2.0 RIO HONDO BACKGROUND

The upper Rio Hondo Basin was intensively sampled by the Surface Water Quality Bureau (SWQB) from March to November 2003 and is addressed in this document. The Rio Hondo Basin includes perennial reaches of the Rio Hondo from the Pecos River to its headwaters, as well as tributaries that enter the Rio Hondo along those perennial reaches. Surface water quality monitoring stations were selected to characterize water quality of the stream reaches. Assessment units that will have a TMDL prepared in this document and those receiving de-list letters are discussed in their respective individual watershed sections. A number of assessment units could not be assessed due to insufficient data. These impairments will remain on the CWA Integrated §303(d)/§305(b) list of waters until additional data are available.

2.1 Location Description

The upper Rio Hondo watershed (US Geological Survey [USGS] Hydrologic Unit Code [HUC] 13060008) is located in Lincoln and Otero Counties and the Mescalero Apache Indian Reservation in southcentral New Mexico (NM). The entire Rio Hondo watershed encompasses approximately 1680 square miles (mi^2) in Lincoln County. The Rio Hondo watershed consists of two smaller subwatersheds of about equal area: the Rio Bonito and the Rio Ruidoso. Both subwatersheds lie east and south of the Capitan and Sacramento Mountains. The Rio Hondo is formed at the confluence of the Rio Bonito and Rio Ruidoso. Landscapes range from forested mountains to desert grasslands to vegetated riparian zones. As presented in Figure 2.1, land use is 45% forest, 33% grassland, 20% shrubland, 1% agricultural, and 1% urban. Figure 2.2 shows land ownership as 45% private, 28% US Forest Service (USFS), 19% Tribal Land, 5% Bureau of Land Management (BLM), and 3% State.

Several species within this watershed are listed as either threatened or endangered by both State and Federal agencies. Federally listed endangered species include the kuenzler's cactus (*Echinocereus fendleri var kuenzleri*), Rio Grande silvery minnow (*Hybognathus amarus*), and Pecos gambusia (*Gambusia nobilis*). Federally listed threatened species include the Mexican spotted owl (*Strix occidentalis lucida*). Additional species listed by the State as endangered include the godding's onion (*Allium gooddingii*). Additional species listed by the State as threatened include the Mexican tetra (*Astyanax mexicanus*), gray redhorse (*Moxostoma congestum*), Pecos pupfish (*Cyprinodon pecosensis*), greenthroat darter (*Etheostoma lepiddum*), Sacramento mountain salamander (*Aneides hardii*), and the broad-billed hummingbird (*Cynanthus laitrostris*).

The vegetation of the Lincoln County area includes Chihuahuan Desert, Mexican Highlands, Great Plains, and Rocky Mountain floras (Barker *et al*. 1991). Tourism is a major component of the economy in the upper Rio Hondo Basin. The relatively cool summer climate and snowy winter conditions support activities such as hiking, mountain biking, camping, fishing, as well as skiing and other winter sports. Ranching and irrigated agriculture are additional contributors to the local economies.

Figure 2.1 Rio HondoWatershed Land Use and 2003 Sampling Stations

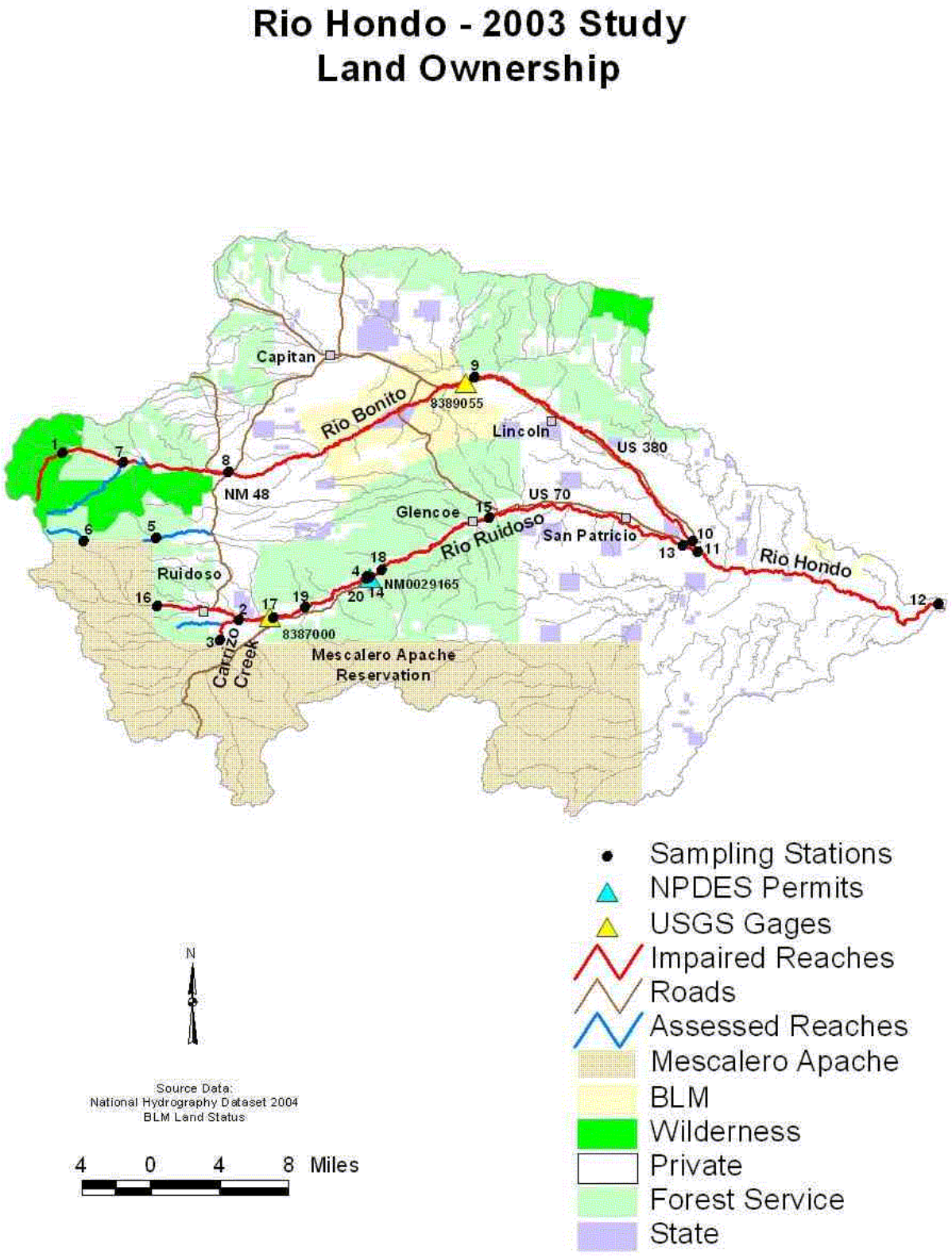


Figure 2.2 Rio Hondo Watershed Land Ownership

2.2 Geology and History

The geology of the Rio Hondo watershed consists of a complex distribution of Cretaceous intrusive rocks, Permian sedimentary rocks, and Cretaceous sedimentary rocks (Table 2.1, Figure 2.3). The high dome of Mt Sierra Blanca is an intrusion of Teriary igneous rocks associated with many nearby faults and dikes (Chronic 1987). Sierra Blanca is separated from the smaller Tertiary intrusions of the Carrizo and Capitan Mountains by the valley of soft, Cretaceous shale around its north end (*Ibid*). The Cenozoic igneous rocks of Sierra Blanca and the northwestern part of the Mescalero Apache Reservation include intrusive plugs, stocks, and dikes of the Sierra Blaca volcanic pile (Ahlen and Hanson 1986). Breccias and purplish-green porphyrys are commonly exposed on Sierra Blanca towards the Ski Area on Sierra Blanca Peak (*Ibid*). Cenozoic roks are also exposed on Sierra Blanca that include igneous intrusive, volcanic, and sedimentary rocks (*Ibid*). There are also glacial deposits in the cirque on the northeast slopes of the Peak at the head of the North Fork of the Rio Ruidoso (*Ibid*). San Andres Limestone formsthe surface between Tularosa and Ruidoso; the stream valleys in this watershed cut down into the red and yellow soil zone of the Yeso Formation (Chronic 1987). Cub Mountain Formation consists of white sandstone, multicolored siltstone, and light-colored igneous rocks (Ash and Davis 1964). The Yeso formation consists of beds of siltstone, sandstone, shale, limestone, anhydrite, gypsum, and salt and does not readily transmit water (Mourant 1963). The Yeso Formation was formed by the precipitation of gypsum and salt from an evaporating inland sea (Chronic 1987). The San Andres Limestone forms the aquifer for Roswell's water (*Ibid*). The upper part of the San Andres Limestone consists of dolomite and chert-limestone, as well as siltstone, sandstone, gypsum, anhydrite, and shale. The Artesia Formation consists of similar sedimentary rocks (Mourant 1963). The Cretaceous Dakota Sandstone consists of quartzose sandstone interbedded with grey shale and conglomerate (*Ibid*). Mancos Shale is black shale, limestone and sandstone while the Mesaverde Formation is grey, yellow, and buff quartzose sandstone, grey shale, and coal (*Ibid*).

Mining activity in Lincoln County has produced a number of minerals and metals including: gold, coal, iron, lead, copper, zinc, fluorite, gypsum, tungsten, and bastnaesite (Griswold 1959). Spaniards likely performed the earliest mining in Licoln County, but no evidence of their activity exists (*Ibid*). However, the first mining in Lincoln County by Americans appears to be a gold vein at the Helen Rae and American mines in 1868 (*Ibid*).

Three Rivers Petroglyphs (west of Sierra Blanca) is a mile-long display of pictures carved into the volcanic rock mostly made by prehistoric Native Americans and may be contemporary with the nearby Mimbres site dating from 900-1,000 A.D. (Ash and Davis 1964). Hale Springs (south of Ruidoso Downs) once fed a Native American irrigation ditch and the caliche formed in this ditch is used to line the driveways in the area (Ash and Davis 1964). One of the first battles of the Lincoln County War occurred at Blazer's Mill (southwest of Ruidoso) on April 5, 1878 when Billy the Kid and the McSween faction attempted to make an arrest (Ash and Davis 1964). The 116-mile Bontio pipeline built in 1908 supplied water for railroad and domestic use from Nogal Lake (Ash and Davis 1964). Bonito Lake was built in the 1930's to store the water from Nogal Lake when the first lake started leaking (Barker *et al.* 1991). As a cub, Smokey the Bear was rescued from a forest fire in Capitan Gap in 1950, nursed back to health, and flown to

Washington, D.C. to become the mascot for the U.S. Forest Service's fire prevention program (Ash and Davis 1964).

Table 2.1 Geologic Unit Definitions for the Rio Hondo

Geologic Unit Code	Definition
Kd	Dakota Sandstone; includes Oak Canyon, Cubero, and Paguate Tongues plus Clay Mesa Tongue of Mancos Shale; Cenomanian.
Km	Mancos Shale; divided into Upper and Lower parts by Gallup Sandstone
Kmv	Mesaverde Group includes the Gallup Sandstone, Crevasse Canyon Formation, Point Lookout Sandstone, Menelee Formation, and Cliff House Sandstone
Pal	Lower part of the Abo Formation
Pat	Artesia Group; shelf facies forming broad south-southeast trending outcrop from Glorieta to Artesia area; includes Grayburg, Queen, Seven Rivers, Yates, and Tansill Formations; Guadalupian. May locally include Moenkopi Formation (Triassic) on top.
Psa	San Andres Formation; limestone and dolomite with minor shale; Guadalupian in south, in part Leonardian to north.
Py	Yeso Formation; sandstones, siltstones, anhydrite, gypsum, halite, and dolomite; Leonardian.
QTp	Older piedmont alluvial deposits and shallow basin till; includes Quemado formation and in northeast, high level piedmont gravels.
Qal	Alluvium, middle and upper Quaternary.
TKi	Paleogene and Upper Cretaceous intrusive rocks; includes Hanover, Fierra, Tyrone, and Lordsburg granediorite-quartz manzonile perphries.
TR	Triassic rocks, general.
Tbc	Tertiary sediments, including Baca Formation and Cub Mountain Formation
Tvl	Tertiary volcanics
pC	Precambrian rocks, undifferentiated.

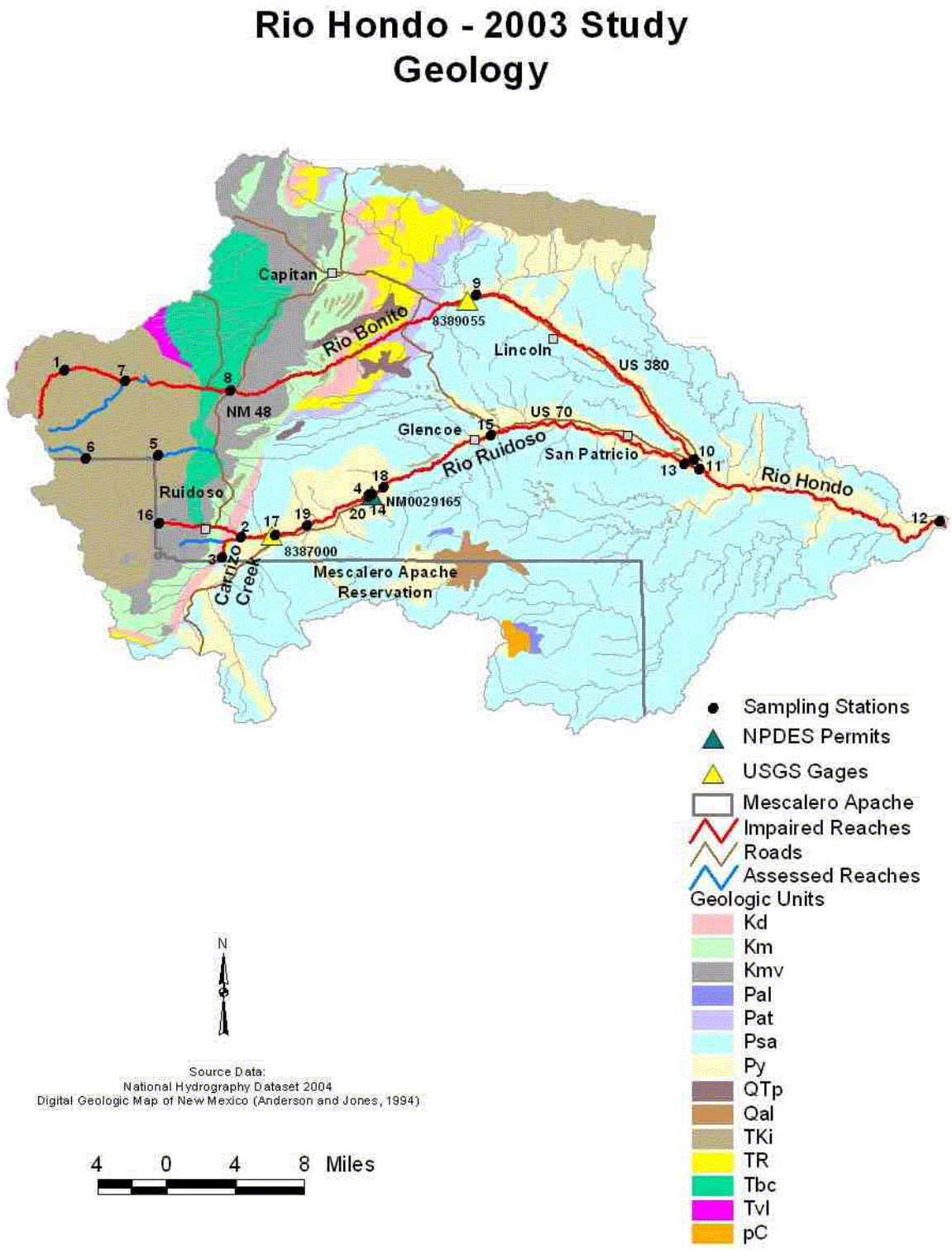


Figure 2.3 Rio Hondo Watershed Geology

2.3 Water Quality Standards

Water quality standards (WQS) for all assessment units in this document are set forth in sections, 20.6.4.208 and 20.6.4.209 of the *NM Standards for Interstate and Intrastate Surface Waters* (NM Administrative Code [NMAC] 20.6.4) (NMAC 2002).

20.6.4.208 **PECOS RIVER BASIN -** Perennial reaches of the Rio Peñasco and its tributaries above state highway 24 near Dunken, perennial reaches of the Rio Bonito downstream from state highway 48 (near Angus), the Rio Ruidoso downstream of the U.S. highway 70 bridge near Seeping Springs lakes, perennial reaches of the Rio Hondo, and Agua Chiquita.

A. Designated Uses: fish culture, irrigation, livestock watering, wildlife habitat, coldwater fishery, and secondary contact.

B. Criteria:

(1) In any single sample: pH within the range of 6.6 to 8.8, temperature shall not exceed 30°C (86°F) and total phosphorus (as P) less than 0.1 mg/L. 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 fecal coliform bacteria 200/100 mL or less; single sample 400/100 mL or less (see Subsection B of 20.6.4.13 NMAC).

20.6.4.209 **PECOS RIVER BASIN** –Eagle creek above Alto reservoir, the Rio Bonito upstream of state highway 48 (near Angus), and the Rio Ruidoso and its tributaries upstream of the U.S. highway 70 bridge near Seeping Springs lakes.

A. Designated Uses: domestic water supply, fish culture, high quality coldwater fishery, irrigation, livestock watering, wildlife habitat, municipal and industrial water supply and secondary contact.

B. Criteria:

(1) In any single sample: conductivity shall not exceed 600 µmhos/cm in Eagle creek, 1,100 µmhos in Bonito creek, and 1,500 µmhos in the Rio Ruidoso, pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F), and turbidity shall not exceed 10 NTU. 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 fecal coliform bacteria 100/100 mL or less; single sample shall exceed 200/100 mL or less (see Subsection B of 20.6.4.14 NMAC).

NMAC 20.6.4.900 provides standards applicable to attainable or designated uses unless otherwise specified in 20.6.4.101 through 20.6.4.899. NMAC 20.6.4.12 lists general standards that apply to all surface waters of the state at all times, unless a specified standard is provided elsewhere in NMAC (2002).

The New Mexico Environment Department (NMED) proposed several modifications to the New Mexico WQS during the February 2004 triennial review hearing. Changes that will potentially affect the Rio Hondo watershed are:

- Changing the criteria related to contact uses from fecal coliform to *E. coli* (monthly geometric mean of 126 colony forming units (cfu)/100 mL or less in 20.6.4.208 and 20.6.4.209, single sample 410 cfu/100 mL in 20.6.4.208, and single sample 235 cfu/100 mL in 20.6.4.209).

- The segment-specific turbidity criteria has been replaced with the following language applicable to all surface waters:

> **Turbidity**: Turbidity attributable to other than natural causes shall not reduce light transmission to the point that the normal growth, function or reproduction of aquatic life is impaired or that will cause substantial visible contrast with the natural appearance of the water. Turbidity shall not exceed 10 NTU over background turbidity when the background turbidity is 50 NTU or less, or increase more than 20 percent when the background turbidity is more than 50 NTU. Background turbidity shall be measured at a point immediately upstream of the turbidity-causing activity. However, limited-duration activities necessary to accommodate dredging, construction or other similar activities and that cause the criterion to be exceeded may be authorized provided all practicable turbidity control techniques have been applied and all appropriate permits and approvals have been obtained.

The State of New Mexico Water Quality Control Commission (WQCC) adopted the proposed WQS changes as of July 17, 2005. However, pending USEPA approval of these new proposed WQS, water quality data were assessed and TMDLs for the Rio Hondo watershed were prepared using the existing WQS (NMAC 2002). Adoption of the new WQS will not affect the turbidity TMDL in this document. Until there is an understanding as to the background levels of turbidity, the existing numeric criteria will be used for assessments. The fecal coliform TMDLs in this document will likewise not be affected, but future studies will incorporate the collection of *E. coli* samples in order to make assessments based on the new standards.

2.4 Intensive Water Quality Sampling

The Rio Hondo watershed was intensively sampled by the SWQB in 2003. A brief summary of the survey and the hydrologic conditions during the intensive sample period is provided in the following subsections.

2.4.1 Survey Design

Surface water quality samples were collected monthly between March and November for the 2003 intensive SWQB study. Temperature data also were collected in 2003. Surface water quality monitoring stations were selected to characterize water quality of various assessment units (i.e., stream reaches and reservoirs) throughout the basin (Table 2.2, Figures 2.1 through 2.3). The locations of 2003 thermograph deployment in the Rio Hondo watershed are described in Section 7.0 (Table 7.1 and Figure 7.1). Stations were located to evaluate the impact of tributary streams and to determine ambient water quality conditions. Data results from grab sampling are housed in the SWQB provisional water quality database and will be uploaded to USEPA's Storage and Retrieval (STORET) database. A water quality survey report is not yet available for this study.

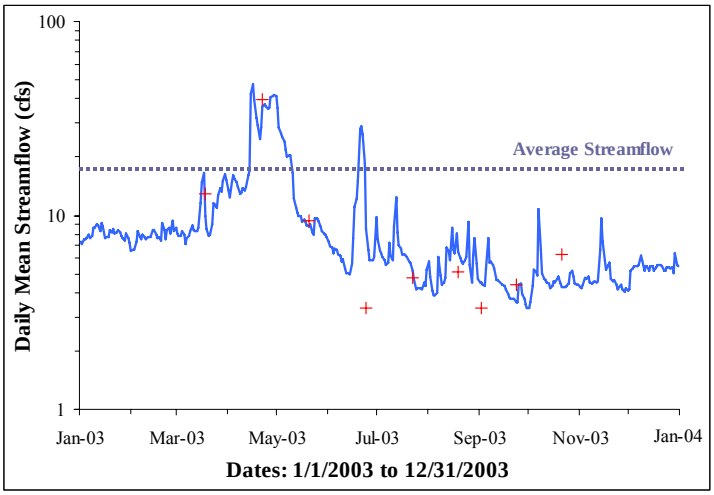
All temperature and chemical/physical sampling and assessment techniques are detailed in the *Quality Assurance Project Plan* (QAPP, NMED/SWQB 2001) and the SWQB assessment protocols (NMED/SWQB 2004b). As a result of the 2003 monitoring effort and subsequent assessment of results, several surface water impairments were determined. Accordingly, these impairments were added to New Mexico's 2004-2006 CWA Integrated §303(d)/305(b) list (NMED/SWQB 2004a).

Table 2.2 SWQB 2003 Rio Hondo Sampling Stations

Station	Station Location
1	Bonito Creek @ White Mountain Wilderness Bounday
2	Carrizo Creek above the Rio Ruidoso
3	Carrizo Creek at Mescalero Boundary
4	City of Ruidoso New WWTP Outfall Pipe
5	Eagle Creek at USGS gage
6	N Fk Rio Ruidoso blw Ski Lodge
7	Rio Bonito abv Bonito Lk at FR 107 blw Bonito S.
8	Rio Bonito at Angus Bridge
9	Rio Bonito at BLM Orchard Site near Lincoln, NM
10	Rio Bonito at Hwy 70 bridge near Hwy 380 bridge
11	Rio Hondo 100 yds below confluence
12	Rio Hondo below Riverside on Rio Hondo Land and Cattle property
13	Rio Ruidoso 1 mi abv Rio Bonito at San Patricio
14	Rio Ruidoso 10 feet above WWTP outfall
15	Rio Ruidoso 7 miles below WWTP at Glencoe-FR 443
16	Rio Ruidoso at Mescalero Boundary at Gage
17	Rio Ruidoso at USGS Gaging Station at Hollywood
18	Rio Ruidoso below New WWTP
19	Rio Ruidoso below Ruidoso Downs Racetrack Property
20	Ruidoso 0.5 mile above WWTP at Hwy 70 Bridge above Seeping Springs

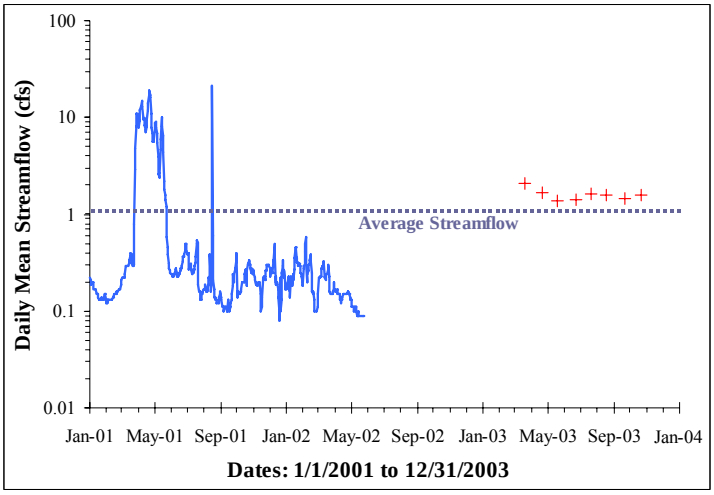
2.4.2 Hydrologic Conditions

There are two U.S. Geological Survey (USGS) gaging stations in the Rio Hondo watershed that are associated with reaches presented in this document. USGS gage locations are presented in Figures 2.1 through 2.3. Daily streamflow for the pertinent gages are presented graphically in Figures 2.4 and 2.5.



EXPLANATION: —— DAILY MEAN STREAMFLOW + SWQB MEASURED STREAMFLOW
▪▪▪▪ AVERAGE YEARLY STREAMFLOW

Figure 2.4 Daily Mean Streamflow: USGS 08387000 Rio Ruidoso at Hollywood, NM (2003)



EXPLANATION: —— DAILY MEAN STREAMFLOW + SWQB MEASURED STREAMFLOW
▪▪▪▪ AVERAGE YEARLY STREAMFLOW

Figure 2.5 Daily Mean Streamflow: USGS 08389055 Rio Bonito near Lincoln, NM (01-02) and SWQB measured streamflow at Rio Bonito near Lincoln, NM (2003)

Flows in Rio Ruidoso (USGS Gage 08387000) during the 2003 survey year were below average based on the period of record, which spans from 1953 to present. Flows in Rio Bonito (USGS Gage 08389055) during the 2003 survey were about average based on the period of record, which spans from 1999-2002. For comparison, the instantaneous discharge measured by SWQB during the intensive survey is shown on Figures 2.4 and 2.5. Since the USGS Gage 08389055 (Rio Bonito near Lincoln, NM) was discontinued in 2002, the real-time, daily mean streamflow was not measured. As stated in the Assessment Protocol (NMED/SWQB 2004b), data collected during all flow conditions, including low flow conditions (i.e., flows below the 4-day, 3-year low-flow frequency [4Q3]), will be used to determine designated use attainment status during the assessment process. In terms of assessing designated use attainment in ambient surface waters, WQS apply at all times under all flow conditions.