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Evaluation of Macroinvertebrate Communities and Habitat for Selected Stream Reaches at Los Alamos National Laboratory

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Los Alamos NATIONAL LABORATORY EST. 1943

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Acronyms

ADEQ	Arizona Department of Environmental Quality
cfs	cubic feet per second
D50	50^{th} cumulative percentile for particle size
ENV-ECO	Ecology Group
ENV-WQH	Water Quality and Hydrology Group
EPA	U.S. Environmental Protection Agency
LANL	Los Alamos National Laboratory
NMED	New Mexico Environment Department
RAWS	Remote Automated Weather Station
RBP	Rapid Bioassessment Protocol
SCI	Stream Condition Index
TA	Technical Area
USDA	U.S. Department of Agriculture

EVALUATION OF MACROINVERTEBRATE COMMUNITIES AND HABITAT FOR SELECTED STREAM REACHES AT LOS ALAMOS NATIONAL LABORATORY

by

Lisa J. Henne and Kevin J. Buckley

ABSTRACT

This is the second aquatic biological monitoring report generated by Los Alamos National Laboratory's (LANL's) Water Quality and Hydrology Group. The study has been conducted to generate impact-based assessments of habitat and water quality for LANL waterways. The monitoring program was designed to allow for the detection of spatial and temporal trends in water and habitat quality through ongoing, biannual monitoring of habitat characteristics and benthic aquatic macroinvertebrate communities at six key sites in Los Alamos, Sandia, Water, Pajarito, and Starmer's Gulch Canyons. Data were collected on aquatic habitat characteristics, channel substrate, and macroinvertebrate communities during 2001 and 2002.

Aquatic habitat scores were stable between 2001 and 2002 at all locations except Starmer's Gulch and Pajarito Canyon, which had lower scores in 2002 due to low flow conditions. Channel substrate changes were most evident at the upper Los Alamos and Pajarito study reaches. The macroinvertebrate Stream Condition Index (SCI) indicated moderate to severe impairment at upper Los Alamos Canyon, slight to moderate impairment at upper Sandia Canyon, and little or no impairment at lower Sandia Canyon, Starmer's Gulch, and Pajarito Canyon. Habitat, substrate, and macroinvertebrate data from the site in upper Los Alamos Canyon indicated severe impacts from the Cerro Grande Fire of 2000. Impairment in the macroinvertebrate community at upper Sandia Canyon was probably due to effluent-dominated flow at that site. The minimal impairment SCI scores for the lower Sandia site indicated that water quality improved with distance downstream from the outfall at upper Sandia Canyon.

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1. INTRODUCTION

In 2001, the Water Quality and Hydrology Group (ENV-WQH) launched an aquatic biological monitoring program to generate impact-based assessments of habitat and water quality for Los Alamos National Laboratory (LANL) waterways. The monitoring program was designed to allow for the detection of spatial and temporal trends in water and habitat quality through ongoing, biannual monitoring of habitat characteristics and benthic aquatic macroinvertebrate communities at six key sites at the Laboratory. The Ecology Group (ENV-ECO) has supported this effort through assistance with fieldwork and data analysis.

Physical and chemical analyses of water quality are useful but limited because they only provide information about the water quality at the time of sampling, and past conditions are not detected (Cairns et al. 1973). Biological monitoring complements physical and chemical analyses by providing information about recurring short-term or stable long-term environmental conditions, even if those conditions are not present at the time of sampling (Gaufin 1973). Aquatic macroinvertebrates are one of the most commonly sampled assemblages for biological monitoring in rivers and streams because they are abundant, diverse, and differ widely among taxa in their sensitivity to environmental disturbances (Chessman 1995).

Because aquatic macroinvertebrate community composition responds predictably to changes in water chemistry and physical stream conditions, measures of community composition provide information about environmental conditions (Cummins 1974, Rosenberg and Resh 1993). Measures of community composition that are known to respond predictably and reliably to environmental impacts (termed *metrics*) provide an indirect means to evaluate how human activities and other ecosystem processes impact water and habitat quality. Habitat assessments and substrate characterization provide context for the interpretation of macroinvertebrate data in addition to providing a means to measure habitat quality and stability.

Information gained through the biological monitoring program will be used to make informed decisions on watershed management practices, evaluate the impacts of activities on LANL property, and monitor trends associated with recovery from the Cerro Grande Fire. Biological and habitat data from the monitoring program are being gathered solely for LANL use and not for the purpose of meeting any existing or future federal or state requirement. However, there are numerous potential uses for the monitoring program data in a regulatory context. The New Mexico Environment Department (NMED) collects biological data on a 5- to 7-year cycle and uses those data in determining whether New Mexico water quality standards are being met and whether designated uses are being supported (NMED 2003). Data from the LANL aquatic monitoring program will allow the Laboratory to quickly detect and address any habitat or water quality problems that might occur during interim years in the NMED monitoring schedule, thereby improving the likelihood of remaining in regulatory compliance. Moreover, long-term data generated from the monitoring program will provide a better understanding of site potential than can be determined from the NMED's periodic sampling, and could be used to support arguments for the designation of reasonable and appropriate attainment levels.

In this report, we present results of our site assessments and macroinvertebrate analysis from samples collected in 2001 and 2002. NMED and Ford-Schmid (1996) provided us with macroinvertebrate data from studies conducted in the 1990s on or near LANL to use for temporal comparisons for our sites. Four of the NMED sampling locations (upper Los Alamos Canyon, lower Sandia Canyon, Pajarito Canyon, and Starmer's Gulch) coincided with or were near enough to our sampling locations that we included them in this report to provide information about how macroinvertebrate communities have changed between the sampling periods. These data represent pre-fire conditions and are useful for evaluating how sites were impacted by the Cerro Grande Fire.

Our analysis of macroinvertebrate data differs from our previous report (Buckley et al. 2003) in that this report reflects recent advances in biocriteria development for New Mexico. Buckley et al. (2003) noted that statistical evaluation and calibration of macroinvertebrate metrics were needed to determine which of the numerous metrics that have been developed for other regions are valid for use in LANL's biogeographic setting. Without this validation of metrics, the utility of macroinvertebrate data is very limited. In addition, the lack of objective information about reference conditions and seasonal variations in the macroinvertebrate community limited our ability to interpret metric values. For this report, we have incorporated recommendations for metric selection and scoring made by Jacobi et al. (2004) under contract with the NMED. These recommendations are described further in the Methods section.

2. ENVIRONMENTAL SETTING

LANL and the associated residential areas of Los Alamos and White Rock are located in Los Alamos County, north-central New Mexico, approximately 60 miles (100 km) north-northeast of Albuquerque and 25 miles (40 km) northwest of Santa Fe (Figure 1).

The 25,600-acre (10,240-ha) LANL site is situated on the Pajarito Plateau. This plateau is a series of finger-like mesas separated by deep east-to-west-oriented canyons that are cut by intermittent streams. Mesa tops range in elevation from approximately 7,800 ft (2,400 m) on the eastern flanks of the Jemez Mountains to about 6,200 ft (1,900 m) at their eastern termination above the Rio Grande.

Most of the finger-like mesas in the Los Alamos area are formed from Bandelier Tuff, which is composed of ash fall, ash-fall pumice, and rhyolite tuff. The tuff, ranging from nonwelded to welded, is more than 1,000 ft (300 m) thick in the western part of the plateau and thins to about 260 ft (80 m) eastward above the Rio Grande. Major eruptions in the volcanic center of the Jemez Mountains deposited the tuff about 1.2 to 1.6 million years ago.

On the western part of the Pajarito Plateau, the Bandelier Tuff overlaps onto the Tschicoma Formation, which consists of older volcanic materials that form the Jemez Mountains. The conglomerate of the Puye Formation underlies the tuff in the central plateau and near the Rio Grande. Chino Mesa basalts inter-finger with the conglomerate along the river. These formations overlay the sediments of the Santa Fe Group, which extend across the Rio Grande Valley and are more than 3,300 ft (1,000 m) thick. LANL is bordered on the east by the Rio Grande and is within the Rio Grande rift. Because the rift is slowly widening, the area experiences frequent minor seismic disturbances.

Los Alamos has a temperate, semiarid mountain climate. However, elevation strongly influences the climate, and the topography causes large temperature and precipitation differences in the area. The average annual precipitation in Los Alamos is 18.73 inches (47.57 cm). The summer rainy season accounts for 48% of the annual precipitation. During the July–September period, thunderstorms form when moist air from the Gulf of Mexico and the Pacific Ocean moves up the sides of the Jemez Mountains. These thunderstorms can bring large downpours, but sometimes they only cause strong winds and lightning. Hail frequently occurs from these rainy-season thunderstorms.

Surface water in the Los Alamos area occurs primarily as short-lived or intermittent reaches of streams. Perennial springs on the flanks of the Jemez Mountains supply base flow into upper reaches of some canyons, but the volume is insufficient to maintain surface flows across the LANL site before evaporation, transpiration, and infiltration deplete the flow. Runoff from heavy thunderstorms or heavy snowmelt reaches the Rio Grande several times a year in some drainage areas. Effluents from sanitary sewage, industrial waste-treatment plants, and cooling-tower blow-down enter some canyons at rates sufficient to maintain surface flows for varying distances.

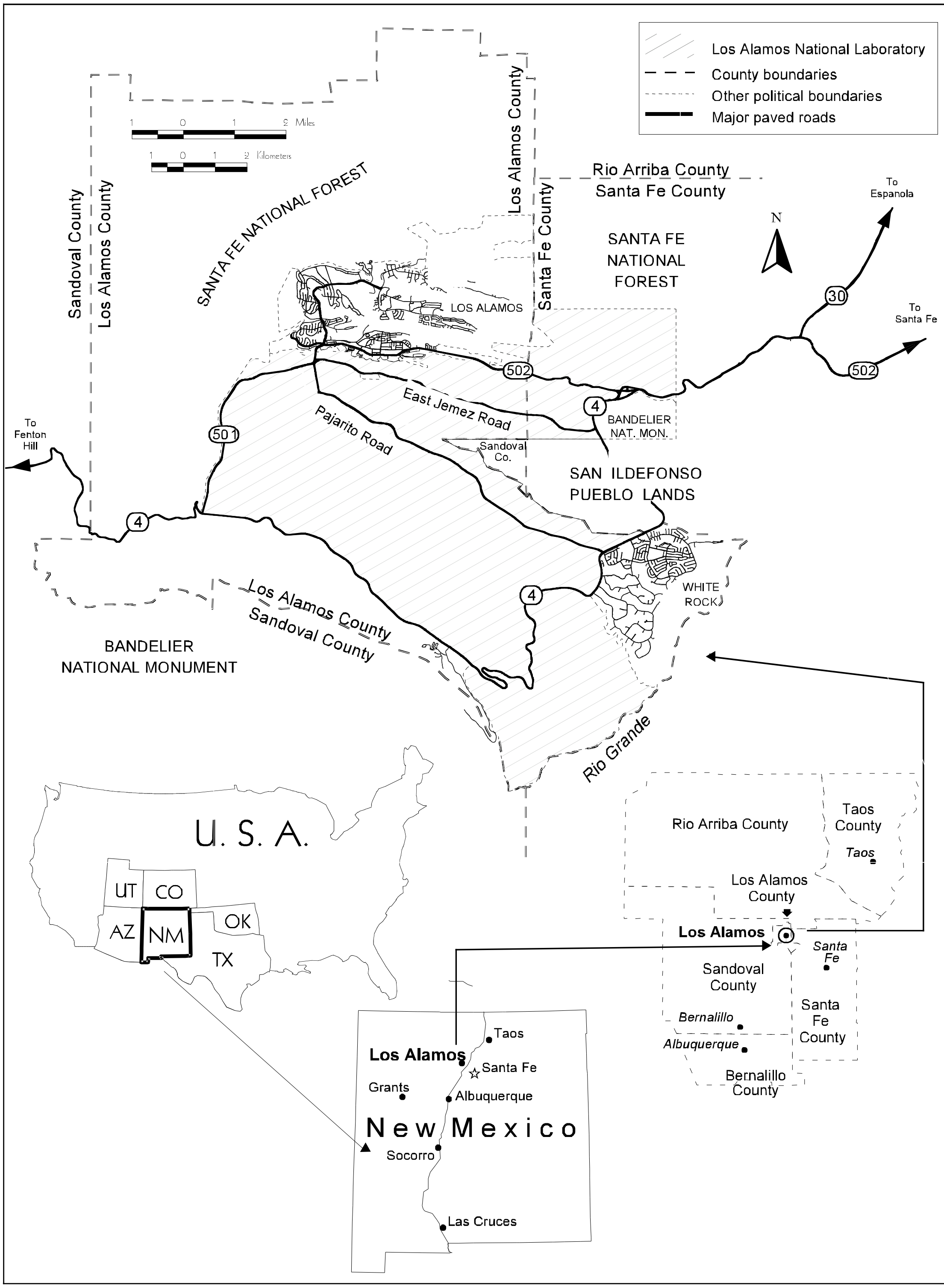


Figure 1. Location of Los Alamos National Laboratory.

In 2000, the Cerro Grande Fire burned more than 43,000 acres (17,400 ha) and significantly altered the soils, vegetation, and surface hydrology throughout the region (BAER 2000). The high heat of the fire altered surface soil structure and created a hydrophobic layer that resisted water infiltration. Loss of effective ground cover (vegetation and litter) increases soil erosion and runoff during storms. Increased runoff and associated gully and rill erosion created dramatic increases in flood discharge that caused geomorphic changes in stream channels such as widening, changes in substrate size, and increased sediment loads. Watersheds affected by the fire in our study area include Los Alamos Canyon (33% burned), Sandia Canyon (11% burned), Pajarito Canyon including Starmer's Gulch (62% burned), and Water Canyon (52% burned).

3. METHODS

LANL staff performed habitat assessments, benthic macroinvertebrate sampling, and pebble counts at five permanent sampling locations twice per year, usually in early summer and fall. The five permanent sampling locations are Los Alamos Canyon upstream of the reservoir; Sandia Canyon upstream and downstream of the wetlands; Starmer's Gulch just upstream of its confluence with Pajarito Canyon; and Pajarito Canyon approximately 1 mile (1.6 km) downstream of the confluence with Starmer's Gulch. In the past we have reported data from Water Canyon (Figure 2) approximately 3 miles (5 km) upstream of Highway 4. Flow at Water Canyon was intermittent and no macroinvertebrate samples were collected during 2002 so this site has been omitted from this report. Due to fire restrictions and other factors beyond the control of ENV-WQH, the spring sampling visits in 2001 were delayed until July**,** and Spring 2002 sampling was conducted only at the two Sandia Canyon locations.

LANL maintains a stream gaging network to monitor stream flow levels and to collect runoff samples for various regulatory and stewardship programs. Most gages at LANL are equipped with complete record collecting equipment that record discharge in 5-minute increments. Daily mean flow and annual mean discharge in cubic feet per second (cfs) are calculated for each station. Data from LANL gage stations located near our sampling sites were used to determine mean daily discharge in cfs.

3.1. Study Locations

3.1.1 Upper Los Alamos Canyon

The Los Alamos Canyon watershed drains 8,834 acres (3,575 ha), with its headwaters located in the Sierra de los Valles. The canyon drains into White Rock Canyon of the Rio Grande, near Otowi bridge. The upper Los Alamos Canyon sampling site is located at an elevation of 7,729 ft (2,356 m), approximately 750 ft (228 m) upstream of the Los Alamos Reservoir on U.S. Department of Agriculture (USDA) Forest Service land. The sample site was heavily impacted by the Cerro Grande Fire of 2000, when approximately 63% of the upper Los Alamos watershed was burned (BAER 2000). The site itself received a moderate-burn severity and is surrounded by steep slopes that received a high-burn severity. The south side of the site has one large gully flowing into it from a steep slope, which has contributed large amounts of fine and course sediment to the stream. The north bank is somewhat buffered by an abandoned road. The riparian vegetation of the site was greatly impacted by the fire. Most of the overstory trees were killed, and the riparian area is being re-colonized by aspen clones, grasses, and forbs.

3.1.2 Upper Sandia Canyon

The Sandia Canyon watershed drains 3,588 acres (1,452 ha) and is located entirely on LANL property near Technical Area (TA) 3 and Diamond Drive. The watershed for upper Sandia Canyon is essentially 100% developed, consisting of industrial buildings and parking lots. The upper Sandia sampling site is located at an elevation of 7,293 ft (2,223 m), approximately 2,500 ft (762 m) south of Diamond Drive. The site is in a tuff canyon with approximately 30 ft (9.1 m) of floodplain. A road crossing with fill-bridge and culvert is located approximately 80 ft (24 m) downstream of the sampling reach. This site was not burned in the Cerro Grande Fire. Riparian vegetation consists of mixed conifer overstory with shrubs such as cherry and rose, grass, and forbs. Benthic substrate consists of bedrock and gravels.

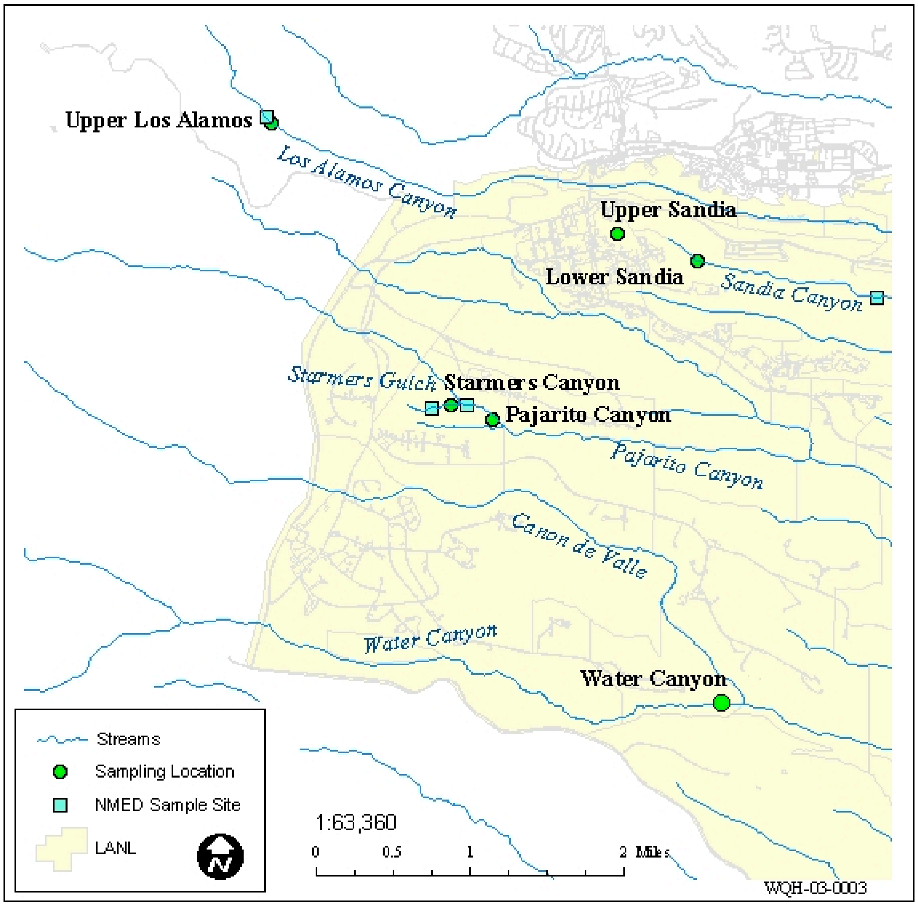


Figure 2. Location of sampling stations. With the exception of Water Canyon, geographic positioning system data were used to locate the sampling stations on the map. The location of the sampling station in Water Canyon was estimated.

3.1.3 Lower Sandia

The lower Sandia sampling site is located at an elevation of 7,178 ft (2,188 m), approximately 2,625 ft (800 m) downstream of the upper Sandia sampling site, and approximately 328 ft (100 m) downstream of the Sandia wetlands. This site has a very narrow riparian area due to large tuff boulders and bedrock outcrops that constrict the stream. Due to the confinement, the stream has a relatively high width-to-depth ratio. This section of watershed is influenced by the same urban watershed factors as the upper Sandia locations, with the addition of the Los Alamos County Landfill on the north bank, and a head cut in the Sandia Wetlands. This site was not directly affected by the Cerro Grande Fire. Riparian vegetation consists of ponderosa pine overstory, with willows, grass, and forbs. Benthic substrate consists of bedrock and fine particles.

3.1.4 Starmer's Gulch

Starmer's Gulch is a tributary to Pajarito Canyon. The watershed starts above LANL in the Sierra de los Valles and drains 1,616 acres (654 ha). The upper portion of the watershed is managed by the USDA Forest Service. The Cerro Grande Fire burned approximately 83% of the watershed (BAER 2000). The Starmer's Gulch sampling site is located at an elevation of 7,381 ft (2,250 m) in a V-shaped canyon, approximately 150 ft (45 m) upstream from the confluence of Starmer's Gulch and Pajarito Canyon. Vegetation consists of mixed conifer on the south bank and ponderosa pine on the north. This vegetation adjacent to the stream received a light burn from the Cerro Grande Fire. Substrate in the stream consists of bedrock and large angular pieces of tuff.

3.1.5 Pajarito Canyon

The Pajarito Canyon watershed starts in the Sierra de los Valles and drains 8,510 acres (3,444 ha). The upper portion of the watershed is managed by the USDA Forest Service. The Cerro Grande Fire burned 62% of the watershed (BAER 2000). The Pajarito Canyon sampling site is located at an elevation of 7,329 ft (2,234 m) in a bedrock canyon approximately 1,600 ft (487 m) downstream from the junction of Starmer's Gulch and Pajarito Canyon. Vegetation consists of mixed conifer on the south bank and ponderosa pine on the north. The vegetation adjacent to the stream received a moderate burn from the Cerro Grande Fire. Substrate in the stream consists of sands and gravels. Riparian vegetation consists of mostly weeds, with little to no grass or shrubs.

3.2 Habitat Assessments

LANL staff evaluated stream habitats in a 330-ft (100-m) reach using the U.S. Environmental Protection Agency (EPA) Rapid Bioassessment Protocol (RBP) Habitat Assessment field data sheet for high gradient streams (in Appendix A, pages 42–43). The EPA RBP Habitat Assessment field data sheet provides criteria for rating the following 10 habitat parameters: epifaunal substrate and cover, embeddedness, velocity/depth regime, sediment deposition, channel flow status, channel alteration, frequency of riffles, bank stability, vegetative bank protection, and riparian vegetation zone. A score of 0 to 20 is possible for each of the 10 parameters. The sum of the scores for the individual parameters provides a numerical basis for comparing the habitat conditions for LANL streams to each other. We also used a modified version of the Arizona Department of Environmental Quality's (ADEQ) site assessment protocol to provide complementary information about physical characteristics and habitat at the sites (Appendix A). Areas of overlap between the RBP and the ADEQ protocol allowed us to confirm or reconsider our ratings for certain parameters, while substantive differences between the protocols provided additional information about the sites. Scores from each site were used to make site-to-site comparisons within a single sampling period and will also be used to monitor for habitat changes at each site over time. These scores and their ratings for each parameter are also used to provide context for interpretation of the macroinvertebrate community data.

3.3 Pebble Counts

Pebble counts are useful for characterizing the composition of channel substrates and evaluating how the substrate composition changes over time (Bevenger and King 1995).

This information can be used to evaluate how prone the stream reach will be to erosion, whether it is being impacted by land use changes and human activities in the watershed, and the suitability of the substrate for supporting aquatic life.

ENV-WQH personnel trained in proper “zigzag” pebble count procedure conducted pebble counts at LANL. The zigzag method is a modification of the Wolman (1954) pebble count procedure. The procedure is conducted by traversing a stream in a zigzag manner from bankfull to bankfull, which is defined as the level of stream flow that fills the channel to a point where any additional water will overflow onto the stream’s floodplain (Rosgen 1996). At each pace the data collector picks up, without looking, the first piece of substrate that is touched at the tip of their boot. The piece of substrate is measured on its median axis and recorded on the field data sheet (Appendix A). This procedure is continued until 100 pebbles have been selected and measured over the sample reach of stream.

Statistical analysis of pebble count data was conducted using the size-class pebble count analysis tool (v1) developed by John Potyondy and Kristin Bunte of the Stream Systems Technology Center, Rocky Mountain Research Station, USDA Forest Service. The size-class pebble count analysis tool performs statistical analysis using contingency tables and the Pearson chi-squared statistic. Pebble count data were analyzed to determine if there were significant differences between data collected in 2001 and 2002. For each of the five sampling locations, the Summer and Fall 2002 data were compared to the Summer and Fall 2001 data sets (our reference data sets) to evaluate if p values for percent fines (<2 mm) were significantly different using a Type 1 error of alpha = 0.05. D50 (50^{th} cumulative percentile for particle size) values were analyzed to determine if there were changes in the median particle size of each reach.

3.4 Benthic Macroinvertebrates

Benthic macroinvertebrates were collected with a Hess sampler (0.086 m^2) with a 500-µm mesh (Figure 3). The Hess sample was collected only if the water velocity and depth (approximately 6 cm) were sufficient to allow the sample to flow through the net[1]. Samples were collected by pushing the sampler firmly into the streambed with the net trailing downstream and disturbing the substrate within the perimeter of the sampler to dislodge the macroinvertebrates and allow the stream current to carry the specimens into the collection net. Large pieces of substrate (>5 cm) were brushed gently with a nylon brush and visually inspected to ensure that all of the macroinvertebrates had been dislodged. The samples were then transferred to a bucket with water and fine substrates were manually disturbed to suspend the macroinvertebrates. The samples were then strained in a #35 sieve, transferred into a plastic sample jar, and preserved in 95% ethanol. Three replicates were collected at each sampling station for a total area of 2.7 ft^2 (0.258 m^2) sampled. Samples from 2001 and 2002 were submitted to a qualified taxonomist (Gerald Z. Jacobi, Ph.D.) and identified to the lowest practicable taxonomic level. The samples were sorted completely.

[1] Fall 2002 flow at Pajarito Canyon and Starmer’s Gulch was insufficient to collect macroinvertebrates with the Hess sampler.

Figure 3. Starmer's Gulch, October 2002, showing Hess sampler used by LANL for collecting benthic macroinvertebrate samples. Note water depth was insufficient for sampling.

LANL staff entered macroinvertebrate sample data into the Ecological Data Application System (Tetra Tech 2003) aquatics database for analysis. In addition to the data from the 2001 and 2002 sampling periods, we also used data collected by the NMED from Pajarito Canyon and Starmer's Gulch in 1994 (Ford-Schmid 1996), from upper Los Alamos Canyon in 1997, and from lower Sandia Canyon in 1996 (NMED, unpublished data). This sample data is presented in Appendix B. We selected these data sets because sampling locations (see Figure 2) and methods were comparable. The NMED collects three replicates using a modified Hess sampler (Jacobi 1978, cited in Ford-Schmid 1996) with a 500-µm mesh. The modified Hess samples an area of 0.63 ft^2 (0.059 m^2), slightly less area than a Hess sampler (for a three-replicate sample, the difference in the area sampled is 82 cm^2). The sampling technique is the same for the two samplers. The NMED macroinvertebrate samples were also identified by Dr. Jacobi, using the same level of taxonomic resolution.

The calculation of benthic macroinvertebrate metrics requires information about specific taxa attributes that provide the inputs for each metric. We referred to Merritt and Cummins (1996) to populate the database with functional and life cycle characteristics such as feeding groups, habit, and habitat for the taxa that were represented in samples collected at LANL in 2001 and 2002 and by the NMED in 1996 and 1997. We also entered pollution tolerance values for each taxon. When available, we used tolerance values developed by Wisseman for western streams (Wisseman 1996; see for tolerance values). For taxa not included in the Wisseman (1996) list, we consulted Barbour et al. (1999), which includes tolerance values for five regions of the U.S. There are no tolerance values for the Southwest listed in Barbour et al. (1999), and moreover, many taxa included in Barbour et al. (1999) do not have tolerance values listed for all regions. We used the following order of preference for selecting tolerance values for our taxa: Northwest, Upper Midwest, Midwest, Southeast, and Mid-Atlantic. The source for each tolerance value was noted in the database, and tolerance values will be updated as they become available for this region. Taxa attributes and tolerance values are presented in Appendix C.

Metric selection was based on Jacobi et al. (2004), which analyzed a large historical aquatic macroinvertebrate data set to arrive at a preliminary set of statistically validated metrics for New Mexico. Jacobi et al. (2004) and Jacobi (personal communication) recommend three different multi-metric Stream Condition Indices (SCIs) depending on watershed size and elevation (high elevation-small catchment, low elevation-large catchment, low elevation-small catchment). With the exception of the site in upper Los Alamos Canyon, LANL sampling locations are classified per Jacobi et al. (2004) as low elevation-small catchment sites. Upper Los Alamos is classified as a high elevation-small catchment site (Appendix D). The low elevation-small catchment SCI is further subdivided by sample season (Table 1), so that one of the metrics is omitted from summer samples.

To arrive at an overall multi-metric score for a site, individual metric scores within each set of metrics were standardized to a 0 to 100 point scale, and the average metric score was then calculated. These overall scores were then calibrated based on season and assigned a condition rating (comparable to reference, slightly impaired, moderately impaired, or severely impaired). Seasonal thresholds used for assigning condition ratings are presented in Table 2.

Table 1. Metrics used for evaluation of LANL sites and their hypothesized response to increases in environmental perturbation.

Metric	Definition	Hypothesized response to environmental perturbation	Recommended metrics by season	
			Low elevation-small catchment samples	High elevation-small catchment samples
Richness				
Total # taxa	Measures overall variety of the macroinvertebrate assemblage	decrease		all seasons
# Ephemeroptera taxa	Number of taxa in the insect order Ephemeroptera (mayflies)	decrease		all seasons
# Diptera taxa	Number of taxa in the insect order Diptera (true flies)	decrease		all seasons
# Plecoptera taxa	Number of taxa in the insect order Plecoptera (stoneflies)	decrease		all seasons
Composition				
Shannon Diversity Index	Incorporates richness and evenness in a measure of general diversity and composition	decrease		all seasons
Pielou's Evenness Index	Measures distribution of individuals among taxa	decrease		all seasons
% Plecoptera	Percent of individuals in the insect order Plecoptera (stoneflies)	decrease		all seasons
Tolerance				
Hydrophsychidae to EPT %	Percent pollution-tolerant caddisflies of all Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies)	increase	all seasons	
# intolerant taxa	Taxa richness of those organisms considered to be sensitive to perturbation (tolerance values 0 to 3)	decrease	all seasons	all seasons
Feeding				
% scraper individuals	Percent of the macroinvertebrates that scrape upon periphyton	decrease	all seasons	
% shredder individuals	Percent of individuals from the shredder functional feeding group	decrease	all seasons	all seasons
# shredder taxa	Number of taxa from the shredder functional feeding group	decrease		all seasons
Habit				
% sprawler individuals	Percent of individuals having fixed retreats or adaptations for attachment to surfaces in flowing water		spring, fall	all seasons
# sprawler taxa	Number of taxa having fixed retreats or adaptations for attachment to surfaces in flowing water	decrease		all seasons
# swimmer taxa	Number of taxa adapted for "fishlike" swimming in lotic or lentic habitats	decrease		all seasons

Table 2. Seasonal thresholds for SCIs. Sites that score at or above the 25th percentile for reference sites are assigned a rating of "comparable to reference." Sites that score lower than the 25th percentile for reference sites are assigned a rating indicating varying degrees of impairment.

		Low Elevation-Small Catchment Index Ranges			High Elevation-Small Catchment Index Ranges		
Rating	**Reference Condition Index Percentile**	**Spring**	**Summer**	**Fall**	**Spring**	**Summer**	**Fall**
Comparable to Reference	≥25	≥33.00	≥42.81	≥33.00	≥53.44	≥53.44	≥56.52
Slightly Impaired	16–24	26.19–32.99	31.34–42.80	26.19–32.99	47.63–53.43	47.63–53.43	50.34–56.51
Moderately Impaired	6–15	18.61–26.18	18.59–31.33	18.61–26.18	41.18–47.62	41.18–47.62	43.47–50.33
Severely Impaired	≤6	<18.61	<18.59	<18.61	<41.18	<41.18	<43.47

4. RESULTS

4.1 Stream Flow

4.1.1 Upper Los Alamos Canyon

LANL does not have a gage station located near the upper Los Alamos sampling location, but flow was visually estimated at less than 1 cfs during stream monitoring. Stream flow at this location is considered perennial (stream flow every day of the year). The nearest LANL gage station (E026) is located in Los Alamos Canyon approximately 3 miles (4.8 km) below the reservoir and near the skate rink. Stream flow is influenced by releases from the reservoir and is not a good indication of flow at our monitoring location.

4.1.2 Upper Sandia Canyon

Stream flow at the upper Sandia Canyon sampling location is considered to be perennial (stream flow every day of the year) and is made up almost entirely of treated wastewater from three sources. Discharge from the TA-3 power plant makes up the majority of the flow, with the remainder coming from two cooling towers also located in TA-3. Outflow from the three sources was visually estimated at 0.5 cfs, which closely matched flow recorded at station E123 downstream. LANL gage station E121 is located upstream of the monitoring location, however, the gage station is relatively new and mean flow was not available at the time of sampling.

4.1.3 Lower Sandia Canyon

Stream flow at the lower Sandia Canyon sampling location is considered to be perennial. Stream flow at this location consists of effluent. LANL gage station E123 is located upstream of the monitoring location. Mean annual discharge at gage E123 was 0.49 cfs during the 2002 water year (Oct. 01 to Sept. 02) (Shaull et al. 2002).

4.1.4 Starmer's Gulch

Stream flow at the Starmer's Gulch site is considered to be perennial, and is the result of spring flow approximately 0.25 mi (0.4 km) upstream of the confluence with Pajarito Canyon. LANL gage station E242 is located downstream of the monitoring location. Mean annual discharge at gage E242 was 0.02 cfs during the 2002 water year (Oct. 01 to Sept. 02) (Shaull et al. 2002). The daily mean discharge was 0.01 or less for 115 days during the 2002 water year.

4.1.5 Pajarito Canyon

Stream flow at the Pajarito Canyon monitoring site is intermittent (flow absent on some days of the year). LANL gage station E241 is located upstream of the Pajarito Canyon monitoring site, the station was installed in 2001. Mean annual discharge at gage E242 was 0.25 cfs during the 2002 water year (Oct. 01 to Sept. 02) (Shaull et al. 2002). Station E242 had a daily mean discharge of zero (0 cfs) for 125 days during the 2002 water year.

4.2 Habitat Assessment

Habitat assessment scores for all sites are summarized in Table 3, with descriptions of habitat characteristics below. The summer of 2002 was very dry with high fire danger. Because of these conditions and personnel changes, Summer 2002 data were only collected at the two Sandia Canyon locations. Habitat assessment data were collected at all locations during Fall 2002.

Table 3. Habitat assessment scores for biological monitoring locations at LANL.

Date	Upper Los Alamos Canyon	Upper Sandia Canyon	Lower Sandia Canyon	Starmer's Gulch	Pajarito Canyon
Summer 2001	53/200	166/200	155/200	164/200	155/200
Fall 2001	53/200	166/200	155/200	164/200	155/200
Spring 2002	No Data	166/200	155/200	No Data	No Data
Fall 2002	53/200	166/200	169/200	147/200	114/200

4.2.1 Upper Los Alamos Canyon

The habitat rating at the Los Alamos Canyon site was low for the fall sampling periods. The habitat rating did not change from 2001 to 2002. Los Alamos Canyon had the lowest habitat scores of all the sampling locations. With the exception of high scores for parameters evaluating the extent of channel alteration and human impacts in the riparian zone, and a marginal score for channel flow status, the site scored poorly on all other habitat parameters such as cover, emdeddedness, velocity/depth regime, and sediment deposition.

4.2.2 Upper Sandia Canyon

The habitat rating for this reach did not change from 2001. The overall site rating from the habitat assessment was higher for all sampling periods at the upper Sandia Canyon location than the other five locations. The site scored high in all habitat parameters.

4.2.3 Lower Sandia Canyon

The overall site rating for lower Sandia Canyon remained high. The habitat score remained the same between 2001 and Summer 2002, but increased in Fall 2002. Similar to the site at upper Sandia, this site scored lowest for parameters related to instream habitats and highest for parameters related to streambank stability and channel morphology. Habitat parameters for epifaunal cover, channel flow, and bank stability increased from Summer to Fall 2002 and led to the increased habitat rating.

4.2.4 Starmer's Gulch

The habitat rating score decreased from Summer and Fall 2001 to Fall 2002 at Starmer's Gulch. The Starmer's Gulch site scored lower than the Sandia sites, but higher than the Los Alamos Canyon and Pajarito Canyon sites. The site scored poorly on the parameters rating cover, velocity/depth regime, sediment deposition, and channel flow status. Bank stability and riparian vegetation scored high. In Fall 2002, low flow contributed to the lower habitat rating score.

4.2.5 Pajarito Canyon

The habitat rating scores decreased from Fall 2001 to Fall 2002. The site ranked lower than Sandia Canyon and Starmer's Gulch, but higher than Los Alamos Canyon. The habitat score for this site was lowered due to very low flow conditions. The site scored lowest for parameters related to instream measurements such as instream habitat, velocity/depth regime, sediment deposition, and channel flow status. Parameters ranking high were related to stream bank stability and riparian vegetation.

4.3 Pebble Counts

4.3.1 Upper Los Alamos Canyon

Pebble counts were conducted at upper Los Alamos Canyon in July 2001, October 2001, and September 2002. The distribution of size class percentages was similar between July 2001 and September 2002, with a shift from gravel-dominated size classes to a mix of cobble and gravel in October 2001 (Figure 4). Percent fines (<2 mm) decreased significantly between Fall 2001 and Fall 2002 (22% to 7%, $p < 0.005$). The D50 increased from medium gravel in Summer 2001 (14 mm) to coarse gravel in Fall 2001 (26 mm) and then decreased to medium gravel in Fall 2002 (14 mm).

4.3.2 Upper Sandia Canyon

Pebble counts were conducted during July and October of 2001 and May and October of 2002. Substrate at the upper Sandia site is dominated by gravel and sand size classes (Figure 5). There were no significant differences in percent fines between Summer 2001 and Summer 2002 ($p = 0.14$). Fall 2002 data are suspect due to observed data collection errors and were not statistically compared to Fall 2001, but are included in Figure 5 for visual comparison. The D50 remained in the coarse gravel size class in all sampling periods except Fall 2002, which had a D50 in the medium gravel size class.

4.3.3 Lower Sandia Canyon

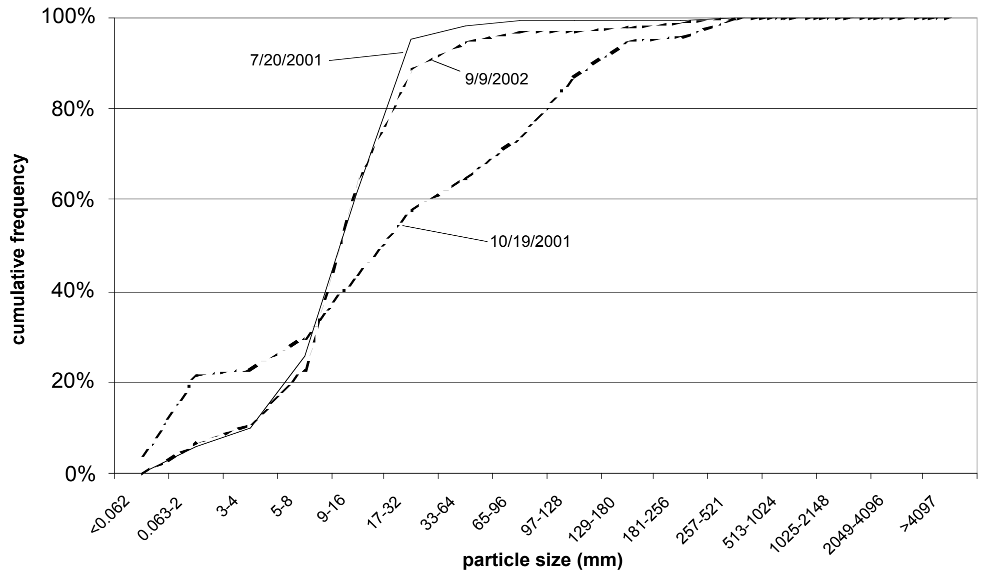
Pebble counts were conducted during July and October of 2001 and May and October of 2002. Substrate at the lower Sandia Canyon site is dominated by bedrock and fines (Figure 6). The distribution of size class percentages was similar over the sampling dates. There were no significant differences in percent fines between Summer 2001 and Summer 2002 ($p = 0.16$) or Fall 2001 and Fall 2002 ($p = 0.32$). The D50 remained in the coarse gravel size class during Summer 2001 (28 mm) and 2002 (23 mm) and Fall 2001 (30 mm), but increased to very coarse gravel in Fall 2002 (46 mm).

4.3.4 Starmer’s Gulch

Pebble counts were conducted during July and November of 2001and in October of 2002. Substrate at this site tends to be distributed across size classes but is slightly dominated by silt (Figure 7). There were no significant differences in percent fines (<2 mm) between Fall 2001 and Fall 2002 ($p = 0.16$). The D50 became larger in size, from coarse gravel in Summer 2001 (24 mm) to small cobble in Fall 2002 (63 mm). Fall 2002 D50 (80 mm) remained in the small cobble particle size class.

4.3.5 Pajarito Canyon

Pebble counts were conducted during July and November of 2001 and October 2002. Percent fines (<2 mm) increased significantly from 24% in October 2001 to 59% in September 2002 ($p < 0.0001$) (Figure 8). The D50 remained in the coarse gravel size class during Summer 2001 (27 mm) and Fall 2002 (23 mm), but decreased significantly ($p < 0.0001$) to the sand size class in Fall 2002.



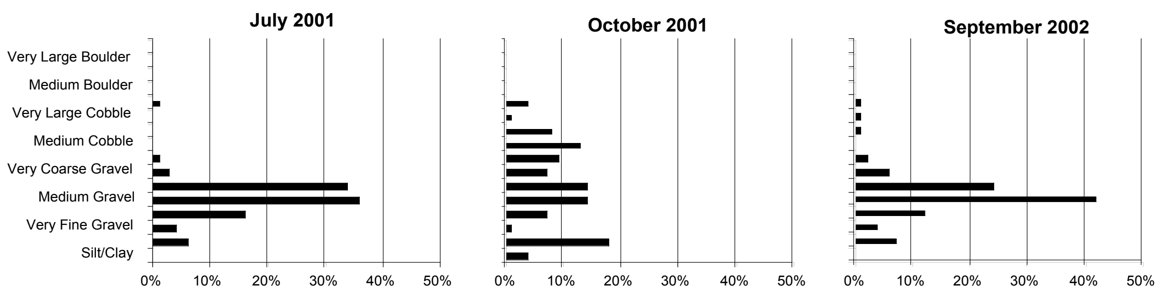


Figure 4. Cumulative percent and size distributions for benthic substrate at upper Los Alamos Canyon.

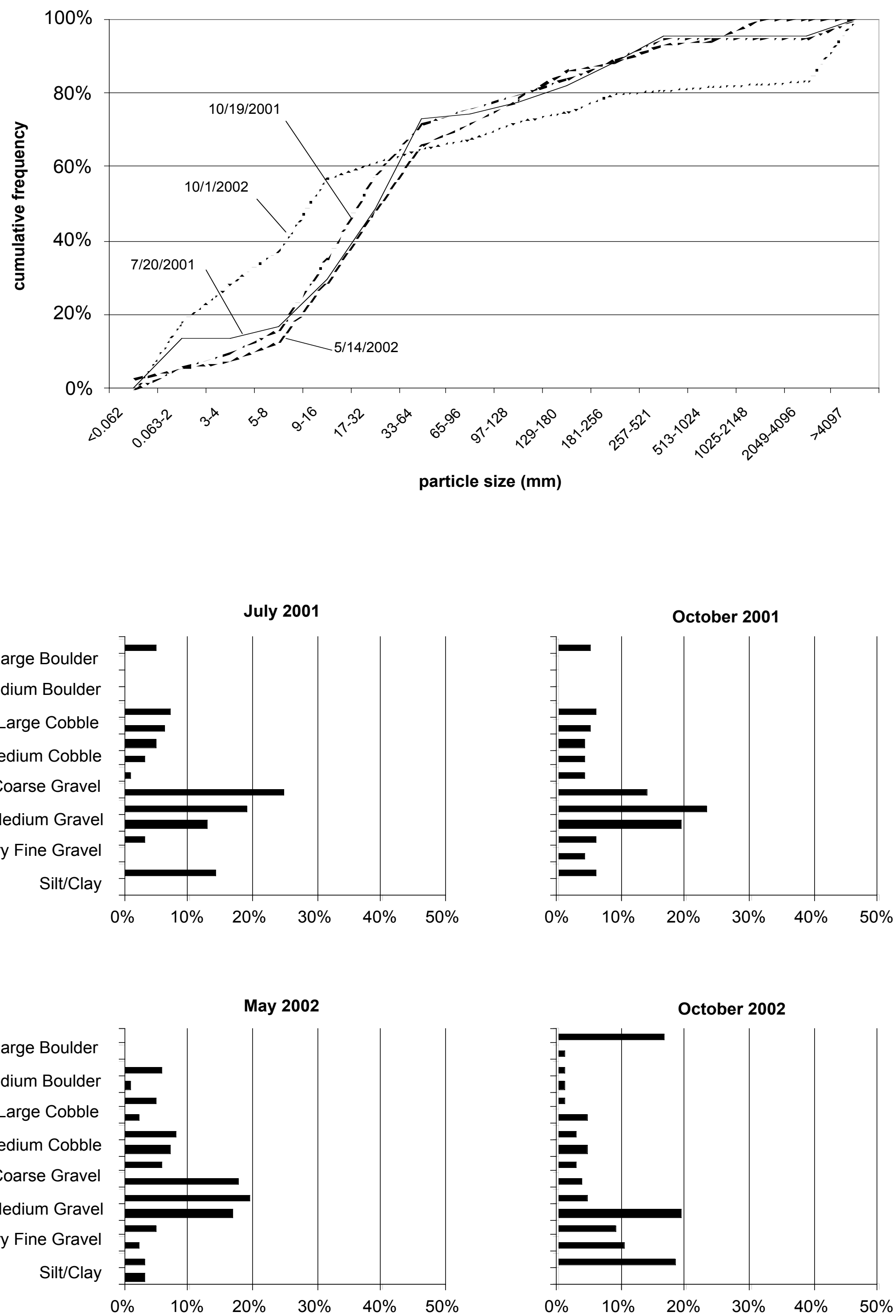


Figure 5. Cumulative percent and size distributions for benthic substrate at upper Sandia Canyon.

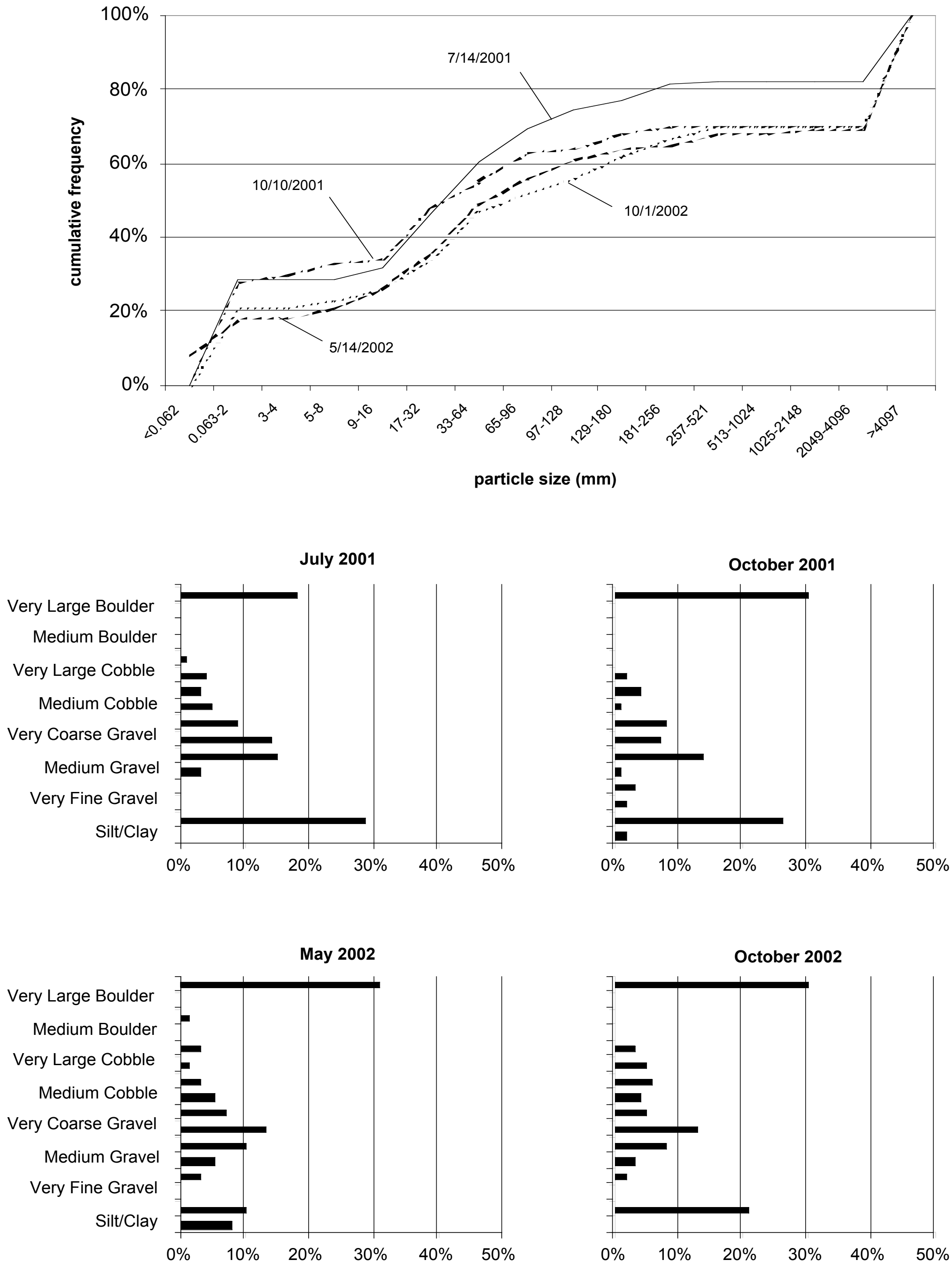
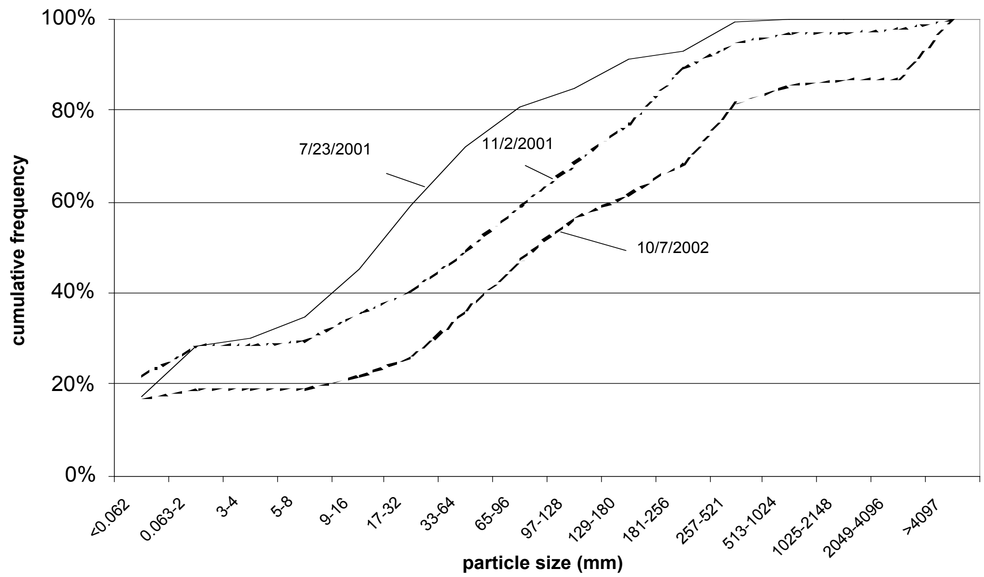


Figure 6. Cumulative percent pebble count data for lower Sandia Canyon.



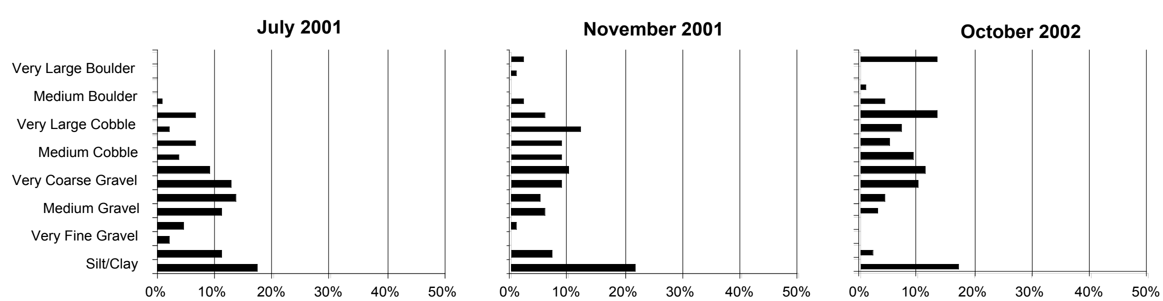


Figure 7. Cumulative percent pebble count data for Starmer's Gulch.

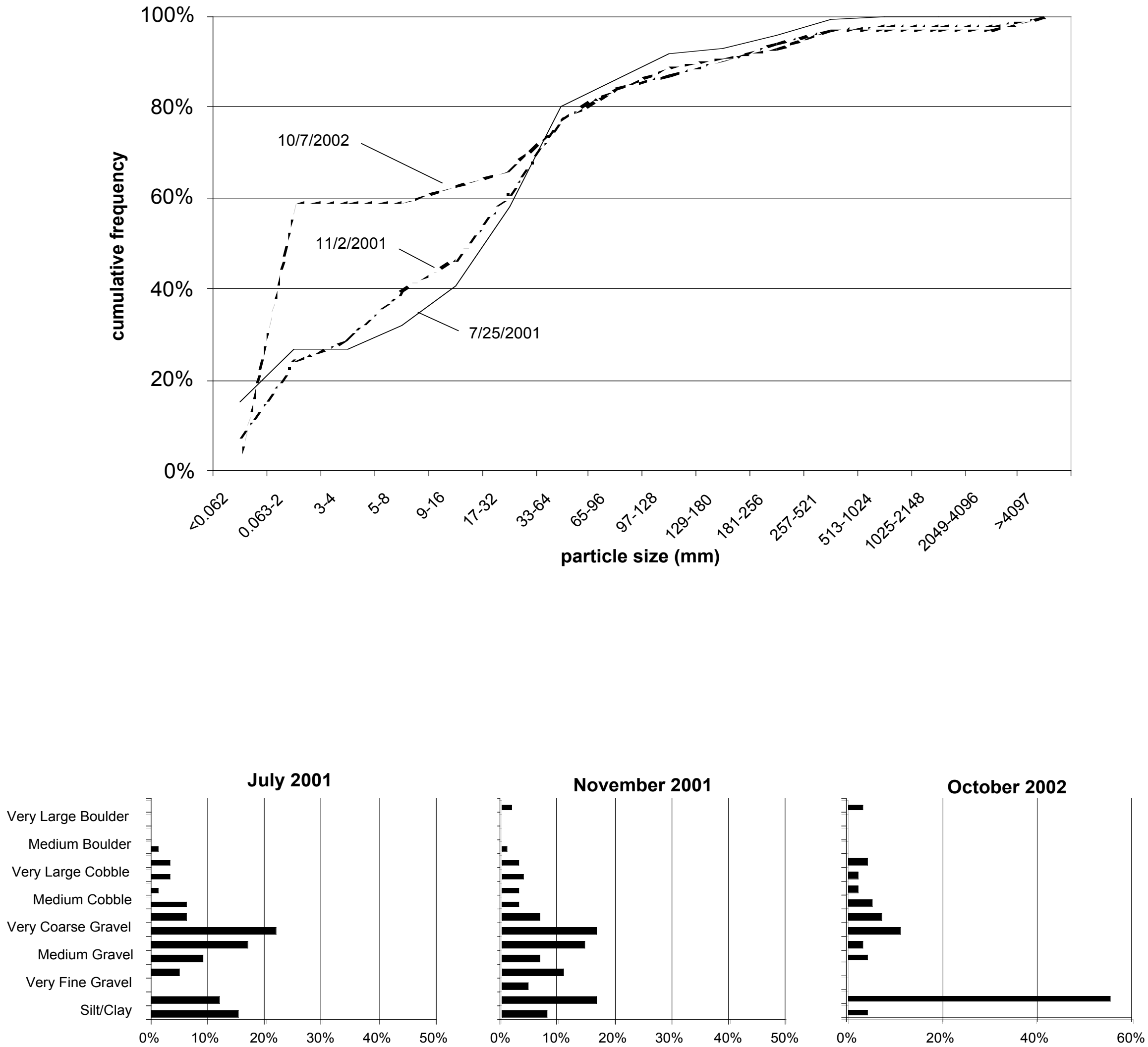


Figure 8. Cumulative percent pebble count data for Pajarito Canyon.

4.4 Macroinvertebrates

SCI scores and ratings are presented in Table 4 and described below.

4.4.1 Upper Los Alamos Canyon

Upper Los Alamos Canyon was evaluated using the index recommended in Jacobi et al. (2004) for high elevation-small catchment sites. This SCI indicates that significant site degradation occurred between 1997 and 2001. Samples from 2001 and 2002 were rated as moderately to severely impaired compared to "comparable to reference" for the sample collected in 1997.

4.4.2 Upper Sandia Canyon

Upper Sandia Canyon was evaluated using the index recommended for low elevation-small catchment sites. This site was rated as "slightly impaired" for 2001 samples (although the sample size for July 2001 was small), "moderately impaired" in the spring of 2002, and improving to "comparable to reference" in the fall of 2002.

4.4.3 Lower Sandia Canyon

Lower Sandia Canyon was evaluated using the index recommended for low elevation-small catchment sites. This site was rated as "comparable to reference" for all sample periods with the exception of the July 2001 sample, which was rated as "slightly impaired."

4.4.4 Starmer's Gulch

Starmer's Gulch was evaluated using the index recommended for low elevation-small catchment sites and was rated as "comparable to reference" for the three sample periods.

4.4.5 Pajarito Canyon

Pajarito Canyon was evaluated using the index recommended for low elevation-small catchment sites. This site was rated as "comparable to reference" for the three sample periods.

Table 4. Overall scores and ratings for macroinvertebrate communities based on NMED-recommended SCIs.

Site	Stream Condition Index	Score	Rating
Upper Los Alamos	High elevation-small catchment		
February 1997		4	Comparable to reference
July 2001		--	Severely impaired*
October 2001		2	Moderately impaired
Spring 2002		Not sampled due to fire restrictions	
September 2002		1	Severely impaired
Upper Sandia	Low elevation-small catchment		
July 2001		3	Slightly impaired**
October 2001		3	Slightly impaired
May 2002		2	Moderately impaired
October 2002		4	Comparable to reference
Lower Sandia	Low elevation-small catchment		
March 1996		4	Comparable to reference
July 2001		3	Slightly impaired
October 2001		4	Comparable to reference
May 2002		4	Comparable to reference
October 2002		4	Comparable to reference
Starmer's Gulch	Low elevation-small catchment		
July 1994		4	Comparable to reference
July 2001		4	Comparable to reference
November 2001		4	Comparable to reference
Spring 2002		Not sampled due to fire restrictions	
Fall 2002		Stream flow inadequate for sampling	
Pajarito	Low elevation-small catchment		
July 1994		4	Comparable to reference
July 2001		4	Comparable to reference
November 2001		4	Comparable to reference
Spring 2002		Not sampled due to fire restrictions	
Fall 2002		Stream flow inadequate for sampling	

* rating assigned based on extirpation of benthic macroinvertebrates from site
**small sample size (n = 60)

5. DISCUSSION

The SCI ratings were consistent with the habitat scores, pebble count data, and our knowledge of particular site stressors, indicating that the SCI functioned well to evaluate site quality. Site-specific observations are discussed below.

5.1 Upper Los Alamos Canyon

Pre- and post-fire habitat assessments (although estimated for pre-fire conditions) and the SCI scores for upper Los Alamos Canyon indicate that the Cerro Grande Fire had a severe impact on this site in 2001 and 2002. Pebble count data were variable over the 2001–2002 sampling period, indicating instability in the stream substrate. During site visits, many rills and gullies were noted flowing from side slopes into the main channel. These features have the potential to introduce large amounts of sediment to the stream, potentially causing debris jams that could change the reach from a high gradient (2+%) channel with degradation characteristics to a low gradient (1%) reach with aggradation characteristics. Fine sediment (<2 mm) also decreases the habitat available to aquatic macroinvertebrates (Furniss et al. 1991).

Precipitation events that produced small runoff events pre-fire can produce large channel-altering runoff events post-fire due to loss of ground cover and chemical and/or physical changes in the soil properties (Moody and Martin 2001). Dramatic increase in post-fire runoff in the Los Alamos watershed may be directly tied to changes in the D50 over our sampling period. On July 13, 2001, 1.17 inches of rain fell on Los Alamos watershed (Remote Automated Weather Station [RAWS] network data) seven days before our sampling period. The D50 during our July 2001 sampling period fell into the medium gravel size class (14 mm). On August 9, 2001, 1.24 inches of rain fell on the Los Alamos watershed (RAWS network data). Fall 2001 has a D50 in the coarse gravel size class (26 mm). The only significant runoff event of 2002 in the Los Alamos watershed occurred on July 18, 2002, when 1.15 inches of rain fell (RAWS network data). There were no other significant flows between this event and our September 9 sampling period. The D50 calculated from our September 2002 data fell into the medium gravel size class (14 mm).

The absence of macroinvertebrates from the Summer 2001 sample is probably related to poor habitat (almost exclusively gravel) resulting from the Cerro Grande Fire. However, low abundance might also be attributed to seasonal effects such as low flow, warmer water conditions, emergence, and scouring from rain (Jacobi 9/5/2003, personal communication). A combination of seasonal and fire effects could also explain low abundance. The improvement in the SCI score during the fall of 2001 could be due to an improvement in habitat indicated by the increase in cobble size classes for that sampling period. The subsequent decline in the SCI during Fall 2002 corresponds with a return to gravel-dominated substrates.

5.2 Upper Sandia Canyon

The upper Sandia Canyon habitat assessments indicated that this site had the highest habitat quality of our sample locations over the four sampling periods, and the habitat has remained stable. The constant, regulated flow and lack of fire impacts helped retain the high habitat assessment score when compared to the other locations. Pebble count data also indicate that the substrate at this site was stable. There were no significant differences in the percent fines between the Spring 2001 and 2002 and Fall 2001 and 2002 sampling periods. The D50 has remained in the coarse gravel size class for all sampling periods. Threats to the site include a new construction project on the bench above the south bank and the Los Alamos County Landfill on the north bank. In addition, if the flow is diverted or otherwise shut off, the site will substantially change.

The combination of having the highest habitat scores among our sites with SCI rankings indicating slight to moderate impairment suggests that in spite of having regular flow, poor water quality related to the effluent-dominated flow at this site might be negatively impacting the biota at the upper Sandia site. It must be noted that without the effluent flow, there would not be perennial flow at this site and the biota at this site would be absent or respond only to ephemeral flow events. Low abundance during the summer of 2001 could have been related to season.

5.3 Lower Sandia Canyon

The increase in median substrate size over the four sampling periods could be related to recovery from initial fire impacts, although this increase is not statistically significant. The high SCI ratings for this site in spite of substrates dominated by fines and bedrock are probably due to the availability of coarse gravel and cobble substrates. Furthermore, water quality is likely to have improved with distance from the effluent outfall located at the head of the canyon just upstream of the upper Sandia site. The Sandia wetland, which is located between the upper and lower Sandia sites, is likely to be a major contributor to improvements in water quality for downstream areas.

5.4 Starmer's Gulch

The increase in substrate particle size at Starmer's Gulch from 2001 to 2002 could be related to fire impact recovery. The low flow conditions that led to a lower habitat assessment score in 2002 and precluded macroinvertebrate sampling probably also limited aquatic life at that site. The high SCI ratings for 2001 suggest that fire impacts on stream biota were minimal.

5.5 Pajarito Canyon

The significant decrease in median particle size between 2001 and 2002 and increase in fines at the Pajarito site are related to sediment deposition, possibly due to fire impacts. The high SCI scores in 2001 were consistent with the habitat assessments and pebble count data, but this site appears to have destabilized between 2001 and 2002. Low flow conditions in 2002 likely limited aquatic life at that site.

6. CONCLUSION

The availability of the NMED's validated set of metrics for evaluating biological condition of LANL streams represents a significant advance in our understanding of Laboratory impacts on stream health. Sampling sites that experienced severe burining in the Cerro Grande Fire (Los Alamos and Pajarito Canyons) continued to show evidence of significant impact, while sites in areas that were less heavily burned showed early signs of recovery (lower Sandia and Starmer's Gulch). The aquatic macroinvertebrate community in upper Sandia Canyon appears to be limited by poor water quality.

For management purposes, it would be useful to have the ability to distinguish macroinvertebrate community response to physical habitat conditions from the community's response to water quality conditions. Based on our field observations, we believe that poor in-stream habitats and drought conditions limit the development of healthy macroinvertebrate communities. To attempt to tease out habitat versus water quality impact on aquatic communities, we are currently conducting a pilot study using artificial samplers side-by-side with the Hess sampler. Results from this study will be presented in subsequent reports.

7. ACKNOWLEDGMENTS

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APPENDIX A. SAMPLE FIELD DATA FORM

LANL Bioassessment Field Data Sheet

SAMPLE LOCATION

Date:(dy/mo/yr): ____________________ Sample Time: ____________________

Stream Name: ____________________ Site Name: ____________________

Site Description ____

Field Crew: ____________________ Program: ____________________

SITE INFORMATION

USGS 7.5' Quadrangle: ____________________ Ownership: ____________________

Watershed Name: ____________________ Elev.(ft): __________

HUC - Reach: ____________________ County: __________ State: ______ Aspect: __________

Site Id Latitude (DMS): __________ Site Id Longitude (DMS): __________ Method: __________

Watershed Area (mi^2): ____________________

Most Recent Flood Event (Date; Discharge): ____________________

Designated Uses: ____________________

POST SAMPLING RECOMMENDATIONS

(Notes about flow regime, relocating site, site access, sample types, analysis parameters, etc.)

____

____

____

____

____

____

____

____

____

____

____

____

Adapted from Arizona Department of Environmental Quality, Version 1, July 2, 2001

Page 1

FIELD OBSERVATIONS

Precipitation (Circle one) None Light Moderate Heavy

Previous precipitation (24hr) (Circle one): None Light Moderate Heavy

Cloud cover (%)

FIELD MEASUREMENTS

Air T (°C): ________________ Turbidity (NTU): ______________

Water T (°C): _____ D.O. (mg/l): _____ D.O. % Sat.: Conductivity (µmos/cm): _____ TDS (mg/l): _____ pH:

Samples Collected **Sample Time:** _____________ **QC Sample (Y / N):**______________

Water Collection Method:	**Parameter Sets:**	**Biological Samples:**	
___ Composite	___ Inorganics	**Macroinvertebrates:**	**Macroinvertebrates:**
___ Grab	___ Nutrients	___ Riffle (field split _____)	___ Edge (field split_____)
	___Total Metals	___ Pool (field split _____)	___ Other (field split_____)
	___ Dissolved Metals	**Algae:**	**Algae:**
	___ Bacteria	___ Diatoms, Riffle	___ Filamentous, Riffle
	___ Radiochemicals	___ Diatoms, Pool	___ Filamentous, Pool
	___ Parasites/Viruses	___ Diatoms, Artificial Substrate	___ Filamentous, composite
	___ Other __________		

ADDITIONAL SAMPLE NOTES

DISCHARGE: Marsh-McBirney USGS Staff Height:____________________

	Distance, ft	Width, ft.	Depth, ft.	Area, ft.^{2}	Velocity, ft/s	Discharge, cfs
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
	TOTAL =		AVG =	TOTAL =	AVG =	TOTAL =

FLOAT METHOD

Float distance should be 2-3 times wetted width of stream.

Float Distance, ft.:	Float Time (seconds)										Average Time

Float Distance (ft.): ________________/Avg. Time(s): ______________=________________ Avg. Velocity (ft/s)

Avg. Velocity: __________________ x 0.85 Correction Factor = __________________ Connected Velocity (ft/s)

Corrected Velocity (ft/s): ______________ x Area (ft^2): ______________= ________________ Discharge cfs

General Site Characteristics

General Appearance in the Stream Reach (Check all that apply)

No refuse visible
Small volume refuse (e.g., cans, paper) rare
Small volume refuse common
Large volume refuse (e.g., tires, carts) rare
Large volume refuse common

General Appearance of the Streambank along the Reach (Check all that apply)

No refuse visible
Small volume refuse (e.g., cans, paper) rare
Small volume refuse common
Large volume refuse (e.g., tires, carts) rare
Large volume refuse common

Water Appearance (Check all that apply)

Clear	Light brown	Reddish
Milky	Dark Brown	Greenish
Turbid	Oily Sheen	Other _

Water Odor (Check all that apply)

None	Chlorine	Rotten eggs
Sewage	Fishy	Other ____

Appearance at Water's Edge (Check one)

_____ No evidence of salt crusts
_____ White crusty deposits rare
Numerous white crusty deposits localized
Banks covered with white crusty deposits

Fish (Based on observation)

1. Abundant Comments: ________________
2. Rare Comments: ________________
3. Absent Comments: ________________

Crayfish (Based on observation)

1. Abundant Comments: ________________
2. Rare Comments: ________________
3. Absent Comments: ________________

Recent (past 2 months) flood or long term drought evidence (Check all that apply)

No recent flood evidence
Fresh debris line
Grasses laid over
Recent flood event greater than baseflow:
< bankfull width
> bankfull width - estimated width ______
_____ Fresh debris suspended in bushes/trees
_____ Other____________________
_____ Drought Conditions Prevailing

Flow Regime (Check one)

Perennial stream channel. Surface water persists all year long.
Intermittent stream channel. One which flows only seasonally or sporadically. Surface sources include springs, snow melt and flows that reappear along various locations of a reach, then run subterranean (interrupted).
Subterranean stream channel. Flows parallel to and near the surface for various seasons; a subsurface flow which follows the stream bed.
Ephemeral stream channel. Flows only in response to precipitation.

Flow Variability (Check one)

Seasonal variation in stream flow dominated primarily by **snowmelt** runoff.
Seasonal variation in stream flow dominated primarily by **stormflow** runoff.
Uniform stage and associated stream flow due to **spring fed condition**.
Regulated stream flow due to diversions, dam release, dewatering, etc.
Altered flows due to development such as urban streams, cut-over watersheds, vegetation conversions (e.g. forested to grassland) that changes flow response to precipitation events.

AQUATIC PLANTS

Filamentous Algae

Estimated percent of filamentous algae covering stream bed throughout study reach: ____________________% cover

Floating Algae

Are any detached clumps or mats of algae floating downstream?

1. Abundant Comments: ____________________
2. Rare Comments: ____________________
3. Absent Comments: ____________________

Algal Slime (not filamentous)

Are the submerged rocks, bedrock, woody material in the stream coated with a layer of algal slime? May be slippery to the touch, but not readily visible.

Abundant - thick-coating Comments: ____________________

Rare - thin-coating Comments: ____________________

Absent Comments: ____________________

Percent macrophytes covering stream bed throughout the reach: ____________________ % cover

Description of algae/macrophytes in reach (emergent and submergent):

CHANNEL/HABITAT COMPLEXITY

(Reach length equals 2 meander lengths or 20-30 times bankfull width of the stream) Use a minimum of 100 m reach to 'entify habitat types for large streams.

Habitat	Number of Paces	%	
Pool			
Riffle			
Run			Riffle/Pool Ratio
Total			

EMBEDDEDNESS

(Estimate the percent Embeddedness of 10 cobbles along each of three riffle transects. Select three different riffles within the reach wherever possible. Begin and end transect at edges of riffle, don't include edge particles of the wetted width. Count sand and fines as 100% embedded and bedrock and hardpan as 0% embedded. Gravel that is selected from a patch of gravel is considered 100% embedded)

											Average % Embeddedness
Transect #1											
Transect #2											
Transect #3											

ORGANIC DEBRIS/CHANNEL BLOCKAGES (IN ACTIVE CHANNEL)

Mark single most appropriate description

No organic debris or channel blockages

Infrequent debris, what's present consists of small, floatable organic debris.

Moderate frequency, mixture of small to medium size debris affects less than 10% of active channel area.

Numerous debris mixture of medium to large sizes - affecting up to 30% of the area of the active channel.

Debris dams of predominantly large material affecting over 30% to 50% the channel area and often occupying the total width of the active channel.

Extensive, large debris dams either continuous or influencing over 50% of channel area. Forces water onto flood plain even with moderate flows. Generally presents a fish migration blockage.

Beaver dams. Few and/or infrequent. Spacing allows for normal stream/flow conditions between dams.

Beaver dams - Frequent. Back water occurs between dams - stream flow velocities reduced between dams.

Beaver dams - abandoned where numerous dams have filled in with sediment and are causing channel adjustments of lateral migration, avulsion, and degradation etc.

Man made structures - diversion dams, low dams, controlled by-pass channels, baffled bed configuration with gabions, etc.

SITE MAP SKETCH: (Include location of riffles, pools, runs, snags, submerged logs, undercut banks, areas of stable cobble habitat, point bars, mid-channel or side bars, areas with cut or eroding banks, location and types of riparian vegetation, etc.)

Riffle Pebble Count (Transect method; do 100 pebble counts in riffle habitat only; measure particles at equal increments across multiple line transects within the wetted width of available riffle habitat throughout the reach)

Size Class	Size Range(mm)	Tally	Count	Percent	Cumulative Percent
Silt/Clay*	<0.062				
Sand**	0.063-2				
Very Fine Gravel	3-4				
Fine Gravel	5-8				
Medium Gravel	9-16				
Coarse Gravel	17-32				
Very Coarse Gravel	33-64				
Small Cobble	65-96				
Medium Cobble	97-128				
Large Cobble	129-180				
Very Large Cobble	181-256				
Small Boulder	257-512				
Medium Boulder	513-1024				
Large Boulder	1025-2048				
Very Large Boulder	2049-4096				
Bedrock	>4097				
	Totals				

Comments: (record # of transects and increment size)		
	%Fines (<2mm)	
	# Size Classes	
	D15	
	D50	
	D84	

* Particles feel slick when rubbing between thumb and forefinger

** Particles feel gritty when rubbing between thumb and forefinger

RIPARIAN VEGETATION COVER: (Record the % cover of each vegetation type. Consider each vegetative layer separately with a score of 0-100% for each)

Riparian Vegetation Cover	Percent Cover
Canopy of riparian trees (>5m high)	
Understory of woody shrubs, saplings, herbs, grasses & forbs (0.5 to 5 m high)	
Ground cover of woody shrubs seedlings, herbs, grasses & forbs (<0.5 m high)	
Barren, bare dirt	

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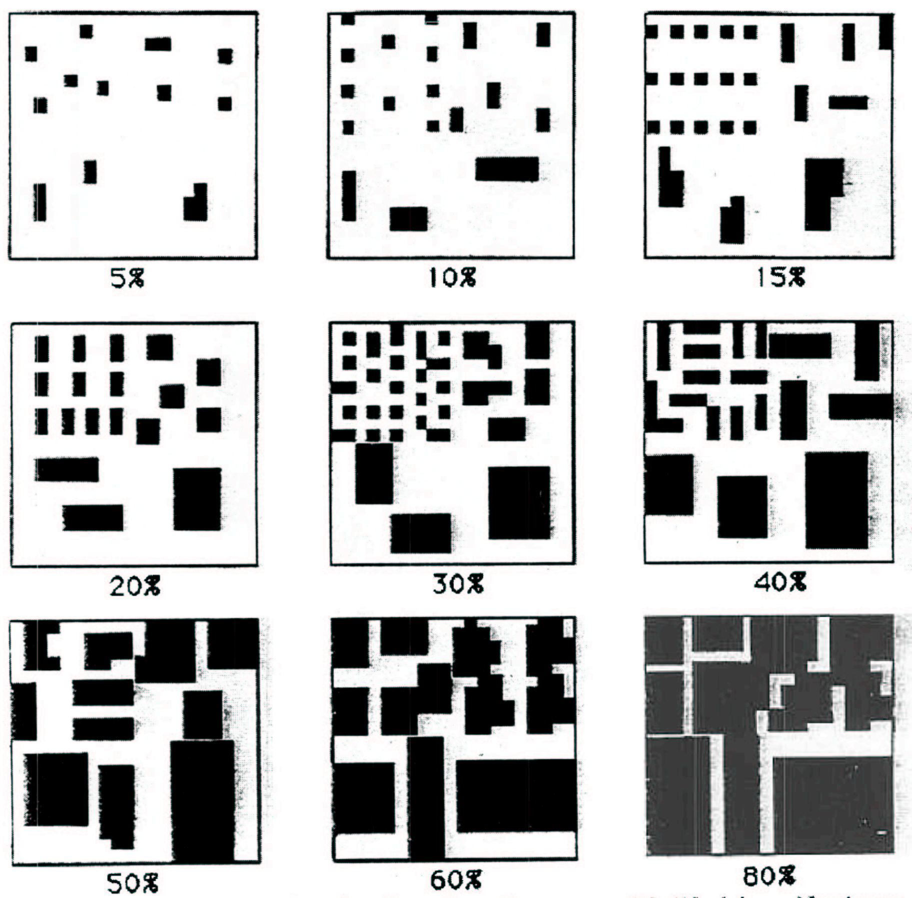

Figure 5.9. Chart for visual estimation of areal coverage. Modified from Northcote (1979) by permission of Rellim Technical Publications

Regeneration Potential of Riparian Trees

'List the common riparian species in order of most abundant to least, then check the boxes for each age class that is esent)

Species	Mature Trees	Young Trees	Saplings	Seedlings*
1)				
2)				
3)				
4)				
5)				

Mature trees = diameter > 40 cm (16") @ 1 m height
Young trees = diameter 3-40 cm @ 1 m height
Saplings = diameter < 3 cm (<1.2")
Seedlings = New growth this year; *note if present but don't count as an age class*

Age Classes of the Dominant Riparian Tree Species (Check the one that applies)

_____ Species abundant in 3 age classes
_____ Abundant in 2 age classes
_____ Only one age class present.
_____ No regeneration evident, few mature trees found, no saplings or seedlings or if present they are heavily grazed/damaged.

ADDITIONAL FIELD NOTES: (Note How stream is confined, geomorphic features, streambed structure, habitat variety, ədimentation, flood/drought evidence, fish, frogs, other wildlife, channel modifications etc.)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of > 25.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score

Adapted from EPA Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition, 1999.

HABITAT ASSESSMENT FIELD DATA SHEET - HIGH GRADIENT STREAMS

STREAM NAME	LOCATION
STATION #________ RIVERMILE________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE ________ TIME ________ AM PM — REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal		Poor
1. Epifaunal Substrate & Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).		Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Adapted from EPA Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition, 1999.

APPENDIX B. SAMPLE DATA

Taxa Name	Site and Date																		
	Upper Los Alamos				Upper Sandia				Lower Sandia					Starmer's Gulch			Pajarito Canyon		
	2/97	7/01	10/01	9/02	7/01	10/01	5/02	10/02	3/96	7/01	10/01	5/02	10/02	7/94	7/01	11/01	7/94	7/01	11/01
Plecoptera – Stoneflies																			
Amphinemura banksi	13		7											227	1	4	1	22	16
Capniidea	2		64			1													4
Hesperoperla pacifica	39													7	1	120	44		
Sweltsa sp.																	32		
Alloperla severa	8													10					
Ephemeroptera – Mayflies																			
Baetis tricaudatus	84		4	4	2	7		8	156	62	196	5	140	49	27	98	90	32	195
Acentrella insignificans	10					11					7				1	9		2	93
Tricorythodes sp.										1			1						
Ameletus														1			13		
Paraleptophlebia	11													1					
Trichoptera – Caddisflies																			
Rhyacophila brunnea cpx.															1				
Glossosomatidae																			1
Hydropsyche sp.	45					11		6	136	1	66	18	234						
Ochrotrichia sp.											10							1	
Limnephilidae	2														2				
Lepidostoma sp.			1								35		1		82	2		14	8
Hesperophylax sp.	2								5	1		6		14	3	42	10		2
Hydroptila sp.													13						
Psychoglypha sp.																		4	
Glossosoma																	1		
Ceratopsyche oslari																	4		
Ecclisomyia																	2		
Micrasema	42																		
Leptoceridae	2																		
Oligophlebodes	2																		

Taxa Name	Site and Date																		
	Upper Los Alamos				**Upper Sandia**				**Lower Sandia**					**Starmer's Gulch**			**Pajarito Canyon**		
	2/97	**7/01**	**10/01**	**9/02**	**7/01**	**10/01**	**5/02**	**10/02**	**3/96**	**7/01**	**10/01**	**5/02**	**10/02**	**7/94**	**7/01**	**11/01**	**7/94**	**7/01**	**11/01**
Dolophilodes	3																		
Rhyacophilidae	16																		
Rhyacophila														2					
Rhyacophila verrula	8																		
Diptera – True Flies																			
Pedicia sp.															2				
Antocha monticola											2			2					
Dicranota sp.	8		6											6	5	55	10	4	19
Tipula sp.						1					2			1		1			
Maruina sp.					1														
Simulium sp.			933	684	9	5	3				25	2		20	9	3	38		153
Diamesinae				2															2
Thienemanniella sp.			6	1												8			2
Diamesa sp.			64	8								1					9		
Odontomesa sp.												2							
Prodiamesa sp.																2			
Tanypodinae												5							
Clinotalypus sp.												4							
Pagastia sp.	624				4		25			2		2		1108	7		20	18	
Thienemannimyia sp.			1			1	1				10	21	5						
Pseudodiamesa sp.			27											57	1	9			
Chaetocladius sp.																3			
Orthocladius sp.	5		25	1		9	1							8		3	1		47
Hydrobaenus sp.																		1	1
Brillia sp.				1										23	4	13	2	2	27
Synorthocladius sp.	9		6										14						2
Orthocladiinae				18			999	14				38	37						
Eukiefferiella sp.	3		64	22	5		97	9		2	8	32	21	11		4			2
Parametriocnemus sp.			1	59	1		59	3			1	2		10			1		2
Tvetenia sp.	19		2											51		7	1		5
Cricotopus sp.				1	4	22	61			1			1	53		1			
Corynoneura sp.														7		1	6		
Rheocricotopus sp.	1		1											7					

Taxa Name	Site and Date																		
	Upper Los Alamos				Upper Sandia				Lower Sandia					Starmer's Gulch			Pajarito Canyon		
	2/97	7/01	10/01	9/02	7/01	10/01	5/02	10/02	3/96	7/01	10/01	5/02	10/02	7/94	7/01	11/01	7/94	7/01	11/01
Chironomus sp.			1									1							
Macropelopia sp.						1									1	2			16
Cryptochironomus sp.						1													
Polypedilum sp.			53																
Micropsectra sp.			21								1			74	4	15		6	18
Pseudochironomus sp.													1						
Phaenopsectra sp.				4			15												4
Larsia sp.				2			9	1				3			1	11			
Nilotanypus												41							
Parochlus kiefferi			9													8			2
Nanocladius sp.													1						
Paraphaenocladius sp.			5	5			2							70					
Pentaneura sp.												11	1					2	4
Stratiomyidae																			1
Tabanus sp.					3		1				3	2							
Chelifera sp.																1			6
Clinocera sp.			9																
Hemerodromia sp.											1								5
Limnophora sp.			21	21			8												
Pericoma	31													10				1	
Cricotopus nostocicola	2																		
Chironomidae				1					1										
Simuliidae									10										
Paramerina sp.														3					
Boreochlus														4					
Limonia	1																		
Ephydra														1					
Odonata – Dragon flies/Damselflies																			
Gomphidae					4														
Argia sp.					19	116				13	26								
Ophiogomphus									1										
Oplonaeschna									4										
Hemiptera – True Bugs																			

	Site and Date																			
	Upper Los Alamos				Upper Sandia				Lower Sandia					Starmer's Gulch			Pajarito Canyon		
Taxa Name	**2/97**	**7/01**	**10/01**	**9/02**	**7/01**	**10/01**	**5/02**	**10/02**	**3/96**	**7/01**	**10/01**	**5/02**	**10/02**	**7/94**	**7/01**	**11/01**	**7/94**	**7/01**	**11/01**
Gerridae					1														
Microvelia sp.																			
Boyeria sp.						16				2	35				1	1			6
Coleoptera - Beetles																			
Dytiscidae															4			1	
Dytiscidae A1																1			
Dytiscus sp.																10			
Helichus sp.										1	1						1		
Hydrophilidae															5				
Optioservus sp.									5	6	6						69	1	1
Curculionidae														1				1	
Staphylinidae															1				
Heterelmis														10					
Cicadellidae			1																3
Narpus														1			10		
Lepidoptera – Moths																			
Petrophila sp.					1	34				6									
Collembola - Springtails																			
Poduridae					1									1		1			1
Annelida – Segmented Worms																			
Tubificidae						3										3			
Naididae																11			
Lumbricidae			1		5	44				21	35			2	8		59		
Lumbriculidae									2										
Platyhelminthes - Flatworms																			
Turbellaria														20	2		9		
Isopoda - Pillbugs																			
Caecidotea sp.						1													
Ostracoda – Seed Shrimp																			
Ostracoda						2					13								
Nematomorpha – Gordian Worms																			
Gordius sp.																			1
Nemata – Round Worms																			

Taxa Name	Site and Date																		
	Upper Los Alamos				Upper Sandia				Lower Sandia					Starmer's Gulch			Pajarito Canyon		
	2/97	7/01	10/01	9/02	7/01	10/01	5/02	10/02	3/96	7/01	10/01	5/02	10/02	7/94	7/01	11/01	7/94	7/01	11/01
Nemata														1					

APPENDIX C. TAXA ATTRIBUTES AND TOLERANCE VALUES

Taxa Name	Habitat	Habit	Feeding Group	Tolerance Value	Tolerance Value Source
Plecoptera					
Acroneuria abnormis	Erosional	Clinger	Predator	0	WI DNR (Barbour et al. 1999)
Alloperla severa	Erosional	Sprawler	Predator	5	Wisseman (1996)
Amphinemura	Eros/Dep	Sprawler	Shredder	2	ID DEP (Barbour et al. 1999)
Amphinemura banksi	Eros/Dep	Sprawler	Shredder	2	Taxonomic parent's TV
Capnia sp.			Shredder	4	Wisseman (1996)
Capniidae	Eros/Dep	Sprawler	Shredder	4	Wisseman (1996)
Chloroperla	Erosional	Clinger	Predator	5	Taxonomic parent's TV
Chloroperlidae	Erosional	Clinger	Predator	5	Wisseman (1996)
Cultus	Erosional	Clinger	Predator	4	Wisseman (1996)
Cultus aestivalis	Erosional	Clinger	Predator	4	Taxonomic parent's TV
Despaxia				0	ID DEP (Barbour et al. 1999)
Hesperoperla pacifica		Clinger	Predator	5	Wisseman (1996)
Isoperla	Erosional	Clinger	Predator	5	Wisseman (1996)
Isoperla fulva	Erosional	Clinger	Predator	2	ID DEP (Barbour et al. 1999)
Isoperla quinquepunctuata	Erosional	Clinger	Predator	5	Taxonomic parent's TV
Kogotus	Erosional	Clinger	Predator	5	Wisseman (1996)
Kogotus modestus	Erosional	Clinger	Predator	4	Taxonomic parent's TV
Leuctridae	Eros/Dep	Sprawler	Shredder	3	Wisseman (1996)
Malenka		Swimmer		6	Wisseman (1996)
Malenka coloradensis				6	Taxonomic parent's TV
Nemoura	Erosional	Sprawler	Shredder	2	Taxonomic parent's TV
Nemouridae	Eros/Dep	Sprawler	Shredder	2	ID DEP (Barbour et al. 1999)
Paraleuctra				0	ID DEP (Barbour et al. 1999)
Paraleuctra vershina				0	Taxonomic parent's TV
Paraperla				3	Wisseman (1996)
Paraperla frontalis				3	Taxonomic parent's TV
Perlodidae	Depositional	Clinger	Predator	4	Wisseman (1996)
Perlodinae	Erosional	Clinger	Predator	4	Wisseman (1996)
Podmosta				3	Wisseman (1996)
Podmosta delicatula				3	Taxonomic parent's TV
Pteronarcella	Eros/Dep	Clinger	Shredder	6	Wisseman (1996)
Pteronarcella badia	Eros/Dep	Clinger	Shredder	6	Taxonomic parent's TV
Pteronarcys	Eros/Dep	Clinger	Shredder	4	Wisseman (1996)
Pteronarcys californica	Erosional	Clinger	Shredder	6	Wisseman (1996)
Skwala			Predator	5	Wisseman (1996)
Skwala parallela			Predator	4	Taxonomic parent's TV
Suwalia			Predator	1	ID DEP (Barbour et al. 1999)
Sweltsa coloradensis	Erosional	Clinger	Predator	5	Wisseman (1996)
Sweltsa sp.	Erosional	Clinger	Predator	5	Wisseman (1996)
Taeniomena				2	ID DEP (Barbour et al. 1999)

Taxa Name	Habitat	Habit	Feeding Group	Tolerance Value	Tolerance Value Source
Plecoptera *(continued)*					
Zapada cinctipes	Erosional	Sprawler	Shredder	5	Wisseman (1996)
Zapada frigida	Erosional	Sprawler	Shredder	4	Wisseman (1996)
Ephemeroptera					
Acentrella insignificans	Erosional	Swimmer	Collector	7	Wisseman (1996)
Ameletus	Eros/Dep	Swimmer	Scraper	0	ID DEP (Barbour et al. 1999)
Baetis	Eros/Dep	Swimmer	Collector	5	Wisseman (1996)
Baetis bicaudatis	Eros/Dep	Swimmer	Collector	2	Wisseman (1996)
Baetis tricaudatus	Eros/Dep	Swimmer	Collector	7	Wisseman (1996)
Callibaetis		Swimmer	Collector	9	Wisseman (1996)
Cinygmula	Erosional	Clinger	Scraper	6	Wisseman (1996)
Drunella		Clinger	Scraper	4	Wisseman (1996)
Drunella coloradensis		Clinger	Scraper	5	Wisseman (1996)
Drunella doddsi		Clinger	Scraper	3	Wisseman (1996)
Drunella grandis (grandis)		Clinger	Scraper	6	Wisseman (1996)
Epeorus	Erosional	Clinger	Collector	4	Wisseman (1996)
Epeorus longimanus	Erosional	Clinger	Collector	4	Wisseman (1996)
Ephemerella	Eros/Dep	Clinger	Collector	1	ID DEP (Barbour et al. 1999)
Ephemerella inermis	Eros/Dep	Clinger	Collector	7	Wisseman (1996)
Ephemerella infrequens	Eros/Dep	Clinger	Collector	2	Wisseman (1996)
Ephemerellidae	Eros/Dep	Clinger	Collector	1	ID DEP (Barbour et al. 1999)
Heptagenia	Erosional	Clinger	Scraper	6	Wisseman (1996)
Nixe	Eros/Dep	Clinger	Scraper	6	Wisseman (1996)
Nixe simplicoides	Eros/Dep	Clinger	Scraper	6	Taxonomic parent's TV
Paraleptophlebia	Erosional	Swimmer	Collector	6	Wisseman (1996)
Rhithrogena	Erosional	Clinger	Collector	6	Wisseman (1996)
Siphlonuridae		Swimmer	Collector	7	ID DEP (Barbour et al. 1999)
Siphlonurus	Depositional	Swimmer	Collector	7	ID DEP (Barbour et al. 1999)
Siphlonurus occidentalis	Depositional	Swimmer	Collector	7	ID DEP (Barbour et al. 1999)
Tricorythodes minutus	Depositional	Sprawler	Collector	8	Wisseman (1996)
Tricorythodes sp.	Depositional	Sprawler	Collector	8	Wisseman (1996)
Trichoptera					
Agapetus	Erosional	Clinger	Scraper	5	Wisseman (1996)
Alisotrichia				4	Taxonomic parent's TV
Amiocentrus	Erosional	Clinger	Collector	1	ID DEP (Barbour et al. 1999)
Anagapetus	Erosional	Clinger	Scraper	2	Wisseman (1996)
Arctopsyche	Erosional	Clinger	Collector	4	Wisseman (1996)
Arctopsyche grandis	Erosional	Clinger	Scraper	4	Wisseman (1996)
Brachycentrus	Erosional	Clinger	Collector	1	ID DEP (Barbour et al. 1999)
Brachycentrus americanus	Erosional	Clinger	Collector	5	Wisseman (1996)
Ceratopsyche oslari	Erosional	Clinger	Collector	6	Taxonomic parent's TV
Cheumatopsyche	Erosional	Clinger	Scraper	8	Wisseman (1996)
Chimarra	Erosional	Clinger	Collector	4	WI DNR (Barbour et al. 1999)
Dicosmoecus	Erosional	Sprawler	Scraper	1	ID DEP (Barbour et al. 1999)

Taxa Name	Habitat	Habit	Feeding Group	Tolerance Value	Tolerance Value Source
Trichoptera *(continued)*					
Dolophilodes	Erosional	Clinger	Collector	4	Wisseman (1996)
Dolophilodes aequalis	Erosional	Clinger	Collector	4	Taxonomic parent's TV
Dolophilodes sortosa	Erosional	Clinger	Collector	4	Taxonomic parent's TV
Ecclisomyia	Erosional	Clinger	Collector	3	Wisseman (1996)
Glossosoma	Erosional	Clinger	Scraper	5	Wisseman (1996)
Glossosomatidae	Erosional	Clinger	Scraper	5	Wisseman (1996)
Gumaga	Erosional	Sprawler	Shredder	3	ID DEP (Barbour et al. 1999)
Helicopsyche	Erosional	Clinger	Scraper	3	ID DEP (Barbour et al. 1999)
Helicopsyche borealis	Erosional	Clinger	Scraper	3	ID DEP (Barbour et al. 1999)
Hesperophylax	Eros/Dep	Sprawler	Shredder	5	ID DEP (Barbour et al. 1999)
Hydropsyche	Erosional	Clinger	Scraper	6	Wisseman (1996)
Hydropsyche occentalis	Erosional	Clinger	Scraper	4	ID DEP (Barbour et al. 1999)
Hydropsyche oslari	Erosional	Clinger	Scraper	4	ID DEP (Barbour et al. 1999)
Hydropsychidae	Erosional	Clinger	Collector	6	Wisseman (1996)
Hydroptila	Eros/Dep	Clinger		8	Wisseman (1996)
Hydroptilidae	Erosional	Clinger		4	ID DEP (Barbour et al. 1999)
Lepidostoma	Eros/Dep	Climber	Shredder	5	Wisseman (1996)
Lepidostomatidae	Eros/Dep	Climber	Shredder	3	ID DEP (Barbour et al. 1999)
Leptoceridae				4	ID DEP (Barbour et al. 1999)
Leucotrichia	Erosional	Clinger	Scraper	8	Wisseman (1996)
Limnephilidae		Climber	Shredder	4	ID DEP (Barbour et al. 1999)
Limnephilus			Collector	8	Wisseman (1996)
Micrasema	Erosional	Clinger	Shredder	5	Wisseman (1996)
Namamyia	Eros/Dep	Sprawler	Collector	0	ID DEP (Barbour et al. 1999)
Ochrotrichia		Clinger		7	Wisseman (1996)
Odontoceridae	Eros/Dep	Sprawler	Shredder	0	ID DEP (Barbour et al. 1999)
Oecetis	Eros/Dep	Clinger	Predator	8	Wisseman (1996)
Oligophlebodes	Erosional	Clinger	Scraper	4	Taxonomic parent's TV
Phylloicus		Sprawler	Shredder		
Polycentropus	Erosional	Clinger	Predator	6	Wisseman (1996)
Psychoglypha	Eros/Dep	Sprawler	Collector	3	Wisseman (1996)
Psychoronia				4	Taxonomic parent's TV
Rhyacophila	Erosional	Clinger	Predator	4	Wisseman (1996)
Rhyacophila acropedes	Erosional	Clinger	Predator	1	ID DEP (Barbour et al. 1999)
Rhyacophila brunnea cpx.	Erosional	Clinger	Predator	5	Wisseman (1996)
Rhyacophila coloradensis	Erosional	Clinger	Predator	6	Wisseman (1996)
Rhyacophila hyalinata	Erosional	Clinger	Predator	4	Wisseman (1996)
Rhyacophila valuma	Erosional	Clinger	Predator	3	Wisseman (1996)
Rhyacophila verrula	Erosional	Clinger	Shredder	2	Wisseman (1996)
Rhyacophilidae	Erosional	Clinger	Predator	4	Wisseman (1996)
Stactobiella	Eros/Dep	Clinger	Shredder	2	ID DEP (Barbour et al. 1999)
Wormaldia	Erosional	Clinger	Collector	5	Wisseman (1996)

Taxa Name	Habitat	Habit	Feeding Group	Tolerance Value	Tolerance Value Source
Diptera					
Ablabesmyia	Eros/Dep	Sprawler	Predator	8	Wisseman (1996)
Aedes		Swimmer	Collector	8	MACS (Barbour et al. 1999)
Antocha	Erosional	Clinger	Collector	7	Wisseman (1996)
Antocha monticola	Erosional	Clinger	Collector	7	Taxonomic parent's TV
Atherix	Eros/Dep	Sprawler	Predator	7	Wisseman (1996)
Bezzia		Burrower	Predator	6	ID DEP (Barbour et al. 1999)
Bittacomorpha	Depositional	Burrower	Collector	7	ID DEP (Barbour et al. 1999)
Blephariceridae	Erosional	Clinger	Scraper	3	Wisseman (1996)
Boreochlus	Erosional	Sprawler	Collector	6	ID DEP (Barbour et al. 1999)
Brachydeutera		Sprawler	Collector	9	Taxonomic parent's TV
Brillia sp.	Eros/Dep	Burrower	Shredder	7	Wisseman (1996)
Cardiocladius	Erosional	Burrower	Predator	6	Wisseman (1996)
Ceratopogonidae	Depositional	Sprawler	Predator	6	ID DEP (Barbour et al. 1999)
Chaetocladius	Erosional	Sprawler	Collector	6	Wisseman (1996)
Chaoborus		Sprawler	Predator	8	Taxonomic parent's TV
Chelifera	Depositional	Sprawler		7	Wisseman (1996)
Chironomidae				6	Wisseman (1996)
Chironomidae, Macropelopini		Sprawler	Predator	6	Taxonomic parent's TV
Chironomidae, Orthocladiinae		Burrower	Collector	5	Wisseman (1996)
Chironomus	Depositional	Burrower	Collector	10	Wisseman (1996)
Chrysops	Depositional	Sprawler	Predator	7	MACS (Barbour et al. 1999)
Clinocera	Erosional	Clinger		6	Wisseman (1996)
Corynoneura	Depositional	Sprawler	Collector	6	Wisseman (1996)
Cricotopus	Eros/Dep	Clinger	Shredder	6	Wisseman (1996)
Cricotopus nostocicola	Eros/Dep	Clinger	Shredder	6	Taxonomic parent's TV
Cryptochironomus	Depositional	Sprawler	Predator	8	ID DEP (Barbour et al. 1999)
Cryptotendipes	Depositional	Sprawler		6	WI DNR (Barbour et al. 1999)
Culex		Swimmer	Collector	8	MACS (Barbour et al. 1999)
Culicidae	Depositional	Swimmer	Collector	8	ID DEP (Barbour et al. 1999)
Culicoides		Burrower	Predator	10	WI DNR (Barbour et al. 1999)
Culiseta		Swimmer	Collector	8	Taxonomic parent's TV
Diamesa	Erosional	Sprawler	Collector	3	Wisseman (1996)
Diamesinae	Eros/Dep	Clinger	Collector	6	Taxonomic parent's TV
Dicranota	Eros/Dep	Sprawler	Predator	6	Wisseman (1996)
Dixa	Eros/Dep	Swimmer	Collector	5	Wisseman (1996)
Dixa californica	Eros/Dep	Swimmer	Collector	5	Taxonomic parent's TV
Empididae	Eros/Dep	Sprawler	Predator	6	Wisseman (1996)
Ephydra	Depositional	Sprawler	Shredder	9	Taxonomic parent's TV
Ephydridae		Burrower	Collector	9	Wisseman (1996)
Eukiefferiella	Erosional	Sprawler	Collector	6	Wisseman (1996)
Hemerodromia	Eros/Dep	Sprawler	Predator	8	Wisseman (1996)
Hexatoma	Eros/Dep	Burrower	Predator	5	Wisseman (1996)
Holorusia	Depositional	Burrower	Shredder	6	Taxonomic parent's TV

Taxa Name	Habitat	Habit	Feeding Group	Tolerance Value	Tolerance Value Source
Diptera *(continued)*					
Holorusia grandis	Depositional	Burrower	Shredder	6	Taxonomic parent's TV
Hydrobaenus	Erosional	Sprawler	Scraper	8	Wisseman (1996)
Labrundinia	Erosional	Sprawler	Predator	4	OH (Barbour et al. 1999)
Larsia	Erosional	Sprawler	Predator	7	Wisseman (1996)
Limnophora	Erosional	Burrower	Predator	8	Wisseman (1996)
Limnophora aequifrons	Erosional	Burrower	Predator	8	Taxonomic parent's TV
Limonia		Burrower	Shredder	8	Wisseman (1996)
Macropelopia	Erosional	Sprawler	Predator	4	Wisseman (1996)
Maruina	Erosional	Clinger	Scraper	5	Wisseman (1996)
Micropsectra	Depositional	Climber	Collector	6	Wisseman (1996)
Microtendipes	Depositional	Clinger	Collector	7	Wisseman (1996)
Muscidae	Eros/Dep	Sprawler	Predator	6	ID DEP (Barbour et al. 1999)
Nanocladius	Erosional	Sprawler	Collector	5	Wisseman (1996)
Nostocladius				6	Taxonomic parent's TV
Nostococladius				6	Taxonomic parent's TV
Odontomyia (=Eulalia)		Sprawler	Collector	8	ID DEP (Barbour et al. 1999)
Oreogeton	Erosional	Sprawler	Predator	2	Wisseman (1996)
Orthocladius	Erosional	Sprawler	Collector	6	Wisseman (1996)
Pagastia				6	Wisseman (1996)
Paramerina sp.	Erosional	Sprawler	Predator	6	Wisseman (1996)
Parametriocnemus	Eros/Dep	Sprawler	Collector	4	Wisseman (1996)
Paraphaenocladius	Eros/Dep	Sprawler	Collector	3	Wisseman (1996)
Parochlus kiefferi	Erosional	Sprawler	Collector	6	Taxonomic parent's TV
Pedicia sp.		Burrower	Predator	3	Wisseman (1996)
Pentaneura	Eros/Dep	Sprawler	Predator	6	Wisseman (1996)
Pericoma	Depositional	Burrower	Collector	6	Wisseman (1996)
Phaenopsectra		Clinger	Scraper	7	Wisseman (1996)
Polypedilum		Climber	Shredder	6	Wisseman (1996)
Procladius	Depositional	Sprawler	Predator	9	ID DEP (Barbour et al. 1999)
Prodiamesa	Eros/Dep	Burrower	Collector	5	Wisseman (1996)
Prosimilium	Erosional	Clinger	Collector	3	Wisseman (1996)
Protanyderus	Erosional	Sprawler		1	ID DEP (Barbour et al. 1999)
Pseudochironomus	Eros/Dep	Burrower	Collector	7	Wisseman (1996)
Pseudodiamesa	Erosional	Sprawler	Collector	6	Wisseman (1996)
Pseudosmittia				5	Wisseman (1996)
Psychodidae	Depositional	Burrower	Collector	10	ID DEP (Barbour et al. 1999)
Ptychoptera	Depositional	Burrower	Collector	7	Wisseman (1996)
Ptychopteridae	Depositional	Burrower	Collector	7	ID DEP (Barbour et al. 1999)
Rheocricotopus	Erosional	Sprawler	Collector	5	Wisseman (1996)
Rheotanytarsus	Erosional	Clinger	Collector	6	Wisseman (1996)
Simuliidae	Erosional	Clinger	Collector	6	Wisseman (1996)
Simulium	Erosional	Clinger	Collector	7	Wisseman (1996)
Stempellina	Erosional	Climber	Collector	3	Wisseman (1996)

Taxa Name	Habitat	Habit	Feeding Group	Tolerance Value	Tolerance Value Source
Diptera *(continued)*					
Stempellinealla	Erosional	Sprawler		4	Wisseman (1996)
Stratiomyidae		Sprawler	Collector	8	Wisseman (1996)
Synorthocladius			Collector	4	Wisseman (1996)
Syrphidae				10	ID DEP (Barbour et al. 1999)
Tabanidae	Depositional	Sprawler	Predator	8	ID DEP (Barbour et al. 1999)
Tabanus	Eros/Dep	Sprawler	Predator	5	ID DEP (Barbour et al. 1999)
Thienemanniella	Eros/Dep	Sprawler	Collector	6	Wisseman (1996)
Thienemannimyia	Erosional	Sprawler	Predator	6	Wisseman (1996)
Tipula	Eros/Dep	Burrower	Shredder	7	Wisseman (1996)
Tipulidae	Eros/Dep	Burrower	Shredder	6	Wisseman (1996)
Tubifera bastardii				10	Taxonomic parent's TV
Tvetenia sp.		Sprawler	Collector	5	Wisseman (1996)
Zavrelia		Climber	Collector	6	Taxonomic parent's TV
Zavrelimyia	Erosional	Sprawler	Predator	7	Wisseman (1996)
Odonata					
Aeshna		Climber	Predator	5	ID DEP (Barbour et al. 1999)
Aeshnidae		Climber	Predator	3	ID DEP (Barbour et al. 1999)
Anax		Climber	Predator	8	ID DEP (Barbour et al. 1999)
Archilestes	Depositional	Climber	Predator	9	Taxonomic parent's TV
Argia	Eros/Dep	Clinger	Predator	7	ID DEP (Barbour et al. 1999)
Boyeria	Eros/Dep	Climber	Predator	3	Taxonomic parent's TV
Coenagrionidae		Climber	Predator	9	Wisseman (1996)
Cordulegaster	Depositional	Burrower	Predator	0	ID DEP (Barbour et al. 1999)
Corduliidae	Depositional	Sprawler	Predator	2	ID DEP (Barbour et al. 1999)
Enallagma	Depositional	Climber	Predator	9	Taxonomic parent's TV
Gomphidae	Depositional	Burrower	Predator	6	Wisseman (1996)
Hetaerina	Eros/Dep	Climber	Predator	6	WI DNR (Barbour et al. 1999)
Ishnura	Depositional	Climber	Predator	9	ID DEP (Barbour et al. 1999)
Ishnura perparua	Depositional	Climber	Predator	9	Taxonomic parent's TV
Leuchorrhina		Climber	Predator	9	Taxonomic parent's TV
Libellula	Depositional	Sprawler	Predator	9	ID DEP (Barbour et al. 1999)
Libellulidae		Sprawler	Predator	9	ID DEP (Barbour et al. 1999)
Neurocordulia	Depositional	Climber	Predator	2	Taxonomic parent's TV
Ophiogomphus	Eros/Dep	Burrower	Predator	8	Wisseman (1996)
Oplonaeschna	Erosional	Clinger	Predator	3	ID DEP (Barbour et al. 1999)
Pantala		Sprawler	Predator	9	Taxonomic parent's TV
Plathemis		Sprawler	Predator	8	WI DNR (Barbour et al. 1999)
Sympetrum		Sprawler	Predator	10	WI DNR (Barbour et al. 1999)
Zoniagrion	Depositional	Climber	Predator	9	ID DEP (Barbour et al. 1999)
Hemiptera					
Ambrysus mormon	Erosional	Clinger	Predator	5	Taxonomic parent's TV
Cicadellidae					
Corisella			Predator	10	Taxonomic parent's TV

Taxa Name	Habitat	Habit	Feeding Group	Tolerance Value	Tolerance Value Source
Hemiptera *(continued)*					
Corixidae		Swimmer		10	ID DEP (Barbour et al. 1999)
Gerridae		Skater	Predator	5	ID DEP (Barbour et al. 1999)
Gerris	Depositional	Skater	Predator	5	Taxonomic parent's TV
Gerris marginatus	Depositional	Skater	Predator	5	Taxonomic parent's TV
Gerris notabilis	Depositional	Skater	Predator	5	Taxonomic parent's TV
Metrobates	Erosional	Skater	Predator	5	Taxonomic parent's TV
Microvelia	Depositional	Skater	Predator	6	MACS (Barbour et al. 1999)
Naucoridae	Erosional	Clinger	Predator	5	ID DEP (Barbour et al. 1999)
Notonecta	Depositional	Swimmer	Predator		
Notonecta undulata	Depositional	Swimmer	Predator		
Rhagovelia	Erosional	Skater	Predator	6	MACS (Barbour et al. 1999)
Salididae	Depositional	Climber	Predator	10	ID DEP (Barbour et al. 1999)
Sigara	Depositional	Swimmer	Collector	9	MACS (Barbour et al. 1999)
Trepobates	Depositional	Skater	Predator	10	ID DEP (Barbour et al. 1999)
Trichocorixa		Swimmer	Predator	5	MACS (Barbour et al. 1999)
Megaloptera					
Corydalidae	Erosional	Clinger	Predator	0	ID DEP (Barbour et al. 1999)
Neohermes	Erosional	Clinger	Predator	0	Taxonomic parent's TV
Coleoptera					
Agabus	Eros/Dep	Swimmer	Predator	8	Taxonomic parent's TV
Agabus cordatus	Eros/Dep	Swimmer	Predator	8	Taxonomic parent's TV
Agabus tristus	Eros/Dep	Swimmer	Predator	8	Taxonomic parent's TV
Ametor	Depositional	Clinger		5	ID DEP (Barbour et al. 1999)
Ametor scabrosus	Depositional	Clinger		5	Taxonomic parent's TV
Amphizoa	Erosional	Clinger	Predator	1	ID DEP (Barbour et al. 1999)
Berosus	Depositional	Swimmer	Collector	5	ID DEP (Barbour et al. 1999)
Berosus styliferous	Depositional	Swimmer	Collector	5	Taxonomic parent's TV
Carabidae		Clinger	Predator	4	ID DEP (Barbour et al. 1999)
Cleptelmis addenda	Erosional	Clinger		6	Wisseman (1996)
Crenitis	Depositional	Burrower		5	ID DEP (Barbour et al. 1999)
Curculionidae		Clinger	Shredder		
Cylloepus	Erosional	Clinger		4	ID DEP (Barbour et al. 1999)
Cymbiodyta dorsalis	Depositional	Burrower		7	Taxonomic parent's TV
Deronectes	Eros/Dep	Swimmer	Predator	5	ID DEP (Barbour et al. 1999)
Deronectes striatellus	Eros/Dep	Swimmer	Predator	5	Taxonomic parent's TV
Dryopidae	Erosional	Clinger	Scraper		
Dubiraphia	Erosional	Clinger		4	ID DEP (Barbour et al. 1999)
Dytiscidae	Depositional	Diver	Predator	8	Wisseman (1996)
Dytiscus	Depositional	Swimmer	Predator	8	Wisseman (1996)
Elmidae	Erosional	Clinger	Collector	4	Wisseman (1996)
Enochrus		Burrower	Collector	5	ID DEP (Barbour et al. 1999)
Gyrinus	Depositional	Swimmer	Predator	5	ID DEP (Barbour et al. 1999)
Haliplidae	Depositional	Swimmer	Shredder	7	ID DEP (Barbour et al. 1999)

Taxa Name	Habitat	Habit	Feeding Group	Tolerance Value	Tolerance Value Source
Coleoptera *(continued)*					
Haliplus		Swimmer	Shredder	7	Taxonomic parent's TV
Helichus	Erosional	Clinger		5	WI DNR (Barbour et al. 1999)
Helichus striatus	Erosional	Clinger		5	ID DEP (Barbour et al. 1999)
Helichus suturalis	Erosional	Clinger		5	WI DNR (Barbour et al. 1999)
Helodidae		Climber	Scraper		
Helophorus	Erosional	Climber	Shredder	8	NC (Barbour et al. 1999)
Heterelmis	Erosional	Clinger		4	ID DEP (Barbour et al. 1999)
Heterlimnius corpulentus	Erosional	Clinger		4	ID DEP (Barbour et al. 1999)
Hydaticus	Depositional	Swimmer	Predator	5	ID DEP (Barbour et al. 1999)
Hydrobius		Climber		8	ID DEP (Barbour et al. 1999)
Hydrochus	Erosional	Climber	Shredder	7	Taxonomic parent's TV
Hydrophilidae	Depositional	Diver	Collector	7	Wisseman (1996)
Hydroporus	Depositional	Swimmer	Predator	5	ID DEP (Barbour et al. 1999)
Hydroporus vilis	Depositional	Swimmer	Predator	5	ID DEP (Barbour et al. 1999)
Hygrotus	Depositional	Swimmer	Predator	8	Taxonomic parent's TV
Laccophilus	Depositional	Swimmer		5	ID DEP (Barbour et al. 1999)
Microcylloepus	Eros/Dep	Clinger		4	ID DEP (Barbour et al. 1999)
Narpus	Erosional	Clinger		4	ID DEP (Barbour et al. 1999)
Narpus concolor	Erosional	Clinger		4	ID DEP (Barbour et al. 1999)
Optioservus	Eros/Dep	Clinger	Scraper	7	Wisseman (1996)
Optioservus castanipennis	Eros/Dep	Clinger	Scraper	4	ID DEP (Barbour et al. 1999)
Optioservus divergens	Eros/Dep	Clinger	Scraper	4	ID DEP (Barbour et al. 1999)
Peltodytes	Erosional	Swimmer	Shredder	7	OH (Barbour et al. 1999)
Phytonomus		Clinger	Shredder		
Prionocyphon					
Psephenidae	Erosional	Clinger	Scraper	4	ID DEP (Barbour et al. 1999)
Psphenus	Erosional	Clinger	Scraper	4	ID DEP (Barbour et al. 1999)
Rhantus	Depositional	Swimmer	Predator	8	Taxonomic parent's TV
Rhizelmis	Erosional	Clinger		1	ID DEP (Barbour et al. 1999)
Staphylinidae		Clinger	Predator	8	ID DEP (Barbour et al. 1999)
Zaitzevia	Erosional	Clinger		7	Wisseman (1996)
Zaitzevia parvula	Erosional	Clinger		7	Taxonomic parent's TV
Lepidoptera				6	ID DEP (Barbour et al. 1999)
Noctuidae		Burrower	Shredder	6	Taxonomic parent's TV
Ostrinia		Burrower	Shredder	5	ID DEP (Barbour et al. 1999)
Paraponyx		Climber	Shredder	5	MACS (Barbour et al. 1999)
Parargyractis		Climber	Shredder	6	Taxonomic parent's TV
Parargyractis kearfottalis		Climber	Shredder	5	Taxonomic parent's TV
Petrophila		Climber	Shredder	7	Wisseman (1996)
Pyralidae		Climber	Shredder	5	ID DEP (Barbour et al. 1999)
Collembola					
Isotomidae		Skater			
Poduridae		Skater	Collector	10	ID DEP (Barbour et al. 1999)

Taxa Name	Habitat	Habit	Feeding Group	Tolerance Value	Tolerance Value Source
Isopoda					
Caecidotea		Swimmer		8	ID DEP (Barbour et al. 1999)
Ostracoda			Collector	6	Wisseman (1996)
Hydracarina					
Annelida					
Oligochaeta		Burrower	Collector	7	Wisseman (1996)
Lumbriculidae				8	ID DEP (Barbour et al. 1999)
Platyhelminthes				5	Wisseman (1996)
Turbellaria		Clinger	Predator	5	Wisseman (1996)
Gordea					
Gordius					
Haplotaxida					
Lumbricidae				10	MACS (Barbour et al. 1999)
Naididae		Burrower	Collector	8	Wisseman (1996)
Tubificidae		Burrower	Collector	8	Wisseman (1996)
Nemata				6	Wisseman (1996)
Nematomorpha				6	Wisseman (1996)
Veneroida					
Pisidium casertanum		Burrower	Collector	7	Wisseman (1996)
Gastropoda			Scraper	7	ID DEP (Barbour et al. 1999)
vallonia			Scraper		
Gyraulus parvus				9	Wisseman (1996)

APPENDIX D. MACROINVERTEBRATE METRICS

Individual and average metric scores for macroinvertebrate samples.

Metrics	Standardized scores for individual macroinvertebrate metrics and overall Stream Condition Index score.														
	Upper Sandia				Lower Sandia					Starmer's Gulch			Pajarito		
	07/01	10/01	05/02	10/02	03/96	07/01	10/01	05/02	10/02	07/94	07/01	11/01	07/94	07/01	11/01
LOW ELEVATION-SMALL CATCHMENT SITES															
Spring/Fall Samples															
% sprawler		14.347	39.285	24.426	4.934		14.940	100	34.572			100			65.176
hydropsychidae to EPT %		63.333	63.333	57.143	54.209		78.710	37.931	39.846			100			100
intolerant taxa		7.692	7.692	7.692	7.692		7.692	15.385	7.692			15.385			15.385
% scraper		8.786	2.508	8.158	100		33.841	29.794	99.244			0.512			2.464
% shredder		68.943	15.431	82.967	5.314		30.779	8.621	14.648			64.029			29.858
Summer samples															
hydropsychidae to EPT %	100					98.462				100	100		97.980	100	
intolerant taxa	0.000					7.692				23.077	23.077		30.769	15.385	
% scraper	3.808					14.150				0.122	0.000		43.585	2.115	
% shredder	28.329					6.017				58.012	100		10.160	100	
Average Score	**33.034**	**32.620**	**25.650**	**36.077**	**34.430**	**31.580**	**33.192**	**38.346**	**39.200**	**45.320**	**55.769**	**55.985**	**45.623**	**54.375**	**42.576**

HIGH ELEVATION-SMALL CATCHMENT SITES	Upper Los Alamos			
	02/97	07/01	10/01	09/02
Number of taxa	96.774	--	80.645	61.290
Ephemeroptera taxa	57.143	--	14.286	14.286
Diptera taxa	100	--	100	100
Plecoptera taxa	71.429	--	28.571	0.000
Shannon Diversity Index	68.830	--	49.900	35.618
Pielou's Evenness Index	52.643	--	37.371	28.346
% Plecoptera	19.866	--	19.277	0.000
# intolerant taxa	15.385	--	23.077	7.692
% shredder individuals	21.359	--	31.927	0.390
# shredder taxa	100	--	66.667	16.667
# sprawler taxa	100	--	100	100
% sprawler individuals	16.802	--	66.406	35.879
% Swimmer individuals	19.366	--	0.636	9.949
Average Score	**56.892**	**0**	**47.597**	**31.547**

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