Sierra Nevada Conservancy-Progress Report

Sierra Nevada Conservancy Grant Program
Safe Drinking Water, Water Quality and Supply, Flood Control
River and Coastal Protection Act of 2008 (Proposition 84)

Grantee Name: Alpine Watershed Group

Project title: Alpine Watershed Group Water Quality Monitoring Program

SNC Reference Number: SNC 070256 **Submittal Date:** 2/29/2012

Report Preparer: Sarah Green and Chris Katopothis **Phone #:** 530-694-2327

Check one:

______ **6-Month Progress Report**
__X__ **Final Report**

6-Month Progress Reports should reflect the previous six months. **Final Reports** should reflect the entire grant period.

A. Progress Report Summary: (Please provide a general description of work completed during this reporting period.)

The report covers the period from July 2011 through February 2012. The primary outcome for the Alpine Watershed Group (AWG) Monitoring Program was the development of our supplemental Data Report, which includes low-flow, stormwater, and bioassessment data analyses. Other activities during this period included Periodic ambient monitoring, bioassessment monitoring, bacterial monitoring, low-flow monitoring, stormwater monitoring, and planning for the 2011 monitoring year.

B. Deliverables or Outcomes completed during this Reporting Period or Milestones Achieved: (Include specific information, such as public meetings held, agency participation, partnerships developed, or acres mapped, treated or restored.)

Outcomes this reporting period involved the following field monitoring activities:

- Ambient monitoring for water chemistry, turbidity and physical habitat - These volunteer-based watershed assessments took place periodic in August and September at eight stream monitoring locations.
- Bacteria sampling – summer bacteria sampling continued with five sampling efforts from July thru September.
- Nutrient sampling – Nutrient samples were collected in association with our periodic volunteer monitoring sessions in August and September.
- Turbidity sampling – completed in September 2011.

- Bioassessment monitoring – conducted at three sites on Markleeville Creek in October 2011.
- Low-flow monitoring – conducted on four occasions on upper West Fork Carson River from August thru October 2011. Installation of 3 permanent flow gaging sites on upper West Fork Carson River, in partnership with American Rivers.
- GIS mapping – GIS development for this project continues with data gathering and input to represent land-use information in Alpine County.
- Data - development of our Supplemental Data Report, which includes low-flow, stormwater, and bioassessment data analyses (attached).

Specific monitoring deliverables completed this period are described in the table below:

DETAILED PROJECT DELIVERABLES	TIMELINE	COMPLETED
Ambient monitoring for water chemistry, turbidity, physical habitat, and flow	periodic	August 13 September 10
Complete and submit six month progress report and final report	Six month intervals/final report	February 2012
Bacterial and nutrient sampling	Bacterial - bi-weekly Nutrient – summer/fall	July 19, August 9, 13, 23; September 10, 13, 29
Bioassessment monitoring	Annually	October
Low-flow monitoring, upper West Fork Carson	During low-flow season	August - October
Data entry, analysis, interpretation, reporting	Ongoing	February

C. Challenges or Opportunities Encountered: (Please describe what has worked and what hasn't; include any solutions you initiated to resolve problems. If your project is not on schedule, please explain why here.)

We continue to collaborate with American Rivers on project work for the Upper West Fork Carson and Hope Valley. Ongoing work has included the installation of 3 permanent flow gaging stations, with the aim of helping to enhance management of instream flow releases from Red Lake, and to gather baseline data for Hope Valley restoration opportunities.

Data analysis for benthic macroinvertebrate samples collected over the course of this grant posed some challenges at first. Initially it was not clear if it was efficient to use the Index of Biological Integrity calculator developed for the Eastern Sierra Nevada for our analysis, or if another approach would be more appropriate. After consultation with the Sierra Nevada Aquatic Research Laboratory and DFG, a plan for analysis and presentation of results was developed, focusing on population dynamics and functional feeding groups.

D. Unanticipated Successes Achieved: (Please describe any additional successes beyond completing scheduled tasks or meeting scheduled milestones.)

Collaborative efforts with American Rivers and CalTrout have resulted in increased capacity for Alpine Watershed Group's flow monitoring capabilities. Part of the increased capability is due to the above mentioned permanent flow gaging stations on the Upper West Fork Carson River. These sites will gather water level and temperature every 15 minutes using Solinst Leveloggers. New opportunities for volunteer monitors have also arisen from these efforts, and training for measuring flow has already begun with yet another American Rivers and Alpine Watershed Group collaboration. Additionally, we have been able to obtain new and much more sophisticated flow monitoring equipment for use at all flow monitoring sites. These equipment upgrades include a USGS style Pygmy flow meter, with a top-set wading rod, and digital counter.

Another success achieved beyond scheduled tasks or milestones is the continued collaboration with Lahontan Regional Water Quality Control Board (Lahontan) for the 2011 bacterial monitoring effort. AWG citizen monitors have helped with bi-weekly monitoring, and Lahontan has analyzed all samples at their Tahoe lab facility. This collaborative effort has not only been extremely cost efficient for AWG programs, but has also yielded a much more comprehensive set of data for 2011, as compared to previous years. 2011 data is currently being organized and graphed and will be included in the supplemental data report as part of this final report.

E. Compare Actual Costs to Budgeted Costs: (Please refer to your grant agreement to list your deliverables/budget categories and budgeted costs compared to actual costs incurred during this reporting period in the table below.)

PROJECT BUDGET CATEGORIES	**Budgeted SNC Dollars**	**Actual Dollars**
Coordinator-Project Management	46,581	**3,741.00**
Equipment and supplies	2,500	**138.72**
Lab fees	10,600	**1,350.00**
Carson Water Subconservancy staff time	0	**0**
Washoe Tribe Education & Training Days	200	**0**
Mileage to travel to monitoring sites	1,020	**15.54**
GRAND TOTAL	**$60,901**	**$5,245.26**

Explanation: N/A

F. Were there any other relevant materials produced under the terms of this Agreement that are not a part of the budgeted deliverables? If so, please attach copies. (Include digital photos, maps, media coverage of project, or other work products.)

All materials created are included in the data reports that have been submitted.

G. Next Steps: (Work anticipated in the next 6 months, including location and timing of any scheduled events related to the project.)

AWG will continue various monitoring activities including periodic ambient, West Fork Carson stream flow, annual bioassessment and summer bacteria levels.

Please Complete this Section for FINAL Report ONLY

Capacity-Building Results and Collaboration and Cooperation with Stakeholders: (What partnerships did you initiate or strengthen as a result of this project? How did they affect the project outcome? If applicable, how did this grant increase your organization's capacity? What is your plan to sustain this increase?)

The various monitoring components of this project have directly resulted in the strengthening of existing, and formation of new partnerships and collaborations between AWG and other agencies and organizations. These collaborative partners include Alpine County, American Rivers, California Department of Fish and Game (DFG), California Trout, Carson Water Subconservancy District, Central Sierra Resource Conservation & Development Council, Lahontan Regional Water Quality Control Board, Sierra Nevada Aquatic Research Laboratory, U.S. Geological Survey, U.S. Forest Service (USFS) Carson Ranger District and Washoe Tribe of California and Nevada.

Collaborative efforts with American Rivers, CalTrout, DFG, and USFS have resulted in increased capacity for Alpine Watershed Group's flow monitoring capabilities. Through these partnerships, permanent flow gaging stations have been installed on the Upper West Fork Carson River. These sites will gather water level and temperature every 15 minutes using Solinst Leveloggers. New opportunities for volunteer monitors have also arisen from these efforts, and training for measuring flow has already begun with yet another American Rivers and Alpine Watershed Group collaboration. Additionally, we have been able to obtain new and much more sophisticated flow monitoring equipment for use at all flow monitoring sites. These equipment upgrades include a USGS style Pygmy flow meter, with a top-set wading rod, and digital counter.

Our collaboration with Lahontan Regional Water Quality Control Board (Lahontan) for the 2011 bacterial monitoring effort has resulted in increased capacity for this component of our monitoring program. AWG citizen monitors have helped with bi-weekly monitoring, and Lahontan has analyzed all samples at their Tahoe lab facility. This collaborative effort has not only been extremely cost efficient for AWG programs, but has also yielded a much more comprehensive set of data, as compared to previous years. Consultation with the Sierra Nevada Aquatic Research Laboratory and DFG has increased the capacity of AWG to process and analyze benthic macroinvertebrate data in a meaningful and useful way. Data from 2008-2010 are graphed and discussed as a component of the Supplemental Data Report, included as an attachment to this final report.

AWG will continue to work with each of these partners in order to implement and enhance our monitoring activities. The partnership with American Rivers has not only increased our capacity but has also led to financial support for involvement in West Fork Carson monitoring and Hope Valley restoration planning. AWG has been able to support our increased capacity with a new grant from the California Department of Conservation for Watershed Coordinator support over the next three years.

Description of Project Accomplishments:

1. **Most Significant Accomplishment**
   Describe in one concise, well-written paragraph, the most significant accomplishment that resulted from this grant.

   A comprehensive data report has been produced that includes analysis and results from all components of the AWG monitoring programs: ambient water chemistry, benthic macroinvertebrate, bacteria, nutrients, stormwater, low-flow, and GIS mapping. This report and associated data results now serve as a foundation and template for reporting on future data. And even more importantly as a means to assess point and non-point sources of pollution, associated land-use impacts, and to identify opportunities for restoration and conservation actions within Alpine County watersheds.

2. **WOW Factor**
   If applicable, please describe anything that happened as a result of the project or during the project that is particularly impressive.

   As a result of this project, the overall capacity and capabilities of the AWG water quality monitoring programs have increased - including upgraded monitoring equipment, increased volunteer participation, and enhanced data processing and reporting capabilities. It is also particularly impressive that during the project and a timeframe that included postponement of grant work (CA funding freeze) for several months, and turnover for the Watershed Coordinator position, AWG has continued to grow in organizational capacity, program work, volunteer participation, stakeholder collaborations, and funding resources.

3. **Design and Implementation**
   When considering the design and implementation of this project, what lessons did you learn that might help other grantees implement similar work?

   With multiple monitoring components, it is very important to develop a detailed schedule of sampling events and volunteer monitor teams. Some components are relatively easy to schedule and arrange monitoring teams e.g. periodic ambient monitoring. Other parameters, such as stormwater and turbidity monitoring, require arranging for "on call" teams to help with monitoring, as these are storm event based and cannot be scheduled in advance. Having alternate monitors to call on when needed helps a great deal for effectively monitoring such events.

4. Indirect Impact

Please describe any indirect benefits of the project such as information that has been developed as a result of the project is being used by several other organizations to improve decision-making, or a conservation easement funded by this grant that encouraged other landowners in the area to have conservation easements on their property.

By maintaining regular contact and submitting our reports to partner agencies, data gathered and analyzed for this project has been serving to inform other organizations and agencies in a number of ways, such as further development of biological indices, potential listing of stream segments for impairment, and baseline data for restoration assessment and planning projects.

5. Collaboration and Conflict Resolution

If you worked in collaboration or cooperation with other organizations or institutions, describe those arrangements and their importance to the project. Also, describe if you encountered conflict in the project and how you dealt with it, or if there was conflict avoided as a result of the project.

Collaborative efforts with American Rivers, CalTrout, DFG, and USFS have resulted in increased capacity for Alpine Watershed Group's flow monitoring capabilities. American Rivers functioned as project lead and sub granted work to AWG. DFG and USFS granted permission and permits for installations on lands they manage. Through these partnerships, permanent flow gaging stations have been installed on the Upper West Fork Carson River.

One challenge that arose in this project was around making sure all of the watershed partners and stakeholders are aware of and bought in to the work that is being planned. For instance, the USFS has made sure that the planning process takes some very specific and somewhat cautious steps in moving forward. Although this has seemed like a delay in progress, it is worth laying a solid foundation for a project as potentially significant as this.

Our collaboration with Lahontan Regional Water Quality Control Board (Lahontan) for the 2011 bacterial monitoring effort has resulted in increased capacity for this component of our monitoring program. Lahontan staff were grateful to have assistance with their weekly monitoring effort. This collaborative effort has not only been extremely cost efficient for AWG programs, but has also yielded a much more comprehensive set of data.

6. Capacity-Building

SNC is interested in both the capacity of your organization, as well as local and regional capacity. Please describe the overall health of your organization including areas in need of assistance. SNC is interested in the strength and involvement of your board, significant changes to your staff, size and involvement of membership. In addition, describe how your project improved capabilities of partners, or the larger community.

The overall health of our organization is strong and continues to improve. This is due in no small way to two primary organization strengths. Firstly, we are fortunate to have a committed, resourceful, and engaged board of directors. Board members represent a cross-section of the community and stakeholders. Several of our board members have been involved with our organization for several years, since the organization first gained 501(c) 3 status. Secondly, a team of 20+ volunteer citizen monitors serve as the backbone of our monitoring programs. Most of these monitors have been involved since our group first began collecting water quality data in 2004. Our monitors are well trained and we have confidence in the quality of data they are able to collect.

Fundraising over the past five years has been successful. Currently, grant funding is in place to provide the necessary hours for two full-time staff members and one part-time assistant, and for all program area needs. However, there is an ongoing issue regarding cash flow. Our primary funding sources (grants) work on reimbursable formats. We are often not able to cover expenses in between billings and reimbursements from our various funding sources. Watershed Coordinators sometimes must go 2-3 months between paychecks. Lack of cash flow also jeopardizes staff stability, as was the case in 2009, when the State shut down all bond measure funding for approximately six months. Our coordinator was forced to seek other employment, and the organization was without a coordinator during most of this period.

This project improved the capabilities of a number of our partners, as well as the Alpine County community. Our partners benefited from participation of AWG staff and volunteers, as we collaborated on a number of projects directly or indirectly related to this one (as described in collaboration above). Data gathered and analyzed for this project serves to benefit the greater community, as this information is now useful for local decision makers and State and Federal agencies managing land in Alpine County.

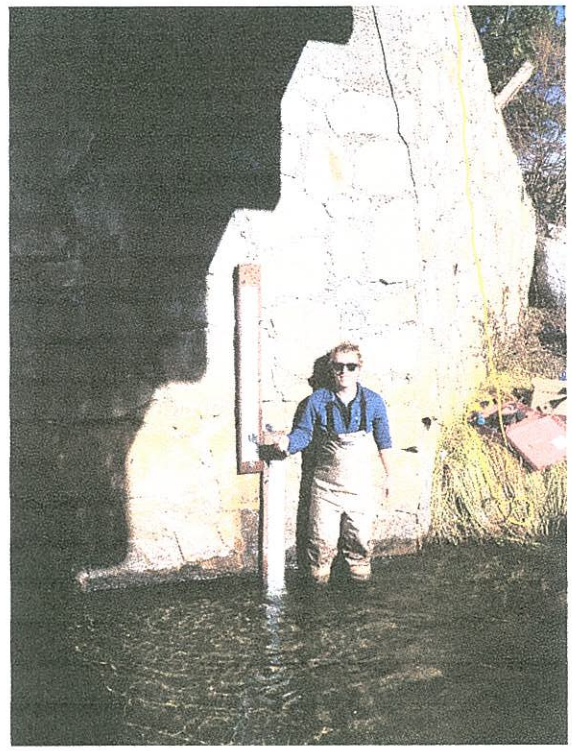
7. **Challenges**

Did the project face internal or external challenges? How were they addressed? Describe each challenge and any actions that you took to address it. Was there something that SNC did or could have done to assist you? Did you have to change any of your key objectives in response to conditions "on the ground"?

Key objectives for this project remained intact and were met throughout and within the project timeframe. On the ground conditions were negotiated as needed and did not impose challenges that changed any of the key objectives, or the ability to achieve them. The major challenge faced was as described above in regards to the funding freeze implemented by the State of California in 2008, and the absence of a Watershed Coordinator during the shut-down period. Regarding this particular challenge, it is understandable the SNC and other agencies were in the same predicament, and had little or nothing they could offer in terms of alleviating the financial and personnel issues that occurred. This challenge was addressed by ongoing meetings and direction from AWG's board and citizen monitors during the dormancy, which kept the group's focus on being able to hit the ground running when grant awards were to be reinstated.

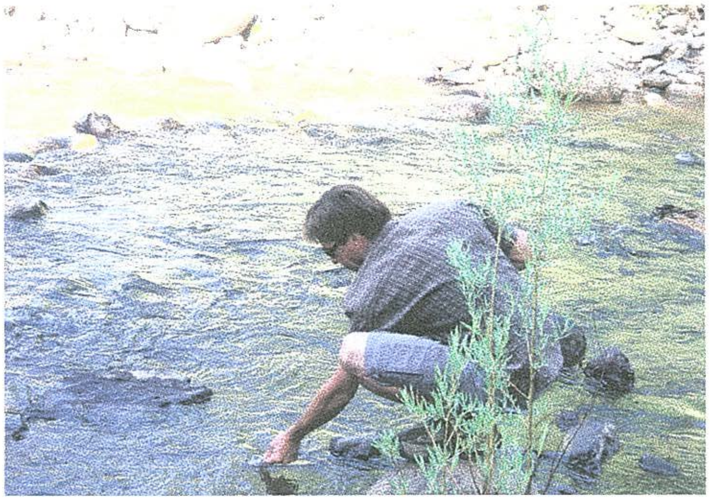
8. Photographs

Low-flow monitoring training - West Fork Carson River



Installation of flow gaging station - West Fork Carson River

Completed flow gaging station - outlet flow of Red Lake



Collection of bacteria samples – Markleeville Creek

Bioassessment monitoring on Markleeville Creek

9. Post Grant Plans

What are the post-grant plans for the project if it does not conclude with the grant? Include a description of the following (if applicable): (1) Changes in operations or scope; (2) Replication or use of findings; (3) Names of other organizations you expect to involve; (4) Plans to support the project financially, and; (5) Communication plans?

1) Periodic ambient monitoring and annual bioassessment monitoring will continue, accomplished primarily by volunteer citizen monitors under direction of the Watershed Coordinator. Low-flow monitoring at the permanent flow gaging stations on the Upper West Fork, will continue, with funding assistance from American Rivers, with the aim of developing rating curves for those sites. With

continued support from Lahontan Regional Control Board, AWG will also continue bacteria monitoring during the summer of 2012. Capacity to continue other components of the program (i.e. stormwater data and nutrients) will be assessed and maybe dependent on additional funding.

2) The Supplemental Data Report will be provided to our project partners. As our monitoring program continues, we will continue to analyze and disseminate data and results to all interested stakeholders, and local, State, and Federal agencies and decision makers.
3) AWG will continue to collaborate with the many partners listed in above sections of this report.
4) AWG is seeking funding from various sources to continue support of water quality monitoring components determined to be valuable by the monitoring committee.
5) Communication plans will continue as in the past.

10. Post Grant Contact

Who can be contacted a few years from now to follow up on the project? Please provide name and contact information.

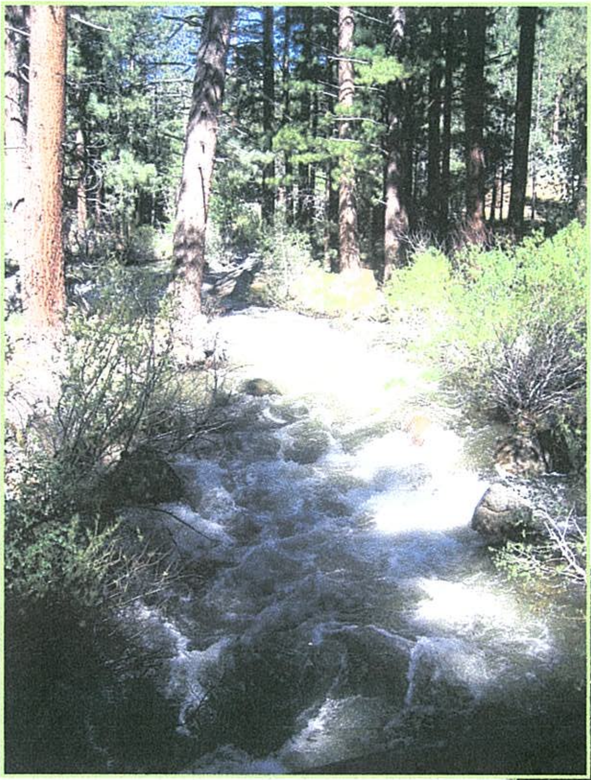
Primary Contact: James C. Donald, Board Chairman, jdonald28@gmail.com, 530-694-2327 (office)

SNC-approved Performance Measures: (Please list each Performance Measure for your Project, as identified in your Grant Agreement, and the results/outcomes.)

DETAILED PROJECT DELIVERABLES	TIMELINE	RESULTS/OUCOMES
Ambient monitoring for water chemistry, turbidity, physical habitat, and flow	Periodic beginning September 2008	Completed Periodic 2008-2011
Bioassessments including benthic macro invertebrate collection, physical habitat, and flow	Fall 2008 & Spring 2009	Completed annually 2008-2011
Bacterial and nutrient sampling	Monthly beginning Summer 2008	Completed monthly August – Dec 2008; completed Periodic 2010-2011
Peak flow monitoring for turbidity and discharge	Storm and High water events (2)	Completed monitoring for eight stormwater runoff events 2008-2011
Summer low flow monitoring	Weekly July-October	Completed weekly July-Sept 2008; completed monthly August-Nov 2011
Data entry, analysis, interpretation, and reporting	Ongoing	Completed final data report 2011; completed final supplemental data report 2012
Complete and submit six month progress reports to SNC	Ongoing	Completed – December 2008, October 2009, June & December 2010, June 2011
Develop a baseline data program using GIS	Ongoing	Completed Summer 2011
Conduct Washoe Tribe youth education and field training	Ongoing	Completed Summer 2011
Final Report/Final Payment request	**March 1, 2012**	

Alpine Watershed Group

2011 Supplemental Water Quality Data Report



Prepared by Chris Katopothis
Alpine Watershed Group
For
Sierra Nevada Conservancy

February 2012

Contents

Introduction

This report is prepared as a supplement to the Alpine Watershed Group (AWG) 2010 Monitoring Data Report, submitted to Sierra Nevada Conservancy in July 2011. The 2010 report included data collected and analyzed for the Volunteer Water Quality Monitoring Program. Some parameters included in the objectives for this project were still being processed and analyzed while the 2010 report was being completed. This supplemental report serves to present the parameters not previously reported on, including summer/fall low-flow monitoring, stormwater and spring runoff monitoring, and bioassessment monitoring. Bacterial data analysis for 2011 is also included here. Periodic ambient water chemistry and nutrient monitoring was conducted in June, August, and September of 2011. The data from those sampling events presented no significant deviations from the statistical results presented in the 2010 report, therefore that data are not included in this report.

Summer/Fall Low-Flow Monitoring

Low-flow monitoring was conducted on the Markleeville Creek system from July through September 2008, and on the Upper West Fork Carson River from August through October 2011. Flow data in this report is displayed in the form of line graphs, charting parameter change over time. Data collected in this program represent discrete points in time, not necessarily reflecting the variability that occurs between monitoring sessions. Therefore, the data are symbolized by points on the graph connected by dotted lines in order to easily view the variations for each monitoring site. Any breaks in the continuity of the graph lines indicate a gap in data collected.

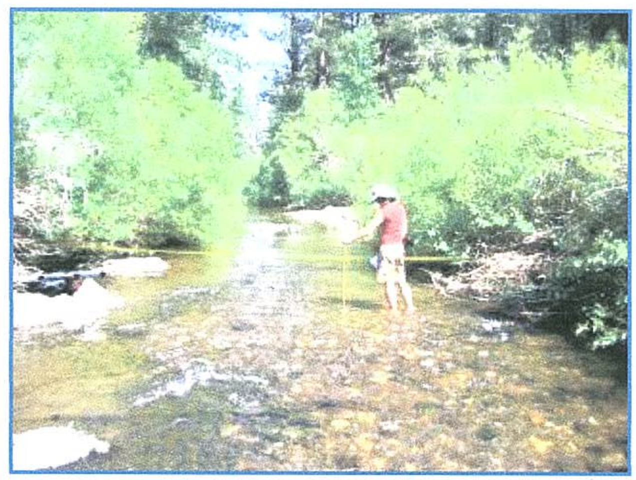


Figure 1 Citizen Monitor gaging flow on Hot Springs Creek

2008

2008 monitoring in the Markleeville Creek watershed was conducted to gather and compile baseline low-flow data, and to analyze and represent comparisons between the main stem of Markleeville Creek and incoming tributaries, as well as agricultural irrigation diversions within existing ditch systems. Monitoring was conducted by AWG staff with assistance from Citizen Monitor volunteers (figure 1). In total four sites were included in the monitoring study, with eight sampling events conducted from July thru September 2008 (figure 2).

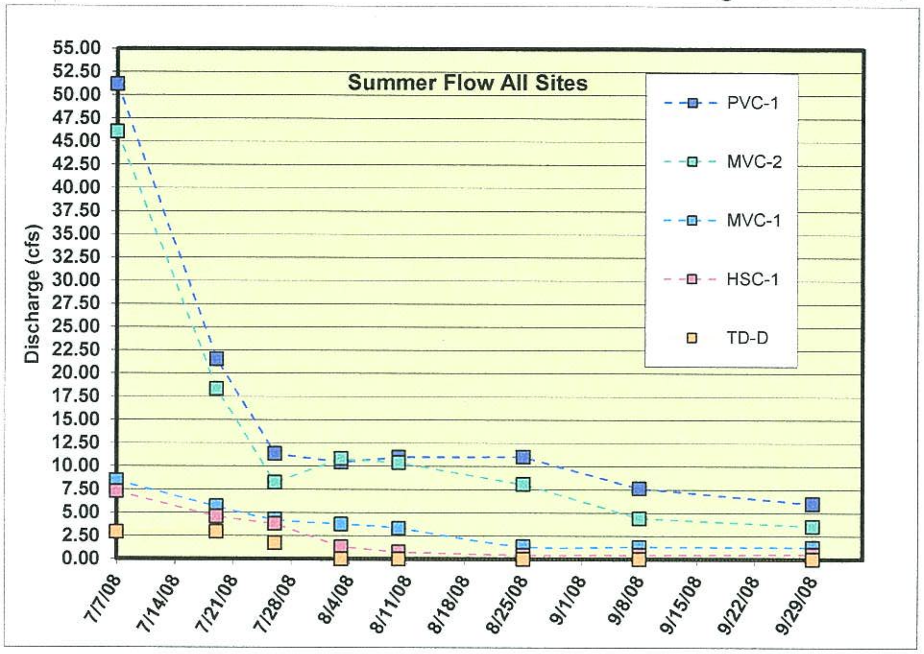


Figure 2 Summer Low-Flow all sites

Site Descriptions:

- **PVC-1 - Pleasant Valley Creek at USFS boundary**
- **MVC-1 - Markleeville Creek at Pleasant Valley Rd crossing**
- **MVC-2 - Markleeville Creek at town Library**
- **HSC-1 - Hot Springs Creek at Grover Hot Springs footbridge**
- **TD-1 - Town Ditch downstream of Hot Springs Rd crossing**

2008 monitoring results indicate that Pleasant Valley Creek, the major tributary to Markleeville Creek, averages slightly higher flow volume to that of a mainstem Markleeville Creek site, measured below the confluence with Pleasant Valley Creek (figure 3). This is important to note because it indicates a loss of flow volume not accounted for by any known diversions within the reach of Markleeville Creek below the confluence with Pleasant Valley Creek. Both Markleeville and

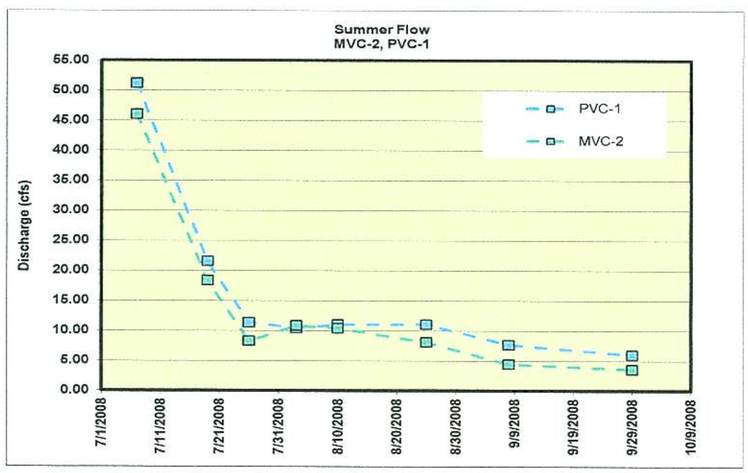


Figure 3 Pleasant Valley Creek and Markleeville Creek comparison flow

Pleasant Valley Creek generally followed the same pattern in terms of decrease in discharge while approaching base-flow conditions.

In addition, the primary agricultural diversion ditch (Town Ditch) within the system was monitored. Discharge at the United States Geological Survey (USGS) gage on the East Fork Carson River below Markleeville, which is the receiving water body for the Markleeville Creek system, was also recorded on monitoring dates. Base low-flow for Markleeville Creek was recorded on September 9, 2008 and measured a discharge of 3.56 cubic feet per second (cfs).

Of particular interest is the flow volume recorded at the Town Ditch diversion during summer low-flow, as discharge is decreasing and moving towards base-flow. On July 17th, 2008, discharge on Markleeville Creek was measured at 5.66 cfs, with the Town Ditch measuring 2.91 cfs. These data indicate that the Town Ditch is capable of diverting a significant portion of the summer low-flow discharge from Markleeville Creek; in this instance carrying greater than 50% the volume of the creek itself. Further low-flow studies could prove valuable, as a more comprehensive monitoring and analysis would provide a better understanding of potential gaining or losing reaches within the system, and impacts from any potential and currently unknown diversion structures. Use of groundwater resources in adjacent developed areas may also play a role in currently unexplained loss of flow volume within particular reaches.

2011

During the late summer/fall of 2011, monitoring on the Upper West Fork Carson River was conducted with the intention of gathering baseline low-flow conditions in Upper Hope Valley. This site is one of four where permanent flow gaging stations are scheduled to be installed for the purpose of gathering long-term flow data in preparation for future meadow and stream restoration efforts. On August 10th, 2011 American Rivers and Alpine Watershed Group conducted a flow gaging training (figure 4) for citizen monitors, who will help to conduct future monitoring at the gaging stations. Alpine Watershed Group is partnering with American Rivers to plan and install the gaging stations and also to evaluate potential restoration options. While the Hope Valley Meadow area is primarily undeveloped, legacy impacts from heavy grazing throughout the twentieth century continue to impact the system. Within the Hope Valley meadow the West Fork is unable to access floodplain

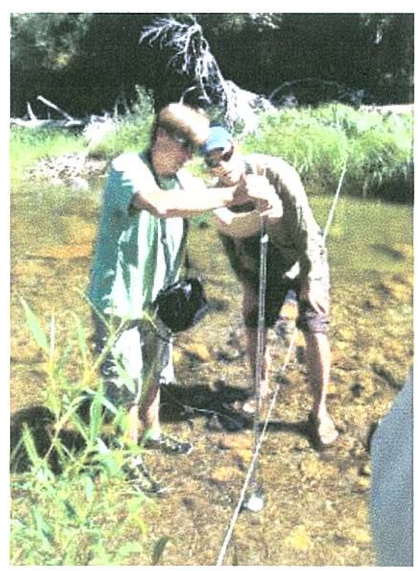


Figure 4 Flow training for citizen monitors

areas and experience proper functioning conditions, a result of downcutting. This lowering of the river surface water elevation will in turn lower meadow groundwater levels, leading to further degradation. Gaging stations will use water level loggers programed to read water level and temperature every fifteen minutes throughout the year. Staff plate gages will also be installed at the sites for the purpose of visual water stage recording at the time of flow gaging with meters. Cross sections will be surveyed in, and flow gaging will be conducted using USGS protocols and flow meters, with the aim of eventually developing a rating curve for stage and discharge at each site. Four discharge readings were recorded at the upper meadow site in 2011 (figure 5). Generally, flows on Alpine County streams will steadily decline during the late summer/early fall period, as snowmelt no longer contributes and new precipitation is yet to come. The graph in figure 5 below displays an anomaly in the expected declining flow sequence represented by the spike from 6 cfs on September 24th, to 42 cfs on October 14th. This dramatic increase in discharge during the normal declining low-flow season is attributable to an early season rain-on-snow event. Rain on snow events in late winter or spring, when snowpack is much deeper, can result in even more drastic increases in flows, and normally include the flood-flow related events for a snowpack system such as the Upper West Fork Carson River. AWG will continue to pursue funding sources for the continued monitoring of installed gaging stations on the Upper West Fork Carson River with the aim of providing valuable data for restoration planning and assessment of restoration success in augmenting flow conditions.

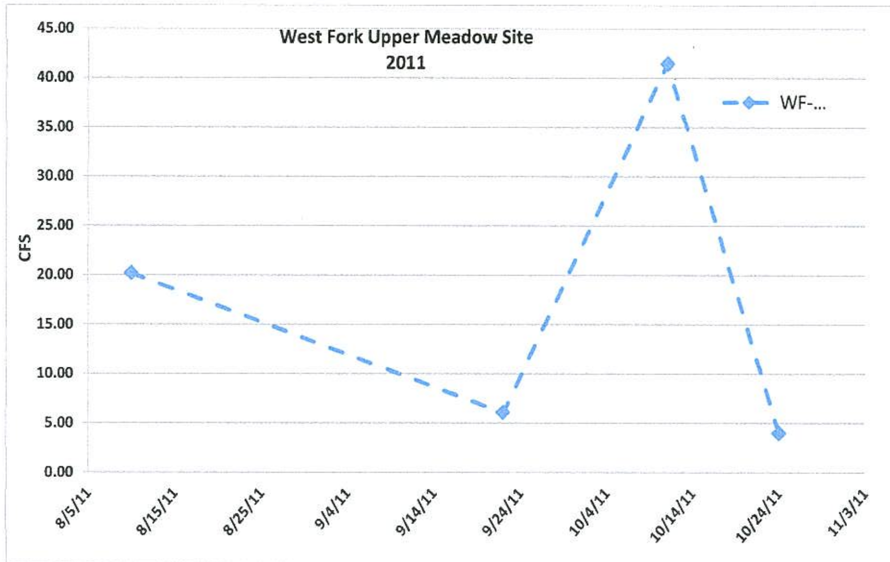
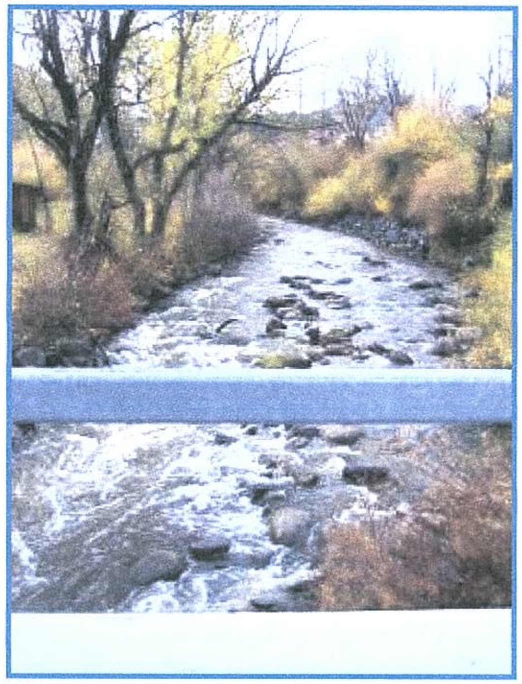


Figure 5 Upper West Fork Carson River low-flow 2011

Stormwater and Spring Runoff Monitoring

Stormwater sampling for turbidity was strategically conducted as conditions warranted for the period of January 2008 through June 2011, to include a total of nine sampling events. Stormwater and spring runoff data collected during periods of higher flows represents increases in discharge and turbidity during three primary scenarios: rainstorm related events, rain on snow events, and gradual spring snow melt periods. The purpose of the sampling is to examine the effects of higher flows on turbidity levels, and to determine if there is an observable correlation between the two parameters. The data demonstrates a strong correlation between discharge and turbidity; as flows increase, turbidity levels increase accordingly.



High Water on Markleeville Creek

Turbidity is a measure of water clarity and how much the suspended solids in water decrease the passage of light through the water. Turbid water absorbs more heat from sunlight and lowers dissolved oxygen levels. Warmer water with lower dissolved oxygen can have negative impacts on cold water aquatic species. Highly turbid water can clog the gills of fish and smother eggs in the stream bottom gravels. High levels of turbidity during high flows can be an indication of actively eroding stream banks, as well as unstable soils upslope of the stream channel.

Stream discharge was logged at the time of sampling using data supplied by the USGS stream gage systems for both the East and West Forks of the Carson River. Water samples were analyzed for turbidity levels using a HANNA HI 93703 turbidity meter.

Figure 6 Turbidity – Discharge correlation

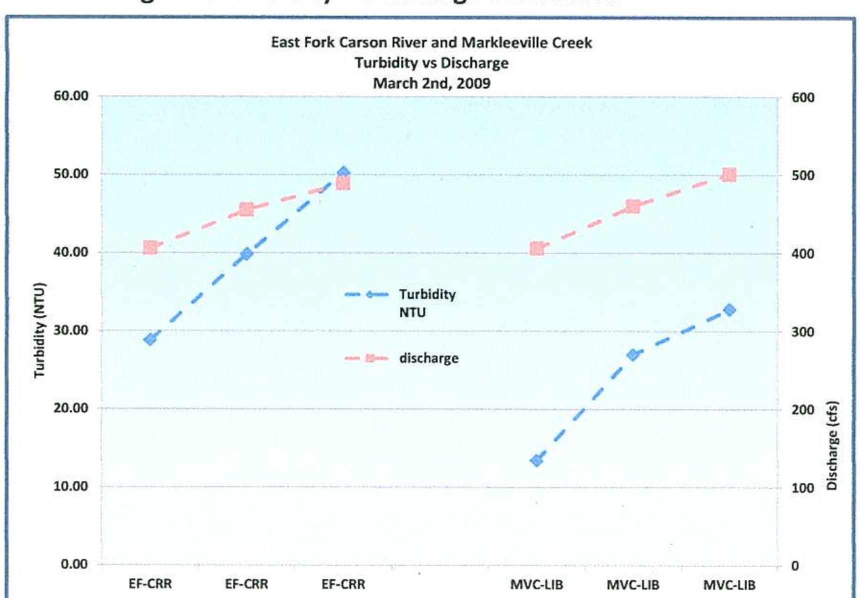


Figure 6 displays stormwater data sampled over a three hour period on March 2nd, 2009 during a heavy rainstorm. The three readings taken at each site for the event show the rising limb of the flow event, with discharge increasing. The data is graphed in figure to show the correlation between discharge and turbidity levels as flows increase.

Data graphed in figure 7 captures gradual spring snowmelt and the associated rise in discharge for spring of 2011, with the initial sampling on March 16th also featuring a rain on snow event that brought both discharge and turbidity levels up significantly within a 24 hour period.

Site descriptions for figure 7 and 8 are:

- **EF-CRR - East for Carson River at Carson River Resort**
- **MVC-LIB - Markleeville Creek at town Library**
- **HSC-GHS – Hot Springs Creek at Grover Hot Springs footbridge**
- **WF - West Fork Carson River at Woodfords Hwy 89 crossing**

The final sampling date of June 29th captures another rain-on-snow event that resulted in the highest recorded discharge and turbidity levels over the sampling period of 3 plus years. Figure 8 graphs the data for the West Fork Carson River system, again demonstrating the correlation between discharge and turbidity levels.

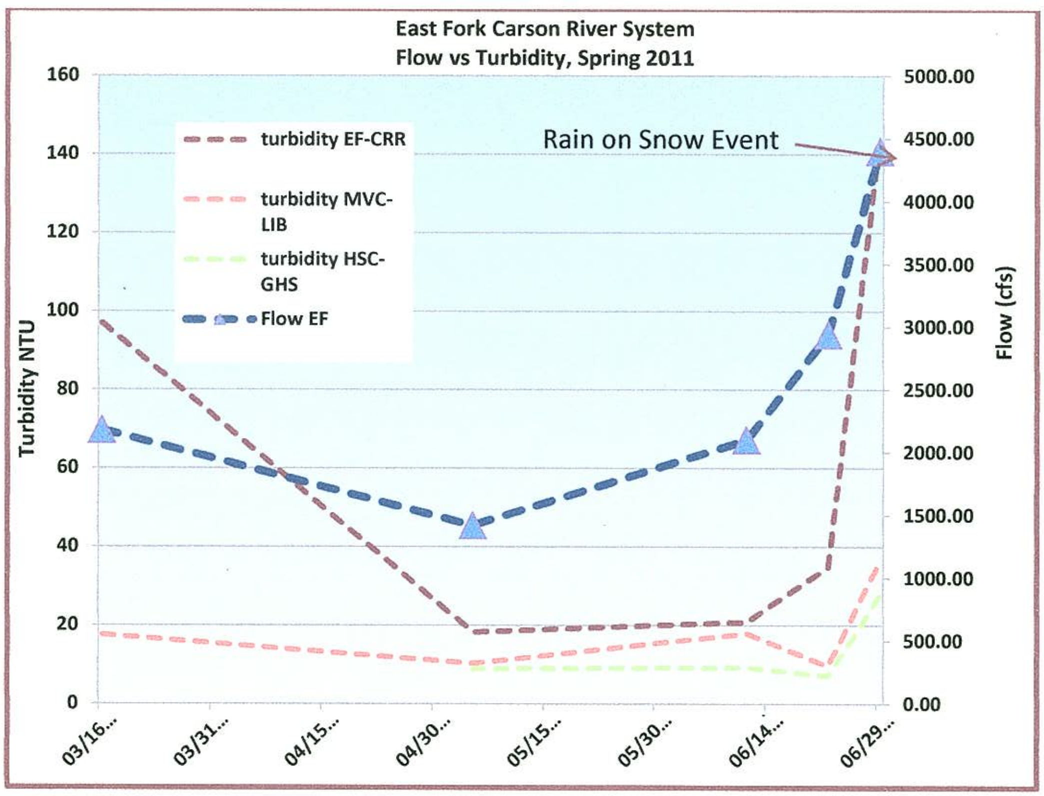


Figure 7 East Fork Carson River flow – turbidity correlation

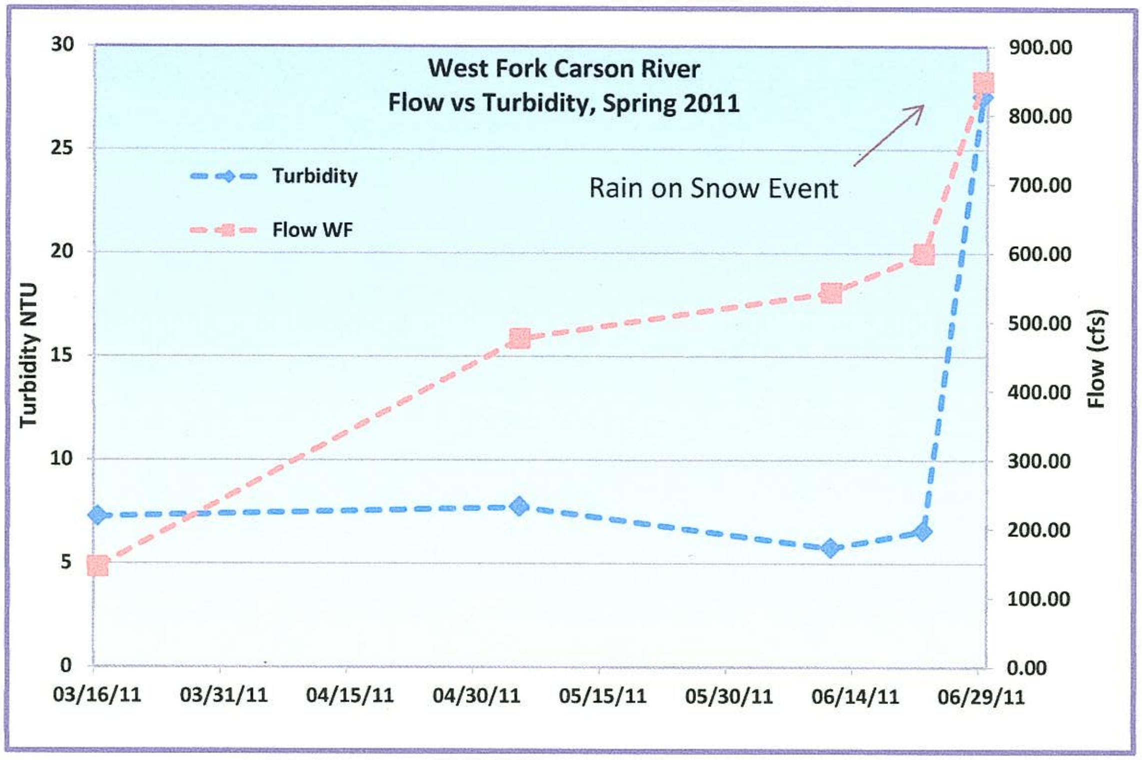


Figure 8 West Fork Carson River flow – turbidity correlation

Continued monitoring for turbidity is important to gain further understanding of the relationship between increases in flow and increases in turbidity. As monitoring continues, data can be evaluated as it relates to land-use, as well as potential sources of sediment and turbidity as a result of unstable stream banks and/or unstable soils upslope of stream channels. Further monitoring for turbidity combined with investigation and assessments of land-use and potential sediment sources will facilitate cost effective prioritization for restoration and conservation efforts within these watersheds.

Bioassessment Monitoring

As a component of the AWG water quality monitoring program, bioassessments have been conducted at two sites on Markleeville Creek annually, from 2007-2011. The two sites monitored on Markleeville Creek were chosen to monitor a planned restoration site at the Markleeville Guard Station, as well as a downstream site at a USFS campground. Additional sites were assessed in 2008 and 2011 as funding allowed. However, for the purpose of this report, data is presented only from the two sites, as these sites have been monitored five years consecutively, allowing for evaluation of changes or trends. Bioassessments are conducted using the California State Water Board Surface Water Ambient Monitoring Program (SWAMP) Bioassessment Procedures protocols and methods, developed in 2007. The SWAMP bioassessment methods include sampling of benthic macroinvertebrate (BMI) populations and measuring a suite of physical and biological habitat conditions. These methods are designed to monitor changes in benthic macroinvertebrate (BMI) populations and community composition in response to changes in water quality and habitat conditions. A series of biological metrics have been developed and are used to describe BMI sample results (figure 9). The biological metrics respond to impairment by either increasing or decreasing, thus also allowing for evaluation of improvement in stream health following stream enhancement and restoration implementations. BMI samples collected for 2011 are currently under analysis and are not included in this report.

BIOLOGICAL METRICS USED TO DESCRIBE BENTHIC MACROINVERTEBRATE (BMI) SAMPLES COLLECTED FOLLOWING THE CALIFORNIA STREAM BIOASSESSMENT PROCEDURE (CSBP)

Biological Metrics	Description	Response to Impairment
Richness Measures		
Taxa Richness	Total number of individual taxa	decrease
EPT Taxa	Number of taxa in the Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly) insect orders	decrease
Ephemeroptera Taxa	Number of mayfly taxa (genus or species)	decrease
Plecoptera Taxa	Number of stonefly taxa (genus or species)	decrease
Trichoptera Taxa	Number of caddisfly taxa (genus or species)	decrease
Composition Measures		
EPT Index	Percent composition of mayfly, stonefly and caddisfly larvae	decrease
Sensitive EPT Index	Percent composition of mayfly, stonefly and caddisfly larvae with Tolerance Values of 0 through 3	decrease
Shannon Diversity Index	General measure of sample diversity that incorporates richness and evenness (Shannon and Weaver 1963)	decrease
Tolerance/Intolerance Measures		
Tolerance Value	Value between 0 and 10 weighted for abundance of individuals designated as pollution tolerant (higher values) and intolerant (lower values)	increase
Percent Intolerant Organisms	Percent of organisms in sample that are highly intolerant to impairment as indicated by a tolerance value of 0, 1 or 2	decrease
Percent Tolerant Organisms	Percent of organisms in sample that are highly tolerant to impairment as indicated by a tolerance value of 8, 9 or 10	increase
Percent Hydropsychidae	Percent of organisms in the caddisfly family Hydropsychidae	increase
Percent Baetidae	Percent of organisms in the mayfly family Baetidae	increase
Percent Dominant Taxa	Percent composition of the single most abundant taxon	increase
Functional Feeding Groups		
Percent Collectors	Percent of macrobenthos that collect or gather fine particulate matter	increase
Percent Filterers	Percent of macrobenthos that filter fine particulate matter	increase
Percent Scrapers (Grazers)	Percent of macrobenthos that graze upon periphyton	variable
Percent Predators	Percent of macrobenthos that feed on other organisms	variable
Percent Shredders	Percent of macrobenthos that shreds coarse particulate matter	decrease

Figure 9 from CALIFORNIA DEPARTMENT OF FISH AND GAME WATER POLLUTION CONTROL LABORATORY AQUATIC BIOASSESSMENT LABORATORY REVISION DATE - MAY, 1999

Richness Measures

Taxonomic richness is the overall metric used to describe the total number of individual taxa for a given sample, which represents the diversity of aquatic insects. Taxa are categories or groupings that describe organisms included together on the taxonomic hierarchy, such as family, order, genes, or species. Other richness measures include the number of taxa for each of these insect families - Ephemeroptera, Plecoptera, and Trichoptera (mayflies, stoneflies, and caddisflies)– and the total number of taxa in all

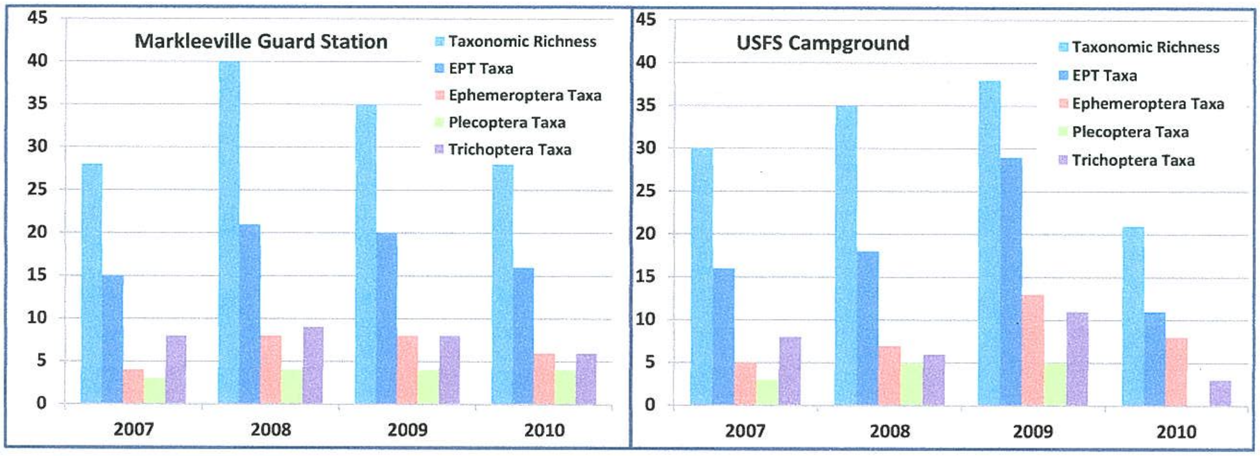
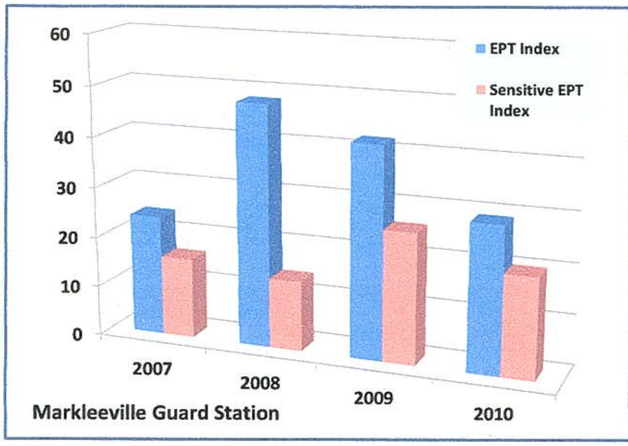


Figure 10 Richness Measures

these families put together, known as the EPT. As water quality and/or habitat conditions decline, a decrease in richness measure metrics will normally occur. The Markleeville Guard Station site shows a trend in decrease for these metrics from 2008-2010, with both sites having a significant decrease for year 2010 (figure 10). Further analysis of water quality and physical habitat conditions present during these monitoring events will be required to evaluate any correlation between these parameters and the demonstrated decline in richness measures. The variation over the 2007 – 2010 time frame may also be attributable to natural fluctuations in BMI populations – longer term data will be required to further assess the apparent decline in water quality for the 2010 sampling.

Composition Measures

Composition measures describe the percent composition of EPT individuals (EPT Index) in proportion to all taxa, as well as percent composition for more sensitive, or pollution intolerant, EPT individuals (Sensitive EPT Index). As with richness measures, the results for composition measures will decrease in response to impairment. Composition measures data displayed in figure 11 show similar patterns to those of richness measures discussed above. Again, the Markleeville Guard Station site shows steady decrease from 2008-2010, with both sites having a significant decrease for year 2010.



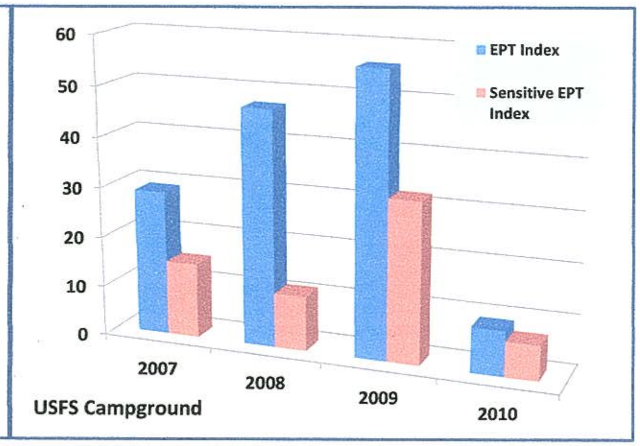


Figure 11 Composition Measures

Tolerance/Intolerance Measures

%Tolerance and %Intolerance metrics assign a numeric value between 0-10 for organisms. The most sensitive, or intolerant organisms, are only able to thrive in high-quality waters, and are assigned values on the low end of the range, 0, 1, or 2. Organisms that are capable of surviving poor quality waters are tolerant, and assigned a value at the upper end of the range, 8, 9, or 10.

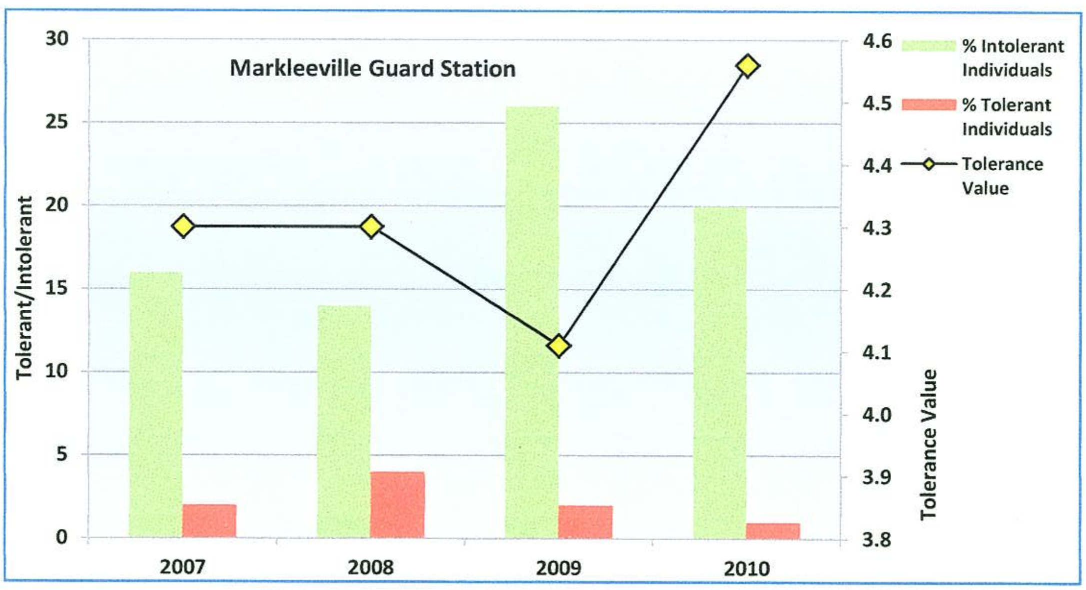


Figure 12 Markleeville Guard Station Tolerance Measures

Another metric, tolerance value, describes the overall community makeup for all organism and their associated tolerance values as described above. Thus, a low Tolerance Value number describes a high quality water; while higher numbers represent lower quality waters. Figures 12 and 13 display %Tolerant/Intolerant and overall

Tolerance Values for years 2007-2010. For each site, 2009 samples have the highest percentage of intolerant individuals, and therefore, the lowest tolerance value number. Just as with Richness and Composition metric results discussed above, the indication for Tolerance Value scores is a decrease in water quality for year 2010.

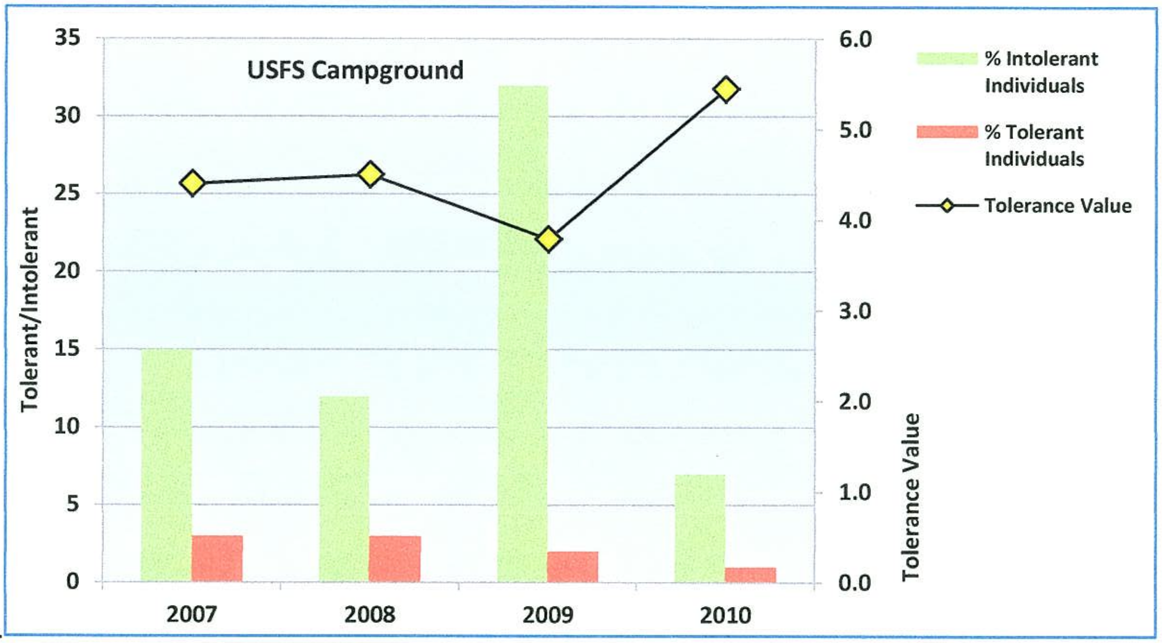
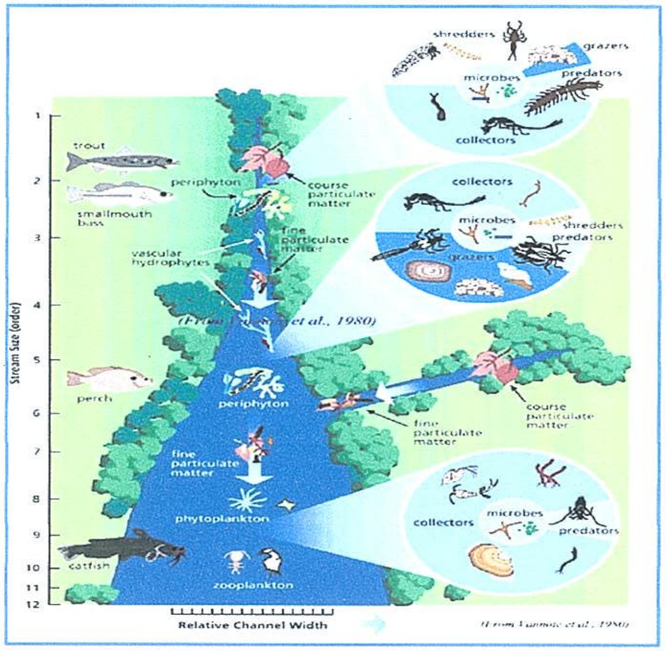


Figure 13 Tolerance Measures USFS Campground

Functional Feeding Groups

The River Continuum Concept (Vannote et al, 1980) describes the changing physical conditions within river systems from headwaters to mouth, and the expected variations in BMI community structure for various reaches and gradients (figure 14). For example, in upper reaches where the stream primary productivity for plant and algae growth is low, the major food source for macroinvertebrates is course particulate matter (leaf fall), and supports larger populations of "shredder" feeding group BMI's. Lower reaches of streams that have slower water and greater productivity will tend to have larger populations of "collectors" of finer particulate matter, and "scrapers" (grazers) that feed on periphyton, the mixture of algae and other microbes attached to the stream substrate, such as rocks. Figure 9 in previous discussion describes the expected increases or decreases in numbers of organisms within functional feeding groups as a response to impairment.

Figure 14 From *The River Continuum Concept* (Vannote et al)



While the two sampling sites on Markleeville Creek are within the lower reach, the entire length of the creek would be classified as a headwater system, as it is a higher gradient stream in a mountain setting. Thus, we should expect to see BMI community representation with higher numbers of headwater functional feeding group organisms. Figure 15 displays percentages of functional feeding groups for samples collected 2007-2010. Again, the data exhibit a potential decrease in water quality for year 2010, as % collector numbers increase, and % shredder numbers decrease. In figure 16 we see a strong correlation between percentage of collector feeders and community tolerance values from one year to the next. As described above in the tolerance value metrics discussion, higher community tolerance values generally indicate lower water quality.

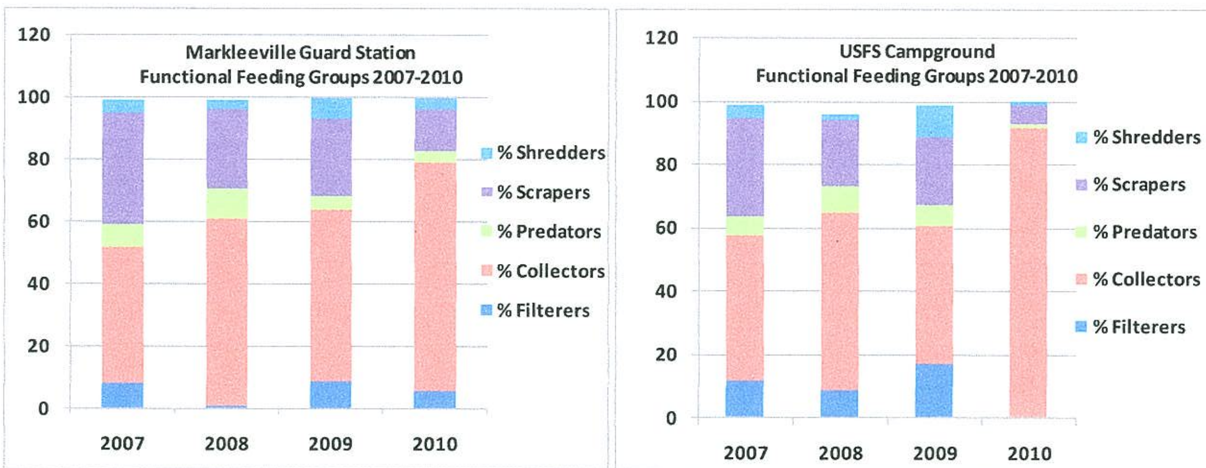


Figure 15 Functional Feeding Groups

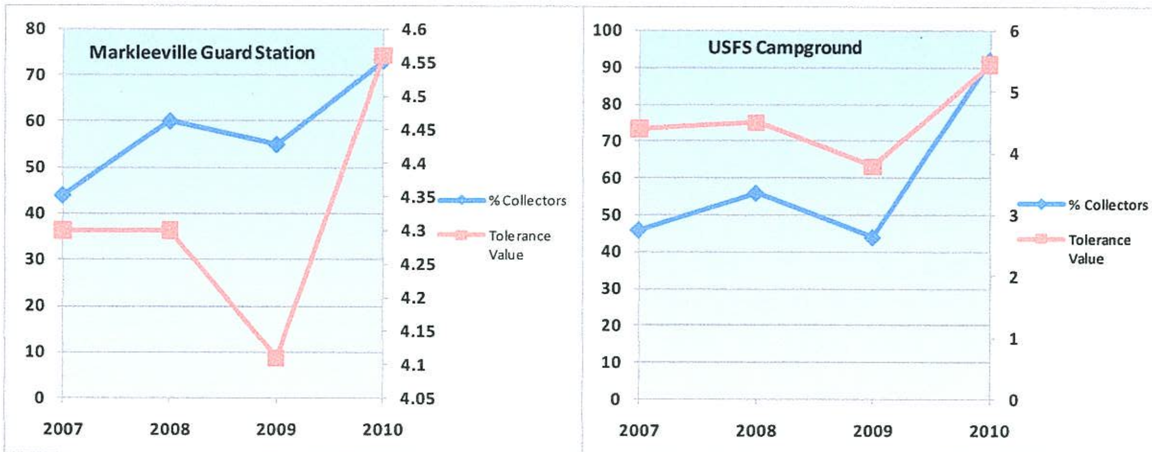


Figure 16 - % Collectors vs. Tolerance Value

Bacterial Monitoring

Alpine Watershed Group worked in collaboration with the Lahontan Regional Water Quality Control Board (Lahontan) on a rigorous bacterial sampling effort for 2011. The Lahontan Basin Plan containing water quality standards stipulates this standard for fecal coliform "*The fecal coliform concentration during any 30-day period shall not exceed a log mean of 20/100 ml, nor shall more than 10 percent of all samples collected during any 30-day period exceed 40/100 ml.*" Preliminary data results from the focused 2011 bacterial sampling effort for the Markleeville Creek system are indicating elevated levels of E. Coli, and now warrant further investigation as to the sources and/or causes of these elevated levels of bacterial contamination within the watershed. Once data analysis is complete, AWG will then work with Lahontan and other local entities to identify next steps for further investigation.

Geographic Information System

Alpine Watershed Group continues to work on the development of a Geographic Information System (GIS) that will facilitate the ongoing assessment of land-use activities and potential impacts to water quality. Land-use data is currently being compiled from numerous sources and added to the GIS program. Figure 17 is an example of data layers provided by the United States Forest Service (USFS) and Alpine County, showing USFS cattle grazing allotment areas, and Alpine County areas designated for agricultural use. Areas that are currently used for irrigated agriculture as visible on aerial images will eventually be digitized into another land-use GIS layer (figure 18). We are also beginning the process of joining our water quality monitoring sites and data sets with the GIS program. Once fully developed, this GIS program will provide a very useful tool in our ongoing assessments and evaluations of land-use practices and water quality impacts.

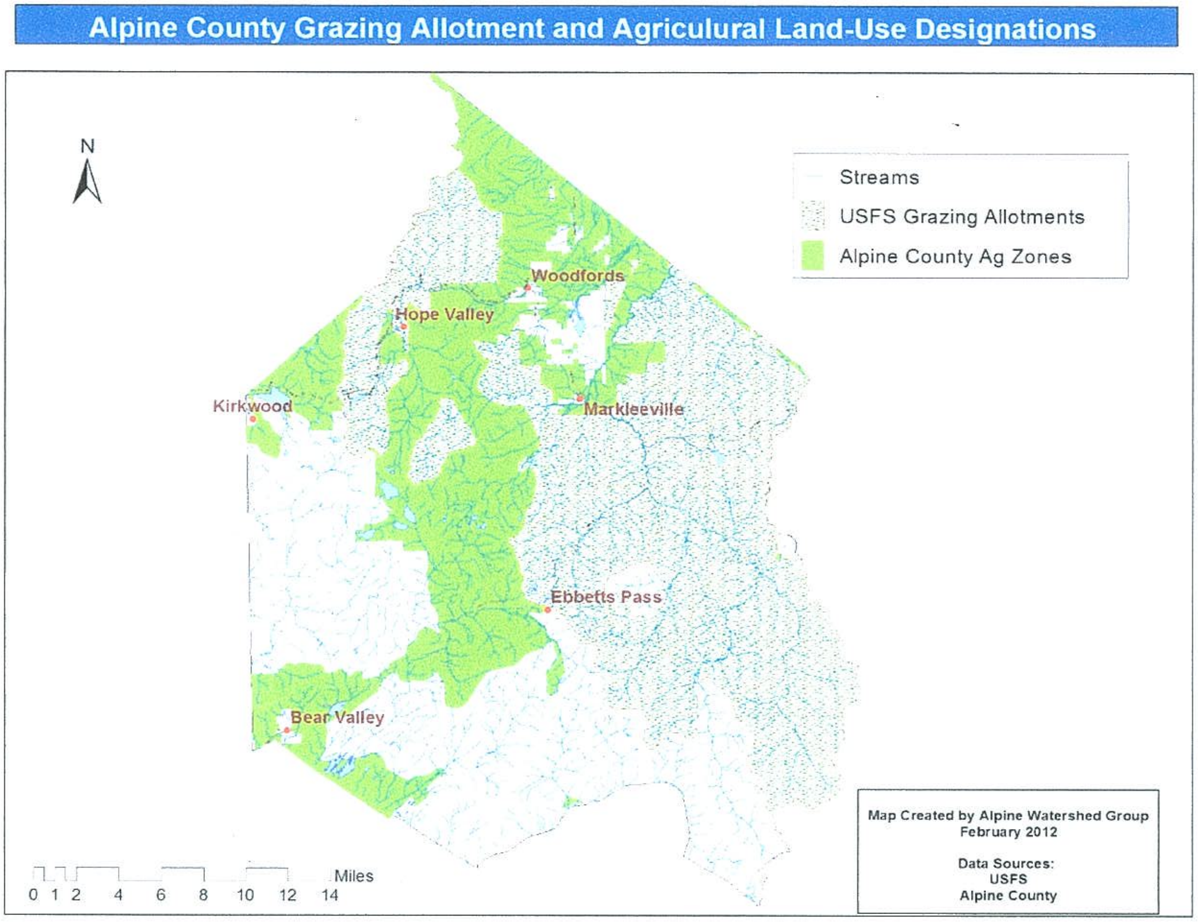


Figure 17 Alpine County Grazing Allotments and Agricultural Land-Use

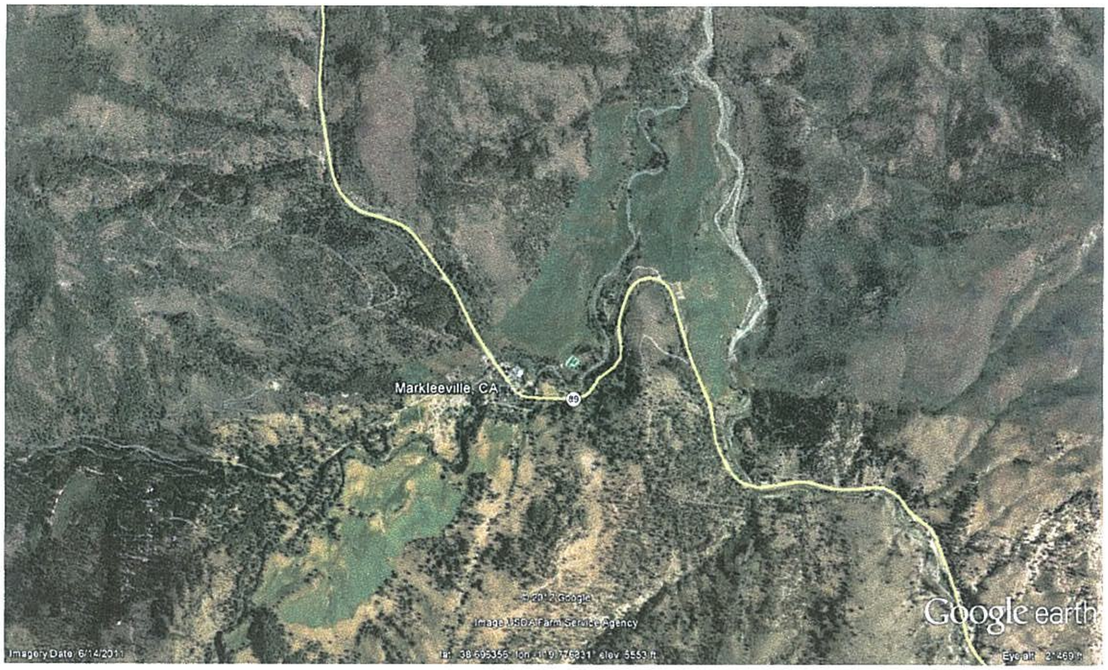


Figure 18 Irrigated Pasture Lands near town of Markleeville, CA

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