WATER QUALITY SURVEY SUMMARY
FOR THE
BEAR CREEK WATERSHED
(From Dorsey Spring to Horseshoe Bend)
2006

Prepared by
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C	Celsius
cfs	cubic feet per second
CWA	Clean Water Act
CWAL	Coldwater Aquatic Life
ELS	Early Life Stage
DO	Dissolved Oxygen
GIS	Geographic Information Systems
HUC	Hydrologic Unit Code
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
OLS	Other Life Stage
QAPP	Quality Assurance Project Plan
STORET	EPA's STOrage and RETrieval Database
SVOCs	Semi-Volatile Organic Compounds
SWQB	Surface Water Quality Bureau
USEPA	United States Environmental Protection Agency
WPS	Watershed Protection Section (SWQB)

1.0 Executive Summary

The Bear Creek watershed encompasses approximately 179 square miles (464 km^2) (HUC 15040002030) with headwaters originating in the Pinos Altos Mountains of the Gila National Forest. Bear Creek is typical of many streams in southwestern New Mexico consisting of perennial reaches interrupted by intermittent reaches which will have consistent flow during average snowmelt and monsoon seasons. The presence or absence of springs and subsurface geologic controls generally determine the location of perennial reaches. The Bear Creek watershed includes the Pinos Altos Mining District, a potential source of impairment. Other potential sources of impairment include residential development around the village of Pinos Altos, roads, recreation uses, wildfire, and grazing.

Sampling of Bear Creek during the 1999-2000 Gila Watershed Water Quality Survey proved inadequate for assessment purposes due to the intermittent nature of the creek at the sites available for sampling in 1999-2000. Intermittent conditions at these sites in 1999-2000 resulted in the 2002 Record of Decision removal of Bear Creek from the 303(d) list of impaired waters. The original reasons for including Bear Creek in the 1999-2000 survey were based on limited historical water quality data collected during a single survey in 1986 (Smolka 1987). This survey collected data during a wetter-than-average period in southwestern New Mexico and many intermittent reaches in Bear Creek that appeared to be perennial dried up during the drought beginning in the mid-1990s.

Continuing efforts by the Surface Water Quality Bureau (SWQB) Watershed Protection Section (WPS) staff in Silver City to work with local private landowners has resulted in the availability of sampling sites on perennial reaches of Bear Creek. On November 10, 2005, SWQB Silver City WPS staff and SWQB Santa Fe Monitoring and Assessment Section (MAS) staff conducted limited data collection efforts at a perennial reach of Bear Creek downstream of Dorsey Spring. Data collected that day included one standard sample suite each for anions/cations, nutrients, dissolved metals, and total mercury/selenium. Procedures under the Nutrient Assessment Protocol were conducted, benthic macroinvertebrates were collected, and a fish survey was performed. Of considerable note, the fish survey proved the existence of a viable fishery comprised entirely of native species, including a previously unknown population of *Tiaroga cobitus* (loach minnow) which is classified as state and federally threatened (**Photo 1**).

Photo 1. Tiaroga cobitus (loach minnow) from Bear Creek.

2.0 Introduction

General Background

Located north of Silver City in the Pinos Altos Mountain Range, the Bear Creek Watershed drains approximately 179 square miles (464 km^2) in Grant County, New Mexico. The watershed sits at a geographical margin where the Mogollon-Datil section of the Colorado Plateau physiographic province meets the Basin and Range physiographic province.

Land in the watershed is predominately public land administered by the U.S. Forest Service (Gila National Forest), Bureau of Land Management, and New Mexico State Trust. Private land is mostly located along Bear Creek, along the eastern margin of the watershed, and in the western part of the watershed. The village of Pinos Altos is located near the eastern edge of the watershed along the Continental Divide at an elevation of about 7,000 feet. The village of Gila is located at the western edge of the watershed near the confluence of Bear Creek and the Gila River at an elevation of about 4,550 feet.

Bear Creek is best described as an interrupted perennial stream with intervening intermittent reaches, which have consistent flow in response to average snowmelt or monsoon seasons. Starting at the eastern upstream end of the watershed, the principle tributaries to Bear Creek are: Cherry Creek, Sycamore Creek, Walnut Creek, and Dorsey Canyon. The larger tributaries are intermittent and most of the remaining watercourses are classed as ephemeral. There are several productive springs in the watershed that feed perennial reaches including a reach of Bear Creek below Dorsey Spring that supports a robust native species fishery.

Climate

The upper reach of the Bear Creek watershed falls within Omernik ecoregion 23e (Arizona/New Mexico Mountains – Conifer Woodlands and Savannas), while the lower reaches are classified as ecoregion 23b (Arizona/New Mexico Mountains – Madrean Lower Montane Woodlands). (Griffith et al., 2006)

The climate of the Bear Creek Watershed is semiarid. In the village of Pinos Altos at the upstream end of the watershed, the average annual precipitation is about 21.3 inches (54.1 cm) and near the downstream end of the watershed the average is about 14.2 inches (36.1 cm) annually. Through the periods of record, the annual precipitation has ranged locally from a high of 31 inches (78.7 cm) to a low of 5 inches (12.7 cm). Most rain falls in the months of July, August and September, when warm moist monsoonal air flows from the south and generates intense thunderstorms. Cold weather storms from November through March bring additional rain and occasional snow leaving late spring/early summer and fall as the usual dry seasons. Potential evaporation loss in Grant County averages 64 inches a year (162.6 cm), exceeding the rate of precipitation by a ratio of nearly four to one. Summer temperatures average in the mid 80s to low 90s (30-35° C). Winter days are moderately warm with temperatures commonly near 50 degrees (10° C). Nights are cool, and temperatures often drop below freezing from mid-October until May.

Geology

The surrounding mountains that form the northern, eastern, and southern boundaries of the watershed are primarily the product of volcanic activity in the Oligocene epoch and more recent Basin and Range deformation that uplifted fault blocks of Mesozoic and Paleozoic marine sediments. The northern mountains of the watershed are dominated by extrusive igneous rocks (rhyolite, andesite, basaltic lava, and some volcaniclastic sediment). The eastern and southeastern mountains of the watershed expose intrusive igneous rocks (monzonite and granodiorite) and inter-bedded sediments (limestone, sandstone, and shale). Thick deposits of sand and gravel eroded from the nearby uplifted mountains fill the Cliff-Gila Basin in the southwestern and western part of the watershed.

Potential Impacts to Water Quality

Potential impacts to water quality are typical of many rural forested areas in the southwest and include both historic and current activities under the broad categories of agriculture, silviculture, mining, roads, and recreation.

Historic accounts in the local newspapers from more than 100 years ago indicate much higher stocking numbers for domestic animals such as cattle, horses, and sheep. Most of the animals were for support of mining and military operations. The need for wood as fuel and lumber coupled with stocking numbers that could not be supported in a semiarid climate resulted in uplands that were soon denuded of vegetative cover. More than seventy-five years of total fire suppression as an official policy of the U. S. Forest

Service coupled with historic grazing numbers and the need for wood exacerbated the changing vegetative of the uplands. These activities resulted in upland soil loss, widespread formation of gullies, and an increasing potential for catastrophic wildfire in the heavily forested areas of the Bear Creek Watershed. Current grazing practices still have the potential to impact water quality but stocking numbers are down significantly from historic levels. Best management practices for grazing such as excluding cattle from riparian areas, seasonal grazing, frequent pasture rotation, and monitoring range conditions are now commonly implemented on public lands.

Gold was discovered in the Pinos Altos Mining District in 1860 and mining has left waste rock and mill tailings in the upper part of the watershed (**Photo 2**). Placer gold claims were located and worked (channel and bank gravels) in the upper most part of Bear Creek and downstream to near Horseshoe Bend. Mining impacts from placer deposits occur in the form of piles of worked gravels within and along the channel, loss of riparian vegetation, stream bank destabilization, and disruption of fluvial process and landforms. Lode claims (hard rock mining) were located to mine the source of the placer deposits resulting in waste rock piles with mixed base metal sulfide ores. Weathering of base metal sulfides generates sulfuric acid dissolving the ores and putting metal ions into solution. Over the last decade, most interest in the old mining claims has been for potential subdivision development for residential homes. Some mining sites have been reclaimed such as the old Mammoth Mill site (**Photo 3**) and the Cyprus Mine but many sites remain as potential sources of pollution.

Parts of the Bear Creek Watershed have a high density of unimproved roads and erosion impacts from recreational off road vehicles are increasing. The Gila National Forest is developing plans to address off road vehicle use but the popularity of this kind of recreation is increasing and minor impacts to water quality can be expected. The main access to Bear Creek near Dorsey Spring is an unimproved road with as many as seven low water crossings per mile.

Presently catastrophic wildfire has the highest potential to severely impact water quality in the Bear Creek Watershed. The Gila National Forest has one of the most progressive programs in the nation to re-establish frequent low-intensity fire back into the ecology of the forest uplands and reduce the potential for catastrophic wildfire.

Photo 2. Historic mill tailings in upper Bear Creek Watershed

Photo 3. Post-reclamation Mammoth Mill Site.

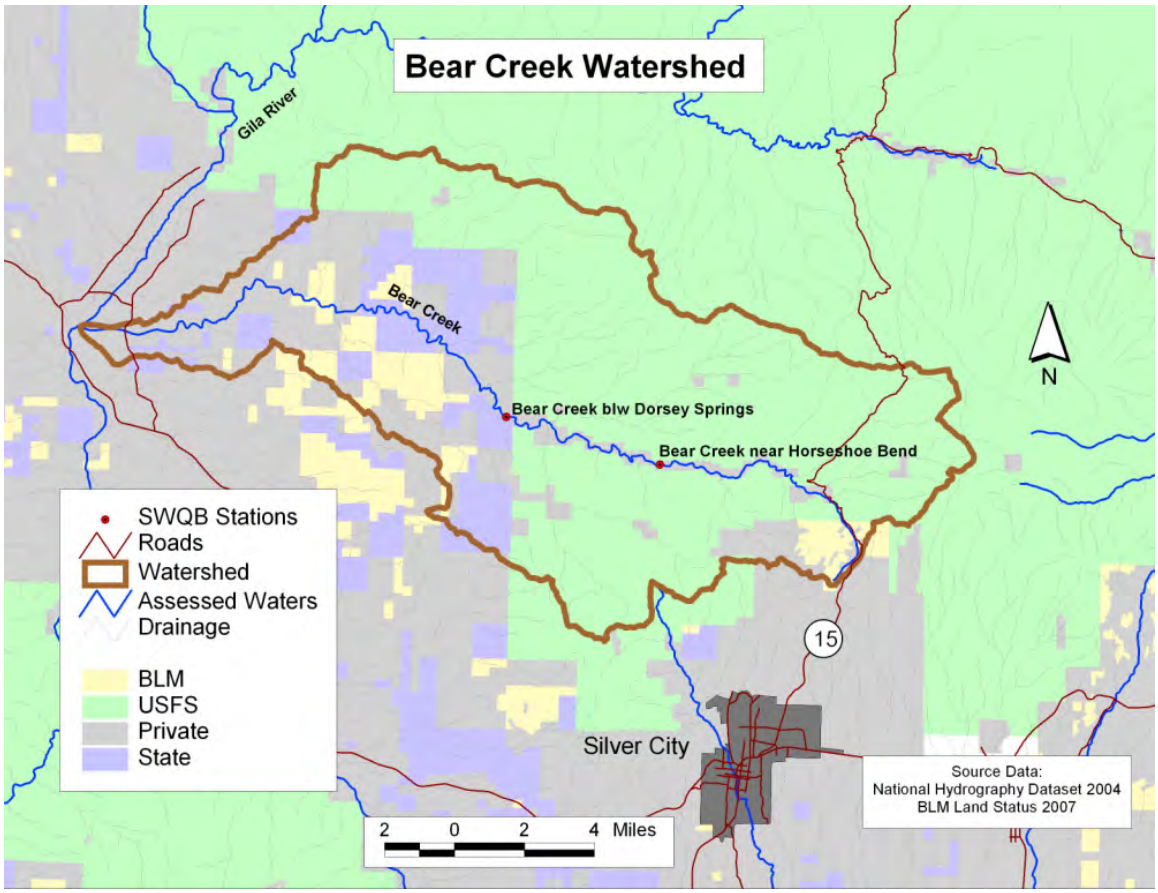

Figure 1. Map of Study Area – Drainage area is approximately 179 square miles (464 km^2).

3.0 Water Quality Standards Segments

The water quality standards for the subject waters fall within segment 20.6.4.502 NMAC. For this segment, the WQS state:

20.6.4.502 GILA RIVER BASIN - The main stem of the Gila river from Redrock canyon upstream to the confluence of the West Fork Gila river and East Fork Gila river and perennial reaches of tributaries to the Gila river below Mogollon creek.
A. Designated Uses: industrial water supply, irrigation, livestock watering, wildlife habitat, marginal coldwater aquatic life, primary contact and warmwater aquatic life.
B. Criteria:
(1) In any single sample: pH within the range of 6.6 to 9.0 and temperature 28°C (82.4°F) or less. The use-specific numeric criteria set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in
Subsection A of this section.

(2) The monthly geometric mean of E. coli bacteria 126 cfu/100 mL or less; single sample 410 cfu/100 mL or less (see Subsection B of 20.6.4.14 NMAC).
[20.6.4.502 NMAC - Rp 20 NMAC 6.1.2502, 10-12-00; A, 05-23-05]

4.0 Methods

Water quality, benthic macroinvertebrate and fish sampling methods were in accordance with the SWQB's Quality Assurance Project Plan for Water Quality Management Programs (QAPP) (NMED/SWQB, 2006). Water chemistry samples were collected monthly from March through November of 2006. Benthic macroinvertebrate and fish sampling occurred once in September 2006 and followed protocols for EPA's Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers (Barbour et al., 1999). Thermographs were deployed for the months of June and July to continuously monitor temperature. Sondes, capable of continuously monitoring pH and DO, were not deployed during the course of this survey.

5.0 Sampling Summary

A map of the study area is provided in **Figure 1**. The STORET identification codes and location descriptions and rationale of sampling stations selected for this survey are provided in **Table 1**. A summary of the current status of support or non-support of the designated uses for this watershed is provided in **Table 2**. There are no existing TMDLs for this watershed.

Table 1. Bear Creek Survey Stations and STORET Codes

SITE #	LATITUDE	LONGITUDE	STATION	STORET_ID	RATIONALE
1	32.92191	-108.39231	Bear Creek blw Dorsey Springs	78BearCr027.0	Perennial reach on State land, 10 miles downstream of Pinos Altos Mining District. Perennial reach, native fishery, needed for assessment.
2	32.90549	-108.31641	Bear Creek near Horseshoe Bend	78BearCr037.3	Perennial reach, native fishery, needed for assessment.

Table 2. Summary of 2008-2010 Integrated List.

Assessment Unit	Marginal Coldwater Aquatic Life	Fish Culture	Irrigation	Livestock Watering	Primary Contact*	Wildlife Habitat	Warmwater Fishery
Bear Creek (Gila River near Cliff to headwaters)	FS	FS	FS	FS	NA	FS	FS

NOTES: FS: Full Support; NS: Non-Support; NA: Not Assessed
* Primary Contact was not assessed because of the logistical difficulty arising from the short holding time for bacterial samples.

Table 3 summarizes data collected in each assessment unit and at each station. The number of times each parameter (or suite of parameters) was sampled is indicated (in the case of stream flow (discharge), some of the data are estimated or calculated). Field data include temperature, specific conductance, pH, dissolved oxygen, and turbidity.

Table 3. SWQB Sampling Summary

Assessment Unit / Station	Field Data	Ions	Total Nutrients	Mercury/Selenium	Dissolved Metals	Cyanides	Radionuclides	Organics (SVOCs)	Thermograph	Discharge	Macroinvertebrates	Electro-fished
Bear Creek (Gila River nr Cliff to headwaters)												
Bear Creek blw Dorsey Springs - 78BearCr027.0	9	8	9	9	9	1	1	1	yes	8	yes	yes
Bear Creek near Horseshoe Bend - 78BearCr037.3	7	7	7	6	7	1	-	-	yes*	7	-	-

* Thermograph was lost during a flood event.

6.0 Water Quality Assessment

6.1 Water Quality Standards Exceedences

The following discussion includes information pertaining to all exceedences of water quality standards (NMAC, 2007) found during the watershed survey. The purpose of this section of the report is to provide the reader with information on where current water quality standards are being exceeded within the watershed. These exceedences are used to determine designated use impairment status. For many water quality parameters, the State of New Mexico has adopted numeric water quality criteria. However, for several parameters (e.g., plant nutrients, stream bottom deposits), only narrative criteria exist.

Water quality standard exceedences are evaluated to determine if the waterbody is impaired, that is to say non-supporting of its designated use. It should be noted that an exceedence of a given criterion may or may not generate an impairment listing. In New Mexico, surface water data are assessed for designated use attainment status for both numeric and narrative water quality standards according to the SWQB *Assessment Protocol* (AP) (NMED/SWQB 2008a). The purpose of the AP is to detail the decision process that the SWQB employs to determine whether or not designated uses are being attained in surface waters of the state. Thus, the AP covers the decision making process for both listing and de-listing. The AP is an evolving document and the current protocol may vary from the procedures in place at the time these assessments were performed.

Final assessment determinations as to whether or not a stream reach is considered to be supporting its designated uses depend on the overall amount and type of data available during the assessment process (Refer to NMED/SWQB's *Assessment Protocol* for additional information on the assessment process, NMED/SWQB 2008a). When available, outside sources of data that meet quality assurance requirements are combined with data collected by SWQB during watershed surveys to determine final impairment status. Final designated use impairment status is housed in the Assessment Database (ADB) and is reported in the biennial *State of New Mexico Integrated Clean Water Act §303(d)/ §305(b) Report ("Integrated Report")* (NMED/SWQB 2008b).

6.1.1 Physicochemical Data

Physicochemical water quality sample type and frequencies are provided in **Table 3**. When a watershed survey is completed, all data are checked against Quality Assurance/Quality Control (QA/QC) measures identified in the QAPP before assessing to determine whether or not designated uses are being met.

Sampling for major ions, nutrients, total and dissolved metals, and field parameters found no exceedences of water quality criteria for any designated use (see section 3.0 above). Certain analytical suites, such as cyanide, radionuclides, and volatile organics, were sampled only once, on a screening basis. While an assessment cannot be performed on the basis of a single data point, no exceedences of applicable criteria were found in these analyses. A complete dataset can be obtained by contacting the SWQB.

6.1.2 Data from Continuous Monitoring Devices

Large datasets generated from data loggers (e.g., sondes and thermographs) are assessed according to protocols developed specifically for such datasets. This is because, unlike grab sample data, it is not reasonable to list as not supporting on the basis of one or a few exceedences out of several hundred or thousand data points. The pH and temperature assessment criteria are tied to the criteria in the *State of New Mexico Standards for Interstate and Intrastate Surface Waters* (NMAC 2007). Dissolved oxygen assessment criteria are linked to season (i.e., if early life stages of fish are likely present) and designated use (coldwater or warmwater aquatic life use). Details of large data set assessment procedures are available in the *Assessment Protocol*.

Temperature data loggers (thermographs) were deployed at both stations, but the instrument at the upper site (Horseshoe Bend) was washed away during a flood. The thermographs were programmed to record hourly. **Table 4** summarizes this dataset.

Table 4. Summary of Thermograph Data

Station Name	Data Collection Interval	WQS Temperature Criterion (°C)	Maximum Recorded Temperature (°C)	Total # of Data Points	# / % of Exceedences
Bear Creek blw Dorsey Spring	Hourly 06/01/2008 through 07/26/2008	28	26.84	1,328	0 / 0%

6.2 Stream Channel Morphology

One station was selected to characterize both channel morphology and substrate characteristics of Bear Creek. Summary data from the pebble count is located in **Table 5**. Additional field data including site maps, photos, distances, elevations, and graphical representations are available on request.

Table 5. Site-specific stream channel particle characteristics

Station Name	D84 mm	D50 mm	% Bedrock	% Boulder	% Cobble	% Gravel	% Sand	Silt/Clay	% Shaded	Stream Type
Bear Creek blw Dorsey Spring	350	22.6	0	14	28	43	15	0		

7.0 DISCUSION

Due to the large volume of data collected during this survey, it will not be included in this report. Those persons requiring a complete dataset or data from a specific site should contact the Surface Water Quality Bureau or search EPA's STORET database. All of the monitoring that was conducting is summarized in **Table 3**. Sampling for major ions, nutrients, total and dissolved metals, and field parameters found no exceedences of water quality criteria for any designated use (see section 3.0 above). Certain analytical suites, such as cyanide, radionuclides, and volatile organics, were sampled only once, on a screening basis. While an assessment cannot be performed on the basis of a single data point, no exceedences of applicable criteria were found in these analyses. A summary of the designated use attainment status for Bear Creek is provided in **Table 2**. This survey found no exceedences of any numeric criterion that led to a finding of non-support of a designated use.

8.0 REFERENCES

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