Idaho State Department of Agriculture
Division of Agricultural Resources

# Squaw Creek Year 2 Water Quality Monitoring Report

## April 2006 through October 2006

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ISDA Technical Report Summary W-18 March 2007

## Introduction

The Idaho State Department of Agriculture (ISDA) working in conjunction with the Squaw Creek Soil Conservation District (SCD) conducted a second year of water quality monitoring on Squaw Creek. Squaw Creek is located within Hydrological Unit Code (HUC) 17050122 and confluences with Black Canyon Reservoir. Squaw Creek is not currently listed on the State of Idaho's 303(d) listing for impaired water bodies.

There were four stations established on the mainstem of Squaw Creek. SQC-5 was established as a background site near 2nd and 3rd Fork Road, SQC-4 at Perkins Lane, SQC-3 Morgan Farm, and SQC-2 at Butte Road (Figure 1). The lower site SQC-2 at Butte Road was unavailable for sample collection after June 1, 2006 due to new bridge construction. This construction only allowed us to collect five samples from this site. A new lower site (SQC-2A) was established, but not until September. The four data points collected from the new lower site were averaged with the earlier station data from the Butte Road site.

Little Squaw Creek (LSQ-1) was monitored in 2006 approximately 1.5 miles upstream from its confluence with Squaw Creek (Figure 1). Soldier Creek (SC-1), which is a tributary to Little Squaw Creek, was also monitored during this program. SC-1 is currently listed for sediment on the State of Idaho's 303(d) listing for impaired water bodies. Unfortunately, permission to access SC-1 was not gained until May and by July the water level within SC-1 was too low for monitoring. This time frame only generated six samples from SC-1 and the early April runoff was missed.

Two drains were also added to the monitoring for 2006 to try and determine their overall impacts on Squaw Creek. The P-drain is located at Perkins Road where station SQC-4 is located. The M-drain site is located on

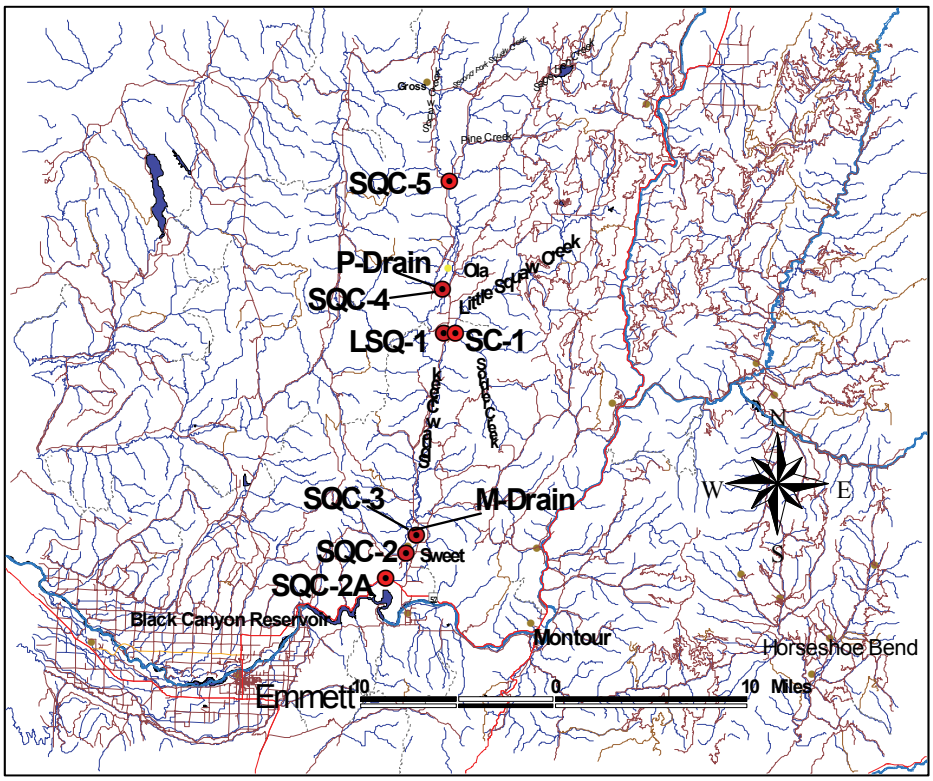


**Figure 1**. Squaw Creek and Little Squaw Creek monitoring sites.

the Morgan property where station SQC-3 is located (Figure 1). Both of these drains return irrigation water back to Squaw Creek.

Monitoring was conducted every two weeks from April through October 2006. A total of 15 samples were collected at stations SQC-5, SQC4, SQC-3, and LSQ-1.
Due to bridge construction, only nine samples were collected at SQC-2. Soldier Creek only had six samples while the P-drain and M-drain had nine and eight samples collected, respectively.

Analytical parameters collected include suspended sediment concentration (SSC), total phosphorus (TP), dissolved phosphorus (DP), and Escherichia coli (*E-coli*). On-site parameters included 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 acceptable levels. The overall average SSC concentrations were below levels (<25 mg/L) that indicate no harmful effects on fish (DFO 2000).

SSC averages did increase approximately 50% over the data collected in 2005 (Table 1). The SSC increase correlates (average $R^2$ = 0.70) with the approximate average discharge increase of 56% (Figure 2).

**Table 1**. Mainstem average SSC concentration 2005 and 2006.

| SSC (mg/L) | SQC-5 | SQC-4 | SQC-3 | SQC-2 | LSQ-1 |
|---|---|---|---|---|---|
| 2005 | 6.6 | 6.6 | 7.1 | 9.7 | 5.8 |
| 2006 | 11.7 | 12.8 | 17.6 | 19.9 | 11 |

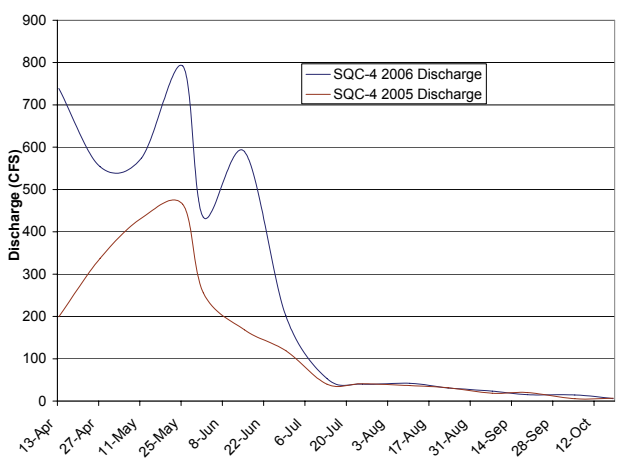


**Figure 2**. Discharge at SQC-4 for 2005 and 2006.

The three new sites for 2006 also had low SSC values. Soldier Creek average was 9.6 mg/L, P-drain average concentration was 5.1 mg/L and M-drain was at 6.1 mg/L. Due to the late start at SC-1, the early runoff period in April, which normally transports a larger volume of sediment, was not captured. Soldier Creek is listed on the State of Idaho's 303(d) list as having impairment due to sediment. Although the suspended sediment numbers were low, observations indicate that transport of a granitic bedload may be occurring within Soldier Creek. In the lower section, large cut-banks were observed and the bottom substrate was armored with medium to coarse granitic materials.

### Phosphorus

Even with the increase of discharge and SSC levels in 2006 the total phosphorus concentrations correlated well with the data collected in 2005 and showed no major increases (Table 2).

**Table 2.** Mainstem average TP concentration 2005 and 2006.

| TP (mg/L) | SQC-5 | SQC-4 | SQC-3 | SQC-2 | LSQ-1 |
|---|---|---|---|---|---|
| 2005 | 0.042 | 0.072 | 0.088 | 0.09 | 0.11 |
| 2006 | 0.039 | 0.078 | 0.078 | 0.081 | 0.1 |

Box plot graphs will be used to compare the phosphorus concentrations on both the Squaw Creek mainstem stations along with the two tributaries (LSQ-1 and SC-1) and the two drains (P-drain and M-drain). The structure of a box plot is indicated in Figure 3.

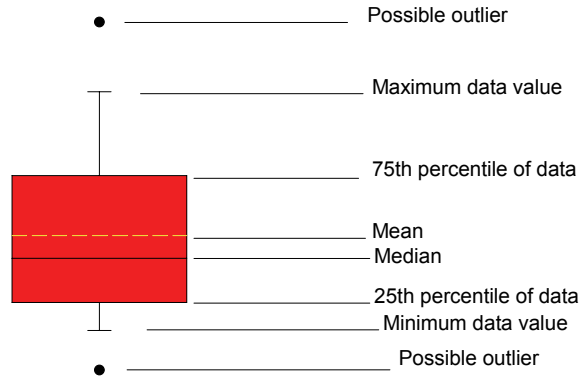


**Figure 3**. Components of a Box Plot graph.

As previously mentioned, Squaw Creek is not listed on the State of Idaho's 303(d) list and has not had any required TP concentration established to protect possible impairment. Since there is not established TP criteria for Squaw Creek, an allocation will be established, for this report, based on the EPA Gold Book (1987) criteria of ≤0.05 mg/L of TP for streams entering lakes or reservoirs (Figure 4).

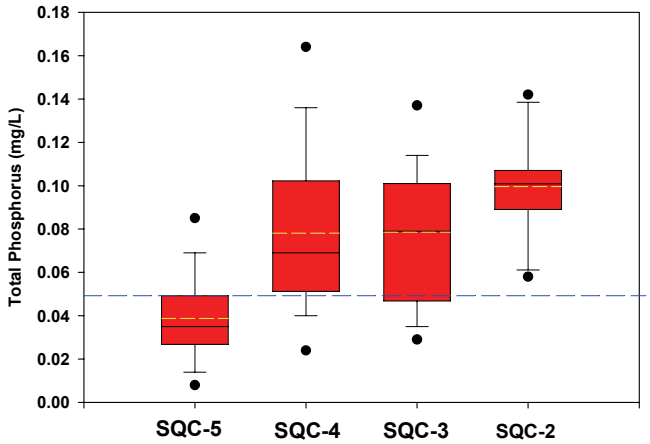


**Figure 4**. Box plot of TP concentrations on the main stem of Squaw Creek. Blue dotted line indicates 0.05 mg/L.

Figure 4 indicates that reduction in TP to meet the 0.05 mg/L goal would be required at stations SQC-4 (36%), SQC-3 (37%), and SQC-2 (38%). Station SQC-5 which is the upstream reference station would not require any reductions in TP. These reductions compare well with the 2005 data (Table 3).

**Table 3**. TP reduction comparison 2005 and 2006.

| Stations | %TP reduction 2006 | %TP reduction 2005 |
|---|---|---|
| SQC-5 | 0 | 0 |
| SQC-4 | 36 | 30 |
| SQC-3 | 37 | 44 |
| SQC-2 | 38 | 42 |

Little Squaw Creek (LSQ-1) is a tributary to Squaw Creek and Soldier Creek (SC-1) is a tributary to LSQ-1. Since these tributaries do not discharge directly into Black Canyon Reservoir they will be evaluated using the TP concentration of 0.07 mg/L that was established for the Snake River Hells Canyon TMDL (IDEQ 2002). Using a goal of 0.07 mg/L would require reduction in TP by 10% for SC-1 and 30% for LSQ-1 (Figure 5).

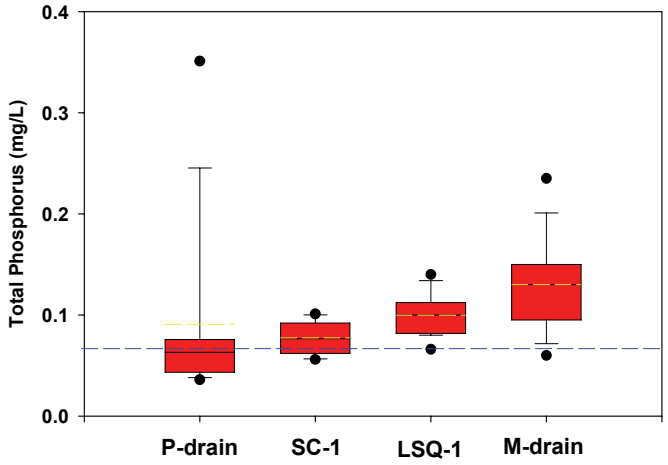


**Figure 5**. Box plot of TP on tributaries and drains. Blue line indicates 0.07 mg/L of TP.

Figure 5 indicates that both drains (P-drain and M-drain) are transporting phosphorus during the irrigation season into Squaw Creek. The reductions of TP from these drains would be dependant on if or when any TP allocation is established for Squaw Creek. There are numerous small irrigation return drains throughout Squaw Creek. At the Perkins Road site, four drains were observed all transporting irrigation water back into Squaw Creek. The monitoring data from 2006 indicate that these drains, along with others, are a delivery source of phosphorus into Squaw Creek. These drains are entering Squaw Creek when discharge within Squaw Creek is at its lowest and insufficient water is available to allow for dilution. The phosphorus load from these drains along with lack of flow within the mainstem may account for the large TP increases starting in June as illustrated at SQC-4 (Figure 6).

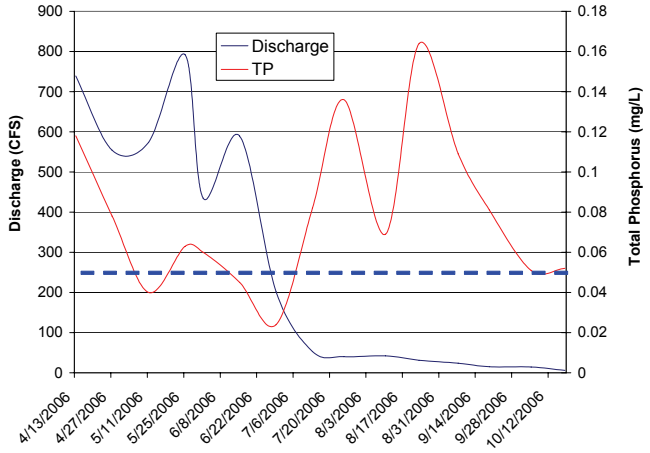


**Figure 6.** Station SQC-4 discharge and TP comparison. Blue dotted line indicates 0.05 mg/L.

Figure 7 indicates that total phosphorus (particulate form) is the majority of phosphorus in the spring during higher runoff. As flow recedes and irrigation increases dissolved phosphorus becomes a larger percentage of TP.

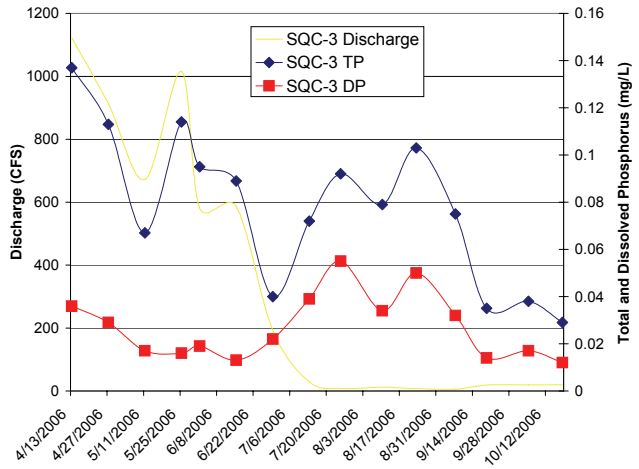


**Figure 7**. Discharge, TP, and DP comparison for SQC-3.

## Dissolved Oxygen and Temperature

Instantaneous dissolved oxygen (DO) levels within the mainstem of Squaw Creek were all above the state water quality criteria of 6.0 mg/L (IDAPA 58.1.02). Station SQC-4 and SQC-3 did exhibit some DO sags in late August and early September. Levels at SQC-4 on August 23rd and September 7th were at 6.30 mg/L and 6.21 mg/L respectively. Station SQC-3 exhibited levels of 6.57 mg/L and 6.55 mg/L on the same dates. As for the drains, the P-drain at Perkins Road had DO measurements of 4.21 mg/L on August 10th, 4.34 mg/L on August 23rd, and 6.7 mg/L on September 7, 2006. The M-drain at Morgan's had its lowest DO measurement of 6.21 mg/L on September 7, 2006.

Waters in Idaho designated for cold water aquatic life require water temperatures of 22°C or less with a maximum daily average of no greater than 19°C (IDAPA 58.1.02). Instantaneous temperature measurements indicate that Squaw Creek at station SQC-3 exceeded 22°C on July 13th and July 25th while Little Squaw Creek exceeded the maximum once on July 25, 2006 (Figure 8). There was no temperature data collected over a 24 hour period to determine the daily average.

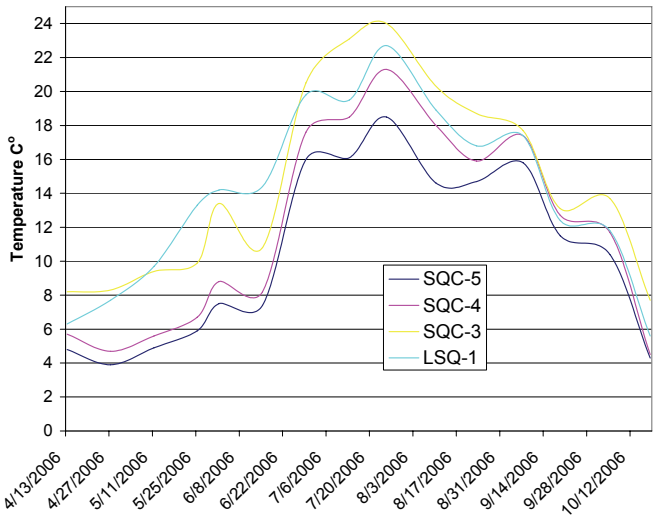


**Figure 8**. Instantaneous temperature measurements.

## Bacteria (Escherichia Coli)

ISDA evaluated bacteria levels again for the 2006 monitoring season 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 (CFUs). 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. No geomean analysis was conducted during the 2006 monitoring season.

Table 4 (red values) indicates that several sites showed increases in *E-coli* detection during the 2006 monitoring period. The largest increases were observed at SQC-4 which went from zero detects in 2005 to four detects in 2006 and LSQ-1 which increased from three detects in 2005 to seven in 2006. Soldier Creek (SC-1) which was not tested in 2005 showed several E-coli concentrations above the 406 CFU instantaneous values. There were no observable reasons for the increase of E-coli detections during the 2006 monitoring season. It would appear, from Table 4, that geomean sampling for E-coli may be warranted at several locations within the watershed.

**Table 4**. Squaw Creek E-coli results (CFUs)

| Date | SQC-5 | SQC-4 | SQC-3 | LSQ-1 | SQC-2 | SC-1 |
|---|---|---|---|---|---|---|
| 4/13/2006 | 32 | 32 | 32 | 30 | 31 | |
| 4/27/2006 | 6 | 40 | 56 | 72 | 72 | |
| 5/11/2006 | 20 | 63 | 55 | 920 | 52 | 2400 |
| 5/25/2006 | 31 | 47 | 110 | 190 | 86 | 120 |
| 6/1/2006 | 36 | 93 | 220 | 920 | 190 | 410 |
| 6/15/2006 | 61 | 91 | 249 | 2420 | 86 | 548 |
| 6/29/2006 | 77 | 130 | 150 | 870 | | 870 |
| 7/13/2006 | 220 | 410 | 91 | 650 | | 330 |
| 7/25/2006 | 290 | 340 | 180 | 400 | | |
| 8/10/2006 | 330 | 980 | 820 | 290 | | |
| 8/23/2006 | 170 | 730 | 490 | 170 | SQC-2A | |
| 9/7/2006 | 410 | 980 | 2000 | 1600 | 170 | |
| 9/19/2006 | 130 | 370 | 190 | 220 | 120 | |
| 10/5/2006 | 110 | 340 | 170 | 83 | 50 | |
| 10/18/2006 | 69 | 120 | 88 | 440 | 67 | |
| Exceedances 2006 | 1 | 4 | 3 | 7 | 0 | 4 |
| Exceedances 2005 | 2 | 0 | 2 | 3 | 2 | NA |

## Conclusions

Although the suspended sediment concentration (SSC) levels increased approximately 50% in 2006, the data still indicates that the levels are well below any acute or chronic levels for aquatic organisms. The SSC increase correlated well with the increase in discharge. Soldier Creek showed some signs of a possible bedload sediment problem due to the armoring observed on its substrate.

The increase in stream discharge and SSC did not reflect a proportional increase in average total phosphorus (TP). The levels recorded in 2006 were quite consistent with the levels seen in 2005. It appears that the dominate phosphorus form during high flow in the spring is particulate phosphorus while dissolved phosphorus dominates later during irrigation season. Phosphorus levels within the tributaries and the mainstem of Squaw Creek may require phosphorus reductions in the future to meet possible concentration requirements.

The two drains (P-drain and M-drain) indicated that they are possible sources of phosphorus during the irrigation season. There are numerous small return drains throughout the Squaw Creek watershed that may be prime sources of phosphorus during the irrigation season.

Even with phosphorus concentrations that may be somewhat higher than desired, there were no large algae blooms or excessive aquatic vegetation observed. Although the dissolved oxygen did show some small sags in the heat of the summer, the levels never dropped below the state criteria of 6.0 mg/L. On Little Squaw Creek, benthic activity was high with a large population of Caddis fly nymphs (Tricoptera) observed.

It is unknown at this time if there is a temperature issue on Squaw Creek. The mainstem site (SQC-3) exceeded the daily high for cold water biota (22$^{o}$C) twice in July while Little Squaw Creek only had one exceedance also in July.

Bacteria levels (*E-coli*) were up approximately 60% (2006-15 detects, 2005-9 detects) over the 2005 data. It appears from the 2006 data that geomean monitoring may be warranted to determine if there truly is an *E-coli* problem within Squaw Creek.

## Recommendations

Future evaluation of potential temperature and bacteria concerns may be warranted within the Squaw Creek watershed.

Other possible efforts that may improve the overall condition of Squaw Creek may include:

- Minimize P losses caused by erosion by using management practices that maintain a complete cover of forages and residues over pasture surfaces.
- 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 filter strips along waterways or at end of fields.
- More efficient methods of irrigation and controlling irrigation runoff.
- Water diversion management to maintain better flows within Squaw Creek's mainstem during low flow summer periods.

## References

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