

Las Huertas Creek: Monitoring of Selected Water Quality and Quantity Parameters 1995 – 2005



Daniel Shaw, Tom Allen, Bob McCormick, Cathy Bailey, Carolyn Valtos, and Students

A Cooperative Effort of:



Las Huertas Creek: Monitoring of Selected Water Quality and Quantity Parameters 1995 – 2005

By Daniel Shaw¹, Bob McCormick², Tom Allen¹, Cathy Bailey¹, Carolyn Valtos¹
And 1995-2005 Bosque School 7th Grade Science Students

Bosque School

Albert J. & Mary Jane Black Institute for Environmental Studies

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¹ Faculty, Bosque School, 4000 Learning Road NW, Albuquerque, NM 87120
www.bosqueschool.org

² Faculty, Stevenson School, 3152 Forest Lake Road, Pebble Beach, CA 93953

Cover photo by Tom Allen

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Monitoring of Selected Water Quality and Quantity Parameters
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Introduction

In September 1995, Bosque School's first class of 18 seventh grade students trekked with their teacher to Las Huertas Creek in the north end of the Sandia Mountains. With a new spectrophotometer, turbidimeter and other equipment provided by the New Mexico Department of Game and Fish (NMDGF), the students measured various water quality and quantity parameters. Their trip began their inquiry into understanding how watersheds function, the health of the Las Huertas watershed and its stream's suitability for supporting aquatic life and providing quality water for downstream users such as the residents of Placitas. The intent has always been to provide meaningful information and analysis to the United States Department of Agriculture Forest Service, NMDGF, New Mexico Environment Department (NMED), and the residents living within the Las Huertas watershed. Over the last ten years, each successive class of Bosque School 7th graders and their teachers have made at least one monthly journey to this small perennial stream to gather information about its condition and to participate in the NMDGF sponsored New Mexico Watershed Watch (NMWW) program.

This report covers the cumulative data gathered over the last ten years of monitoring. All monitoring has taken place along New Mexico State Highway 165 at mile marker 12 (\pm 0.25 miles), located about halfway between the Las Huertas Picnic Area and the Sandia Man Cave parking lot (N 35° 14.845', W 106° 24.814'). The NMED water quality standards for Las Huertas Creek designate its status to support high quality coldwater aquatic life, irrigation, livestock watering, wildlife habitat, and secondary contact. Out of the 123 months covered in this report, only four months were not monitored at all.

Students continue to enjoy and accept responsibility for the stewardship and monitoring of this resource. While at the site, they initiated trash pick ups, played in winter snow, splashed in the cool summer creek, and observed both a black bear fresh out of hibernation and wild turkey strut across their work site. Their connection to the location is strong. Many former student monitors continue to speak positively about their experiences in Las Huertas Canyon and take pride in their contribution to this study even though they are now college graduates with adult lives of their own.

Site and Las Huertas Creek and Watershed Description

The monitoring site is within a cottonwood (*Populus* sp.) dominated area, south to north flowing stream and riparian corridor. It is bounded to the east by the unpaved, dirt road of New Mexico State Highway 165 that at most is only ever a few meters away from the stream. An open meadow is adjacent to the west side of the stream. The current landowner of the monitoring site is the US Department of Interior, United States Forest Service and is presently within the Tijeras District of the Cibola National Forest.

The upstream area of this study's watershed covers roughly seven and a half square miles with its surface bedrock consisting mostly of the Madera limestone formation. The stream originates with regularity at around 8,200 feet where it is spring fed from the base of limestone cliffs. The watershed's highest point is Sandia Crest at 10,768 feet. The perennial portion of the stream extends about two miles above and one mile below this study's monitoring location. The watershed itself has mostly an easterly exposure (Brekhus et al. 1991).

At lower elevations, pinon pine and oak dominate the watershed while mixed conifer dominates higher elevations. The stream is usually dry before it leaves the Forest Service's property and enters Placitas. During wet times, such as high spring runoffs and flash flood events, the water flows to the south end of Algodones, New Mexico and enters the Rio Grande.

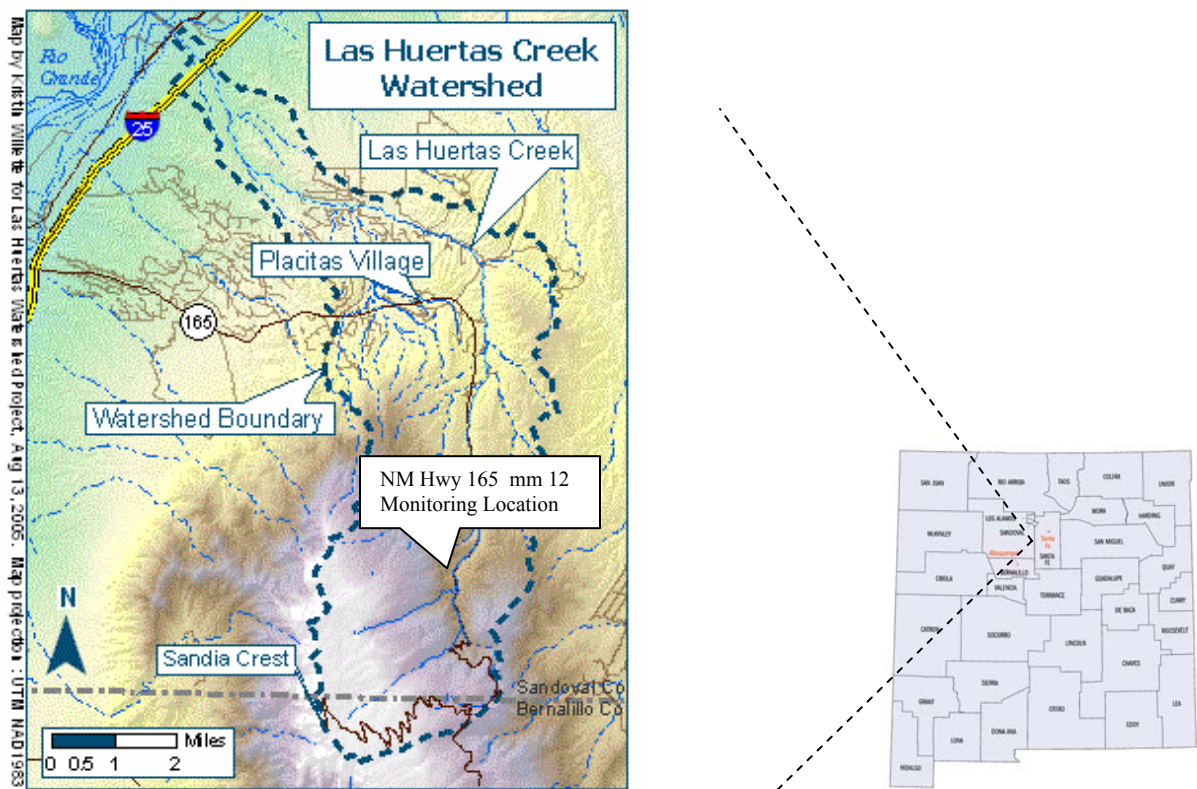


Figure 1. Map of Las Huertas Creek and its watershed showing the Bosque School monitoring location along New Mexico State Highway 165, mile marker 12. Core map by Kristin Willette

The meadow adjacent to the monitoring site was once part of a small farming and ranching operation extending from early in the area's Spanish Colonial period (late 18th century) to well into the 20th century. There is also evidence of the canyon's use by Paleo Native Americans extending back to at least 10,000 years ago and the area's last major ice age. Recent and historic use of the canyon by Puebloan Native Americans is documented (Brekhus et al. 1991 and Musello and Walt 1999).

The watershed upstream of this study's monitoring location is mostly part of the Sandia National Forest's designated wilderness area, though there are several other landscape features worth noting. This watershed includes: several miles of the paved and designated National Scenic Byway, New Mexico State Highway 536 leading to the top of the Sandia Crest; a large array of television, radio, and related telecommunications towers, devices, and related infrastructure; the previously mentioned Highway 165 including several miles of dirt road; and an assortment of privately owned in holdings within the Forest Service property. Those parcels include a church camp and about a dozen small cottages and summer homes. There is also a constructed fishing pond within those in holdings. The Forest Service has constructed and maintains a recreation site upstream of the monitoring location consisting of picnic tables, paved roads, vaulted-pit latrines, and related facilities. The dominant land use both within and outside of the wilderness boundaries of this watershed is recreation.

Downstream users of the Las Huertas Creek include the Las Huertas-La Jar Ditch Association (acequia) in the Village of Placitas. Las Huertas Creek also supplies descendents of the San Antonio de Las Huertas Land Grant and other Placitas residents. Las Huertas Creek is perennial where monitored. Within the Cibola Forest lands, a diversion device of the local acequia is used downstream from the monitoring location to take water for agricultural purposes. There is strong local interest in Las Huertas Creek as demonstrated through the ongoing activities of Las Placitas Association and its Las Huertas Creek Watershed Project. This includes the cooperation of a wide variety of stakeholders to ensure the health and sustainability of the watershed (<http://www.lasplacitas.org/watershed.htm>).

Partnerships and Support

In 1991 Dr. William Fleming, a NMDGF contractor, founded the New Mexico Watershed Watch (NMWW) program. He and his associates sought to create a network of students to monitor streams near their schools and across the state and is part of the NMDGF's Aquatic Resources Education Program (Shaw 1993). The original goals of helping students better understand fisheries, the watersheds they depend upon, and the value of being stewards of the waterways within one's community still remain. Another NMDGF contractor, Richard Schrader of River Source, now directs NMWW and its current network of roughly 600 students across New Mexico. Primary funding for NMWW comes from the Sport Fish Restoration (Wallop Breaux) Act that is managed by the US Fish and Wildlife Service, Department of the Interior.

Bosque School received additional funding to support its watershed monitoring and related outreach and environmental education programs through the generosity of the 7Bar Foundation, Albuquerque Community Foundation, Educational Foundation of America, Good Samaritan Foundation, and PNM Foundation.

Since the actual monitoring takes place on US Forest Service, Department of Agriculture lands, we are grateful for the cooperation of this agency and its local Tijeras Ranger District, Cibola National Forest office. The New Mexico Environment Department, New Mexico Riparian Council, and others have provided additional program support through staff and volunteer time. The NMWW program also works cooperatively with the Bosque Ecosystem Monitoring Program (BEMP) as described in Eichhorst et al. (2001) in developing and providing teacher and other environmental education training.

During the summer months, Bosque School NMWW teachers completed most of the monitoring. In the summers of 2002-2005 the monitoring was done by student participants in the New Mexico

Museum of Natural History and Science's summer Young Explorers program led by Bosque School science teachers who use the NMWW curriculum and equipment during the school year.

Quality Control And Assurance

All monitoring has been done according to the most current protocols of the NMWW program as articulated in Schrader's *New Mexico Watershed Watch Workbook* (2002). Each Bosque School teacher involved with the program has completed initial NMWW training and continuing education inservice training which includes training from technical representatives from Hach, the major supplier of almost all of our electronic sensors and probes. All electronic instruments are calibrated at least once a year though most are done more often than that such as every time new batteries are installed or there is a question about accuracy or precision. All teachers and their classes have site field visits and critiques from NMWW contractors and occasionally NMDGF personnel.

Although every reasonable attempt has been taken to provide quality assurance, there should be an assumption that each individual measurement or test has some modest degree of inaccuracy. Teams of seventh grade students do the measurements and analysis. Although the students take their work seriously and are closely supervised by their teachers, some mistakes are inevitable. To reduce the risk of error, whenever possible, multiple tests are conducted from multiple samples, by up to four different groups of students who generally use different equipment. When that is the case, results from the various groups are averaged to provide final results reported in this document. When teachers are aware of or suspect that an individual group has made an error, those results are discounted and are not included in this report.

Throughout the years, there are data gaps for particular parameters. Those gaps have a variety of origins. The most frequent problems include equipment malfunction, time constraints, the development of dangerous weather or driving conditions, or failure of a data point to pass teacher and other quality control procedures.

The data within this report can be most effective when looked at over time. Trends and data ranges emerge from such a longitudinal study. Individual data points have less standing than the entire data set. This report is most helpful in identifying situations over time rather than at any particular point in time.

Materials and Methods

Stream Quantity Measurements

Streamflow: Streamflow is calculated by hand using tape measures, measuring sticks, floating objects (such as an orange), and a stopwatch. A standard ten foot length of stream is used each month. Average depths and widths are determined as is the average water velocity following NMWW protocols (Schrader 2002). A sample streamflow calculation and data form with directions is attached (Appendix A).

Stream Quality Measurements

With the exception of water temperature, all water quality measurements are taken from a composite grab sample. The grab sample is gathered using a clean beaker. Students, working from downstream to upstream and from at least three different locations, gather sub samples from different representative locations and depths within the flowing stream to be mixed together in a composite sample.

All water quality monitoring equipment is manufactured by Hach and standard procedures were followed as outlined in Hach instruction manuals available online at <http://www.hach.com> unless otherwise stated. All data is recorded on a stream data summary form (Appendix B).

Turbidity: A Hach® 2100 series turbidimeter is used according to the manufacturer's guidelines to measure turbidity.

Water temperature: A standard laboratory and field suitable thermometer is used to measure stream temperature. It is placed in the water, and after one minute it is checked at 30 second intervals until it remains stable for at least two consecutive readings.

Total Dissolved Solids: A Hach® TDS Pocket Pal™ or equivalent device is used according to the manufacturer's guidelines to measure the level of total dissolved solids.

pH : For six of the ten years studied, various Hach® pH meters, probes, or an equivalent device was used according to the manufacturer's guidelines to measure pH. From the spring of 1998 through June of 2002, Hach® wide range pH indicator solution and color wheels were used to measure pH.

Nitrate: Nitrates have been measured using Hach® DR 2000 series field portable spectrophotometers according the manufacturer's guidelines for method number 8171 "Nitrate, MR, cadmium reduction method, 0 to 4.5mg/L, NO₃⁻-N" (Hach 1998).

Nitrogen Ammonia: Nitrogen ammonia has been measured using Hach® DR 2000 series field portable spectrophotometers according the manufacturer's guidelines for method number 8155 "Nitrogen, Ammonia, salicylate method, 0.01 to 0.50 mg/L NH₃-N" (Hach 1998).

Total Phosphorus: Total Phosphorus has been measured using Hach® DR 2000 series field portable spectrophotometers according the manufacturer's guidelines for method number 8048 "Total Phosphorus, Total, orthophosphate Phosphate 3, ascorbic acid method, 0 to 2.50 mg/L PO₄³⁻" (Hach 1998) as modified by the NMWW with potassium persulfate used in the sample.

Copper: Copper has been measured using Hach® DR 2000 series field portable spectrophotometers according the manufacturer's guidelines for method number 8143 "Copper, porphyrin method, 2 to 210µg/L Cu" (Hach 1998).

Weather

For the first five years of the program, weather readings were recorded using standard laboratory and field thermometers, sling psychrometers, and anemometers. For the second five years, weather measurements have been recorded using Kestrel® 3000 series pocket weather stations.

Other

Incidental wildlife, weather, and other observations are noted and recorded in field reports.

Las Huertas Creek Data

Unless otherwise stated, all human water quality standards are the current standards of the United States Environmental Protection Agency (EPA) for drinking water. Unless otherwise stated, all fish standards are the current standards of the described in Oswood and Barber (1982) for a high quality coldwater fishery.

Streamflow Results

Streamflow was measured 119 out of 123 months (97%) (Figure 2). The mean streamflow was 1.15 cubic feet per second (CFS) with a standard deviation of 5.67 CFS. The maximum flow was 31.9 CFS in May of 2005. The minimum flow was 0.1 CFS in June 1996, June 2002, August 2003, and September 2003. Although there is no formal standard for minimal streamflow the NMDGF considers flows of greater than 2 CFS to be optimal for a cold water fishery and flows of less than 0.5 CFS to be unacceptable. Of the 119 surveyed months, 88 (74%) had flows equal to or greater than 0.5 CFS (marginal flow) with 26 (22%) months having flows over 2 CFS (high flow). The longest consecutive period of marginal to high flows lasted 28 months from September 1996 to January 1999. There were also 16, 15, 12, 5, 4, 3, and 2 month long consecutive marginal to high streamflow episodes. There were also three nonconsecutive months of marginal streamflow. There were 31 (26%) months when the flows were under 0.5 CFS (low flow). The longest consecutive period of low flow was a 10 month stretch from June 2003 to March 2004. There were 3 episodes of four consecutive low flow months, two consecutive month low flow episodes, and six non-consecutive low flow months.

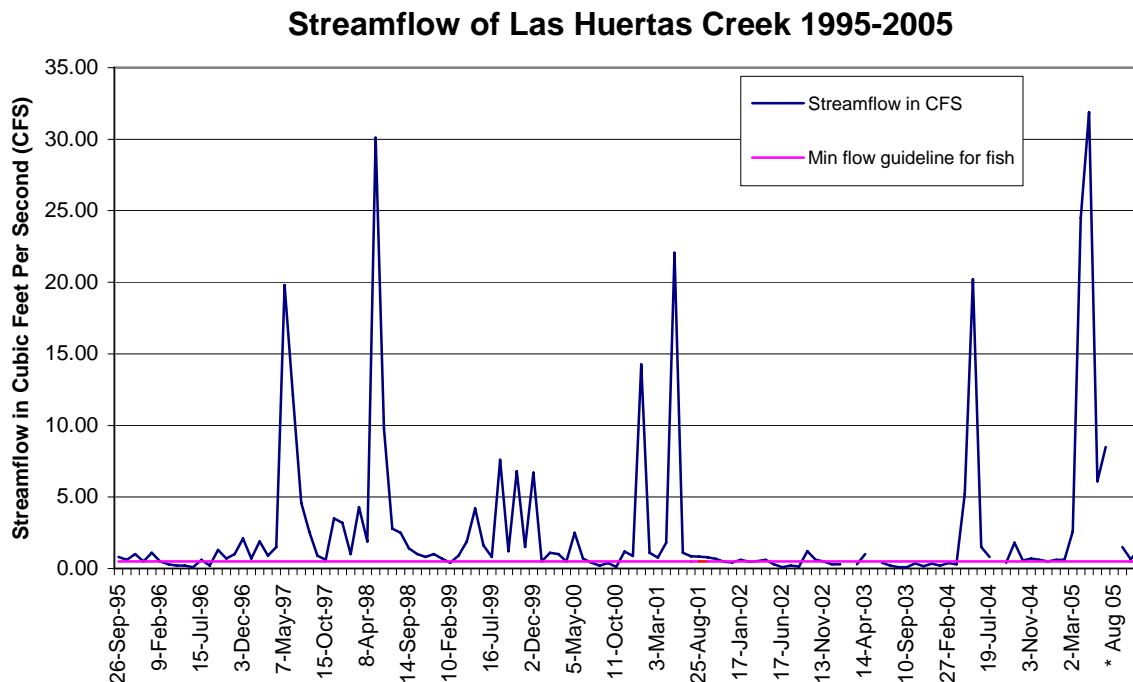


Figure 2. Streamflow of Las Huertas Creek

pH Results

Readings for pH were recorded 118 out of 123 months (96%) (Figure 3). All pH readings were within the acceptable New Mexico standards for a cold water fishery of 6.6 to 8.8 pH. The readings were all slightly to moderately alkali with readings in a range from 7.3 to 8.8 pH. During the period from June of 1998 through June of 2002, only pH color wheels were used to measure pH. The device is reliable and accurate, but only detects pH levels in increments of 0.5 pH units. Hence, all values during that period were a pH of 8. The mean pH for all 118 months was 8.1 with a standard deviation of 0.3. Removing the June 1998 through June 2002 data, the mean pH for the remaining months was still 8.1 with a standard deviation of 0.3. It is likely that the alkali results are due at least in part to Las Huertas Creek's emergence from limestone bedrock.

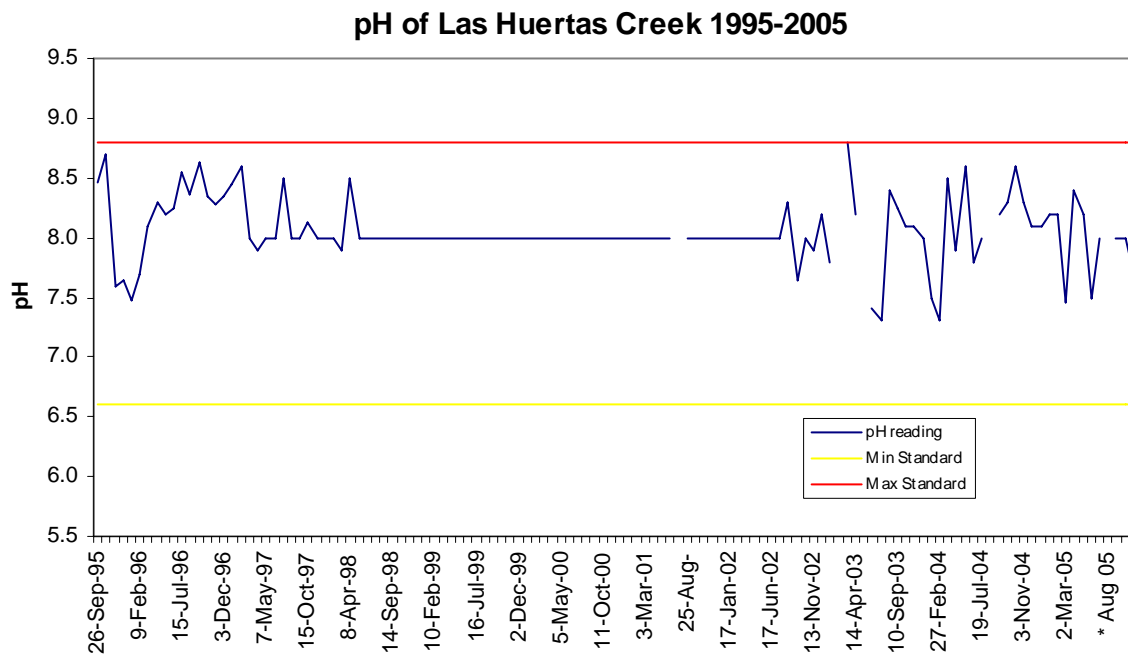


Figure 3. pH of Las Huertas Creek

Stream Temperature Results

Stream temperature was measured 116 out of 123 months (94%) (Figure 4). Mean temperature was 8° Celsius (C) with a standard deviation of 5 ° C. The temperature ranged from 0 to 18° C and never exceeded the NMED coldwater aquatic life standard of 25° C. For comparison air temperature is presented in figure 5.

Stream Temperature in Las Huertas Creek 1995-2005

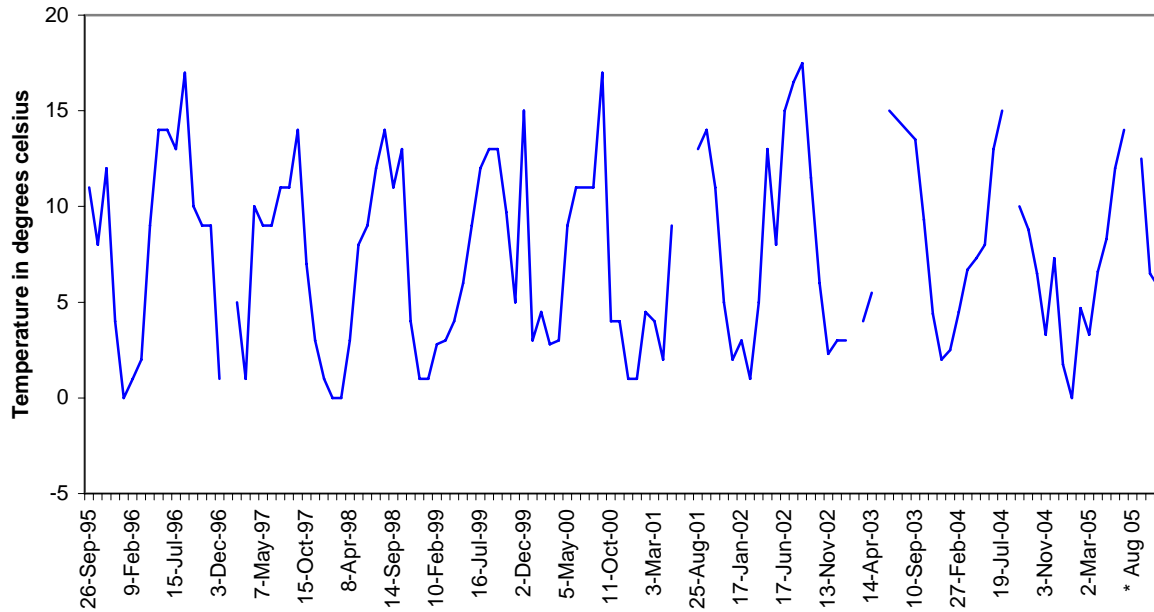


Figure 4. Water Temperature in Las Huertas

Air Temperature Las Huertas Creek °C 1996-2005

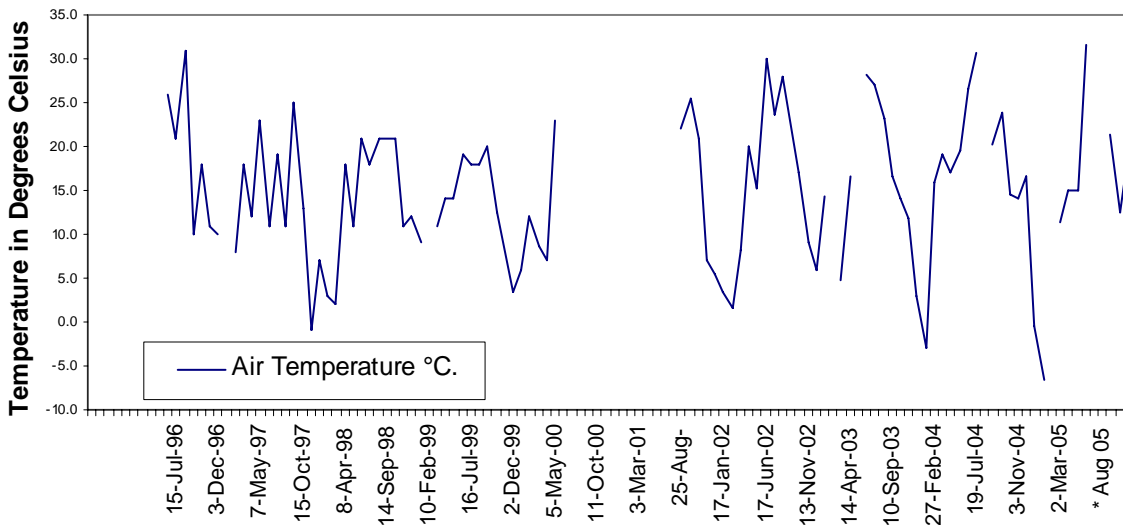


Figure 5 Air Temperature at Las Huertas

Turbidity Results

Turbidity was measured 115 out of 123 months (93%) (Figure 6). Mean turbidity was 4.61 Nephelometric Turbidity Units (NTU) with a standard deviation of 9.6 NTU. Turbidity ranged from 0.3 to 102 NTU. There were five months, May 1997, May 1998, July 2001, July 2002, and September 2003 when turbidity exceeded the state standard of 10 NTU for a high quality cold water fishery. In all measured months, except for January 1996, turbidity exceeded the human drinking water standard of 0.5 NTU.

Turbidity In Las Huertas Creek 1995-2005

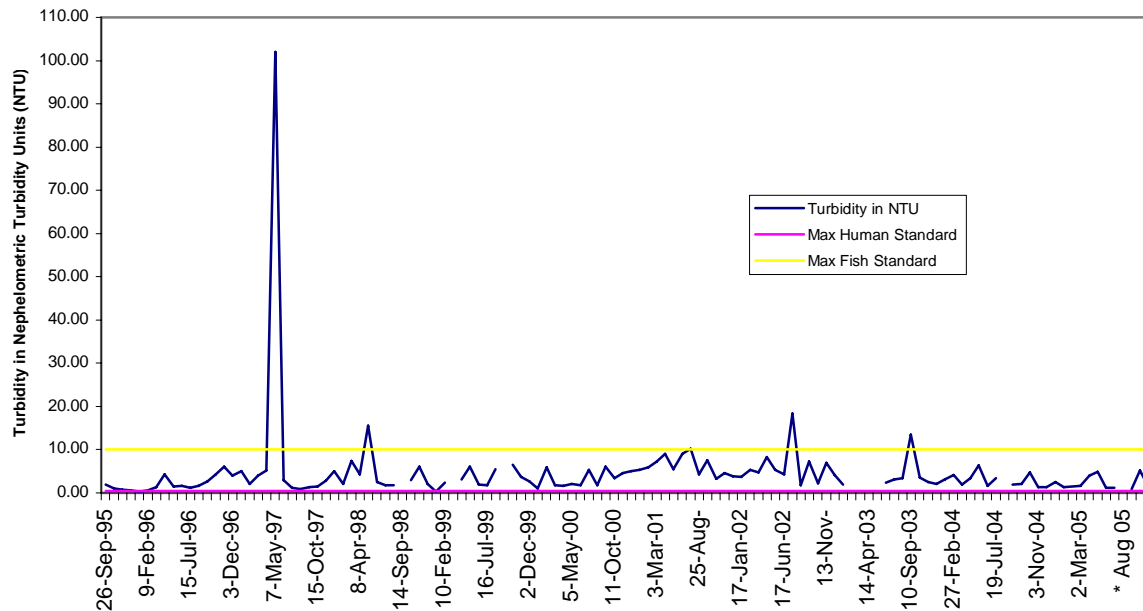


Figure 6. Turbidity in Las Huertas Creek

Total Dissolved Solids Results

Total Dissolved Solids (TDS) were measured 111 out of 123 months (90%) (Figure 7). Mean TDS reading was 178 Parts Per Million (PPM) with a standard deviation of 46 PPM. TDS ranged from 98 to 320 PPM. It appears that there is a general increasing and more erratic trend of TDS in Las Huertas Creek. During the first five years of the study, the mean TDS was 162 PPM with a standard deviation of 20 PPM and with a range of 130 to 201 while during the second five years of the study there was a mean TDS value of 194 with a standard deviation of 56 PPM and a range of 98 to 320 PPM. During the ten years of this study, TDS remained well below the human drinking water standard of 500 PPM.

Total Dissolved Solids (TDS) in Las Huertas Creek 1995-2005

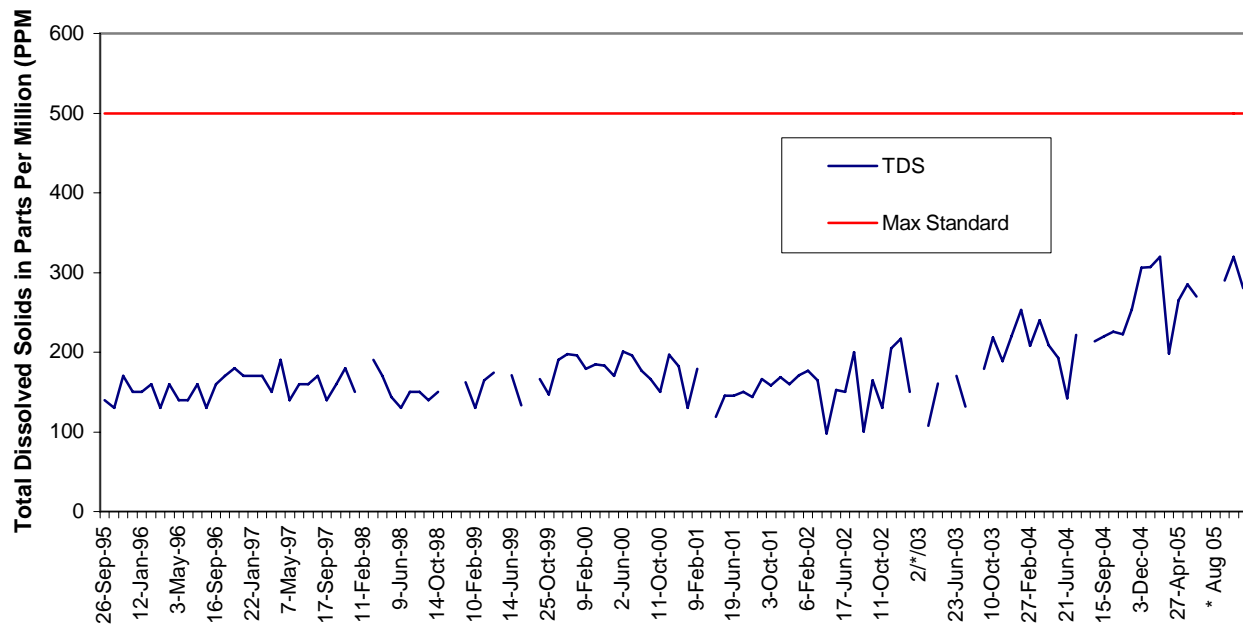


Figure 7. Total Dissolved Solids in Las Huertas Creek

Nitrate Results

Nitrates ($\text{NO}_3^- \text{N}$) were measured 107 out of 123 months (87%) (Figure 8). The mean nitrates reading was 0.31 milligrams per liter (mg/l) with a standard deviation of 0.49 mg/l. Nitrates ranged from 0.0 to 3.1 mg/l with all readings well below the maximum human drinking water standard of 10 mg/l.

Nitrates in Las Huertas Creek 1995 -2005

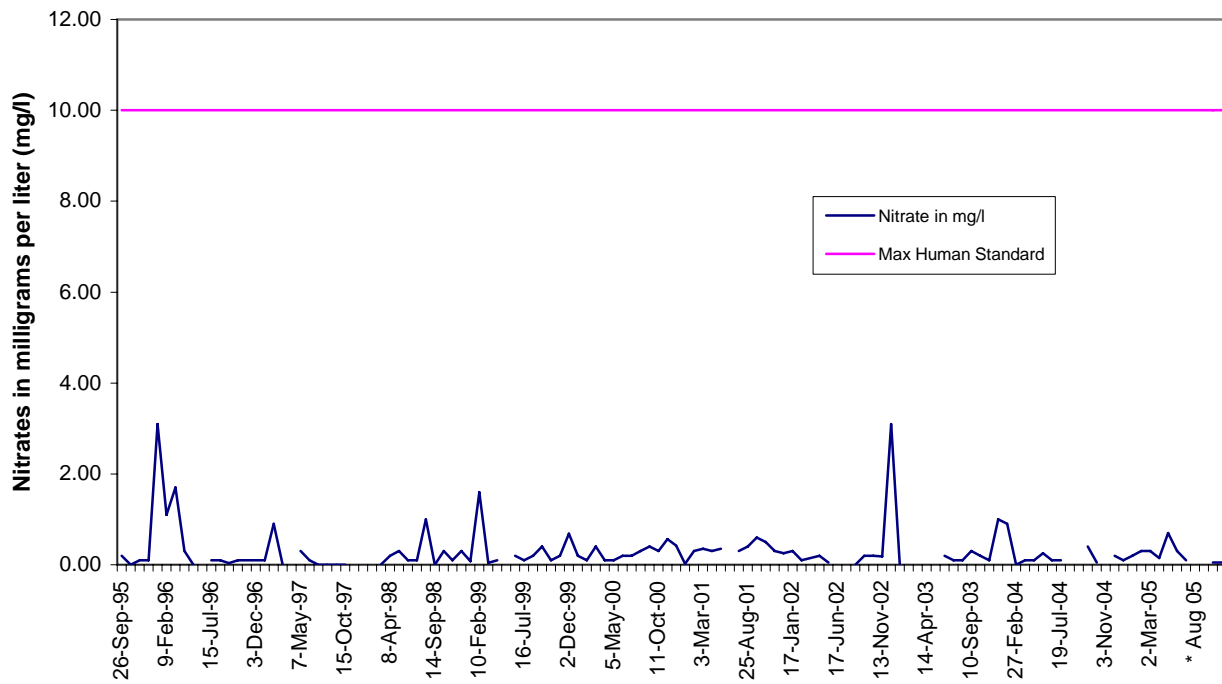


Figure 8. Nitrates in Las Huertas Creek

Total Phosphorus Results

Total phosphorus (PO_4^{3-}) was measured 86 out of 123 months (70%) (Figure 9). Mean total phosphorus reading was 0.67 milligrams per liter (mg/l) with a standard deviation of 1.35 mg/l. Total phosphorus ranged from 0.00 to 8.01. Phosphorus occurs naturally in high amounts in most NM soils and there is no longer a NM State Standard for phosphorus in that most NM aquatic communities are adapted to high phosphorus levels. The concern would be if abundant phosphorus led to excessive levels of algae production leading to eutrophication. That does not seem to be the case in this stream.

Total Phosphorus in Las Huertas Creek 1995 -2005

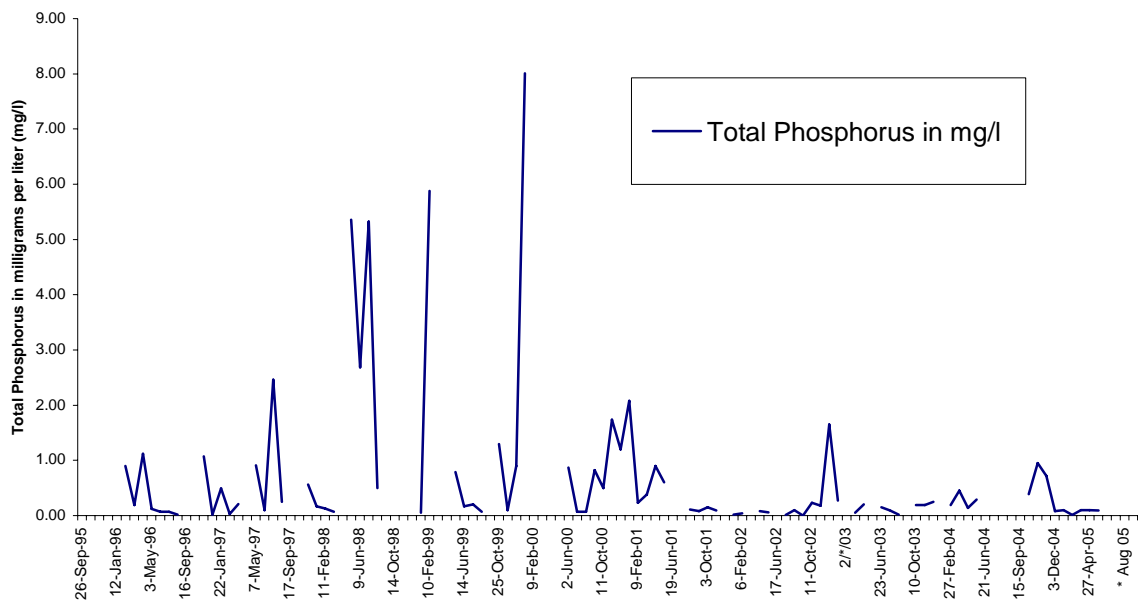


Figure 9 Total Phosphorus in Las Huertas

Nitrogen Ammonia Results

Nitrogen ammonia was measured 80 out of 123 months (65%) (Figure 10). The mean nitrogen ammonia reading was 0.11 milligrams per liter (mg/l) with a standard deviation of 0.15 mg/l. Nitrogen ammonia ranged from 0.0 to 0.8 mg/l. The cold water fishery standard for ammonia varies with water temperature and pH. Throughout the sampled months, all ammonia results were well below the ammonia limits for the given temperature and pH values.

Nitrogen Ammonia in Las Huertas Creek 1995 -2005

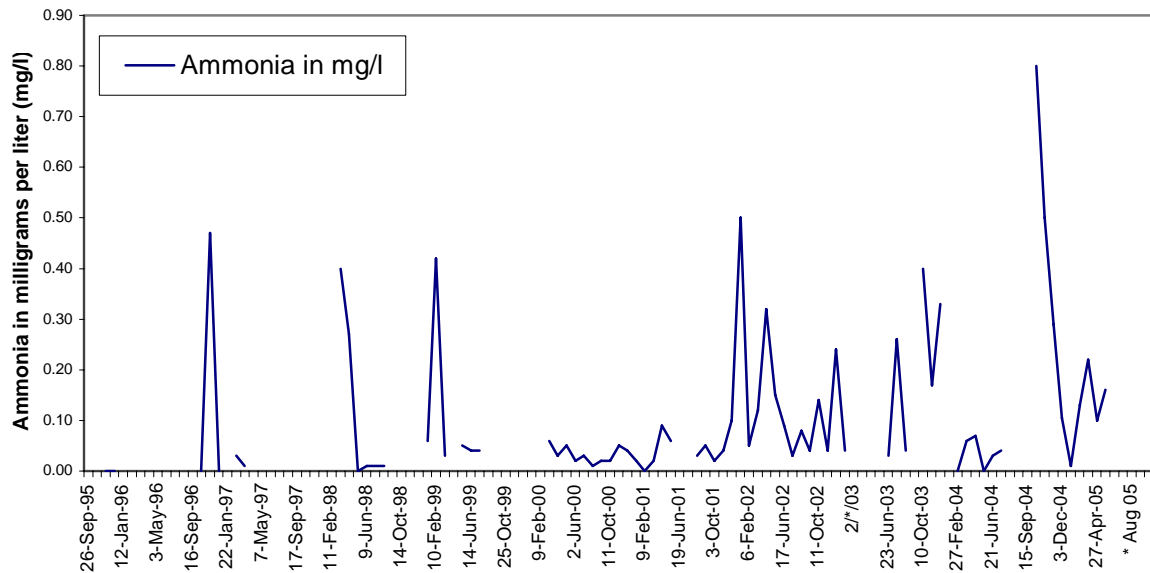


Figure 10 Nitrogen Ammonia in Las Huertas

Copper Results

Copper (Cu) was measured 45 out of 57 (79%) months between 2001 and 2005 (Figure 11). All data prior to June 2001 was not used in this report because of a procedural problem not discovered until 2001. Mean copper reading was 0.0095 milligrams per liter (mg/l) with a standard deviation of 0.0103 mg/l. Copper ranged from 0.0001 to 0.0500 mg/l. All readings were well below the human drinking water standard of 1.3 mg/l. There were 39 months (87% of measured months) when copper exceeded the acute and chronic cold water fishery standard of 0.00096 mg/l.

Mg/L of Copper in Las Huertas Creek 2001 - 2005

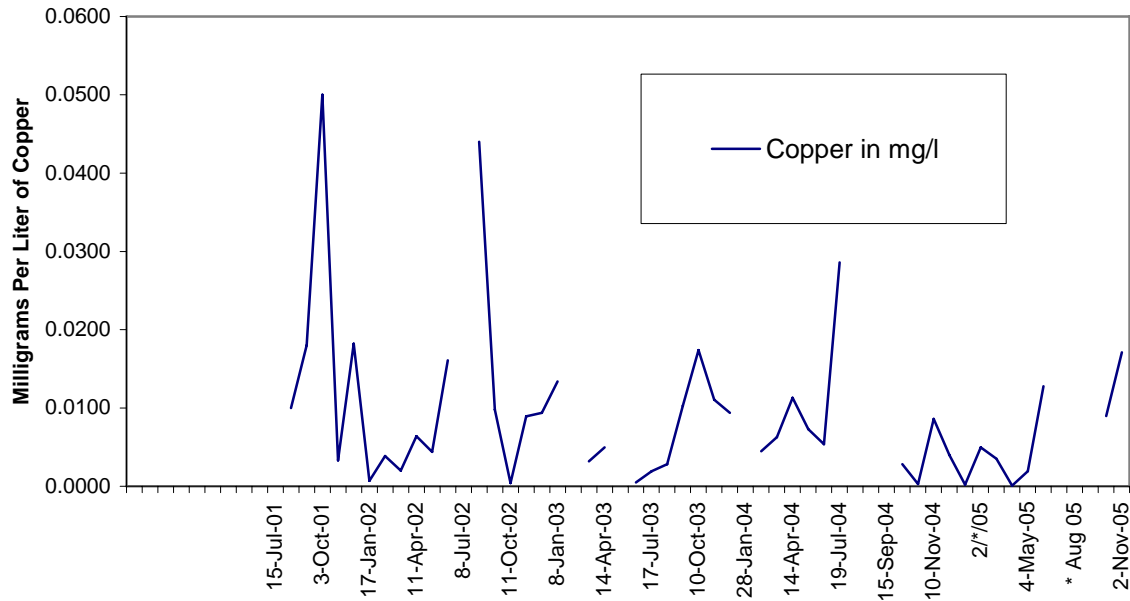


Figure 11 Copper in Las Huertas

Interpretations and Discussion

Between the autumns of 1995 to 2005, Las Huertas creek remained a small flowing stream of moderate to good water quality. Although streamflow levels were often adequate to support at least a marginal fishery, it is important to note that roughly a quarter of the surveyed months had flows of less than 0.5 CFS. However, there was always at least some flow. Las Huertas Creek stream morphology variation creates small pools even during low flow periods and provides possible reservoirs for fish and other aquatic organisms to survive.

Water temperature and pH readings were always within standards and no problem was ever detected. That is also true for Total Dissolved Solids (TDS) though there is increasing trend of TDS values between 2000 and 2005. Further study and analysis related to TDS would be helpful. Turbidity readings were generally well within fisheries standards though there were several acute elevations in turbidity generally corresponding with spring runoff and late summer showers. Overall, turbidity is not a chronic problem.

In terms of studied nutrients, nitrates and nitrogen ammonia were always well within cold water fishery standards. However, total phosphorus readings exceeded state standards nearly two thirds of the measured months. Additional study and analysis related to total phosphorus appears to be warranted.

Copper has proven to be the most problematic studied parameter. With nearly 90% of surveyed months exceeding the acute and chronic levels for copper, it appears that there is some sort of copper problem. A more comprehensive understanding of copper in the Las Huertas watershed should be attempted. Avenues for study might include following up with Las Huertas Canyon private property owners about their former use of copper sulfate to control algae growth in the private fishing ponds upstream of the monitored location. Another study path should consider finding out about the extent and the location of former copper mines within the Sandia Mountains.

Overall watershed health, as reflected by our studies in Las Huertas Creek, appears to be good with several parameters needing additional study. Periodic watershed health and macroinvertebrate surveys, though not reported in this study, reinforce our overall impression of the health of Las Huertas Creek. At this time, drought and low flows appear to be the stream's largest threat to its well-being. Without doubt, Las Huertas Creek and its associated watershed have proven to be excellent and engaging learning environments for over 750 Bosque School students and their teachers.

Acknowledgements

We owe a great deal of thanks to Bill Fleming, Rich Schrader and the New Mexico Department of Game and Fish for their creation, support, and leadership of the New Mexico Watershed Watch program. The cooperation of the United States Department of Agriculture Forest Service, Cibola National Forest, Tijeras Ranger District has also been instrumental in this study. Many thanks also to Gary Gruber, Andrew Wooden, Sheryl Chard and the staff and faculty at Bosque School who have been so flexible and supportive in allowing us to travel every month to Las Huertas Creek.

We are particularly grateful for the dozens of parent volunteers who took days off from work and their other responsibilities to serve as extra adult leaders, drivers, and true colleagues in all manner of weather to make this work possible.

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