Twentyfourmile Creek
Water Quality Monitoring Report

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Technical Report Summary
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Introduction

The Idaho Association of Soil Conservation Districts (IASCD) recently completed a water quality monitoring project in the Twentyfourmile Creek watershed in southeastern Idaho. This monitoring was conducted to measure the impacts of Best Management Practice (BMPs) that have been implemented in the watershed.

Twentyfourmile Creek is included on the State of Idaho §303(d) list of water quality impaired streams. Sediment was identified as the major pollutant of concern in Twentyfourmile Creek (IDEQ, 1999) and the stream was found to be a major source of sediment to the Portneuf River. Phosphorous, nitrogen, and bacteria were also identified by the IDEQ as polluntants of concern within the greater Portneuf subbasin (Table 1). Eighty-six percent of the 17,062 acres in the Twentyfourmile Creek watershed are privately owned. Rangeland is the dominant land use in the watershed. The beneficial uses designated for Twentyfourmile Creek are cold water aquatic life (CWAL), secondary contact recreation (SCR), and agricultural water supply.

Recent conservation efforts in the Twentyfourmile Creek watershed have largely been guided by the Portneuf River TMDL Agricultural Implementation Plan that was developed by the Idaho Soil Conservation Commission (ISCC) in 2002. This plan details recommendations that were based on visual assessments and water quality monitoring data (Fischer, 2002). Stream assessments showed that livestock grazing, roads, streambank erosion, crop land runoff, and animal feed operations negatively impacted water quality in the watershed (ISCC 2002).

Table 1. Pollutant targets for streams in the Portneuf River subbasin (IDEQ 1999).

Pollutant of Concern	Pollutant Targets for the Portneuf River Subbasin
Total Suspended Sediment (TSS)	Not to exceed 50 mg/L (low flow) or 80 mg/L (high flow)
Total Phosphorus (TP)	Not to exceed 0.075 mg/L
Nitrate + Nitrite	Not to exceed 0.3 mg/L Not to exceed 1.0 mg/L (2008 revised TMDL recommendation)
Escherichia coli (SCR)	Not to exceed 576 cfu/100 mL

The Caribou Soil Conservation District (SCD) has worked extensively with private landowners in the Twentyfourmile Creek watershed to improve water quality. The Caribou SCD obtained Idaho Nonpoint Source §319 and state Water Quality Program for Agriculture (WQPA) funds to treat 14,390 critical acres in the watershed. Typical projects included: livestock exclusion fencing, offsite watering, grazing management, and berms to contain animal waste.

The current Twentyfourmile Creek monitoring project was initiated with the support of the Caribou SCD.

The project goal was to evaluate the effectiveness of BMPs that have been implemented on Twentyfourmile Creek. Water quality monitoring was originally conducted in the watershed by IASCD from 1999-2001 (Jenkins, 2005) to measure baseline conditions. This report quantifies how water quality has changed since BMPs have been implemented in the watershed. IASCD worked cooperatively with Idaho State Department of Agriculture (ISDA), and the Caribou SCD to implement this monitoring project.

Monitoring Schedule and Site Descriptions

Water quality monitoring was conducted at four sites on Twentyfourmile Creek from April 2006 to October 2007 (Figure 1). Sites were selected to allow for upstream-downstream comparisons of water quality. The TC2 site was the original IASCD monitoring sites and was revisited to allow for direct comparison of water quality before and after BMP implementation.

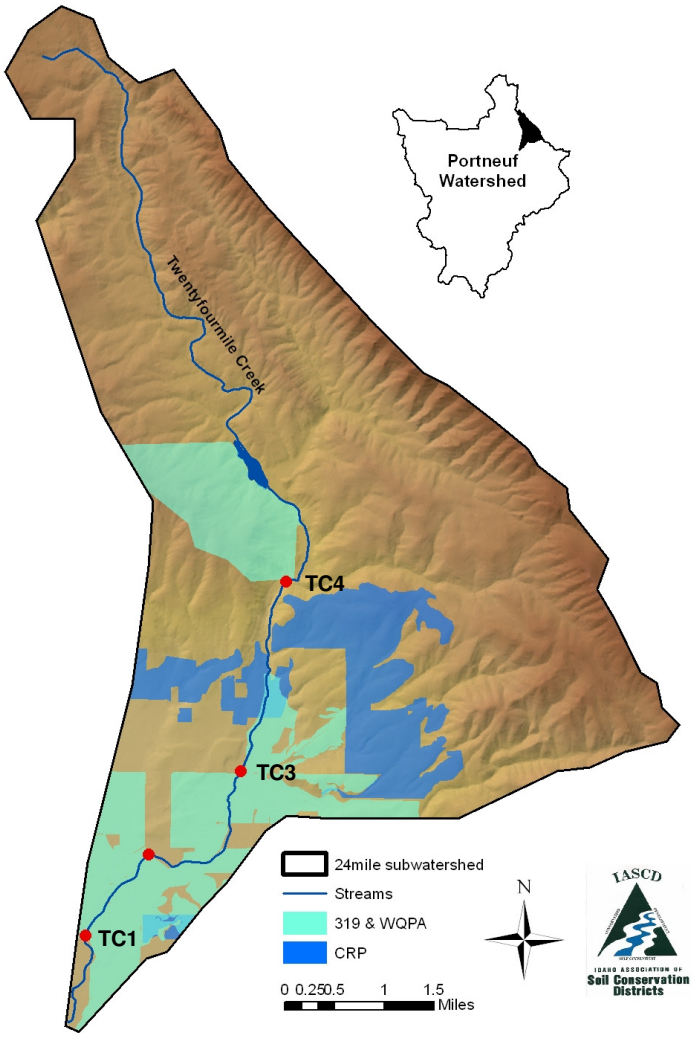

Figure 1. IASCD monitoring locations in the Twentyfourmile Creek watershed.

Monitoring stations were located upstream of the east-west Hansen Road (TC1), upstream of the north-south Hansen Road (TC2, previous IASCD site), upstream of Chesterfield Road (TC3) and just below the confluence with Pole Canyon Creek (TC4).

IASCD monitored twice a month from March through October and once a month during winter months. During each visit, samples were collected and analyzed for Total Suspended Sediment (TSS), total phosphorous (TP), orthophosphorus, nitrate + nitrite, and *E. coli*. Stream discharge, temperature, dissolved oxygen, pH, and conductivity were measured in the field.

Results

Discharge

Discharge rates fluctuated seasonally as is common in systems that are largely influenced by snow melt (Figure 2). Stream flow peaked during spring months and declined to base flows for the remainder of the year. There was a relatively large spring runoff event in 2006 and flows were significantly higher compared to 2007 levels at the TC3 and TC4 sites ($p \leq 0.051$).

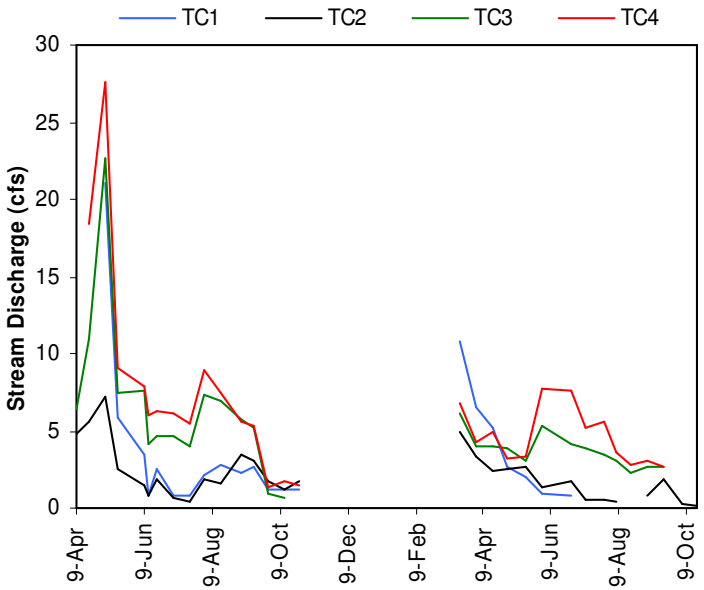

Figure 2. Stream discharge (cfs) from April 2006 to October 2007.

Average stream discharge rates were not significantly different between the pre-implementation sampling and the current monitoring period (Figure 3). Flows were significantly higher at the upper sites (TC3, TC4) compared to the TC2 site ($p \leq 0.0008$). This is likely due to irrigation withdrawals and stream topography. Immediately above the TC2 site stream gradient is greatly reduced and during high flows the stream exceeds the stream channel. During these events much of the water is transported as overland flow and is not measured in the stream channel.

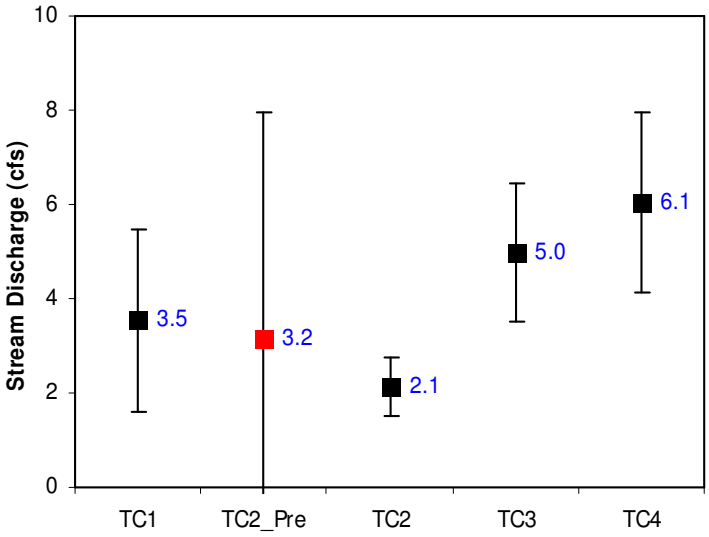

Figure 3. Mean stream discharge (± 95% CI) at four sites on Twentyfourmile Creek.

Total Suspended Sediment

Total suspended sediment (TSS) concentrations at the TC3 and TC4 sites fluctuated on a seasonal basis. As is typical of snowmelt dependent systems, TSS levels increased during spring runoff events and declined to low levels throughout the rest of the year (Figure 4). Conversely, TSS concentrations at the TC1 site was not correlated with stream flow. Instead, TSS levels were low (≤ 11 mg/L) and the lack of variation made it difficult to correlate TSS with flow. TSS at the TC2 site exhibited an atypical, negative relationship with stream flow. As flows receded, TSS concentrations became elevated. One explanation for this may be that sediment is deposited on relatively flat fields adjacent to the stream during high water events. In late spring and summer these fields are flood irrigated for alfalfa production and sediment particles that were previously deposited may be mobilized.

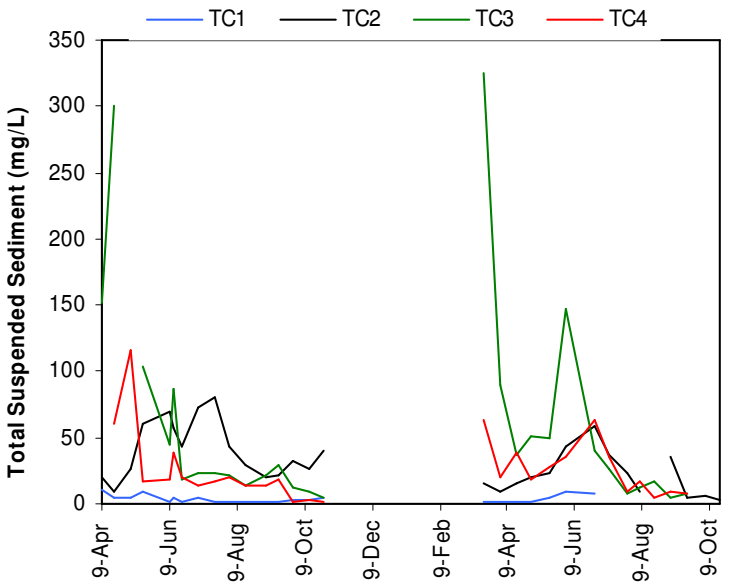

Figure 4. Total suspended sediment levels (mg/L) from April 2006-October 2007.

Mean TSS concentrations at the four sites were low and on average did not exceed the 50 mg/L target (Figure 5). TSS levels were significantly higher at the middle sites (TC2, TC3) than at upper- and lowermost sites ($p \leq 0.008$). While not statistically significant, TSS levels at the TC2 site were reduced by 14 mg/L (31%) after implementation of BMPs.

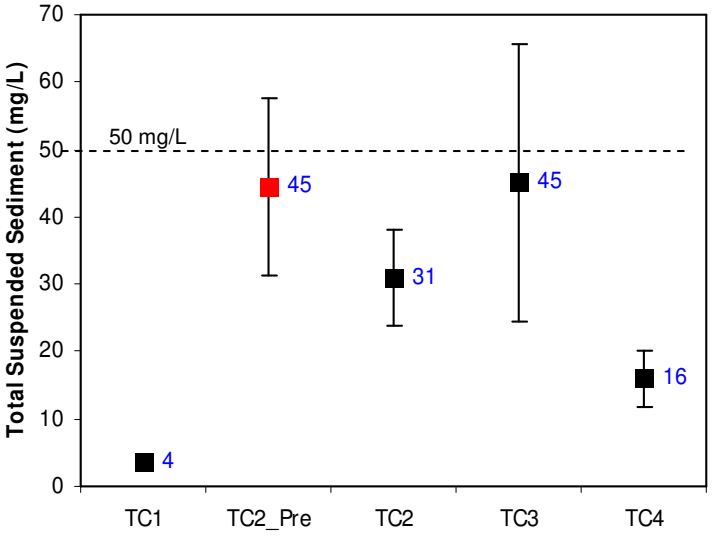

Figure 5. Mean suspended sediment concentrations (± 95% CI) measured before and after implementation in the Twentyfourmile Creek watershed.

Total Phosphorus

Phosphorus is the major nutrient of concern in the Portneuf Subbasin. TP concentrations in the Twentyfourmile Creek watershed fluctuated throughout the year (Figure 6). TP levels at TC3 and TC4 exhibited typical seasonal patterns. At these sites, TP concentrations peaked during spring runoff and decreased during base flow. TP levels at TC2 paralleled suspended sediment concentrations and were highest during summer months. With the exception of one measurement, TP concentrations at TC1 were low and were correlated with suspended sediment concentrations, but did not exhibit a seasonal pattern.

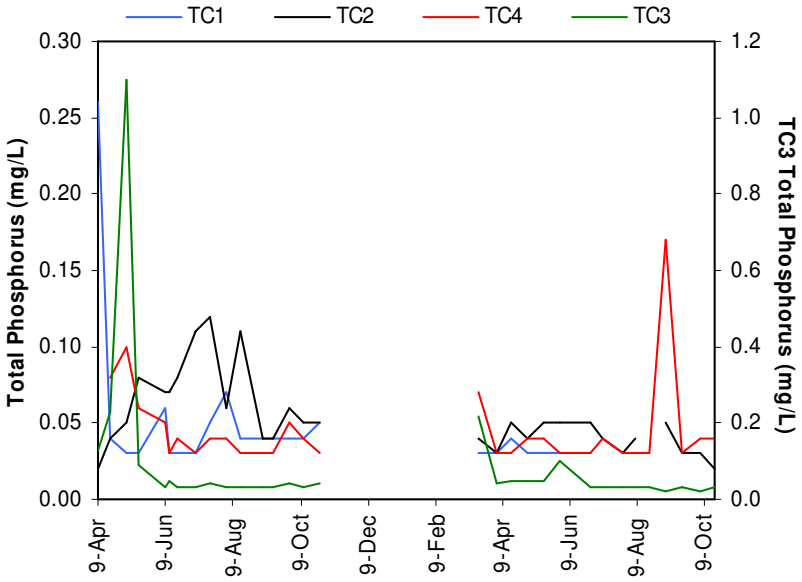

Figure 6. Total phosphorus concentrations at the four sites. Note: TC3 is graphed using the secondary y-axis.

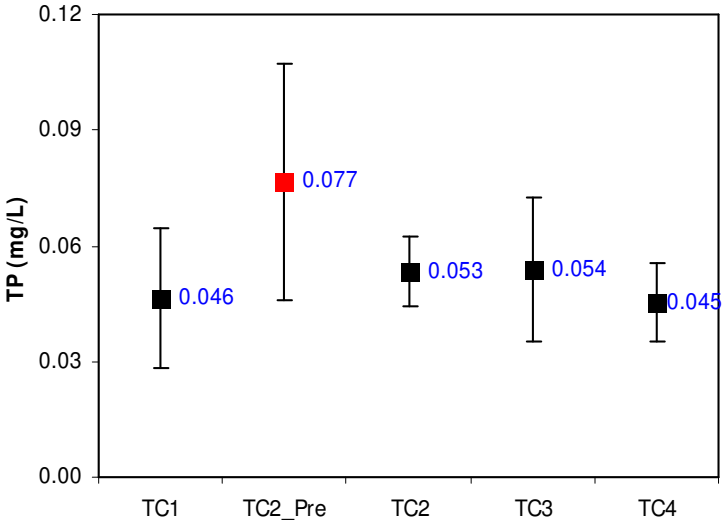

Figure 7. Mean phosphorus concentrations (± 95% CI) before and after BMP implementation. The dashed line represents the DEQ target of 0.075 mg/L.

Average TP concentrations were below the water quality target of 0.075 mg/L and did not differ significantly among sites. (Figure 7). TP levels at the TC2 site were reduced from pre-implementation levels by 0.024 mg/L (31%), but the difference was not significant. Phosphorus is likely entering these streams attached to sediment particles and efforts to further decrease sediment inputs may reduce TP levels in these systems.

Nitrogen

The original Portneuf TMDL (DEQ, 1999) cited nitrogen as a pollutant of concern in the watershed and set a target of 0.3 mg/L. The Portneuf TMDL is currently being revised and it has been proposed by the Watershed Advisory Group (WAG) that the nitrogen target be increased to 1.0 mg/L

Distinct patterns of variability in nitrogen concentrations were observed at the four sites (Figure 8). Nitrogen levels in the TC2, TC3, and TC4 sites typically mirrored each other and varied seasonally. Nitrogen concentrations at these sites were highest during spring and summer months and declined through the fall. TC2 deviated from this pattern during September and October when nitrogen increased. This may have been the result of limited livestock grazing in the area. The TC1 site differed from the rest of the sites in that nitrogen was not detected in many (32%) of the samples. While numerous exceedances of the 1999 target were measured across the four sites (56-73%), no samples exceeded the proposed target of 1.0 mg/L.

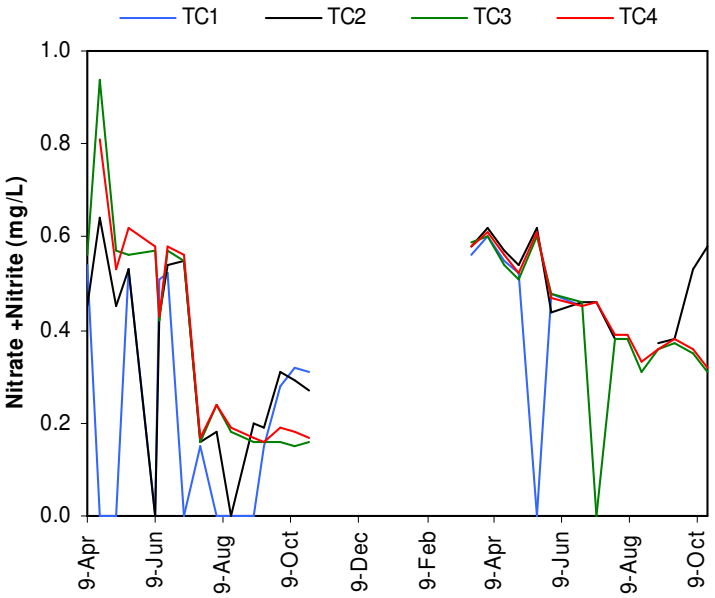

Figure 8. Nitrogen levels (mg/L) in Twentyfourmile Creek.

Average nitrogen (nitrate + nitrite) concentrations in Twentyfourmile Creek did not differ significantly across sites (Figure 9). On average, concentrations at the TC2, TC3, and TC4 sites were above the 1999 target of 0.3 mg/L, while TC1 narrowly met the target. However, average nitrogen concentrations at all four sites meet the revised target of 1.0 mg/L that the Portneuf WAG has proposed. There was a non-significant increase in nitrogen levels (0.09 mg/L, 29%) at the TC2 site after BMP implementation.

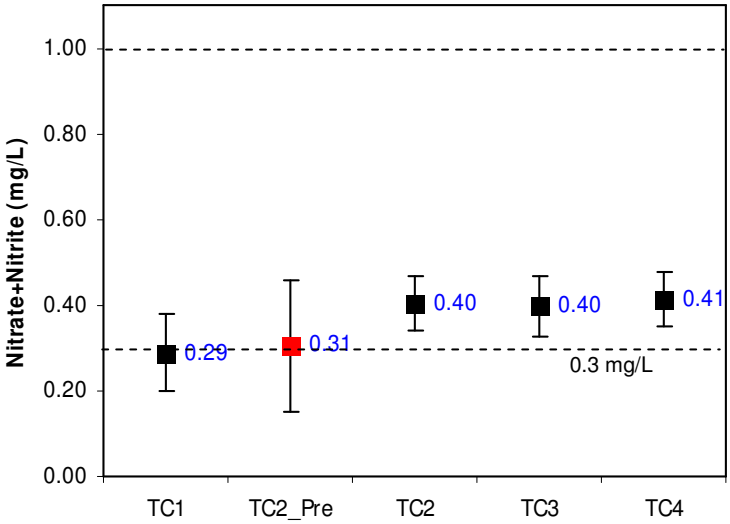

Figure 9. Mean nitrate + nitrite (± 95% CI) at the four monitoring sites. The dashed lines represent the 1999 target of 0.3 mg/L and the proposed revised target of 1.0 mg/L.

Escherichia coli

Escherichia coli (*E. coli*) concentrations were highly variable, but did not follow an obvious spatial or temporal pattern (Figure 10). Across the four sites, 12 to 23% of samples exceeded the state standard of 576 cfu/100 mL for secondary contact recreation (SCR).

Mean *E. coli* concentrations in Twentyfourmile Creek were below the state standard (Figure 11). Concentrations did not differ significantly across the four sites. After implementation of BMPs, average *E. coli* concentrations increased at the TC2 site. This increase was sizable, but not statistically significant. The percent of samples at the TC2 site that exceeded the state standard increased from 7 to 21% after BMPs were installed and may be due to limited livestock grazing that occurred in the fall.

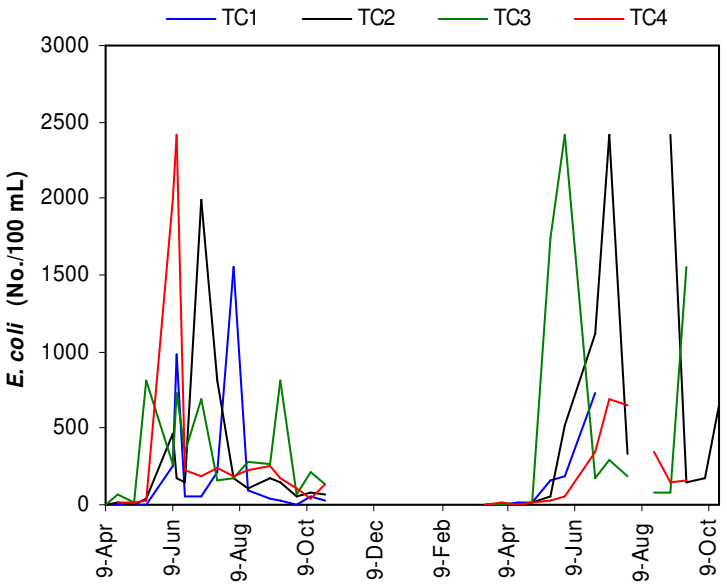

Figure 10. *E.coli* concentrations at the four sites from April 2006 to October 2007.

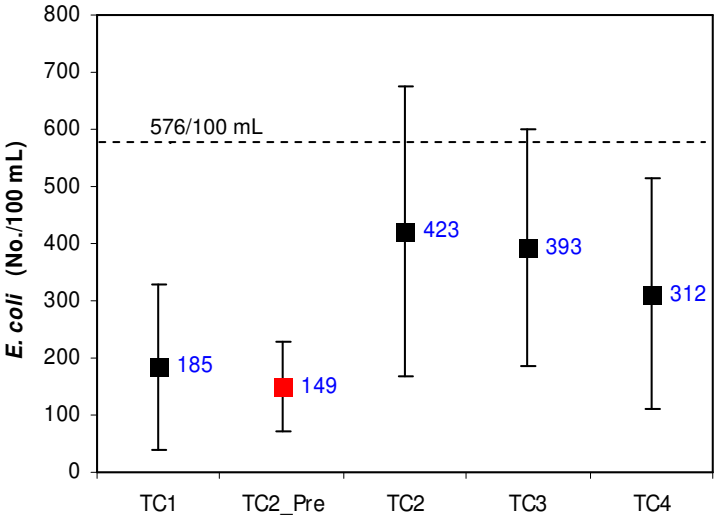

Figure 11. Mean *E. coli* concentrations (± 95% CI) at the Twentyfourmile Creek sites.

Conclusions and Recommendations

The monitoring conducted by IASCD indicated that water quality in Twentyfourmile Creek is relatively good. The stream typically met water quality targets for the watershed. Best Management Practices were implemented throughout the Twentyfourmile Creek watershed. While qualitative assessments of BMP effectiveness indicate that the practices have benefited the stream and riparian zone, quantitative water quality

data did not show a difference before and after implementation. This is likely due to the fact that water quality in Twentyfourmile Creek prior to implementation was relatively good and sampling began as practices were being completed. The conservation practices that have been implemented (ie: grazing management) may need to be implemented for a number of years before their benefits are fully realized. Additionally, visual observations and water quality data suggest that fall grazing that occurs above the TC2 site may negatively impact water quality. This may have obscured the benefits of BMPs that have been implemented upstream.

The benefits of BMPs to water quality are often not fully detectable for a number of years. As streambanks continue to stabilize due to livestock exclusion and grazing management, sediment and TP concentrations may further decline. Therefore, it is recommended that water quality monitoring be conducted in the Twentyfourmile Creek watershed in future years to fully quantify the impacts of the BMPs that have been installed. It is also important that BMPs such as berms and exclusion fencing be maintained to provide long-term benefits to the watershed.

Acknowledgements

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