

**Friends of the Inyo
Water Quality Report
Upper San Joaquin Watershed Assessment**

**Interim Report 2008
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Project Overview

Introduction

Much of the Upper San Joaquin is undeveloped US Forest Service land and is designated wilderness. It is assumed that these vast expanses of open space have allowed for the maintenance of healthy ecosystems and high quality water. However, there is very little scientific research to show that this is true. There are many land uses that could be threatening these ecosystems. Land uses in this region are primarily diverse recreation uses such as angling, hiking, camping and packing. These uses create impacts that are sources for non-point source pollutants, such as sediment, human waste, and pack animal waste. Impacts on terrestrial and aquatic resources could include loss of native vegetation, surface disturbance, and compaction from trails and dispersed campsites. There is also one semi-developed, highly visited area in the Upper San Joaquin watershed project area, the Reds Meadow/Devils Postpile area west of Mammoth Lakes. In addition to the typical low impact recreation uses, this area also has developed campgrounds, roads, high volume human traffic, and pack outfitters.

Water quality can be used as an indicator of the health of a watershed and a measurement of the impacts that land uses may have on the water. The downstream impacts from the more developed areas of the watershed have a greater impact on the water and ecosystem. However, it is still important to consider all aspects of a watershed in order to get a clear picture of the system.

Summary of Program

Friends of the Inyo is a non-profit organization dedicated to protecting the Eastern Sierra's wildlands for wildlife and future generations through preservation, exploration, and stewardship. In 2007, the first citizen-based water quality monitoring program in the Eastern Sierra was started by Friends of the Inyo. The Sierra Nevada Alliance facilitated this program with training and support, and provided funding through a grant from the State Water Resources Control Board.

In 2008, partnering with the Inyo National Forest and interested stakeholders, the Eastern Sierra Water Watchers began sampling in the Upper San Joaquin watershed. This data will provide baseline water quality and benthic macroinvertebrate data for a comprehensive watershed assessment that the Inyo National Forest will be completing over the next two years.

Monitoring Parameters and Sites

Dissolved oxygen, pH, conductivity, temperature, turbidity, and nitrates/nitrites were sampled in the field. Water samples were collected to be processed by the Mammoth Community Water District for fecal bacteria and total suspended solids (TSS). With the exception of one site, all sites had a complete bioassessment with benthic macroinvertebrate (BMI) samples and habitat assessment collected for analysis in September 2008. The one exception was too dense with vegetation to be accessible. Appendix I contains the data quality objectives for each monitoring parameter as laid forth in the Quality Assurance Project Plan (QAPP).

Due to the difficulty in accessing this high elevation areas and limited time frame for getting samples to the laboratory, sampling occurred only in two primary regions. It was only done in the July, August, and September since snow makes the sites inaccessible until early summer. One of the regions was the Reds Meadow area. There were three sites near and within the Reds Meadow Campground on Reds Creek, as seen in Figure 1.1. The second site was the Mono Creek region, with three sites on this creek, as seen in Figure 1.2.

Site #**	Stream Location	Description	UTM Coordinates (NAD 83, Zone 11S)
19	Upper Mono Creek	500 m downstream from 4 th Recess Lake. Many dispersed campsites near site.	0341826 E 4145837 N
20	Middle Mono Creek	North of Mono rock, upstream end of unnamed dry meadow near “N of Mono Rock” meadow.	0340956 E 4145717 N
21	Lower Mono Creek	Downstream from “N of Mono Rock” meadow. Near user trail that follows creek when main trail leaves creekside.	0340335 E 4145507 N
22	Sotcher Creek	At the end of north loop in campground. Upstream from man-made weirs and pools.	0317064 E 4165855 N
23	Middle Reds Creek	Campsite #4. Campsite is right on creek.	0316761 E 4165630 N
24	Lower Reds Creek	On trail from Reds Campground to Devils Postpile. Upstream side of foot bridge	0316528 E 4165593 N

** Site numbers follow other monitoring sites for other Friends of the Inyo projects.

Figure 1.1

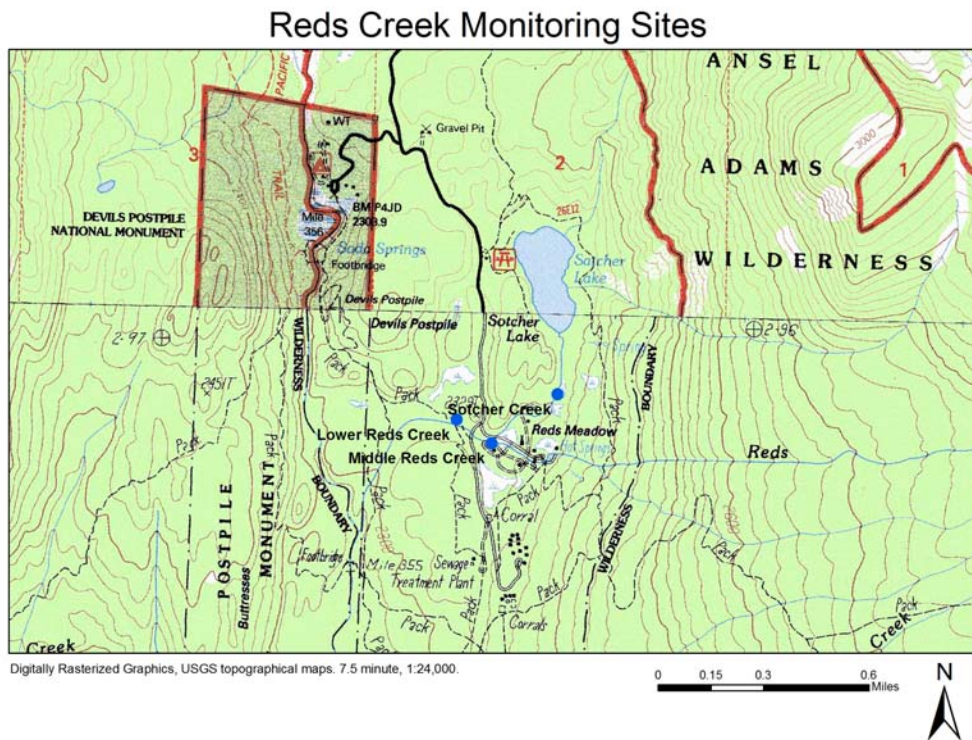
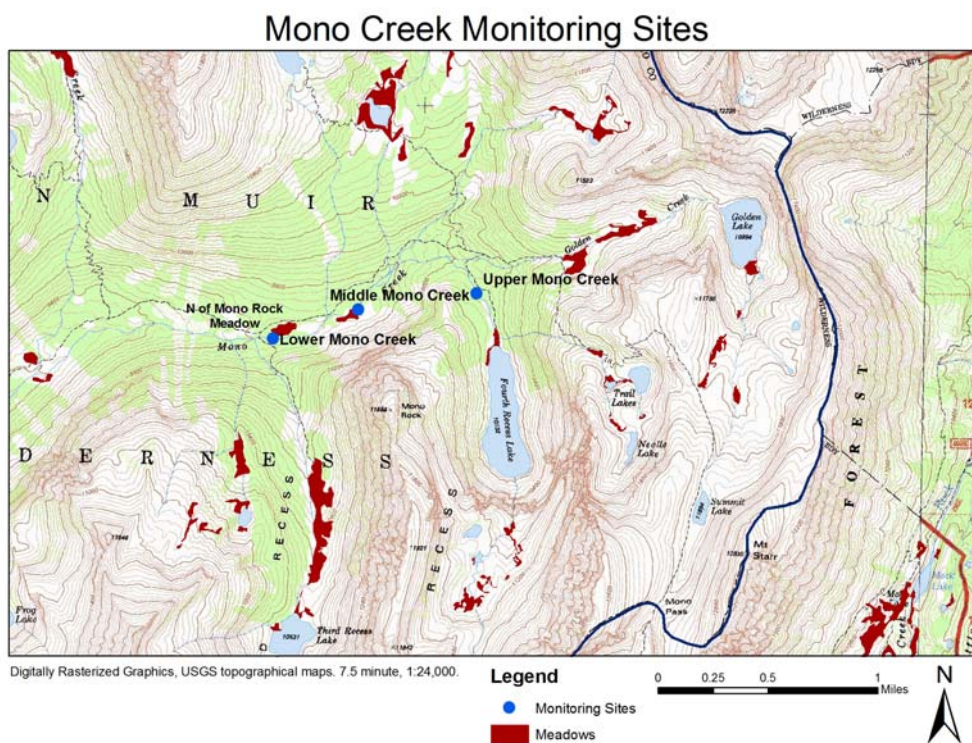


Figure 1.2



Data and Site Analysis

Mono Creek

There are three sites on Mono Creek, all at least 10 miles upstream from the Lake Thomas Edison reservoir. The upper reaches of this creek are all in Sierra National Forest and John Muir Wilderness. It is a popular backpacking and stock-supported camping area. The Upper site is just downstream from 4th Recess Lake which is highly visited with many dispersed campsites. The Middle site is downstream from here, after the confluence with water from the Pioneer Basin. The Lower site is downstream from a highly grazed meadow and is near the main trail.

The pH sampled for these areas has remained well within the Lahontan standards for the beneficial uses for these waters, which is between 6.5 and 8.5 units. The mean pH for all sites in 2008 can be found in Figure 2.1. The conductivity has also shown very little variation, with an average around 10 μ s for all three sites, as seen in Figure 2.2. This conductivity is consistent with waters flowing from this part of the Sierra.

Figure 2.1

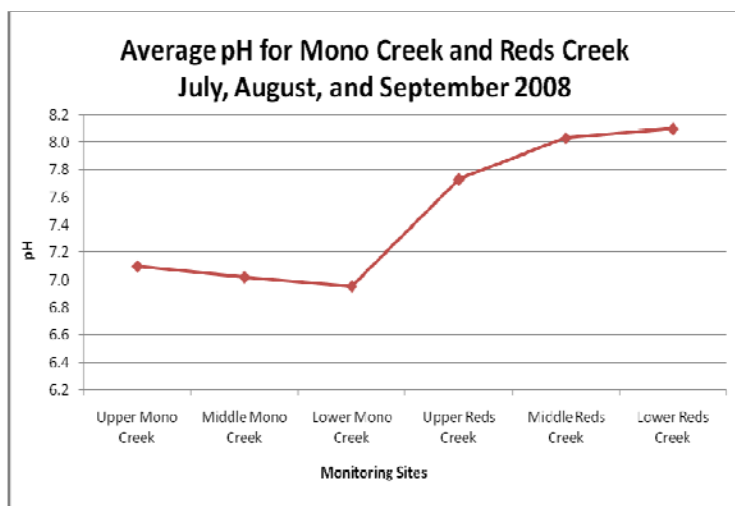
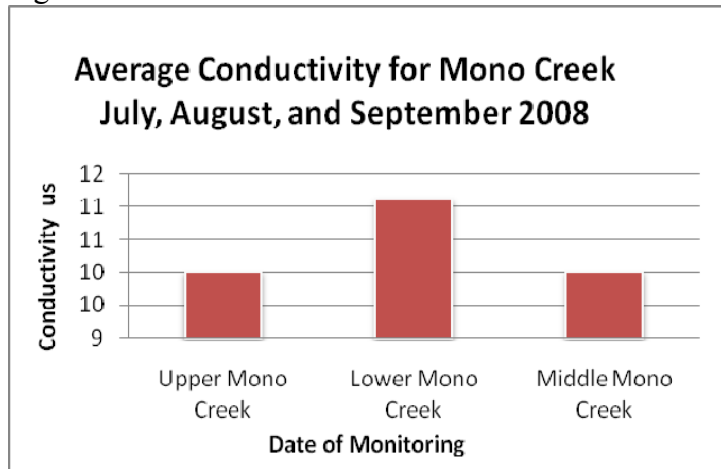


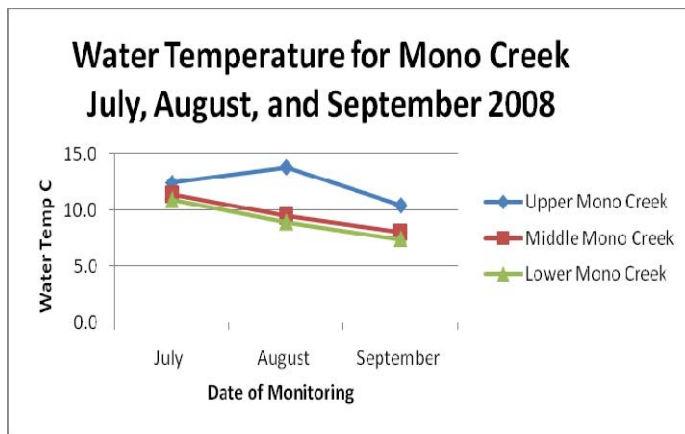
Figure 2.2



With the pack stock grazing in the Mono Creek area there is the possibility of an increase in nitrate/nitrite levels in the water. Sampling for nutrients was only done in August and September because that is when the meter was available. All results were under 0.03 mg/mL, which are insignificant levels. It is also less than the standard error for the meter, ± 0.05 mg/mL, making it difficult to know how accurate this data is. It can be assumed that since the results are so low that they are unusable, nutrients are not a significant issue in this area.

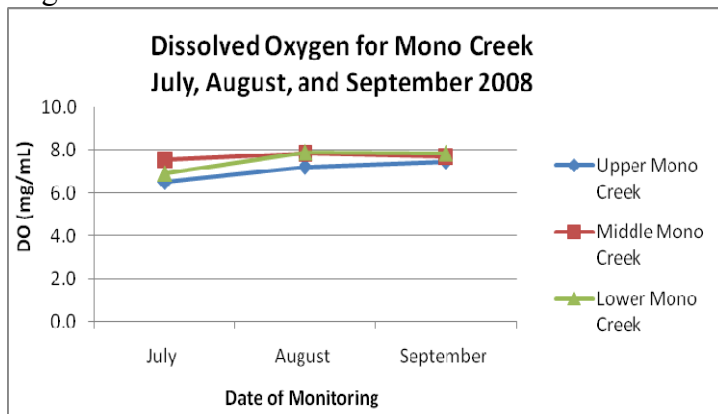
Thus far the most significant trends for water temperature and dissolved oxygen are typical seasonal changes. Further data will be needed to determine if this data accurately represents environmental conditions. With the distance between the two sites and limited people to sample, there was some timing inconsistencies with sites sampled slightly later than others. The primary example of this is in August when Upper Mono Creek is inconsistent with the cooling trend from July to September. On this day, this site was sampled later than in other months. Figure 2.3 shows this cooling trend and August outlier.

Figure 2.3



As can be seen in Figure 2.4, the dissolved oxygen varies as appropriate for these water temperatures and elevation (all sites are above 9000'. These fall within the Central Valley Basin Plan standards for the beneficial uses of these waters.

Figure 2.4



The in-house turbidity meter that is used for grab samples has been found to give inconsistent readings. Since sediment is one of the most crucial parameters for evaluating the effects of land use on the creeks that we are monitoring we are also sampling TSS for analysis at the Mammoth Community Water District laboratory. The results for the total suspended solids are found in Figure 2.5. Turbidity averages are found in Figure 2.6. For both TSS and turbidity no significant trends were seen on any of the Mono Creek sites. Results were low, with insignificant amounts of sediment and normal for these types of water systems.

Figure 2.5

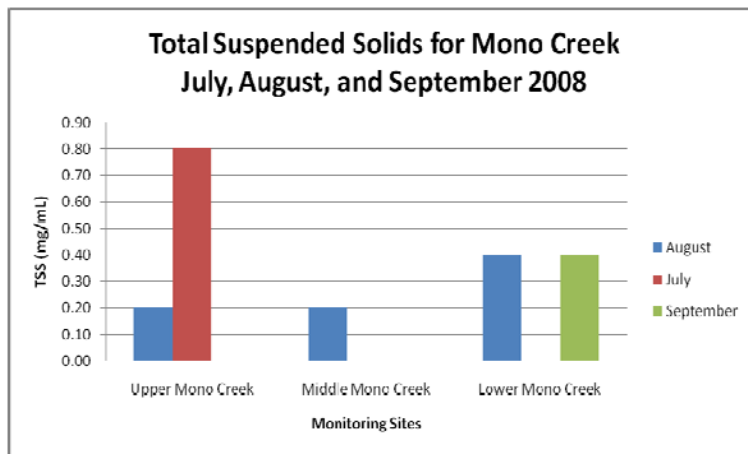
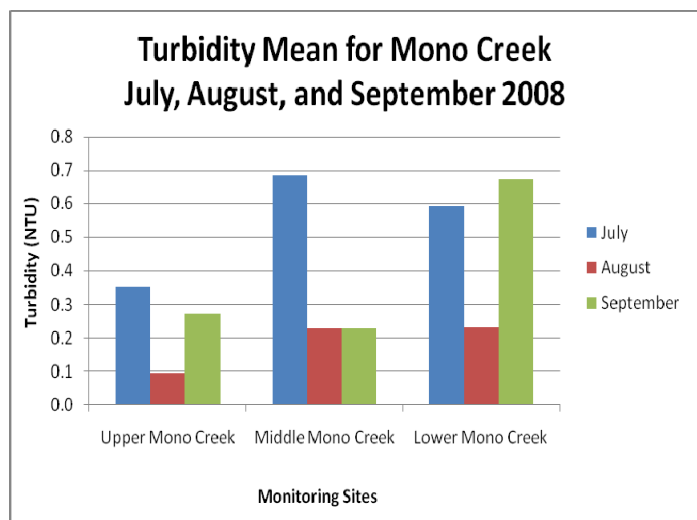


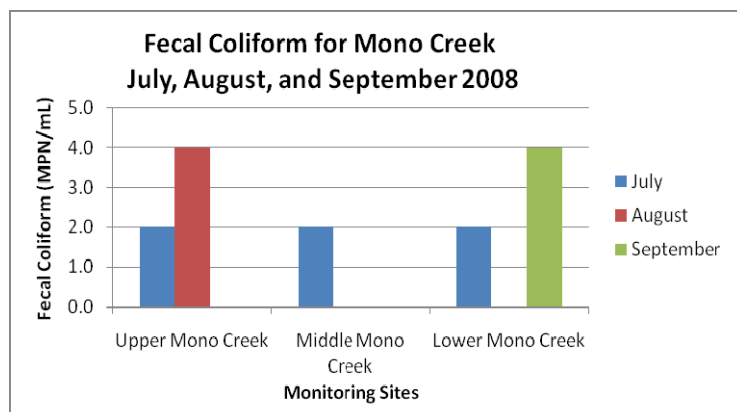
Figure 2.6



Fecal coliform was also sampled to determine if the high frequency of packing and camping in the area are causing increases in the fecal coliform. As shown in Figure 2.7, results were under 5.0 MPN/mL showing that on the sampling days there were insignificant amounts of fecal

coliform in the water. None of the samples collected was above 200 MPN/mL, the Central Valley Basin allowable limit for the mean in a 30 day period for water with contact recreation.

Figure 2.7



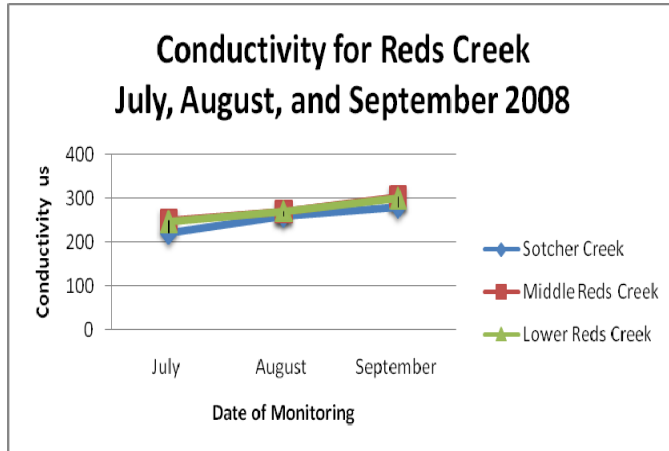
It is considered more accurate to collect storm event samples to achieve more accurate results for TSS and fecal coliform. However in July, there was regular thunderstorms prior to and during the sampling period, and there was still insignificant differences between the July and other sampling times.

Sotcher and Reds Creeks

There are three sites on Reds and Sotcher Creek which are either near or within the high volume, developed Reds Meadow campground. This Sotcher Creek site is upstream from the end of one loop of the campground. The creek is flowing through the meadow at this site. Middle Reds Creek is on the downstream end of the campground and after the confluence of Sotcher Creek and Reds Creek. Prior to this site are several campground bathrooms and showers. The Lower Reds Creek site is downstream from the main paved road crossing and is at the crossing of the trail from Reds Meadow to Devils Postpile. The trail has a good foot bridge to keep hikers out of the creek. All sites are around 7800'-8000' in elevation.

The pH sampled for these areas has remained within the Lahontan standards for the beneficial uses for these waters, which is between 6.5 and 8.5 units. The mean pH for all three sites in 2008 can be found in Figure 2.1. The conductivity has shown a slight increasing trend from July to September. These creeks flow down from Mammoth Mountain through volcanic soils. This could be one of the causes of the conductivity which ranges between 250-300 μ s for all three sites, as seen in Figure 3.1. It also could be related to erosion from the campground or grazed meadow. More research is needed to determine what would be the typical conductivity of water flowing from this part of the Sierra.

Figure 3.1



Water showed a cooling trend from July to September, similar to Mono Creek, Figure 3.2. As can be seen in Figure 3.3, the dissolved oxygen increases as the water temperature decreases and is within the Central Valley Basin standards for the beneficial uses of these with waters. Saturation is lower then what would be found at lower elevations but is normal for water at these elevations.

Figure 3.2

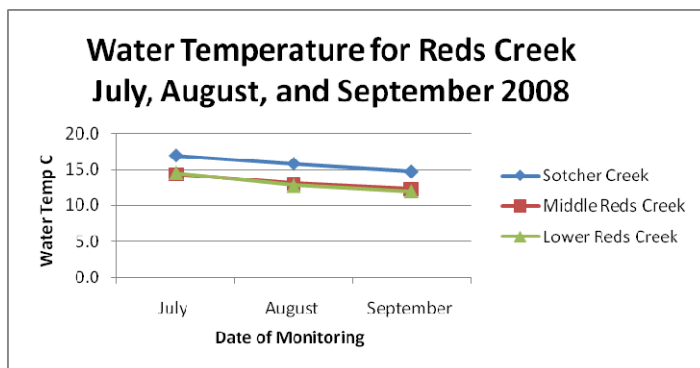
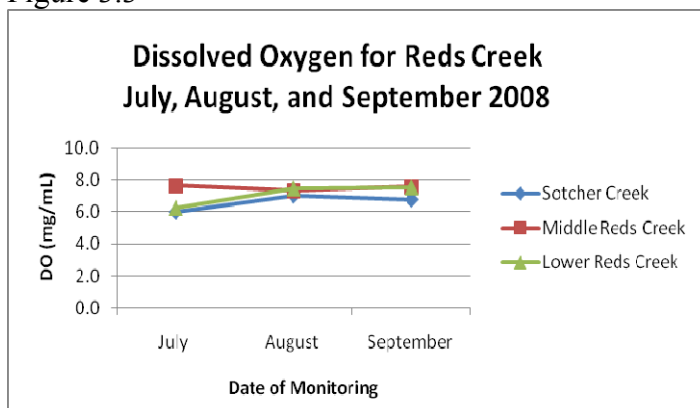


Figure 3.3



Similar to Mono Creek, Reds Creek also is a pack stock grazing area and there is the possibility of an increase in nitrate/nitrite (nutrient) levels in the water. Again, sampling for nutrients was only done in August and September because that is when the meter was available. All results were under 0.05 mg/mL. Since the results were less than or equal to the standard error for the meter this makes the results too low to be usable. It can be concluded that nutrient levels are not increased by the various land uses in this region.

The results for the total suspended solids are found in Figure 3.4. Turbidity averages are found in Figure 3.5. Turbidity results were highly variable, while the TSS results were more consistent. It is likely that the inconsistent turbidity results are related to the turbidity meter which has shown inconsistent results for this project and other projects. All sites showed an increase in TSS in July. This could be a result of an unknown increase in precipitation which would increase run-off just prior to sampling.

Figure 3.4

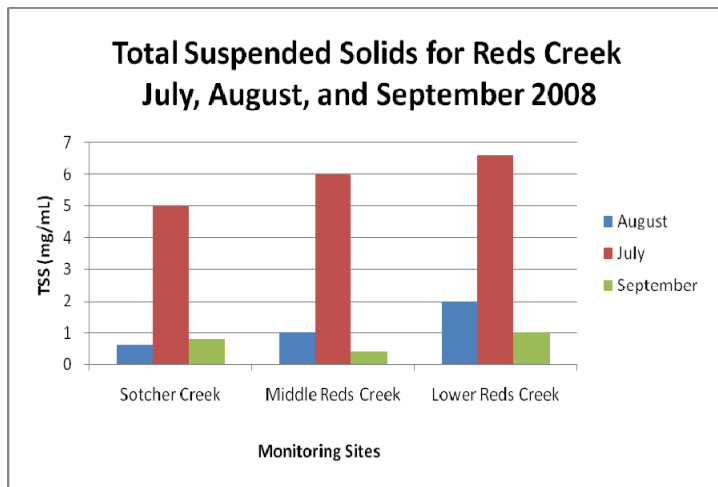
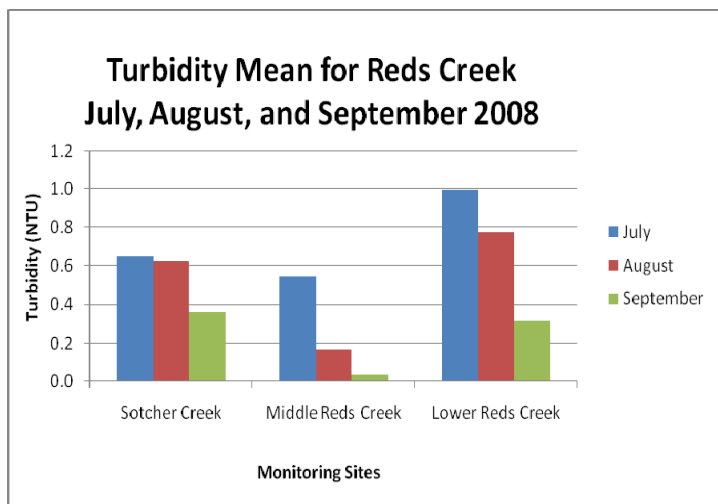
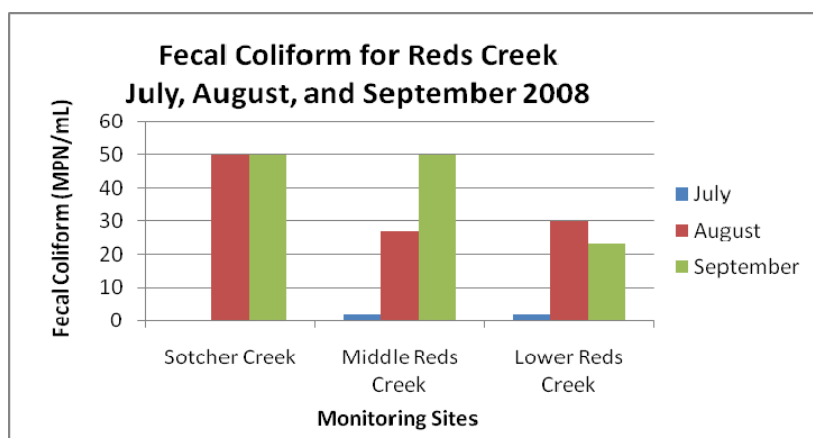


Figure 3.5



There are several land uses in this area that could cause potential increases in fecal coliform, including stock grazing in Reds Meadow, campground toilets, and sewage system for Reds Meadows resort, and dispersed recreation. As shown in Figure 3.6, results were fairly consistent across sites. For July, coliform was very low for all sites. In August, results of 50 MPN/m, 27 MPN/mL, and 30 MPN/mL show an increase. Similar results were found in September. Since one of the sites, Sotcher Creek, is upstream from the campground and a far distance from the resort sewage area, it seems possible that grazing in the meadow might be the cause for this increase. More research on the areas available to stock for grazing, grazing timing, and other possible sources for fecal coliform will need to be done in order to pinpoint the source of this fecal coliform. Even with the increase in fecal coliform in August and September, results were still well below the Central Valley Basin limit of 200 MPN/mL allowable limit for the mean in a 30 day period for water with contact recreation.

Figure 2.4



Again, it would be more accurate to collect storm event samples for TSS and fecal coliform. Unlike the Mono Creek sites, Reds Creek samples were not known to have been collected with storm events.

Conclusions and Next Steps

It is early to make any broad statements about the condition of the streams or watersheds with only three sites and three collection days for each system. However, thus far it appears that in a wilderness setting, water quality is not greatly impacted by uses. However, in a more developed setting, like that of Reds Meadow/Devils Postpile area there are impacts to water quality, in particular an increase in sediment and an increase in fecal coliform. The results from the bioassessment have still not been completed. These results will also contribute to the conclusions and the watershed assessment.

After discussion with other stakeholders and members of the local scientific community there has been a consideration to sample from different regions and sites in 2009 to get a wider geographic sample rather than continuing to sample the same sites. There will be further discussion on this with a decision being made prior to the start of the 2009 field season.

Outreach and community education will be increased in the next year. The project will be included with a greater presence on the Friends of the Inyo websites (www.friendsoftheinyo.org). One final goal is an explanation and incorporation of this project with other discussions of Friends of the Inyo's water quality monitoring work.

Acknowledgments

Support for this project was provided partially by the Department of Water Resources of the State of California, as implementing agency for the CALFED Bay-Delta Watershed Program, to support the Upper San Joaquin Watershed Assessment. Friends of the Inyo was able to support the Inyo National Forest's work on the Upper San Joaquin Watershed Assessment because of support for the Eastern Sierra Water Watchers program from the Sierra Nevada Conservancy.

Appendix I

Table 1 Data quality objectives for field measurements.

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limit	Completeness
Field Testing	Dissolved Oxygen	± 0.5 mg/L	± 0.5 or 10%	NA		90%.
	pH	± 0.5 units	± 0.5 or 5 %	NA		90%
	Temperature	± 0.5 °C	± 0.5 or 5%	NA		90%
	Conductivity	$\pm 5\%$	$\pm 5\%$	NA		90%
	Turbidity	$\pm 10\%$ or 0.1	$\pm 10\%$ or 0.1 whichever is greater	NA		90%
	Nitrates/Nitrates	$\pm 25\%$	$\pm 20\%$	$\pm 20\%$		90%

Table 2 Data quality objectives for laboratory measurements.

Group	Parameter	Accuracy	Precision	Recovery	Target Reporting Limits	Completeness
Laboratory Analyses	Total suspended solids	Standard Reference Materials (SRM, CRM, PT) 80% to 120%	Laboratory duplicate, $\pm 25\%$ RPD	Matrix spike 80% -120%	0.5 mg/L	90%
	Fecal Bacteria	Laboratory positive and negative cultures- proper positive or negative response	R_{log} within 3.27*mean R_{log} (reference is section 9020B 18 th edition of Standard Methods)	NA	2 MPN/100 mL	90%
	Benthic Macroinvertebrates	$\leq 5\%$ difference	$\leq 5\%$	NA		100%