WATER QUALITY STATUS REPORT

LITTLE MALAD RIVER DRAINAGE
ABOVE DANIELS RESERVOIR

(Oneida County, Idaho)

1981-1982

Idaho Department of Health and Welfare
Division of Environment
Boise, Idaho 83720

April, 1983

Report No. WQ-52

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SUMMARY

1. Water quality samples were collected from July, 1981 to June, 1982 in the Upper Little Malad River drainage from tributaries above Daniels Reservoir. Important tributaries are Wright Creek, Dairy Creek, and Little Malad Spring. The major land use in the area is dry cropland used for production of small grains. The primary objective of measuring sediment load at peak discharge stage was not accomplished since major runoff events did not develop during the survey period. The water quality data collected defines existing conditions during base flow periods only.

2. Suspended sediment concentrations were low during most of the survey period. One sample collected below the reservoir in April illustrates the potential for high sediment runoff. Drainage from several fields directly above the sample site (Little Malad River below the dam) were responsible for a suspended sediment concentration of 15,770 mg/l. It was calculated that the Little Malad River was carrying 596 tons of sediment per day due to erosion from that area.

3. Total phosphorus concentrations were fairly high for base flow conditions. The overall mean for all samples collected was 0.27 mg/l. This can be compared to a recommended maximum criteria of 0.1 mg/l. Comparison of phosphorus forms indicates that most of the phosphorus was in a dissolved state - not associated with sediment particles. The phosphorus is probably due to natural sources, such as phosphate-bearing deposits, although there may be some contribution from livestock wastes.

4. The overall mean for total inorganic nitrogen was 0.4 mg/l. Inorganic nitrogen exceeded the criteria of 0.3 mg/l approximately 50% of the time in the Little Malad drainage. Although inorganic nitrogen exceeds the criteria periodically, the concentrations reported are much lower than those found in other dry cropland areas at base flow stage. Concentrations of nitrate in Palouse area streams are approximately ten times higher than those reported here for the Little Malad River drainage.

5. Fecal coliform bacteria counts did not exceed Idaho Water Quality Standards for secondary contact recreation. Bacteria counts were highest at the uppermost station on Wright Creek, S-6. The fecal coliform logarithmic mean was 154/100 ml and the fecal streptococcus logarithmic mean was 268/100 ml. The source of bacteria was livestock as indicated by the fecal coliform/fecal streptococcus ratio.

6. Temperature, dissolved oxygen, pH, and dissolved solids were within Idaho Water Quality Standards. Mineral concentrations indicate a "very hard" water if used as a domestic supply.

INTRODUCTION

The Little Malad River drainage has been identified by the Agricultural Pollution Abatement Plan as high priority due to sediment from erosion on dryland farming. Sediment and associated pollutants are washed into the stream during spring runoff and seasonal thunderstorms. The Oneida SCD developed a water pollution abatement plan for a segment of the watershed under a 208 Planning for Implementation project. The Division of Environment assisted in this effort by collecting baseline water quality data on streams in the watershed.

The specific objectives of this survey were:

(1) To define the baseline water quality status of streams in the project area. This allows comparison of water quality to other measured streams and to appropriate state standards.

(2) To identify sub-basins or major reaches within the project which are critical to correcting the water quality degradation.

DRAINAGE DESCRIPTION

The 208 project encompasses the drainage area above Daniels Reservoir in Oneida County and a small segment of the Little Malad River below the reservoir. The major tributaries above the reservoir are Wright Creek and Dairy Creek. The source of the Little Malad River is Little Malad Springs which is approximately one mile above the reservoir (See Figure 1). In addition to perennial streams there is a waterway above the reservoir which carries surface runoff into the reservoir during snowmelt and storms. Several small channels drain into the reservoir from the east side.

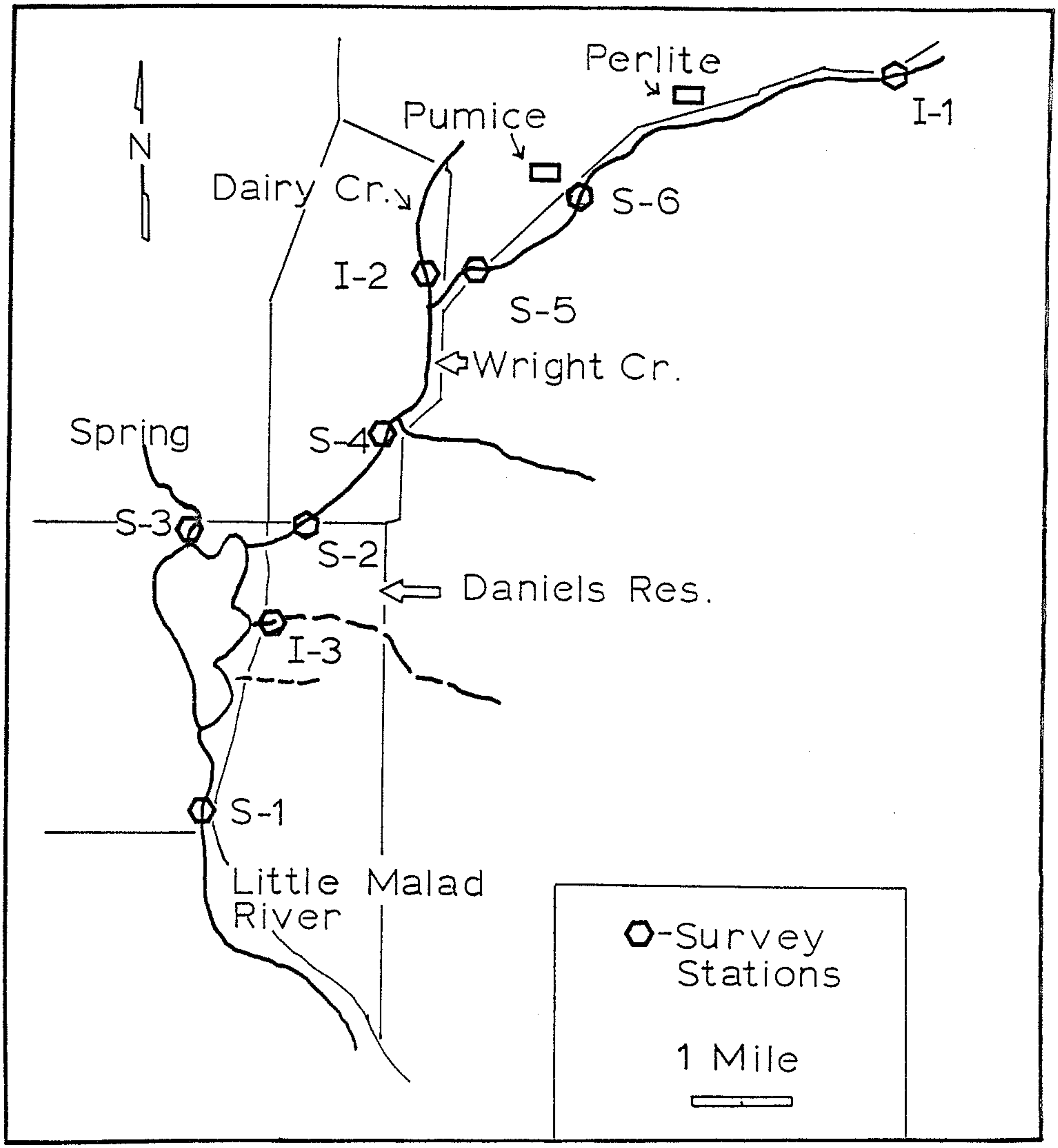


Figure 1. Water Quality Survey Station Locations in Little Malad River Drainage, July, 1981 to June, 1982.

The major land use in the drainage is dry cropland used for production of small grains. Fields are left fallow during the winter under certain rotations. It is erosion from this cropland that is considered the major water quality problem. The other major land use in the area is cattle grazing. A perlite and a pumice mine are located in upper Wright Creek, but there is no evidence that these facilities are causing a pollution problem.

A detailed description of the watershed and the agronomic practices can be found in the report by SCS River Basins staff on sedimentation of Daniels Reservoir (SCS, 1981) and recommended solutions (SCS, 1982).

SURVEY DESIGN

Survey stations are listed in Table 1 and shown in Figure 1. Stations with an "S" designation were sampled approximately every other month. Field parameters, bacteria, nutrients, sediment, and dissolved solids were measured each sampling run. Stations with an "I" designation were to be sampled only during high flow for sediment. Samples were collected between July 1981 and June 1982.

The major objective of the survey was to measure sediment load during high flows. This objective was not accomplished. Water samples were collected only during low flow. The primary reason for this is the nature of storm events and runoff in the watershed, and specifically runoff patterns during the survey period.

Runoff events during the survey period were abnormally low and infrequent. Snowmelt occurred gradually during early spring, and the soil was able to absorb most of the water so that snowmelt runoff was low. This was good for maintaining low erosion rates, but made survey objectives unattainable. Runoff events that cause erosion and sediment damage are powerful but shortlived.

STATION #	STORET #	DESCRIPTION	NUMBER OF SAMPLES
Ambient			
S-1	2080343	Little Malad R. @ Sublett Road Bridge	7
S-2	2080344	Wright Cr. @ Daniels Road	6
S-3	2080212	Little Malad Spring-Source L. Malad	7
S-4	2080346	Wright Cr. below Indian Mill Cr.	7
S-5	2080347	Wright Cr. below Perlite Plant	7
S-6	2080348	Wright Cr. above Perlite Plant	7
Intensive			
I-1	2080352	Wright Cr. above Confl. with Dairy Cr. above Pumice Plant	3
I-2	2080353	Dairy Cr. above Confl. with Wright Cr.	2
I-3	2080354	Hill Cr. @ Culvert, West Daniels Road	2

TABLE 1. Water Quality Sample Locations

Again, this makes it difficult to sample. The field collector noted that a major event had deposited sediment in channels prior to the April 8, 1982 sample date, but flows were back to low stage when samples were collected.

METHODS

Field parameters (discharge, dissolved oxygen, temperature, and pH) were measured according to Idaho Department of Health and Welfare, Division of Environment, Technical Procedures Manual (IDHW, 1976). Other parameters were analyzed according to Methods for Chemical Analysis of Water and Wastes (EPA, 1979).

RESULTS

DISCHARGE

Flow is regulated by the dam for Daniels Reservoir which was built in 1967. Major surface tributaries to the reservoir are the Little Malad Spring and Wright Creek.

Flow measurements obtained during the survey are shown in Table 2. Except for the June sampling period the discharge measured can be considered representative of base flow conditions. Flows were slightly elevated in June in Wright Creek. A flow of 20 cfs was measured in Wright Creek below Indian Mill Creek (S-4) in June, which can be compared to an average of 3.6 cfs for the previous six samples.

Discharge from Little Malad Springs varied from 2.1 cfs in January to 14 cfs in April, and averaged 3.4 cfs. This variation is probably due to changes in groundwater recharge since surface water inputs to this channel appear to be minor.

SUSPENDED SEDIMENT

Suspended sediment concentrations are shown in Table 3. Water was clear or only slightly turbid on sample dates from July 1981 to April 8, 1982. Some elevated concentrations were measured on April 14 and June 7, 1982.

One extremely high concentration (15,770 mg/l on April 14) was measured in Little Malad River below the reservoir. It was observed that the sediment was coming off of several fields directly above the sample site. Sediment load based on this sample was 596 tons/day.

SCS (1981) measured the amount of sediment deposited in Daniels Reservoir in October 1980. They calculated that 1,730 acre feet had been deposited.

Date	Discharge (cfs)							
	Station							
	S-1	S-2	S-3	S-4	S-5	S-6	I-1	I-2
July 22, 1981	3.3	1.9	3.9	1.0	0.6	0.3	---	----
Sept 01, 1981	3.6	2.4	3.0	0.6	0.6	0.5	---	----
Oct 08, 1981	5.8	----	10.3	4.0	1.0	2.0	---	----
Nov 02, 1981	5.6	5.2	2.7	7.5	2.7	0.8	---	----
Jan 13, 1982	4.8	----	2.1	3.0	2.2	1.0	0.3	----
April 08, 1982	7.7	9.1	10.8	5.6	2.5	2.5	0.6	2.9
April 14, 1982	14.0	----	14.0	----	10.0	----	---	10.0
June 07, 1982	42.5	8.7	12.2	20.1	9.5	12.0	4.0	5.2

TABLE 2. Discharge measurements for Little Malad River Study

Date	Suspended Sediment (mg/l) Station								
	S-1	S-2	S-3	S-4	S-5	S-6	I-1	I-2	I-3
July 22, 1981	17	25	3	31	24	32	---	---	---
Sept 01, 1981	20	14	3	13	27	20	---	---	---
Oct 08, 1981	4	11	6	18	28	29	6	12	241
Nov 02, 1981	5	45	23	10	7	16	3	19	19
Jan 13, 1982	48	---	40	19	31	20	10	---	---
April 08, 1982	25	72	6	58	42	18	5	21	---
April 14, 1982	15,770	---	40	---	220	---	---	530	---
June 07, 1982	17	159	33	184	256	239	82	54	---

TABLE 3. Suspended Sediment (mg/l) in Little Malad River Drainage

This represents 133 acre feet per year or approximately 255,000 tons per year since construction of the dam in 1967. Sediment delivery of this magnitude was neither measured nor observed during the survey period. The survey period was obviously atypically low for erosion damage and sediment delivery.

NUTRIENTS

The major nutrients of concern as pollutants are forms of nitrogen and phosphorus. In excess these nutrients will cause eutrophication of the reservoir and stimulate undesirable growth of algae and aquatic plants. If excessive, the algal and plant growth can interfere with recreational uses and may reduce night-time dissolved oxygen to harmful levels for fish.

Phosphorus

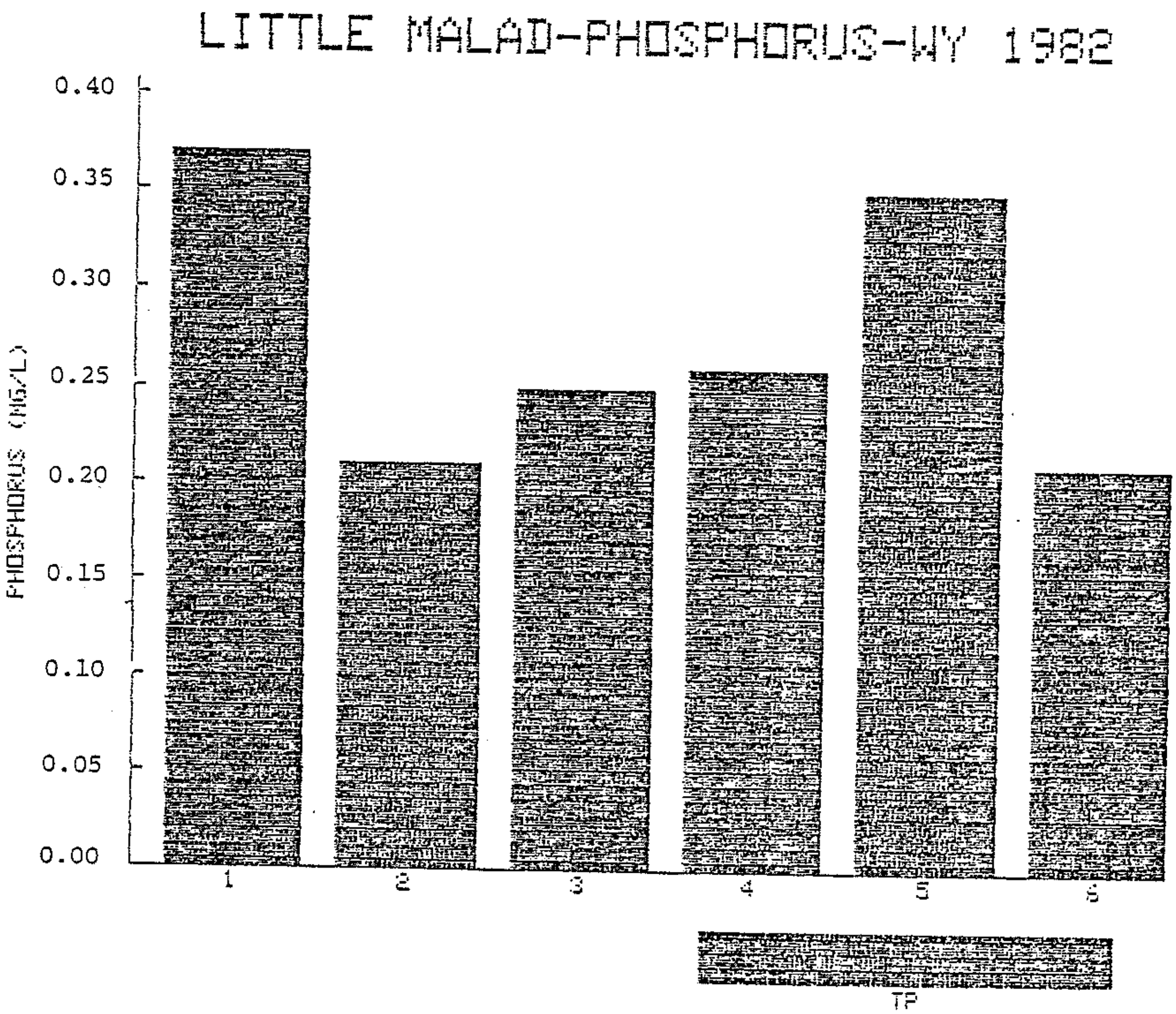
Total phosphorus measures the phosphorus dissolved in the water plus the phosphorus contained in soil particles suspended in the water column. Orthophosphate measures only the dissolved phosphorus. Comparing the two forms indicates how much of the phosphorus is washed into streams with sediment. The instream criteria for total phosphorus in running water is 0.1 mg/l (EPA, 1976) and is based on stimulation of algal growth.

Total phosphorus data is shown in Table 4 and Figure 2. Individual measurements and average total phosphorus exceeds the 0.1 criteria at most sites. A comparison of total phosphorus to ortho-phosphate indicates that most of the phosphorus shown is in the dissolved form and is not associated with sediment. This is supported by the results from the sample taken in November; suspended sediment concentrations were very low, but phosphorus concentrations reached peak values at five of the stations (See Table 4).

Total Phosphorus (mg/l)

Date	Station					
	S-1	S-2	S-3	S-4	S-5	S-6
July 22, 1981	0.10	0.12	0.04	0.11	0.21	0.23
Sept 01, 1981	0.19	0.15	0.34	0.24	0.26	0.30
Oct 08, 1981	0.06	0.10	0.06	0.12	0.42	0.37
Nov 02, 1981	2.04	0.83	0.84	1.01	1.09	0.15
Jan 13, 1982	0.16	----	0.14	0.14	0.20	0.20
April 08, 1982	0.04	0.18	0.04	0.12	0.17	0.14
April 14, 1982	----	----	----	----	----	----
June 07, 1982	0.03	0.11	0.02	0.06	0.12	0.11
Mean	0.37	0.25	0.21	0.25	0.35	0.23

TABLE 4. Total Phosphorus (mg/l) in Little Malad River Drainage



1. Little Malad R. at Sublett Rd.
2. Wright Creek at Daniels Rd.
3. Little Malad Spring
4. Wright Creek below Indian Mill Creek
5. Wright Creek below Perlite Plant
6. Wright Creek above Perlite Plant

FIGURE 2. Mean Total Phosphorus Concentrations, mg/l. Number of Samples: 6-7.

The contribution of phosphorus from agriculture cannot be determined from this data. The phosphorus sampled at these flows is more likely due to natural sources (e.g., phosphate-bearing deposits) than to agricultural sources.

Nitrogen

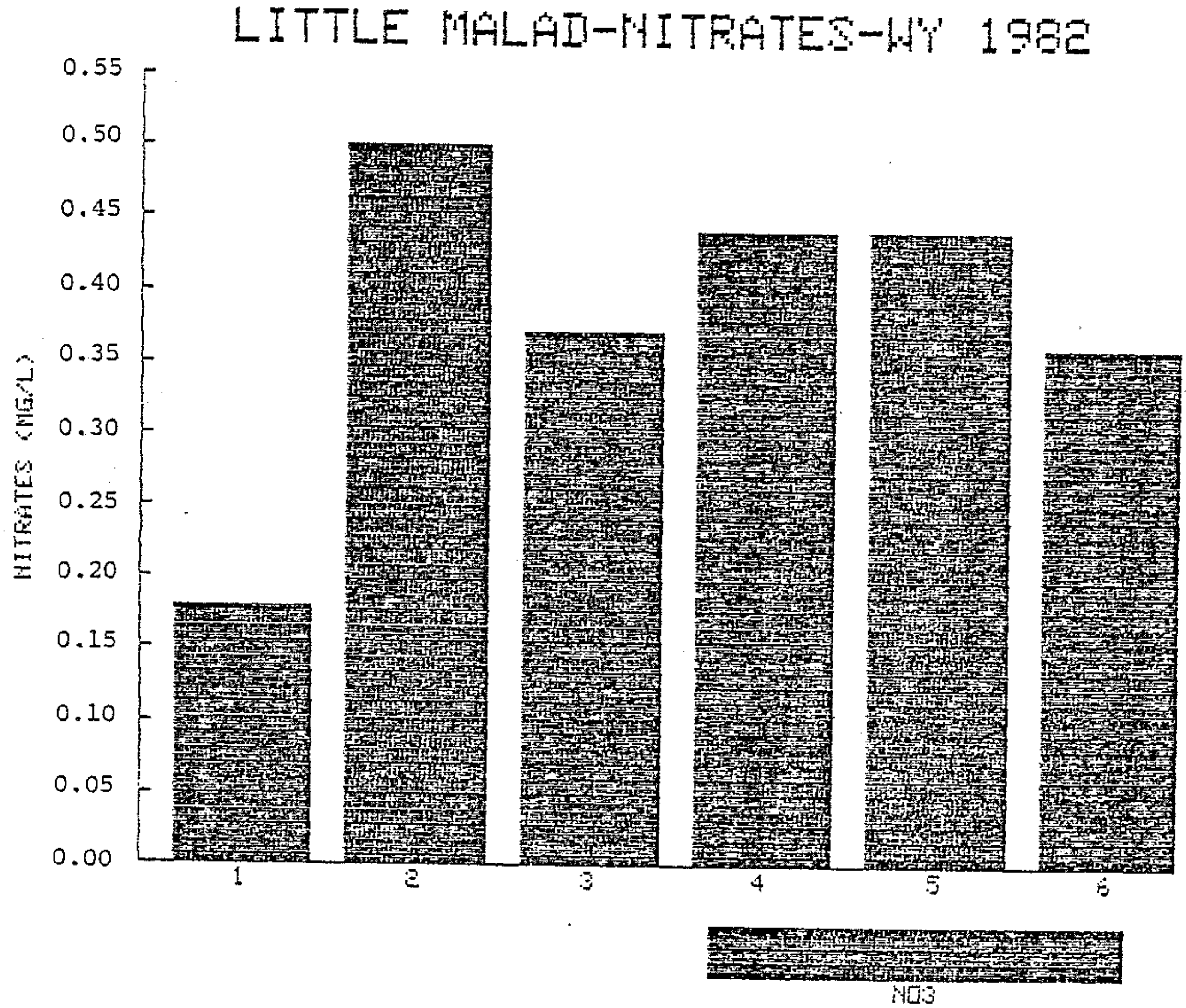
Inorganic nitrogen is the sum of nitrate (NO_3), nitrite (NO_2), and ammonia (NH_3). Inorganic nitrogen is not associated with soil particles, but is carried dissolved in the water column. Nitrates percolate readily through the soil and are carried in the shallow groundwater to surface streams. Possible sources of nitrogen in the watershed include nitrogen applied as fertilizer and nitrogen from livestock wastes.

The instream criteria for inorganic nitrogen is 0.3 mg/l (IDHW-DOE, 1980a). Samples for inorganic nitrogen from the Little Malad watershed exceed this criteria approximately 50% of the time (Table 5). Average concentrations are shown in Figure 3. The peak in nitrates in the April sample is likely due to the increased percolation of nitrate-saturated water into the soil. In addition, warming temperatures cause conversion of any ammonia or urea-applied fertilizer to the more mobile nitrate form.

Although nitrates exceed the instream criteria part of the time, the concentrations found here are not as severe as those reported in other dry cropland areas in the state. In the Palouse farmland, inorganic nitrogen concentrations peak during winter low flows. In South Fork of the Palouse River and Paradise Creek, nitrate concentrations reached maximum levels of 15-20 mg/l (IDHW-DOE, 1981). In Hangman Creek, Benewah County, peak concentrations up to 13.4 mg/l were found (Bauer and Wilson, 1983). The concentrations of inorganic nitrogen shown in Table 5 for the Little Malad area are much lower.

Date	Total Inorganic Nitrogen (mg/l)					
	Station					
	S-1	S-2	S-3	S-4	S-5	S-6
July 22, 1981	0.21	0.30	0.41	0.48	0.36	0.19
Sept 01, 1981	0.22	0.23	0.55	0.45	0.18	0.18
Oct 08, 1981	0.09	0.25	0.63	0.28	0.19	0.21
Nov 02, 1981	0.42	0.14	0.51	0.20	0.26	0.06
Jan 13, 1982	0.39	----	0.55	0.43	0.43	0.31
April 08, 1982	0.14	0.18	0.71	0.97	1.24	1.08
April 14, 1982	----	----	----	----	----	----
June 07, 1982	0.21	0.54	0.58	0.59	0.73	0.80
Mean	0.24	0.27	0.56	0.48	0.48	0.40

TABLE 5. Total Inorganic Nitrogen in Little Malad River Drainage. Total Inorganic Nitrogen is the Sum of Nitrate (NO_3), Nitrite (NO_2), and Ammonia (NH_3)



1. Little Malad R. at Sublett Rd.
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5. Wright Creek below Perlite Plant
6. Wright Creek above Perlite Plant

FIGURE 3. Mean Nitrate (NO_2+NO_3) Concentrations, mg/l. Number of Samples: 6-7.

BACTERIA

Fecal coliform and fecal streptococcus bacteria are found in the intestinal tract of warm-blooded animals and are therefore used as indicators of fecal contamination. Little Malad River and its tributaries are protected for secondary contact recreation, which includes activities like wading and floating. The standards (IDHW, 1980b) specify that fecal coliform numbers not exceed a geometric mean of 200/100 ml or exceed 800/100 ml at any time.

Results of bacterial sampling are shown in Table 6 and Figure 4. Fecal coliform numbers did not exceed the 200/100 ml geometric mean standard. Only 2 out of 40 samples throughout the drainage exceeded the individual 800/100 ml criteria. Therefore, the data collected do not indicate a problem with bacterial contamination.

There is no specific standard for fecal streptococcus bacteria. However, this species can be used as an indicator of the sources of contamination. Animal feces contain a greater number of streptococci, such that the ratio of fecal coliform to fecal streptococcus is always less than 0.7. Human feces contain a greater number of coliforms, causing the FC/FS ratio to exceed 4.0 (Clausen, et. al., 1977). As can be seen in Table 6, fecal streptococci numbers exceed fecal coliform numbers so that FC/FS ratios are low. This indicates an animal source of bacteria. This supports what one would expect from land usage in the area. There are very few farmsteads above Daniels Reservoir, but there is a considerable amount of livestock grazing in the area.

OTHER PARAMETERS

Several other water quality parameters were sampled to establish the base line condition in regards to protected uses. These parameters are summarized in Table 7.

Bacteria Number/100 ml

Station	Fecal Coliform (log mean)	Fecal Streptococcus (log mean)	Mean FC/FS Ratio
S-1, L.M. River at Sublett Rd.	57	151	0.7
S-2, Wright Creek at Daniels Rd.	106	267	0.7
S-3, Little Malad Spring	26	121	0.5
S-4, Wright Creek below Indian Mill Cr.	139	210	0.9
S-5, Wright Creek below Perlite Plant	81	147	0.6
S-6, Wright Creek above Perlite Plant	154	268	0.9

TABLE 6. Summary of Bacteria Data for Little Malad River Drainage. Number of Samples is 6-7

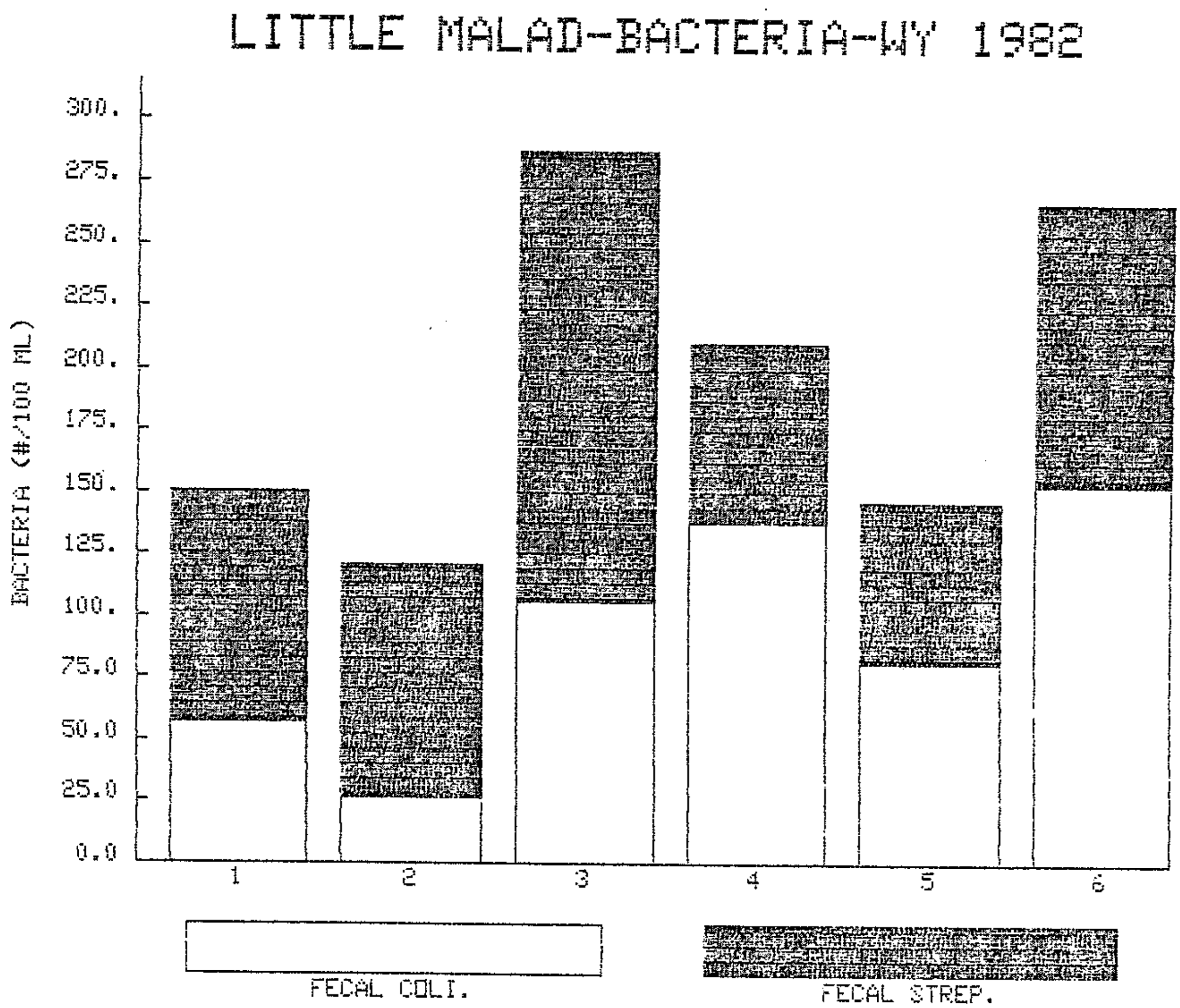

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FIGURE 4. Geometric Means for Fecal Coliform and Fecal Streptococcus Bacteria, Number/100 ml. Number is 6-7.

The Idaho water quality standards for pH require that pH be within the range of 6.5-9.0. Water in the Little Malad drainage is on the alkaline side, but all samples were within the standard.

No problems with dissolved oxygen concentrations were detected. All samples exceeded the 6 mg/l minimum standard for protection of cold water biota (See Table 7).

Average dissolved solids concentrations ranged between 262 mg/l to 317 mg/l. Major constituents are calcium carbonate and sodium chloride. Based on a scale used by USGS (1970) the water is considered "very hard". The break point for this category is 180 mg/l calcium carbonate; the average hardness measured in Wright Creek was 225 mg/l.

Data Summary

Station	Number	Mean Dissolved Oxygen (mg/l)	pH Range	Mean Dissolved Solids (mg/l)
S-1, L.M. River at Sublett Rd.	7	9.8	8.0-8.8	299
S-2, Wright Creek at Daniels Rd.	6	10.3	8.0-8.5	298
S-3, Little Malad Spring	7	8.4	7.4-8.0	262
S-4, Wright Creek below Indian Mill Cr.	7	10.5	8.0-8.5	295
S-5, Wright Creek below Perlite Plant	7	10.5	7.7-8.3	317
S-6, Wright Creek above Perlite Plant	7	10.5	7.7-8.2	302

TABLE 7. Summary of Dissolved Oxygen, pH, and Dissolved Solids Data for the Little Malad River Drainage

CONCLUSIONS AND RECOMMENDATIONS

These conclusions are based on samples collected at a low discharge stage and are, therefore, relevant only to baseflow conditions.

The occurrence and composition of fecal bacteria indicate that livestock wastes are washed into the tributaries to Daniels Reservoir. However, the concentrations measured are within Idaho Water Quality Standards for secondary contact recreation. If the designation for Daniels Reservoir was upgraded to protection for primary contact recreation, then standard violations would be expected to occur on a regular basis. However, to meet current standards, no additional control procedures for livestock wastes are indicated.

Dissolved phosphorus levels are fairly high during baseflow. It appears that these concentrations are characteristic of the drainage and are probably due to a natural source. For these reasons, it would be advantageous for management of the reservoir and canal system to control any additional input of phosphorus associated with sediment loads.

Total inorganic nitrogen concentrations were fairly low in comparison to other dry cropland areas during similar baseflow conditions. This indicates that application procedures for agricultural fertilizers are not a major water quality concern in the Little Malad River drainage.

No recommendations regarding sediment loading from dry cropland can be made from this data since samples were collected only at low flows.

In regards to water quality assessment, we recommend that grab sampling procedures not be used in any future studies. Automated stage-triggered sediment sampling would be needed to adequately measure the contribution of sediment from tributaries. A less expensive and probably more useful procedure would be to repeat the sedimentation study of Daniels Reservoir performed by SCS (1981) in 1980. Implementation of erosion control practices should be completed in a major portion of the drainage prior to a reassessment of sediment deposition rates.

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