Idaho State Department of Agriculture
Division of Agricultural Resources

Water Quality Evaluation
Crane Reservoir and Crane Creek
Washington County, Idaho
April 2007 through October 2007

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ISDA Technical Report Summary W-22

January 2008

Introduction

At the request of the Weiser River Watershed Advisory Group (WAG), the Idaho State Department of Agriculture (ISDA) conducted a water quality monitoring project on Crane Creek and the outlet of Crane Reservoir. Crane Reservoir and Crane Creek reside within Hydrological Unit Code 17050124. They are located in Washington County and are northeast of the city of Weiser. Crane Creek and the Weiser River are 303(d) listed for total phosphorus (TP), suspended sediment concentration (SSC) and Escherichia Coliform (*E-coli*).

The Weiser River WAG is concerned about the water quality within Crane Reservoir and its direct effect on Crane Creek and the Weiser River when Crane Reservoir water is released through Crane Creek during irrigation season. Crane Reservoir encompasses approximately 3,000 acres and was primarily designed and built for the collection and storage of irrigation water.

ISDA established three sites for this study with two on Crane Creek and one just below the outlet of the reservoir. Station CR-3 was at the reservoir outlet, site CR-2 was located on Lower Crane Creek Road, and CR-1 was located at the mouth of Crane Creek on Weiser River Road. The distance from the reservoir outlet to the mouth of Crane Creek is approximately 12 miles. The distance between station CR-2 and CR-1 is 1.2 river miles (Figure 1). Samples were collected on a bi-weekly schedule starting on April 12, 2007 through October 25, 2007.

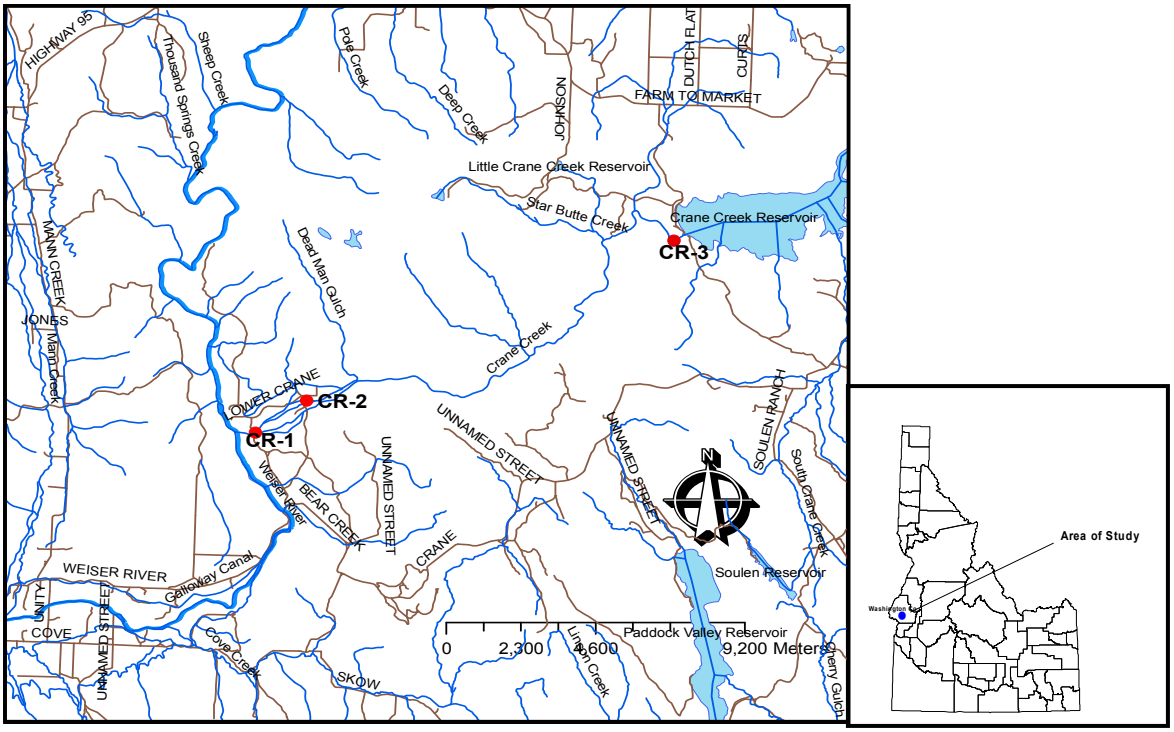

Figure 1. Map of study area.

Results

Suspended Sediment Concentration (SSC)

Reviewing soil survey information (NRCS) for the area around Crane Reservoir indicates that the shallow soils throughout the area consist of a mixture of silt, clay, loam, gravel, and stony soils (Table 1).

Table 1. Crane Reservoir soil classifications.

Soil Classification	Characteristics
Gem-Reywat	Stony clay loam and clay with stony loam and gravelly clay
Brownlee Sandy Loam	Sandy loam and sandy clay loam
Deshler	Stony clay loam and silty clay loam
Bakeover-Reywat	Stony loam and gravelly clay loam
Crane Creek-Reywat	Loam clay and loam with stony loam and gravelly clay
Deshler-Devnot	Silty clay loam and very stony clay loam and stony clay
Deshler-SCL	Silty clay loam

These fine materials appear to be what is suspended in the water column within the reservoir. Once the reservoir water starts entering Crane Creek the difference in water color and turbidity is obvious. The very fine suspended particulate makes it difficult to pass a minimum of 20 milliliters of sample water through a 0.45 µm glass fiber filter without clogging. The material retained on the filter is very fine and smooth to the touch. The quick clogging of the filter would indicate that the material is very close to the 0.45 um filter size and would place it within the classification of fine silt (0.016-0.008 mm) to very fine clay (0.0005-0.00024 mm). These smaller clays and silts have very large surface areas that allow them to adsorb nutrients to their surface for transport.

The statistics from the three locations for SSC concentrations show no significant difference between stations (Table 2). The data collected indicates that SSC concentrations within the Crane Creek system are not necessarily impacted by the overall discharge rate (Figure 2). The overall SSC concentrations are somewhat consistent and appear to originate from the reservoir and are unaltered by discharge within Crane Creek.

Data indicate that as water is released from Crane Reservoir both of the two lower stations (CR-1 and CR-2) show a spike in SSC (Figure 2). This indicates that deposited sediments are being flushed downstream by increased discharge of reservoir water.

Table 2. SCC statistics.

Statistics (mg/L)	CR-1	CR-2	CR-3
Mean	36.3	39.5	39.4
Median	30.1	35.1	29.1
St. deviation	30.4	30.8	22
High	114.7	119.3	78
Low	3.2	2.5	16.2

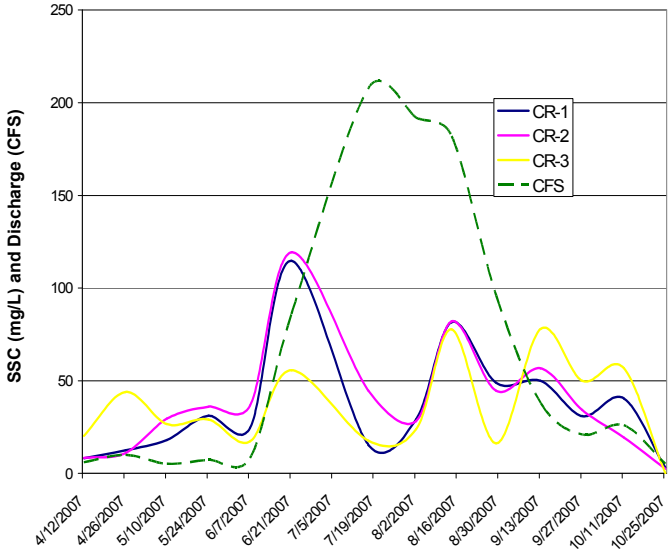

Figure 2. SSC concentration and discharge relationship.

The box plot (Figure 3) shows the comparison of the mean (redline) and median (black line) SSC concentrations for the three stations. In general, mean and median values have similar concentrations for all three sampling sites.

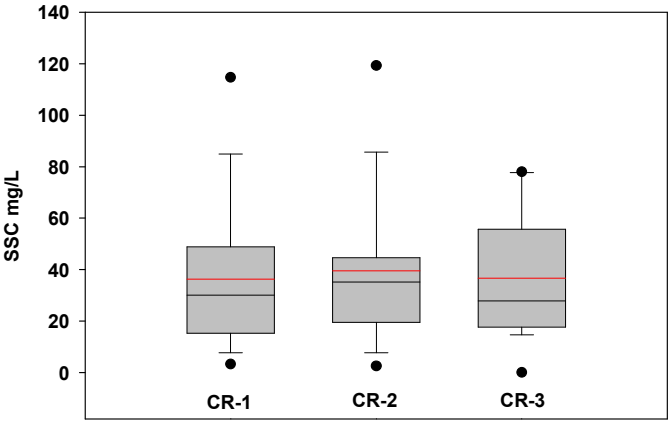

Figure 3. Box plot comparing SSC concentrations.

Total Phosphorus (TP)

The fine suspended particulate that is generated within Crane Reservoir also carries significant amounts of TP (Table 3).

Table 3. TP statistics.

Statistics (mg/L)	CR-1	CR-2	CR-3
Mean	0.246	0.255	0.342
Median	0.25	0.28	0.32
St. Deviation	0.099	0.12	0.169
High	0.366	0.411	0.822
Low	0.074	0.056	0.151

Table 3 indicates that CR-3 had a very high TP concentration which increased the mean concentration. This high value was collected on April 26, 2007 and field notes indicated that this site (CR-3) was very turbid when compared to the two lower sites. The actual cause of this high value is unknown.

The same trend appears, that appeared for SSC, when discharge rates are compared to TP. TP levels seem to level off while discharge increased and decreased later in the irrigation season (Figure 4).

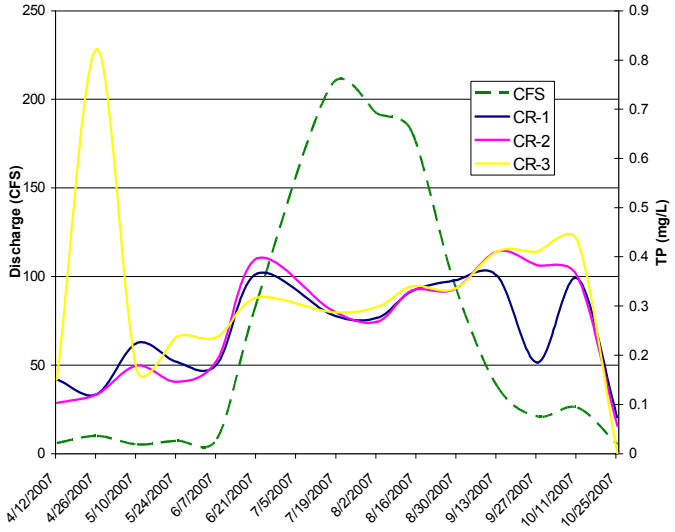

Figure 4. TP concentration and discharge relationship.

The percentage of dissolved phosphorus (DP) increased slightly from upstream to downstream. The average percentage of DP consisted of 38% at CR-3, 46% at CR-2, and 48% at CR-1 (Figure 5).

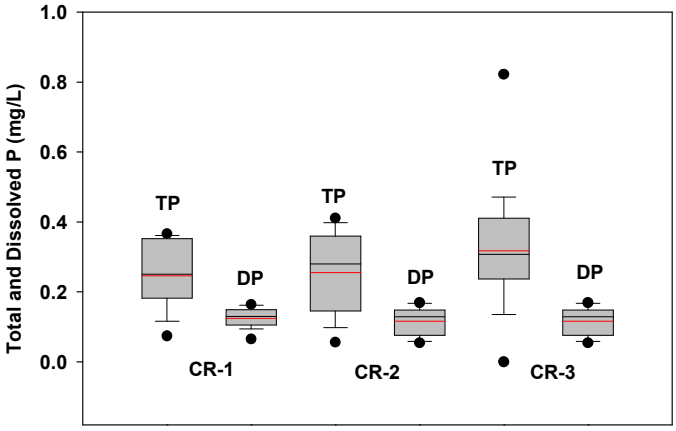

Figure 5. Box plot comparing mean and median TP and DP concentrations. Redline is mean black line is median.

The Weiser River total maximum daily load (TMDL) established a TP target of 0.07 mg/L for Crane Creek (DEQ 2007). This target is based on the concentration of 0.07 mg/L TP established for the Snake River Hells Canyon TMDL.

To reach this goal of 0.07 mg/L TP levels at CR-1 and CR-2 would require an approximate reduction of 72% while TP levels at the reservoir, would require an approximate reduction of 80%.

Escherichia Coliform (*E-coli*)

Crane Creek was also 303(d) listed for water quality impairment due to excessive bacteria (*E-coli*) levels. *E-coli* data collected during this project (Table 5) indicate that on occasion *E-coli* levels exceeded the one time state water quality level of 406 colony forming units (CFUs) for primary contact waters. Geomean sampling, which requires five samples collected over a 30 day period, is necessary to determine if a water quality violation for bacteria has occurred. No geomean sampling was conducted during this program.

Table 5. E-coli results (CFUs), yellow indicates an exceedance.

Date	CR-1	CR-2	CR-3
4/12/2007	350	180	46
4/26/2007	870	41	20
5/10/2007	330	96	14
5/24/2007	1200	120	11
6/7/2007	310	550	20
6/21/2007	770	820	10
7/17/2007	120	73	6
8/2/2007	2000	56	3
8/14/2007	130	36	0.5
8/29/2007	140	74	2
9/13/2007	76	51	5
9/27/2007	37	19	12
10/11/2007	86	19	48
10/25/2007	40	10	0

Table 5 indicates that the majority of detections occurred at the lowest station CR-1 with no exceedances from the outlet of Crane Reservoir (CR-3). Exceedances seemed to occur at CR-1 when there were livestock in the vicinity of CR-2 and pastures were being flood irrigated.

Conclusions

The sediment target for Crane Creek established in the Weiser River TMDL states: less than or equal to 50 mg/L for no more than 30 days, less than or equal to 80 mg/L for no more than 14 days, both calculated as a geometric mean over the exposure duration (DEQ 2006). The suspended sediment within Crane Reservoir is very fine and light. The suspended sediment stays suspended in the water column and does not readily settle out. Due to the lightness of the material, it does not lend itself to consistently high SSC values when analyzed. There was one event on June 21st when stations CR-1 and CR-2 had high SSC concentrations of 114.7 and 119.3 mg/L respectively. The overall mean concentrations for CR-1 (36.3 mg/L), CR-2 (39.5 mg/L), and CR-3 (39.4 mg/L) were below the 30 and 14 day levels outlined in the TMDL.

Although the SCC concentrations are not extremely high, the overall turbidity caused by the suspended fine sediment can have unwanted effects. Some concerns are as follows:

* Particles absorb warmth from the sun and can cause increased water temperature.
* Excess sediment contains organic matter that can contribute to oxygen depletion as it decomposes.
* High concentrations can irritate fish gills and could cause death.
* Difficulty for fish to see and hunt their prey.
* Excess sediment can increase transport of nutrients.

Once Crane Reservoir water enters Crane Creek the phosphorus levels in Crane Creek increase dramatically (Figure 4). This is due to the fine particulate material emanating from Crane Reservoir and its capacity to adsorb and transport phosphorus. The reductions that would be necessary to meet the Weiser River TMDL TP concentration at the reservoir outlet would be 80%. Without TP reductions within the reservoir, there will never be a reduction in TP levels in Crane Creek. The high TP levels are solely driven by the poor quality of the reservoir's water.

The bacteria data is not conclusive enough to indicate a violation in the state's water quality rules. Further evaluation using five samples collected over a 30 day period to calculate the geomean would be required to determine if the data exceeds the state's established geomean of 126 CFUs.

References

NRCS Web Soil Survey. http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

USGS water data. http://waterdata.usgs.gov/id/nwis/uv?dd_cd=04&format=gif&period=7&site_no=13265500

Idaho Department of Environmental Quality, 2006. Weiser River Watershed Subbasin Assessment and Total Maximum Daily Loads.

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