.670	0.81	0.18	0.026	31	0.084
	11/10/88	-	0.1	-	-	-	-	-	-	-	-	
	2/10/88	3.0	5.3	239	7.4	0.308	6.680	0.76	0.66	0.590	90	1.288
	2/22/88	4.0	9.7	83	7.1	0.023	2.850	0.26	0.08	0.018	8	0.210
	4/4/88	4.0	61.6	66	6.6	0.039	1.650	0.44	0.10	0.052	24	3.992
	6/1/88	10.0	6.8	85	8.1	0.027	0.282	0.58	0.10	0.032	8	0.146
	8/10/88	-	0.1	-	-	-	-	-	-	-	-	

STATION	DATE	TEMP.	FLOW	COND. µhmos	pH	NH3	NO2+ NO3	TKN	TOTAL P	D.ORTHO P	S.S.	S.S.
S-4		°C	CFS	@25°C	S.U.	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ton/day
	2/5/87	5.0	80.0	113	7.1	-	7.000	7.02	3.45	-	2950	637.200
	2/16/87	-	44.0	-	-	0.050	3.130	0.93	0.25	-	-	
	2/23/87	-	27.3	-	-	0.051	1.980	0.56	0.11	-	24	1.769
	3/2/87	-	150.0	-	-	0.166	3.910	5.83	2.53	-	2750	1113.750
	3/3/87	9.0	164.0	84	7.0	0.075	2.720	1.47	0.60	0.012	492	217.858
	3/9/87	-	130.0	-	-	0.074	2.370	0.89	0.15	-	-	
	3/16/87	-	48.0	-	-	0.047	1.380	0.47	0.14	-	40	5.184
**	3/23/87	5.5	27.3	89	7.0	0.018	1.660	0.30	0.09	0.016	19	1.400
	11/10/88	-	0.0	-	-	-	-	-	-	-	-	
	2/10/88	3.0	17.7	273	6.9	0.346	13.400	1.40	0.88	0.076	136	6.499
	2/22/88	3.5	12.6	118	7.2	0.031	4.630	0.40	0.12	0.021	26	0.885
	4/4/88	3.0	91.7	85	7.2	0.047	1.850	0.58	0.13	0.050	52	12.875
	6/1/88	11.0	6.5	89	7.7	0.014	23.700	0.60	0.12	0.240	6	0.105
	8/10/88	-	0.0	-	-	-	-	-	-	-	-	

STATION	DATE	TEMP.	FLOW	COND. µhmos	pH	NH3	NO2+ NO3	TKN	TOTAL P	D.ORTHO P	S.S.	S.S.
S-5		°C	CFS	@25°C	S.U.	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ton/day
	2/5/87	5.0	2.0	116	7.0	-	9.630	5.86	2.29	-	1880	10.152
	3/3/87	10.5	2.8	212	7.1	0.651	10.300	1.81	0.46	0.029	112	0.847
	11/10/87	-	0.0	-	-	-	-	-	-	-	-	
	2/10/88	3.0	1.2	308	6.8	0.346	17.100	1.14	0.67	0.103	32	0.104
	2/22/88	3.0	0.2	273	7.3	0.129	8.940	1.08	0.18	0.089	10	0.005
	4/4/88	4.0	0.9	224	7.8	0.080	6.100	1.26	0.26	0.113	14	0.034
	6/1/88	10.5	0.2	306	7.7	0.235	0.290	1.01	0.33	0.161	6	0.003
	8/10/88	-	0.0	-	-	-	-	-	-	-	-	

STATION	DATE	TEMP.	FLOW	COND. µhmos	pH	NH3	NO2+ NO3	TKN	TOTAL P	D.ORTHO P	S.S.	S.S.
S-6		°C	CFS	@25°C	S.U.	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ton/day
	2/5/87	5.0	-	126	7.0	-	4.800	1.02	0.39	-	240	
	2/9/87	-	-	-	-	0.050	2.880	0.68	0.20	-	-	
	2/23/87	-	-	-	-	0.059	2.210	0.37	0.10	-	18	
	3/3/87	10.5	173.0	86	6.9	0.154	2.650	1.43	0.62	0.007	548	255.971
	3/9/87	-	-	-	-	0.004	1.230	0.34	0.05	-	-	
	3/16/87	-	-	-	-	0.065	1.550	0.59	0.16	-	56	
	3/23/87	6.0	-	107	7.2	0.016	1.330	0.30	0.09	0.008	20	
	11/10/87	-	0.0	-	-	-	-	-	-	-	-	
**	2/10/88	3.0	21.0	359	6.8	0.367	12.600	1.50	1.00	0.088	206	11.680
**	2/22/88	8.0	11.4	104	7.5	0.038	4.910	0.69	0.13	0.033	35	1.077
**	4/4/88	3.0	95.1	85	7.7	0.078	2.000	0.67	0.18	0.076	70	17.974
**	6/1/88	11.0	6.6	96	7.7	0.046	0.490	0.72	0.09	0.029	19	0.339
	8/10/88	-	0.0	-	-	-	-	-	-	-	-	