Idaho State Department of Agriculture
Division of Agricultural Resources

Little Salmon River Year Two Water Quality Monitoring Report

April 2005 through October 2005

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Introduction

The Idaho State Department of Agriculture (ISDA) with assistance from the Idaho Association of Soil Conservation Districts (IASCD) and the Idaho Department of Environmental Quality (IDEQ) completed a second year (2005) of water quality monitoring on the Little Salmon River (LSR). The monitoring was conducted by ISDA at the request of the Little Salmon River Watershed Advisory Group (WAG). LSR and its tributaries are located within Hydrological Unit Code (HUC) 17060210, in Adams County. The additional year of monitoring was scheduled to help define other potential sources that are contributing excessive levels of phosphorus and bacteria to the mainstem Little Salmon within the meadow area.

There were three stations established on the Little Salmon River with the following designations: LSR-at Circle C bridge, LSR-MC at Meadow Creek Lodge, and LSR-4 at Old Highway 95 (Figure 1). Along with the mainstem stations three tributaries were included in the monitoring plan. The three were identified as Little Creek (LC-1), Big Creek (BC-1), and Mud Creek (MC-1) (Figure 1).

Two additional sites were added later in the project to help further evaluate loadings into the Little Salmon River meadow area. Both of these sites (SC-drain and Fourmile Creek) were evaluated periodically when they were accessible and discharging to the Little Salmon river (Figure 1).

Monitoring was conducted every two weeks from April through October 2005. The Little Salmon sites along with the major tributaries all had 16 samples collected during this monitoring period. The SC-drain site had five samples collected while the Fourmile Creek site had seven collected.

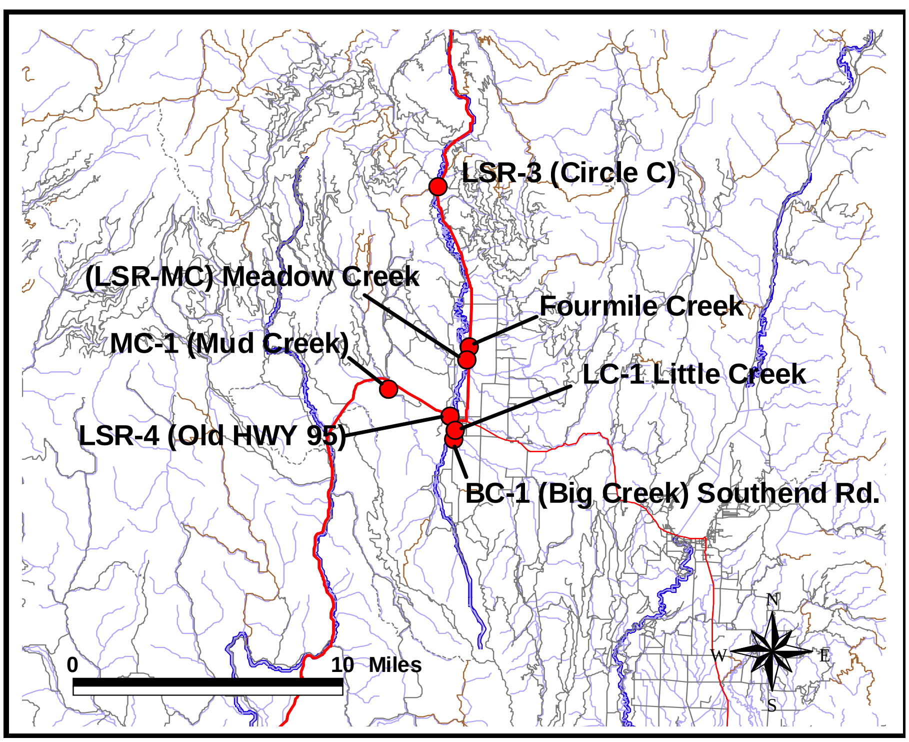

Figure 1. Little Salmon River monitoring sites SC-Drain not shown.

Analytical parameters collected were suspended sediment concentration (SSC), total phosphorus (TP), dissolved phosphorus (DP), nitrate (NO_3), and Escherichia coli (*E-coli*). On-site parameters measured were dissolved oxygen, percent saturation, pH, total dissolved solids, conductivity, and discharge.

General Results

Suspended Sediment Concentration (SSC)

Suspended sediment samples were collected at all locations to determine if suspended sediment concentrations (SSC) were at unacceptable levels. As with the 2004 data the overall SSC concentrations were well below any chronic or acute levels for aquatic species. At no time did any station exceed the low risk value of 25-100 mg/L (DFO 2000) which is considered the threshold concentration for quality fish habitat (Table 1).

Table 1. SSC statistics (mg/L).

Statistics	MC-1	BC-1	LC-1	LSR-4	LSR-MC	LSR-3
n	16	16	16	16	16	16
mean	1.5	6.3	11.4	5.4	4.9	5.4
median	1.3	6.4	7.2	4.5	3.5	3.5
St.deviation	1.2	3.3	11.8	3.1	3.7	4.0
minimum	0.2	1.7	1.5	2.1	0.5	0.9
maximum	4.0	14.7	52.5	14.6	12.9	14.0

The two sites that were added SC-drain and Fourmile Creek also did not indicate any potential problems with SSC concentrations. SC-drain averaged 2.9 mg/L with a maximum level of 5.7 mg/L. Fourmile Creek had an overall average of 7.5 mg/L with the maximum SSC level at 11.8 mg/L.

Phosphorus

The data collected in 2004 showed a problem with excessive phosphorus levels within the Little Salmon River meadow area. The elevated phosphorus levels in 2004 caused excessive periphyton growth and lower dissolved oxygen concentrations within the area of LSR-3 (Circle C Bridge).

Two types of phosphorus, total and dissolved were evaluated during this study. Total phosphorus (TP) is usually bound to particulate matter or plant matter while dissolved phosphorus (DP) is dissolved in the water column and not associated with particulate matter, making it the most bioavailable form for plant uptake.

During the 2004 monitoring it was difficult to tell what percentage of the total phosphorus was dissolved due to a higher laboratory detection limit for TP and DP (0.05 mg/L) For the 2005 monitoring the laboratory detection limit for phosphorus was lowered to 0.005 mg/L which allowed a better evaluation of the percent dissolved phosphorus present in the system (Table 2). Dissolved phosphorus can consist of both organic and inorganic phosphorus but it is the dissolved inorganic form that is required by plants for growth. The percent DP does not indicate whether it is in the organic or inorganic form only that it is DP.

Table 2. Percent Dissolved Phosphorus

Site	Avg. % DP	Site	Avg. % DP
MC-1	60	LSR-MC	41
BC-1	52	Fourmile	30
LC-1	41	SC-Drain	26
LSR-4	52	LSR-3	40

Small amounts of phosphorus running off from fields into streams during low water levels and warmer temperatures (critical period) pose a higher risk of causing temporary eutrophication symptoms. As with the 2004 data the 2005 data showed this trend especially at station LSR-3 (Circle C). In the latter part of July through the early part of August (approximately 14-20 days) LSR-3 had excessive growth of periphyton during the period of warmer temperatures and higher phosphorus concentrations (Figure 1).

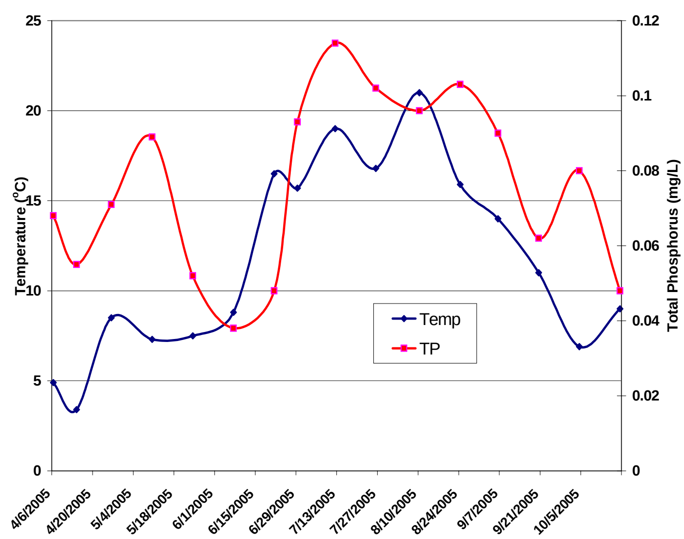

Figure 1. LSR-3 temperature and total phosphorus concentrations.

This condition during the critical period caused severe dissolved oxygen sags that were in violation of the State of Idaho water quality standards (Figure 2).

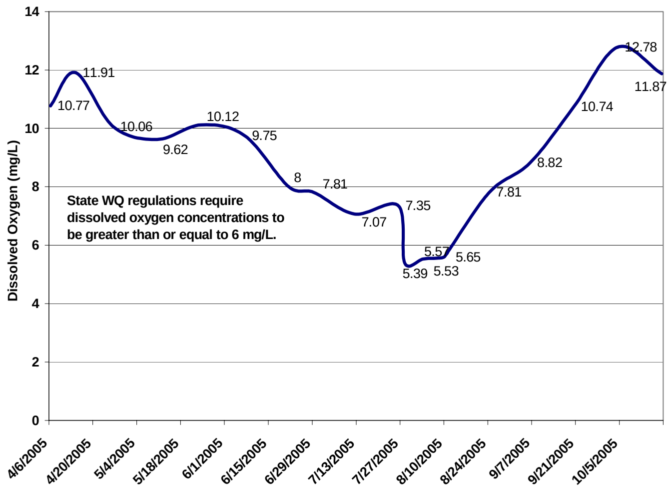

Figure 2. Dissolved oxygen levels for LSR-3.

The critical period for problems within the meadows area of the Little Salmon River (high temperatures, bacteria, phosphorus levels and dissolved oxygen) appears to take place between June and August. This is also the time when the phosphorus levels are at their highest (Table 3).

Table 3. Phosphorus statistics critical period (June-August).

Statistics	MC-1	BC-1	LC-1	LSR-4	LSR-MC	LSR-3
n	16	16	16	16	16	16
Mean	0.019	0.110	0.123	0.095	0.077	0.085
Median	0.019	0.115	0.124	0.102	0.090	0.096
Stdev.	0.001	0.039	0.041	0.033	0.029	0.029
Minimum	0.017	0.048	0.051	0.038	0.030	0.038
Maximum	0.022	0.155	0.192	0.132	0.102	0.114

The LSR Total Maximum Daily Load (TMDL) proposes a phosphorus limit of 0.075 mg/L for the Little Salmon River within the meadow area (IDEQ 2005). With this proposed limit the required reductions at the stations listed in Table 3 during the critical period are as follows: BC-1 40%, LC-1 32%, MC-1 0%, LSR-4 22%, LSR-MC 3%, and LSR-3 12%.

Fourmile Creek had four samples collected during the critical period (June through August) and the average phosphorus level was 0.114 mg/L. To meet the proposed TMDL phosphorus target, Fourmile would need a reduction of 35%. SC-Drain had five samples collected over the critical period with an average of 0.183 mg/L and would require a 59% reduction to meet the TMDL target. Although SC-Drain has a high TP concentration, it does not contribute a large load of TP to the LSR. The average discharge from SC-Drain was only 0.56 cubic feet per second and discharge is intermittent during the irrigation season.

Bacteria (Escherichia Coli)

As with the 2004 study ISDA along with IDEQ evaluated bacteria levels for the 2005 monitoring schedule using the state water quality standard for Escherichia Coli (*E-coli*). The state criteria for *E-coli* (primary contact) is made up of a two step process using a trigger value of 406 colony forming units (CFU) that requires the geomean evaluation of the water body (IDAPA 58.1.02).

The 406 CFU trigger indicates a violation in *E-coli* concentration that requires 5 samples collected over a 30 day period to calculate the monthly geomean for *E-coli*. A geomean concentration over 126 CFU indicates a water quality violation. As with the 2004 data the 2005 data showed multiple *E-coli* violation throughout the LSR meadow area. (Table 4)

Table 4. E-coli geomean results (CFUs).

Date	LSR 3	LSR-MC	LSR 4	MC-1	BC-1	LC-1
6/21/2005	980	340	**2400**	80	2000	**2400**
6/29/2005	1700	**2400**	**2400**	150	**2400**	**2400**
7/7/2005	150	1200	1400	440	2000	1600
7/12/2005	250	250	870	200	2000	2000
7/18/2005	57	**2400**	1300	160	**2400**	**2400**
geomean	324	899	1556	176	2151	2134

Table 4 indicates that geomean violations occurred at every sampling station. The sites with numbers at 2400 CFUs were actually higher and the results from the laboratory were reported at greater than 2400 CFUs.

Fourmile Creek and SC-Drain were not evaluated for *E-coli* by collecting sufficient data for geomean analysis. Grab samples were collected for bacteria analysis to determine if either of these sites are potential sources. The average E-coli values from the seven samples collected at Fourmile were 1824 CFU and the six samples from SC-Drain were 37 CFU. This data indicates that Fourmile Creek would most likely exceed the water quality criteria of 126 CFU if a geomean analysis was conducted.

Conclusions

As with the 2004 data it does not appear that suspended sediment concentrations (SCC) are causing any short term acute or long term chronic problems for fisheries within the upper Little Salmon River.

Data from the 2005 monitoring indicates there is still a concern with excess phosphorus concentrations especially during the critical period of June through August. The combination of higher water temperatures and higher TP concentrations are causing excessive aquatic plant growth which is causing dissolved oxygen sags (<6.0 mg/L) that violate the State of Idaho water quality standards.

Reductions of TP to meet the new proposed Little Salmon River TMDL (0.075 mg/L) would required reductions at all locations that were monitored with the exception of Mud Creek. The largest reductions would have to come from Big Creek and Little Creek with 40% and 32% respectively. The actual reductions needed within the LSR corridor are somewhat lower with LSR-4 at Old Highway 95 requiring a 22% decrease, LSR-MC at Meadow Creek 3% and LSR-3 at Circle C 12%. To eventually meet the TMDL level of 0.075 mg/L all potential sources into the LSR will need some type of reduction. These reduction may or may not lower the dissolved phosphorus to levels that will not encourage excessive algae growth. The actual DP concentration needed to alleviate excessive aquatic plant growth is unknown at this time.

There appear to be numerous sources of *E-coli* both within the mainstem of the LSR along with the tributaries. The highest geomean levels were found at Big Creek (2151 CFUs) and Little Creek (2134 CFUs). The geomean levels within the mainstem decreased from upstream to downstream as follows: LSR-4 1556 CFUs, LSR-MC 899 CFUs, and LSR-3 at 324 CFUs.

Recommendations

It appears from two years of data analysis that portions of the Little Salmon River within the meadow area are being impacted and are showing signs of degraded water quality.

The primary driver of these problems appears to be an excessive phosphorus (P) source along with warm temperatures and lower flow rates in the mainstem. I will only address the excessive P issue at this time.

To cause an environmental problem (excessive algae growth) there must be a source of P (high soil levels, manure of fertilizer application, etc.) and a transport mechanism (leaching, runoff erosion etc.) to a sensitive location (Sharply, 1999). It appears that both of these conditions are currently available through out areas within the LSR meadow corridor.

A potential source of phosphorus from research indicates that on average cattle ranging between 500 and 1000 lbs. will produce on average 0.08 lbs/day of phosphorus (MPSC, 1985). The transport mechanism could be the flood irrigation techniques used in the corridor for pasture irrigation. The meadow area may be identified as an agricultural area of high potential P export and need to implement management plans to effectively minimize P export. These can include but are not limited to the following:

- Minimize P losses caused by erosion by using management practices that maintain a complete cover of forages and residues over the pasture surface.
- Minimize P losses caused by runoff by not surface applying fertilizer or manure to soil that is saturated, snow-covered, or frozen.
- Avoid extensive grazing of animals in or near streams especially when land is wet or saturated or when streams are at low flow.
- Possible fencing off creeks and streams or off site watering.
- Riparian buffers or filters along water ways.
- More efficient methods of irrigation.

References

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