Idaho State Department of Agriculture
Division of Agricultural Resources

Little Salmon River Meadows Area Water Quality Monitoring Report Tributary Evaluation

May 2006 through October 2006

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ISDA Technical Report Summary W-17 January 2007

Introduction

At the request of the Little Salmon River Watershed Advisory Group (LSRWAG) the Idaho State Department of Agriculture (ISDA) conducted a third year of water quality monitoring on the Little Salmon River meadow reach. The LSR meadow reach has an approved Total Maximum Daily Load (EPA approved March 2006) that has determined beneficial uses are being impaired by bacteria, temperature, low dissolved oxygen and excess phosphorus. The critical period for the LSR TMDL was defined as June through September (summer).

This third year of monitoring was conducted to continue defining the source and transport of pollutants into the Little Salmon River meadow reach. Due to extreme flooding during April 2006, monitoring could not commence until May 2006. Six tributaries that had not been evaluated in the past two years of monitoring were chosen for assessment by the LSRWAG.

The six tributaries are as follows: West Goose Creek (WGC), East Goose Creek (EGC), Three Mile Creek, Four Mile Creek, Martin Creek (MC), and Six Mile Creek (Figure 1). A reference site was established on upper Four Mile Creek which transports natural runoff early in the year and then diversion water (mid-June) from the Campbell Ditch (CD) for pasture irrigation (Figure 1). The CD irrigation water is diverted from Four Mile Creek at several locations to irrigate portions of the lower meadows. All of these creeks are diverted for pasture irrigation and transport irrigation return water back to the LSR.

Sites were monitored twice per month from May through October 2006. Due to very low flows, Martin Creek (MC) was monitored twice a month from May through June and then only periodically (n = 7) thereafter.

Analytical parameters collected were suspended sediment concentration (SSC), total phosphorus (TP), dissolved

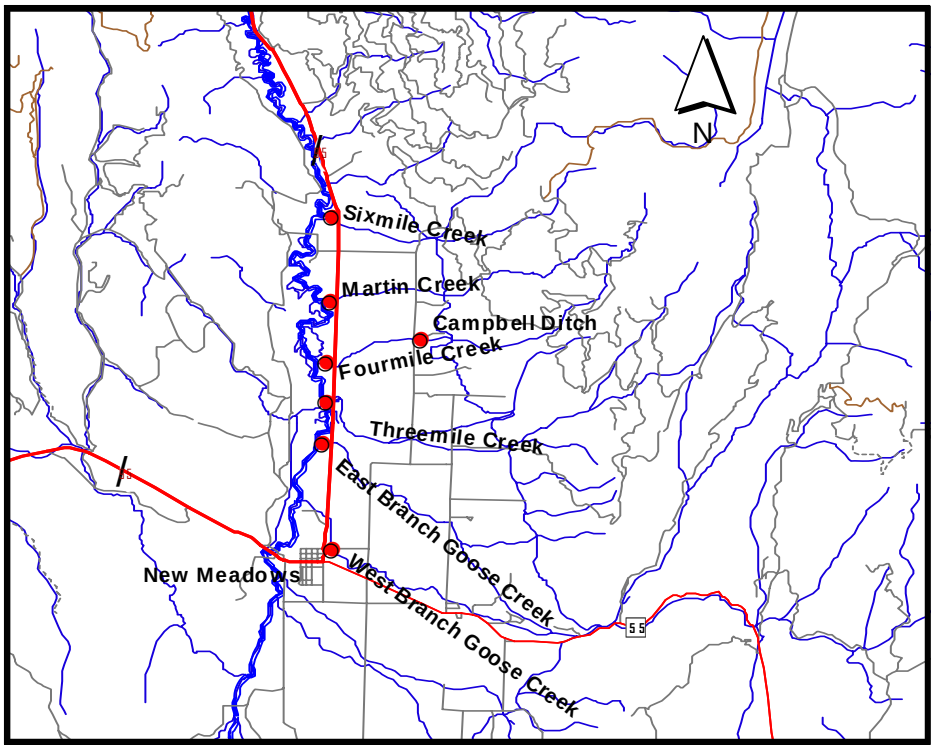

Figure 1. Little Salmon River tributaries with monitoring site locations.

phosphorus (DP), and Escherichia coli (*E-coli*). Instantaneous on-site measured parameters were dissolved oxygen, percent saturation, temperature, 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 acceptable levels. As with the previous two years of data (2004 and 2005), the overall SSC levels were low (Table 1). At the upper Four Mile site (CD) there was a high SSC level of 400 mg/L during heavy runoff in May. A high level (191 mg/L) was also recorded at the lower Four Mile site during the same time period. The heavy runoff from the upper area of Four Mile Creek caused extensive movement of sands and gravels that dammed off portions of lower Four Mile and caused flooding. These blockages had to be mechanically removed in order to restore transport of water to the lower valley. These channel disturbances may also be part of the reason that another high SSC value was recorded on June 27, 2006 (174 mg/L) after irrigation water from the Campbell Ditch was turned into Four Mile Creek. All of the higher SSC levels recorded appeared to be episodic in nature and are the cause of the higher SSC mean and standard deviation values for Four Mile and CD (Table 1). Overall the SSC values remained good to moderate (25-80 mg/L) for fisheries during the critical period of June through September. (DFO 2000/01).

Table 1. SSC statistics (mg/L) May through October 2006.

Statistics	WGC	EGC	Three Mi.	Four Mi.	MC	Six Mi.	CD
n	12	13	13	13	7	12	13
mean	2.7	6.9	3.2	41.9	8.4	5.5	40.9
median	2.6	4.2	3	9.3	8	2.6	9.4
st. dev.	1.1	8.6	1.5	65.1	4.9	7.6	108.2
low	1.3	1.6	1	2	3.4	1.5	1.1
high	5.4	15.8	6.6	191	16.9	28.4	400

Discharge

The overall hydrograph of these tributaries indicate a steep drop in discharge after runoff followed by low flows during the summer irrigation season (Figure 2). The discharge rates fluctuate throughout the summer based on irrigation schedules. The timing of this study (bi-weekly monitoring) most likely missed certain irrigation events which could have a negative effect on the creek's water quality.

During the critical period these six creeks make up approximately 41% (28 CFS) of the two year average discharge (68 CFS) measured in 2004 and 2005 at the Circle C Bridge site (Figure 3.)

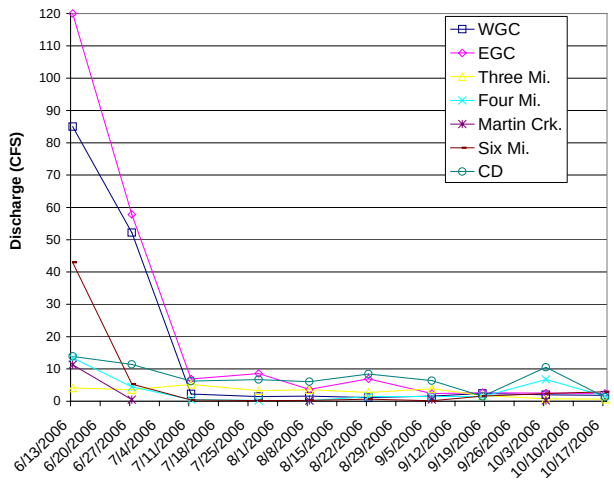

Figure 2. Hydrograph June 13 through October 17, 2006.

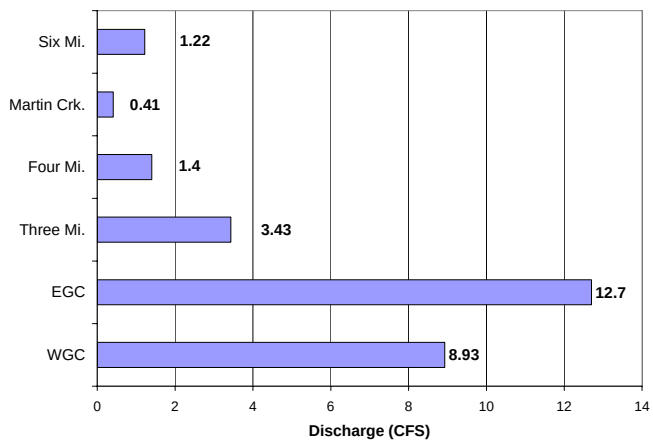

Figure 3. Mean discharge critical period (June through September 2006).

Phosphorus

One of the reasons for monitoring these six tributaries was to determine their overall contribution of phosphorus into the LSR meadow area. As determined by the TMDL, the LSR meadow section requires reduction in phosphorus to help reduce unwanted aquatic vegetation and to address the low dissolved oxygen issues.

The LSR TMDL established a critical period from June 21st through September 22nd (summer) where phosphorus levels should be maintained at or below 0.075 mg/L to prevent excessive aquatic plant growth and dissolved oxygen problems.

Dodd et al., 1998 developed the stream trophic status that was used in the LSR TMDL to establish the TMDL phosphorus level. The 0.075 mg/l concentrations is at the upper limit that generally may separate a system from being Mesotrophic (0.025–0.075 mg/L) or Eutrophic (>0.075 mg/L). In this report 0.075 mg/L was used for data comparison.

A background TP level for the LSR TMDL was established by DEQ at 0.02 mg/L. This TP figure was subtracted from the background or reference site average TP concentration of 0.038 mg/L measured at the Campbell Ditch. The background canal water TP level of 0.018 mg/L was accounted for by subtracting this concentration from the average measured levels for each creek (Table 2).

Table 2 indicates that Four Mile Creek will require the highest reduction in TP to meet the TMDL. The high average concentration (0.171 mg/L) was due to a very high TP concentration (0.56 mg/L) measured on June 27, 2006 (Figure 4). This correlated with the high SSC level (174 mg/L) also recorded for this period. These high numbers appear to be a result of turning in irrigation water along with disturbances within the lower Four Mile Creek channel to remove deposited gravel and debris from earlier runoff events. This high concentration in June does not appear to be a normal condition for Four Mile Creek. Samples collected from Four Mile Creek on June 21st and 29th in 2005 indicated TP levels of 0.117 mg/L and 0.102 mg/L respectively. Without this high TP spike, in 2006, Four Mile Creek would require an approximate reduction of 32% to meet the LSR TMDL.

Table 2. Approximate TP reductions to meet LSR TMDL.

Statistics	WGC	EGC	3mile	4Mile	MC	6Mile
n	7	7	7	7	3	7
median (mg/L)	0.072	0.081	0.15	0.162	0.112	0.06
st.dev (mg/L)	0.027	0.035	0.062	0.171	0.061	0.052
high (mg/L)	0.094	0.132	0.25	0.559	0.18	0.188
low (mg/L)	0.024	0.04	0.067	0.022	0.058	0.048
mean (mg/L)	0.063	0.080	0.163	0.189	0.117	0.088
minus background (mg/L)	0.018	0.018	0.018	0.018	0.018	0.018
average TP (mg/L)	0.045	0.062	0.145	0.171	0.099	0.07
TMDL TP level (mg/L)	0.075	0.075	0.075	0.075	0.075	0.075
reduction needed	0%	0%	48%	56%	24%	0%

Figure 4 illustrates the overall TP concentrations for all of the tributaries over the entire study period. The redline in Figure 4 indicates the approximate TMDL TP target of 0.075 mg/L. The blue dashed line (box) encompasses the approximate TMDL critical time period (summer) for TP concentrations within the LSR.

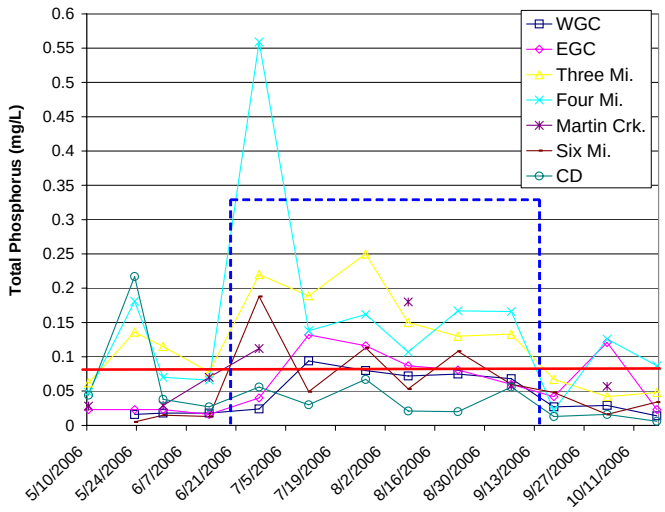

Figure 4. TP levels without background (0.018 mg/L) concentration subtracted.

Dissolve Oxygen

Dissolved Oxygen (DO) concentrations in sections of the LSR indicate a problem and the LSR TMDL lists DO as a concern. Measurements for DO at the creek locations indicate periodic levels that are below the 6.0 mg/L state standard (Figure 5).

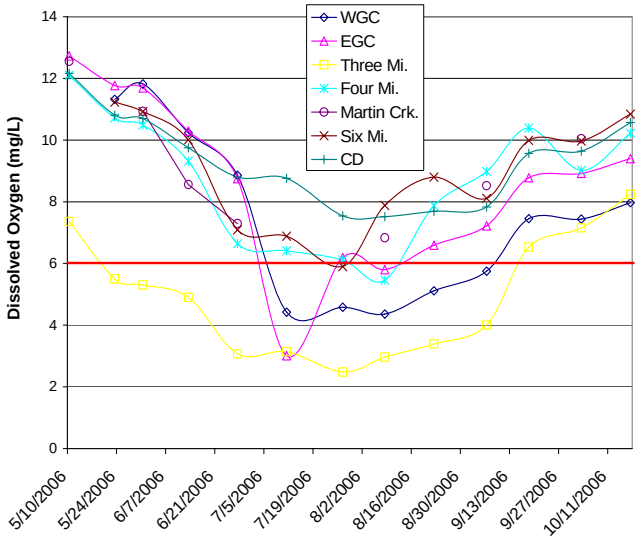

Figure 5. DO concentrations mg/L. Redline indicates state standard (6.0 mg/L).

As can be seen in Figure 5, Three Mile Creek showed depressed DO levels starting in May through the first part of September. West Goose Creek (WGC) and Three Mile showed the largest time spans of reduced DO concentrations.

These low DO levels can be caused by multiple factors within each creek. Quite often it's the presence of excess nutrients which can cause excessive aquatic vegetation that uses up dissolved oxygen during respiration. Another cause could be excessive bacteria reducing the DO in the water column as the bacteria uses oxygen to decompose excessive organic material.

Some other possible contributors to low DO could be due to flood irrigation and the returning of ground water through the hyporeic zone. Water returning from shallow ground water storage usually returns somewhat cooler than the surface water but often lower in DO concentrations. Also diminished return flow along with increased temperature can reduce DO levels. The diminished return flows in the creeks decrease the chance for re-aeration thus lowering the oxygen levels.

Bacteria (Escherichia Coli)

ISDA evaluated bacteria levels for the 2006 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. ISDA did not conduct any geomean analysis during 2006.

Although no geomean analysis was performed the data in Table 3 suggest that most of the creeks would probably fail the geomean analysis for *E-coli*. Campbell Ditch and West Goose Creek lack of exceedances would indicate that these two sites would probably pass the geomean analysis.

Table 3. *E-coli* Results (CFUs)

Date	WGC	EGC	3mile	4mile	Martin	6mile	CD
5/10/2006		13	17	30	45		10
5/23/2006	260	130	440	200	240	130	4
5/31/2006	51	370	2400	920	2400	25	130
6/13/2006	52	240	550	2400	2400	170	19
6/27/2006	1600	820	2400	2400		2400	770
7/11/2006	310	610	980	2000		2400	280
7/27/2006	140	2000	2400	2400		2000	2400
8/3/2006	220	1100	370	370	2400	1200	190
8/22/2006	180	2400	170	2400		1300	290
9/6/2006	460	490	350	1600	1100	2400	170
9/18/2006	74	120	340	410		2000	76
10/3/2006	59	140	43	2400	2400	650	250
10/17/2006	160	260	120	580		580	190

Conclusions

As with the 2004 and 2005 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.

Although there were several high SSC events on the upper and lower Four Mile sites the overall concentrations for all the creeks, during the critical period, were within acceptable ranges. The upper Four Mile site had a high concentration of 400 mg/L for SSC during a major spring runoff event in May. The other high event 174 mg/L SSC occurred at the lower Four Mile site on June 27, 2006 after irrigation water was turned in from Campbell Ditch.

Of the six creeks monitored only three would require TP concentration reductions to meet the LSR TMDL. Four Mile would require the largest at 56% which was primarily due to the two high SSC events that resulted in TP concentrations of 0.22 mg/L and 0.56 mg/L respectively. Three Mile was next with a TP reduction of 48%. Three Mile TP levels did not have high spikes like Four Mile but the TP levels remained relatively constant at a moderately high level throughout the critical period. The final reduction was for Martin Creek (MC) which would require a 24% reduction. MC was only monitored seven times during this study due to its minimal average discharge (0.41 CFS) into the LSR.

Three Mile Creek showed the most depressed dissolved oxygen (DO) levels with the average over the critical period at 3.65 mg/L. West Goose Creek had the second lowest critical period average of 5.79 mg/L. Mixing areas where these creeks entered the Little Salmon River exhibited overall lower DO levels.

It appears that all of the creeks at one time or another provide large loads of *E-coli* into the LSR. Geomean analysis was not conducted on the creeks but from the discrete data collected it would appear that only West Goose Creek (WGC) and Campbell Ditch (CD) might succeed in passing the geomean criteria.

Recommendations

Inputs of phosphorus and bacteria are causing water quality issues for the meadows area of the Little Salmon River. Best management practices (BMPS) that landowners can implement, to reduce nutrient and bacteria inputs, would be a positive step forward to help improve the water quality of the Little Salmon River. Both the excessive phosphorus and large loads of bacteria are

adding to dissolved oxygen problems observed on the main stem of the LSR within the meadows area.

Reviewing the LSR 2005 data indicated that Big Creek and Little Creek required TP reductions of 40% and 32% respectively. Two options for TP reductions should be considered when seeking funds for BMP installations. The first option would look only at the creeks that exceed the TMDL TP concentration. That would require averaging Four Mile, Three Mile, Martin, Big Creek and Little Creek and would result in an average TP reduction of 40% for the landowners within those drainages. Option one would focus all potential funding towards those specific stakeholders.

Option two would keep from excessively burdening one landowner over another and seek TP reduction with an equitable split between all of the tributaries to the LSR. By dividing the total percent reductions by all eight tributaries (two tributaries from 2005 and six from 2006) the average load reduction for property owners along these creeks would average approximately 25%. A 25% reduction of TP from all contributors could possibly be easier to achieve than a large percent reduction from only one or two contributors.

Some BMPs to help reduce loading from phosphorus and bacteria are listed below:

- 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.
- Fencing off creeks and streams.
- Develop off site watering.
- Riparian buffers or filters along water ways.
- More efficient methods of irrigation and controlling irrigation runoff.

It should also be noted that since the LSR has an established TMDL, funding for BMP projects to reduce phosphorus and bacteria loading are available through a variety of loans and grants (Department of Environmental Quality, Idaho Soil Conservation Commission, Natural Resource Conservation Service and others).

Acknowledgement

I would like to personally thank the Lower Salmon River Watershed Advisory Group for their support over the last three years of monitoring on the Little Salmon River. I would like to thank the landowners that allowed me access to their property to conduct this monitoring. Special thanks goes to Mr. Steve Campbell (local rancher) and Mr. Vic Armacost (WAG chair) for their guidance, time, and helpful contacts that allowed me to complete this monitoring program. Additional thanks goes to Leslie Freeman (DEQ) for her technical and field support along with Kalissa Copeland (IASCD) for her field support and logistics. I would like to thank the Idaho State Department of Agriculture for allowing me to pursue this project over the last three years.

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