# WATER QUALITY SURVEY SUMMARY

## FOR SELECT

## MIDDLE RIO GRANDE TRIBUTARIES

**(SURVEY YEAR 2005, PLUS ADDITIONAL MONITORING 2000-2009)**


Prepared by

Surface Water Quality Bureau
New Mexico Environment Department

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***Cover Photo:*** *Santa Fe River immediately below City of Santa Fe WWTP effluent channel during municipal reservoir spring release (04/29/10)*

## TABLE OF CONTENTS



## LIST OF TABLES



## LIST OF FIGURES

## LIST OF ACRONYMS

| | |
|---|---|
| ALU | Aquatic Life Use |
| AU | Assessment Unit |
| BLM | Bureau of Land Management |
| BMP | Best Management Practice |
| CWA | Clean Water Act |
| DO | Dissolved Oxygen |
| MAS | Monitoring and Assessment Section |
| NMAC | New Mexico Administrative Code |
| NPDES | National Pollutant Discharge Elimination System |
| PC | Primary Contact |
| PCBs | Polychlorinated biphenyls |
| RGA | Rapid Geomorphic Assessment |
| RHA | Rapid Habitat Assessment |
| SC | Secondary Contact |
| SCI | Stream Condition Index |
| SFNF | Santa Fe National Forest |
| STORET | Storage and Retrieval System |
| SWQB | Surface Water Quality Bureau |
| TMDL | Total Maximum Daily Load |
| UAA | Use Attainability Analysis |
| USEPA | United States Environmental Protection Agency |
| USFWS | United States Fish and Wildlife Service |
| WPS | Watershed Protection Section |
| WQCC | Water Quality Control Commission |
| WQS | Water Quality Standards |
| WWTP | Wastewater Treatment Plant |

## EXECUTIVE SUMMARY

During 2005, the Monitoring and Assessment Section (MAS) of the Surface Water Quality Bureau (SWQB) conducted water quality surveys of the Middle Rio Grande and several tributaries from Tijeras Arroyo near Albuquerque, NM, to the Santa Fe River. Information on the water quality of the mainstem of the Middle Rio Grande can be found in two separate reports available on the SWQB web site (NMED/SWQB 2008a, 2009a). Tributaries of the Middle Rio Grande sampled during the 2005 survey included Abo Arroyo, Cienega Creek, Las Huertas Creek, Rio Salado, San Pedro Creek, Santa Fe River, and Tijeras Arroyo. Sampling at select tributary stream stations was conducted on a monthly basis from March through October when water was present at the station. A significant amount of additional sampling has occurred on the Santa Fe River including: limited stormwater sampling occurred at non-perennial stations through the city of Santa Fe during the 2005 monsoon season; limited sampling for polychlorinated biphenyls (PCBs) at select stations in 2007; bacteria, ions, and nutrients sampling at select stations through the city of Santa Fe in 2008; and finally SWQB Watershed Protection Section (WPS) has conducted water quality monitoring at four stations in the Santa Fe Municipal Watershed during 2000-2004, 2006 and 2007.

The primary purpose of the 2005 water quality survey was to collect chemical, physical, and biological data to evaluate water quality within the tributary watersheds. The data collected were assessed against New Mexico Water Quality Standards (WQS; NMAC 2007). Water quality impairment conclusions are summarized in the Integrated List portion of the biennial *State of New Mexico Integrated Clean Water Act §303(d)/305(b) Report* (NMED/SWQB 2010). It is important to note that both the assessment protocols and water quality standards are revised periodically to incorporate new information and refinements. Any assessment conclusions presented in this report are based on water quality standards and assessment protocols that existed at the time the report was developed. The U.S. Environmental Protection Agency (USEPA) uses the most recent state-developed assessment protocols and the most recent USEPA-approved water quality standards when deciding whether or not to approve impairment determinations on the biennial Integrated List. Therefore, the current impairment conclusions in the Integrated List supersede assessment conclusions in this survey report if they should differ.

Core water quality monitoring at survey stations included basic field parameters, major anions and cations, total nutrients, total and dissolved metals, and *E. coli*. Additional parameters monitored based on study objectives and proximity to potential sources and/or previous survey findings included radionuclides, organics, and PCBs. Data loggers were deployed at select stations to collect temperature, pH, dissolved oxygen (DO), conductivity, and turbidity data for two to seven days to monitor diurnal fluctuations. Biological surveys were conducted at select stations and included the collection of benthic macroinvertebrates, periphyton, fish, and associated habitat data.

Water quality in several of the Middle Rio Grande Tributaries surveyed was found to exceed a number of water quality standards. No impairments were noted in Abo Arroyo, Cienega Creek, or Rio Salado. Documented findings of surface water quality impairment are as follows:

- ***E. coli*:** Available data exceed the applicable criterion in the Santa Fe River through the city of Santa Fe (i.e., Santa Fe WWTP to Nichols Reservoir) during stormwater sampling.

- **Nutrients:** Assessment of available data indicate nutrient enrichment in portions of the Santa Fe River below the city of Santa Fe, Las Huertas Creek, and Tijeras Arroyo.

- **Dissolved Oxygen:** Assessment of available data indicate insufficient levels of dissolved oxygen in portions of the Santa Fe River below the city of Santa Fe.

- **Turbidity:** Available water quality data exceed the historic segment-specific criterion of 25 NTU in Las Huertas Creek and 50 NTU in the Santa Fe River between Cochiti Reservoir and Paseo del Canon. Available benthic macroinvertebrate data for these reaches confirm impairment.

- **PCBs:** Available data exceed the applicable criterion in the Santa Fe River (Santa Fe WWTP to Nichols Reservoir) during stormwater sampling.

- **Sedimentation/Siltation:** Excessive sedimentation was documented in the Santa Fe River between Cochiti Reservoir and Paseo del Canon. San Pedro Creek and Tijeras Arroyo were listed for Benthic-Macroinvertebrate Bioassessments as the reason for the suppressed benthic macroinvertebrate community is unknown based on available data.

- **Aluminum:** Available data exceed the applicable criterion in the Santa Fe River (Santa Fe WWTP to Nichols Reservoir) during both stormwater sampling and during the spring reservoir release.

## 1.0 INTRODUCTION

The Monitoring and Assessment Section (MAS) of the Surface Water Quality Bureau (SWQB) conducted a water quality survey of select Middle Rio Grande tributaries in 2005 between March and November. This water quality survey included 18 sampling sites (Figures 1 and 2, Table 1). Monitoring these sites enabled an assessment of the cumulative influence of the physical habitat, water sources, and land management activities upstream from the sites. Several sites were sampled 8 times, whereas some secondary sites were sampled only one to four times. In addition, limited stormwater sampling occurred in the Santa Fe River through the city of Santa Fe during the 2005 monsoon season, as well as limited sampling for polychlorinated biphenyls (PCBs) at select stations on the Santa Fe River during the June 2007 municipal reservoir release. Also, stations with flow through the city of Santa Fe during the 2008 reservoir release were sampled for E. coli, nutrients, and ions in response to a request by the Santa Fe Watershed Association.

As part of a watershed restoration effort, the SWQB Watershed Protection Section (WPS) conducted water quality monitoring at four stations in the Santa Fe Municipal Watershed from 2000-2004, 2006 and 2007 during spring, summer, and fall (stations 11 – 14 in Figure 2). Snowmelt runoff from this watershed provides a substantial portion of Santa Fe's water supply. Surface water is captured and stored in two reservoirs managed by the city. Forest thinning projects aimed at reducing fuel loads and improving water quality began in the Santa Fe Municipal Watershed in 2003. Monitoring was conducted in both treated and control locations in the watershed. Parameters measured included nutrients, organics, radionuclides, ions, dissolved metals, metals, bacteria, cyanide, pH, dissolved oxygen, temperature, conductivity, and turbidity. Fish and benthic macroinvertebrates populations were also surveyed along with fluvial geomorphology measurements (Rosgen 1996). Water quality data collected during this effort were combined with data from the 2005 Middle Rio Grande survey to make impairment determinations for the Integrated List (NMED/SWQB 2010). In addition, a professional project report was developed by a University of New Mexico master's candidate to evaluate the relationship between forest thinning and selected water quality parameters collected from 2000-2004, including total dissolved solids, electrical conductivity, total suspended solids, turbidity, calcium, magnesium, total Kjeldahl nitrogen, total organic carbon, total phosphorous, precipitation, water yield, and discharge (Arvidson 2006).

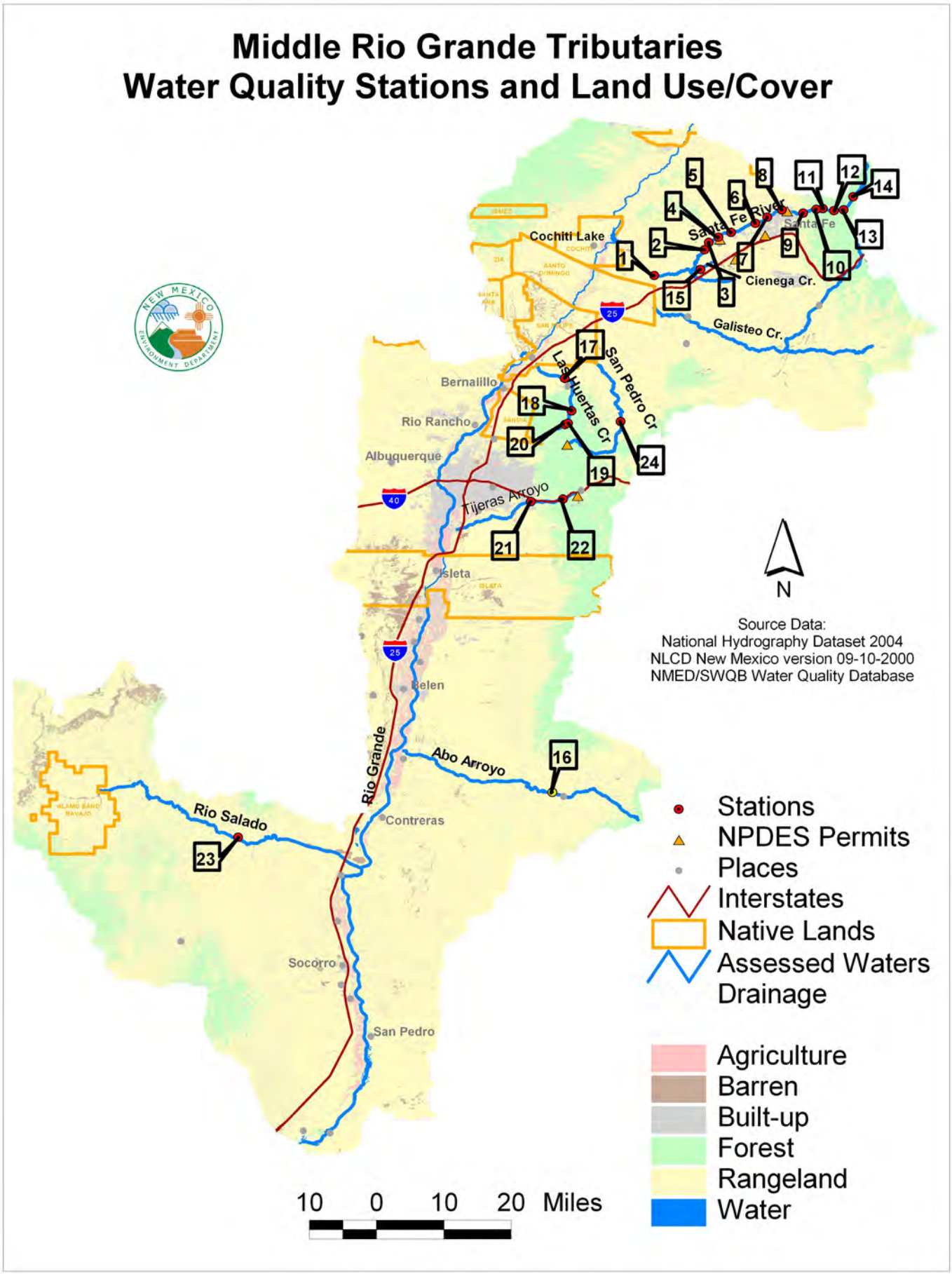


**Figure 1. Location of Middle Rio Grande tributary watershed sampling stations**

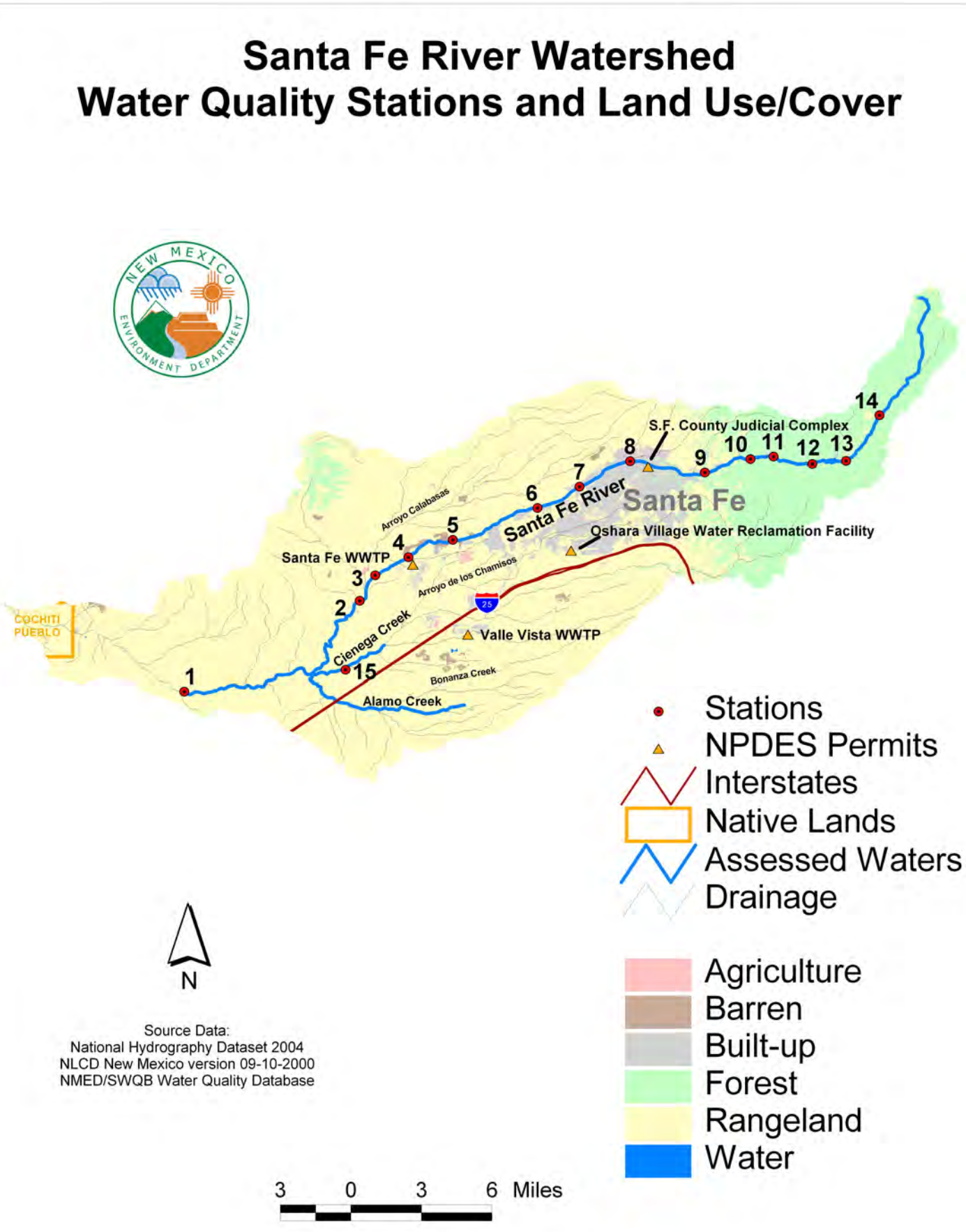


**Figure 2. Location of Santa Fe River sampling stations**

**Table 1. Middle Rio Grande tributary sampling stations**

| STATION # | Assessment Unit / Station Name | STORET/ WQX ID | AU/ Station Rationale | WQS Reference (Aug 2007) |
|---|---|---|---|---|
| | Abo Arroyo (Rio Grande to headwaters) | | Tributary to MRG; no previous data | 20.6.4.103 |
| ***16*** | Abo Arroyo blw Hwy 60 | 32AboArr037.7 | Bottom of AU | |
| | Cienega Creek (Santa Fe River to headwaters) | | Tributary to Santa Fe River; previously listed as impaired | 20.6.4.113 |
| ***15*** | Cienega Creek 0.3 miles below bridge in La Cienega | 30LaCien002.1 | Near bottom of AU – access denied at confluence with Santa Fe River | |
| | Las Huertas Creek (perennial portion Santa Ana Pueblo bnd to headwaters) | | Tributary to MRG; previously listed as impaired; watershed restoration project | 20.6.4.111 |
| 20 | Las Huertas @ Ellis Ranch Upper Spring | 30LHuert023.2 | BMP implementation | |
| 19 | Las Huertas below Ellis Ranch | 30LHuert022.5 | BMP implementation | |
| ***18*** | Las Huertas Creek blw Caves | 30LHuert019.0 | BMP implementation | |
| ***17*** | Las Huertas Creek @ Tres Amigos Rd | 30LHuert010.0 | Bottom of AU | |
| | Rio Salado (Rio Grande to Alamo Navajo bnd) | | Tributary to MRG above Sevilleta NWR; no previous data | 20.6.4.98* |
| ***23*** | Rio Salado 1 mile above The Box | 38RSalad030.0 | Bottom of AU | |
| | San Pedro Creek (San Felipe bnd to headwaters) | | Tributary to MRG; no previous data | 20.6.4.125 |
| ***24*** | San Pedro Creek @ Conservation Easement | 30SanPed011.1 | Bottom of AU | |
| | Santa Fe River (Nichols Rsvr to headwaters) | | Perennial reach above city of Santa Fe in municipal watershed; forest thinning restoration project | 20.6.4.121 |
| 14 | Santa Fe River at lower wilderness boundary | 30SantaF064.9 | BMP implementation | |
| 13 | Santa Fe River above McClure Reservoir at gage | 30SantaF061.1 | BMP implementation | |
| 12 | Santa Fe River above Nichols Reservoir at gage 08316000 | 30SantaF059.1 | BMP implementation | |
| 11 | Santa Fe River approx 500 m above Nichols Reservoir | 30SantaF056.7 | Bottom of AU; BMP implementation | |
| | Santa Fe R (Santa Fe WWTP to Nichols Rsvr) | | Intermittent reach through the city of Santa Fe depending on municipal reservoir release | 20.6.4.98* |
| 10 | Santa Fe River at Nichols Reservoir outfall | 30SantaF055.3 | Top of AU | |
| ***9*** | Santa Fe River below Cerro Gordo RD | 30SantaF052.4 | Downstream of municipal reservoir release | |
| ***8*** | Santa Fe River blw St Francis Dr. | 30SantaF047.9 | | |
| 7 | Santa Fe River below Frenchies Field | 30SantaF044.5 | | |
| ***6*** | Santa Fe River @ CRd 68A | 30SantaF041.2 | | |
| ***5*** | Santa Fe River above Hwy 599 | 30SantaF035.9 | Bottom of AU | |

| STATION # | Assessment Unit / Station Name | STORET/ WQX ID | AU/ Station Rationale | WQS Reference (Aug 2007) |
|---|---|---|---|---|
| | Santa Fe River (Paseo del Canon to Santa Fe WWTP) | | Effluent-dominated reach below city of Santa Fe (except during substantial municipal reservoir release); previous impairment listings | 20.6.4.113 |
| ***4*** | Santa Fe River at effluent channel outfall | NM0022292-M | WWTP effluent water quality | |
| 3 | Lower Santa Fe River Preserve | 30SantaF030.5 | Downstream end of phase one BMP implementation | |
| 2 | Santa Fe River above CRd 56 | 30SantaF028.4 | Bottom of AU | |
| | Santa Fe River (non-pueblo, Cochiti Rsvr to Paseo del Canon) | | Effluent-dominated reach below city of Santa Fe (except during substantial municipal reservoir release); previous impairment listings | 20.6.4.113 |
| ***1*** | SANTA FE RIVER above Cochiti AT USGS GAGE 08317200 | 30SantaF012.9 | Bottom of AU; historic sampling location | |
| | Tijeras Arroyo (Rio Grande to headwaters) | | Tributary to MRG; no previous data | 20.6.4.99** |
| ***21*** | TIJERAS ARROYO AT FOUR HILLS BRDG AT ALBQ, NM | 32Tijera021.0 | Bottom of AU | |
| ***22*** | Tijeras Arroyo blw Deadmans Curve | 32Tijera027.2 | | |

**NOTES:**

***BOLD ITALIC MAP #*** = station in 2005 Middle Rio Grande tributaries water quality survey
AU = assessment unit; WWTP = wastewater treatment plant; BMP = best management practice; blw = below
* = This unclassified AU may be ephemeral or intermittent; however, per EPA Region 6 instruction, it is being noted under 20.6.4.98 at this time. Marginal warmwater aquatic life (MWWAL) and primary contact (PC) are presumed uses for all waters noted as 20.6.4.98.
** = This entire AU may not be perennial. Per EPA Region 6 instruction, warmwater aquatic life (WWAL) and primary contact (PC) are presumed uses for all waters noted as 20.6.4.99.

## 1.1 Land/cover and ownership

There were seven tributary watersheds to the Middle Rio Grande sampled during the 2005 survey. Historic and current land uses in these watersheds include farming, ranching, forestry, and residential/commercial related activities. Much of the land ownership is private including ownership by several pueblos, but the United States Forest Service (USFS), Bureau of Land Management (BLM), US Fish and Wildlife Service (USFWS), and State of New Mexico also own and manage tracts of public lands in the watersheds. These watersheds are located in Omernick Level III ecoregions 21 (Southern Rockies), 22 (Arizona/New Mexico Plateau) and 23 (Arizona/New Mexico Mountains). The elevation range for the various watersheds in the survey spanned from 1,430 to 3,530 meter (4,700 to 11,580 feet above sea level.

Land use/cover and ownership information specific to each tributary watershed based on the National Landcover GIS grid is presented below and in Figures 1 and 2 above:

- The **Abo Arroyo** watershed ranges from 1,450 to 2,097 meters (4,760 to 6,880 feet) in elevation, and covers approximately 989 $km^2$ (382 square miles $mi^2$). Primary land use/cover include 61%

grassland, 27% shrubland, 11% forested upland, and <1% developed residential or commercial uses. Land ownership is 71% private, 14% USFS, 9% state, 4% BLM, and 1% USFWS.

- The **Cienega Creek** watershed ranges from 1,786 to 1,834 meters (5,860 to 6,020 feet) in elevation, and covers approximately 181 $km^2$ (70 $mi^2$). Primary land use/cover includes 62% grassland, 10% shrubland, 15% forested upland, and 11% developed residential or commercial uses. Land ownership is 81% private, 12% USFS, 6% state, and 1% BLM. Arroyo de Los Chamisos (the largest arroyo network through the city of Santa Fe) and Arroyo Hondo are major tributaries to Cienega Creek.
- The **Las Huertas Creek** watershed ranges from 1,609 to 2993 meters (5,280 to 9,820 feet) in elevation, and covers approximately 78 $km^2$ (30 $mi^2$). Primary land use/cover include 20% grassland, 20% shrubland, 60% forested upland, and <1% developed residential or commercial uses. Land ownership is 33% private, 57% USFS, 2% Santa Ana pueblo, and 7% BLM.
- The **Rio Salado** watershed ranges from 1,433 to 1,804 meters (4,702 to 5,920 feet) in elevation, and covers approximately 2,849 $km^2$ (1,100 $mi^2$). Primary land use/cover include 16% grassland, 58% shrubland, 22% forested upland, 3% barren, and <1% developed residential or commercial uses. Land ownership is 34% private, 17% USFS, 22% Navajo Nation (Alamo band), 14% BLM, 7% USFWS, and 4% state. The Rio Salado flows through the Sevilleta National Wildlife Refuge before entering the Middle Rio Grande.
- The **San Pedro Creek** watershed ranges from 1,688 to 2,746 meters (5,540 to 9,010 feet) in elevation, and covers approximately 502 $km^2$ (194 $mi^2$). Primary land use/cover include 49% grassland, 23% shrubland, 27% forested upland, and <1% developed residential or commercial uses. Land ownership is 70% private, 11% USFS, 14% San Felipe pueblo, and 4% BLM.
- The **Santa Fe River** watershed ranges from 1,676 to 3,530 meters (5,500 to 11,580 feet) in elevation, and covers approximately 663 $km^2$ (256 $mi^2$). Primary land use/cover includes 68% grassland, 9% shrubland, 17% forested upland, and 6% developed residential or commercial uses. Land ownership is 59% private, 21% USFS, 4% state, 6% Cochiti Pueblo, and 9% BLM. The 6% noted as "developed" is likely an underestimate in the National Landcover grid based on the inability to discern developed lands in thick pinon – juiper areas in the city of Santa Fe from this GIS coverage.
- The **Tijeras Arroyo** watershed ranges from 1,518 to 1,996 meters (4,980 to 6,550 feet) in elevation, and covers approximately 342 $km^2$ (132 $mi^2$). Primary land use/cover includes 13% grassland, 24% shrubland, 58% forested upland, and 3% developed residential or commercial uses. Land ownership is 34% private, 47% USFS, 17% US Department of Defense (DOD), and 1% state. The Tijeras Arroyo flows through Kirtland Air Force Base before entering the Middle Rio Grande.

## 2.0 NEW MEXICO WATER QUALITY STANDARDS

State water quality standards constitute the baseline of water quality standards (WQS) in effect for Clean Water Act purposes. The United States Environmental Protection Agency (USEPA) approved water quality standards were used to determine if waterbodies throughout the watershed are supporting their designated uses. The applicable WQS for Middle Rio Grande tributary assessment units covered in this report are set forth in sections 20.6.4.98, 20.6.4.99, 20.6.4.103, 20.6.4.111, 20.6.4.113, 20.6.4.121, and 20.6.4.125 of the *State of New Mexico Standards for Interstate and Intrastate Surface Waters* (NMAC 2007).

**20.6.4.98 INTERMITTENT WATERS - All intermittent surface waters of the state that are not included in a classified water of the state in 20.6.4.101 through 20.6.4.899 NMAC.**

**A. Designated Uses:** livestock watering, wildlife habitat, aquatic life and secondary contact.

**B. Criteria:**

**(1)** The use-specific criteria in 20.6.4.900 NMAC.

**(2)** The monthly geometric mean of E. coli bacteria shall not exceed 548 cfu/100 mL, no single sample shall exceed 2507 cfu/100 mL (see Subsection B of 20.6.4.14 NMAC).

[20.6.4.98 NMAC - N, 05-23-05]

**20.6.4.99 PERENNIAL WATERS - All perennial surface waters of the state that are not included in a classified water of the state in 20.6.4.101 through 20.6.4.899 NMAC.**

**A. Designated Uses:** aquatic life, livestock watering, wildlife habitat and secondary contact.

**B. Criteria:**

**(1)** Temperature shall not exceed 34°C (93.2°F). The use-specific criteria in 20.6.4.900 NMAC are applicable to the designated uses listed in Subsection A of this section.

**(2)** The monthly geometric mean of E. coli bacteria shall not exceed 548 cfu/100 mL, no single sample shall exceed 2507 cfu/100 mL (see Subsection B of 20.6.4.14 NMAC).

[20.6.4.99 NMAC - N, 05-23-05]

**20.6.4.103 RIO GRANDE BASIN - The main stem of the Rio Grande from the headwaters of Caballo reservoir upstream to Elephant Butte dam and perennial reaches of tributaries to the Rio Grande in Sierra and Socorro counties**.

**A. Designated Uses:** fish culture, irrigation, livestock watering, wildlife habitat, marginal coldwater aquatic life, secondary contact and warmwater aquatic life.

**B. Criteria:**

**(1)** In any single sample: pH within the range of 6.6 to 9.0 and temperature 25°C (77°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 548 cfu/100 mL or less, single sample 2507 cfu/100 mL or less (see Subsection B of 20.6.4.14 NMAC).

**C. Remarks:** Flow in this reach of the Rio Grande main stem is dependent upon release from Elephant Butte dam.

[20.6.4.103 NMAC - Rp 20 NMAC 6.1.2103, 10-12-00; A, 05-23-05]

**20.6.4.111 RIO GRANDE BASIN - Perennial reaches of Las Huertas creek.**

**A. Designated Uses**: high quality coldwater aquatic life, irrigation, livestock watering, wildlife habitat and secondary contact.

**B. Criteria**:

**(1)** In any single sample: pH within the range of 6.6 to 8.8 and temperature 25°C (77°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).

[20.6.4.111 NMAC - Rp 20 NMAC 6.1.2108.5, 10-12-00; A, 7-25-01; A, 05-23-05]

[NOTE: The segment covered by this section was divided effective 05-23-05. The standards for the additional segment are under 20.6.4.125 NMAC.]

**20.6.4.113 RIO GRANDE BASIN - The Santa Fe river and perennial reaches of its tributaries from Cochiti reservoir upstream to the outfall of the Santa Fe wastewater treatment facility.**

**A. Designated Uses**: irrigation, livestock watering, wildlife habitat, marginal coldwater aquatic life, secondary contact, and warmwater aquatic life.

**B. Criteria**:

**(l)** In any single sample: pH within the range of 6.6 to 9.0, temperature 30°C (86°F) or less and dissolved oxygen 4.0 mg/L or more. Dissolved oxygen 5.0 mg/L or more as a 24-hour average. Values used in the calculation of the 24-hour average for dissolved oxygen shall not exceed the dissolved oxygen saturation value. For a measured value above the dissolved oxygen saturation value, the dissolved oxygen saturation value will be used in calculating the 24-hour average. The dissolved oxygen saturation value shall be determined from the table set out in Subsection N of 20.6.4.900 NMAC. 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 548 cfu/100 mL or less, single sample 2507 cfu/100 mL or less (see Subsection B of 20.6.4.14 NMAC).

[20.6.4.113 NMAC - Rp 20 NMAC 6.1.2110, 10-12-00; A, 10-11-02; A, 05-23-05]

**20.6.4.121 RIO GRANDE BASIN - Perennial tributaries to the Rio Grande in Bandelier national monument and their headwaters in Sandoval county and all perennial reaches of tributaries to the Rio Grande in Santa Fe county unless included in other segments.**

**A. Designated Uses**: domestic water supply, high quality coldwater aquatic life, irrigation, livestock watering, wildlife habitat, municipal and industrial water supply, secondary contact and primary contact.

**B. Criteria**:

**(1)** In any single sample: specific conductance 300 µmhos/cm or less, pH within the range of 6.6 to 8.8 and temperature 20°C (68°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 235 cfu/100 mL or less (see Subsection B of 20.6.4.14 NMAC).

[20.6.4.121 NMAC - Rp 20 NMAC 6.1.2118, 10-12-00; A. 05-23-05]

[NOTE: The segment covered by this section was divided effective 05-23-05. The standards for the additional segments are under 20.6.4.126, 20.6.4.127 and 20.6.4.128 NMAC.]

**20.6.4.125 RIO GRANDE BASIN - Perennial reaches of San Pedro creek.**

**A. Designated Uses:** coldwater aquatic life, irrigation, livestock watering, wildlife habitat and secondary contact.

**B. Criteria:**

**(1)** In any single sample: pH within the range of 6.6 to 8.8 and temperature 25°C (77°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).

[20.6.4.125 NMAC - N, 05-23-05]

Current impairment listings for the Middle Rio Grande tributaries are included in the *2010-2012 State of New Mexico Clean Water Act §303(d)/ §305(b) Integrated List* (NMED/SWQB 2010). The Integrated List is a catalog of assessment units (AUs) throughout the state with a summary of their current status-assessed/not assessed and impaired/not impaired. Once a stream AU is identified as impaired, a TMDL guidance document is developed for that segment with guidelines for stream restoration.

Only USEPA-approved standards are applicable for Clean Water Act (CWA) purposes such as impairment determinations used to develop the Integrated List. WQS sections applicable to select Middle Rio Grande tributaries that have not yet received full USEPA approval include 20.6.4.98 and 20.6.4.99 NMAC. USEPA cited the reason for non-approval because the general "aquatic life" designated use proposed during the 2005 triennial review does not provide sufficient protection, and the "secondary contact" use cannot be assigned without a use attainability analysis (UAA).

The New Mexico Water Quality Control Commission (WQCC) is considering proposals presented during the December 2009 triennial review of water quality standards to remedy the situation. USEPA was not anticipated to approve changes to 20.6.4 NMAC as a result of the triennial review by April 1, 2010, therefore the below approach was used to determine impairment and develop the 2010-2012 Integrated List for water bodies falling under 20.6.4.98 and 20.6.4.99 NMAC:

- Applicable Uses noted on the Integrated List for all waters with a “WQS Reference” of 20.6.4.98 included at a minimum livestock watering, wildlife habitat, aquatic life, **marginal warmwater aquatic life**, and **primary contact**.

- Applicable Uses noted on the Integrated List for all waters with a “WQS Reference” of 20.6.4.99 included at a minimum livestock watering, wildlife habitat, aquatic life, **warmwater aquatic life**, and **primary contact**.

Subsection J of Section 20.6.4.900 NMAC, as referenced in the above site-specific criteria, provides a list of water chemistry analytes for which SWQB tests and the associated criteria for varying designated uses. The table of numeric criteria provided in this section is used for assessing streams for use attainment. General criteria for sedimentation/siltation, plant nutrients, and turbidity are also addressed in this report, and found in 20.6.4.13 NMAC, subsections A, E, and J, respectively.

## 3.0 METHODS

All water quality data within this project were collected in accordance with the procedures set forth in the *SWQB Quality Assurance Project Plan* (NMED/SWQB 2005) and generally following the procedures detailed in the *SWQB Standard Operating Procedures for Data Collection* (NMED/SWQB2007) which was posted to the SWQB website after the 2005 survey, with the exception of the habitat measures. The data collected as part of this study were later combined with all other readily available or submitted data that met state quality assurance/quality control requirements to form the basis of designated use attainment determinations. These data were assessed in accordance with protocols established in the *State of New Mexico Procedures for Assessing Standards Attainment for the Integrated §303(d)/§305(b) Water Quality Monitoring and Assessment Report* (*Assessment Protocols*) (NMED/SWQB 2008b, 2009b).

## 4.0 SAMPLING SUMMARY

A map of the study area is provided in Figures 1 and 2. The station numbers, USEPA Storage and Retrieval database (STORET) identification codes, and rationale of AUs and sampling stations selected for this survey are provided in Table 1. Stations are often located at AU breaks to include all inputs from that area before entering a new AU. The Santa Fe Wastewater Treatment Plant (WWTP) effluent channel was sampled to account for pollutant loading from this permitted facility into the receiving stream.

Water samples were collected and analyzed for plant nutrients, ions, total and dissolved metals, bacteria, radionuclides, and anthropogenic organic compounds. Variables such as dissolved oxygen (DO), pH, turbidity, and specific conductance were measured in the field. Physical habitat and benthic macroinvertebrate communities were surveyed to determine the impacts of excessive nutrients and settled sediment on aquatic life within a stream. The type of monitoring done at each site is summarized in **Table 2**. The number of sampling events by parameter or parameters suite collected during the SWQB MAS 2005 survey are included in the table. Fish community data were not collected during the 2005 MAS survey.

**Table 2. SWQB Middle Rio Grande Tributaries sampling summary**

| Assessment Unit / Station Name | Field Data | Ions | Nutrients | Total Metals | Dissolved Metals | *E. coli* | Cyanide | Radionuclides | Organics | PCBs | Thermograph | Sonde Deployment | Habitat Survey | Macroinvertebrates | Periphyton |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Abo Arroyo (Rio Grande to headwaters) | | | | | | | | | | | | | | | |
| Abo Arroyo blw Hwy 60 | 3 | 3 | 3 | 3 | 3 | 3 | -- | -- | 1 | -- | ✓ | -- | -- | -- | |
| Cienega Creek (Santa Fe River to headwaters) | | | | | | | | | | | | | | | |
| Cienega Creek 0.3 miles below bridge in La Cienega | 4 | 4 | 4 | 2 | 2 | 4 | -- | 1 | 1 | -- | -- | -- | -- | -- | |
| Las Huertas Creek (perennial portion Santa Ana Pueblo bnd to headwaters) | | | | | | | | | | | | | | | |
| Las Huertas @ Ellis Ranch Upper Spring | 1 | 1 | 1 | -- | -- | 1 | -- | -- | -- | -- | -- | -- | -- | -- | |
| Las Huertas below Ellis Ranch | 1 | 1 | 1 | -- | -- | 1 | -- | -- | -- | -- | -- | -- | -- | -- | |
| Las Huertas Creek blw Caves | 5 | 5 | 5 | 4 | 4 | 5 | 1 | -- | -- | -- | ✓ | -- | -- | -- | |
| Las Huertas Creek @ Tres Amigos Rd | 8 | 8 | 8 | 8 | 8 | 7 | 1 | 1 | 2 | -- | -- | -- | ✓ | ✓ | |
| Rio Salado (Rio Grande to Alamo Navajo bnd) | | | | | | | | | | | | | | | |
| Rio Salado 1 mile above The Box | 4 | 2 | 4 | 1 | 3 | 2 | 1 | 1 | -- | -- | -- | -- | -- | -- | |
| San Pedro Creek (San Felipe bnd to headwaters) | | | | | | | | | | | | | | | |
| San Pedro Creek @ Conservation Easement | 4 | 4 | 4 | 3 | 4 | 3 | 1 | 1 | 1 | -- | ✓ | ✓ | ✓ | ✓ | |

| Assessment Unit / Station Name | Field Data | Ions | Nutrients | Total Metals | Dissolved Metals | *E. colii* | Cyanide | Radionuclides | Organics | PCBs | Thermograph | Sonde Deployment | Habitat Survey | Macroinvertebrates | Periphyton |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Santa Fe River (Nichols Rsvr to headwaters) | | | | | | | | | | | | | | | |
| Santa Fe River at lower wilderness boundary | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | -- | ✓ | -- | ^ | ✓* | |
| Santa Fe River above McClure Reservoir at gage | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | -- | ✓ | -- | ^ | ✓* | |
| Santa Fe River above Nichols Reservoir at gage 08316000 | ✓ | ✓ | ✓ | ✓ | ✓ | -- | ✓ | ✓ | ✓ | -- | -- | -- | ^ | ✓* | |
| Santa Fe River approx 500 m above Nichols Reservoir | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | -- | ✓ | -- | ^ | -- | |
| Santa Fe R (Santa Fe WWTP to Nichols Rsvr) | | | | | | | | | | | ✓ | | | | |
| Santa Fe River at Nichols Reservoir outfall | ✓ | -- | -- | -- | -- | -- | -- | -- | -- | ✓ | -- | -- | -- | -- | |
| Santa Fe River below Cerro Gordo RD | 2(4) | 2(4) | 2(4) | 2 | 2 | 1(3) | -- | -- | -- | -- | -- | -- | -- | -- | |
| Santa Fe River blw St Francis Dr. | (1) | (1) | (1) | -- | -- | (1) | -- | -- | -- | 1 | -- | -- | -- | -- | |
| Santa Fe River below Frenchies Field | (2) | (2) | (2) | -- | -- | (2) | -- | -- | -- | -- | -- | -- | -- | -- | |
| Santa Fe River @ CRd 68A | 1 | -- | -- | -- | -- | -- | -- | -- | -- | 1 | -- | -- | -- | -- | |
| Santa Fe River above Hwy 599 | 3(1) | 3(1) | 3(1) | 3 | 3 | 4(1) | -- | -- | 1 | 2(1) | -- | -- | -- | -- | |
| Santa Fe River (Paseo del Canon to Santa Fe WWTP) | | | | | | | | | | | | | | | |
| Santa Fe River at effluent channel outfall | 8 | 8 | 8 | 3 | 3 | 8 | 1 | 4 | 3 | 1 | ✓ | ✓ | -- | -- | |
| Lower Santa Fe River Preserve | ✓ | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | ✓ | -- | -- | |
| Santa Fe River above CRd 56 | ✓ | ✓ | ✓ | -- | -- | -- | -- | -- | -- | -- | -- | -- | ✓ | ✓ | |
| Santa Fe River (non-pueblo, Cochiti Rsvr to Paseo del Canon) | | | | | | | | | | | | | | | |
| SANTA FE RIVER above Cochiti AT USGS GAGE 08317200 | 9 | 9 | 9 | 4 | 4 | 8 | 1 | 3 | 2 | (2) | ✓ | ✓ | ✓ | ✓ | |
| Tijeras Arroyo (Rio Grande to headwaters) | | | | | | | | | | | | | | | |
| TIJERAS ARROYO AT FOUR HILLS BRDG AT ALBQ, NM | 6 | 6 | 6 | 6 | 6 | 5 | -- | 1 | 3 | 1 | -- | -- | -- | -- | |
| Tijeras Arroyo blw Deadmans Curve | 5 | 5 | 5 | 5 | 5 | 5 | 1 | -- | -- | -- | ✓ | ✓ | ✓ | ✓ | |

**NOTES:**

Numbers in parentheses are the number of 2007 or 2008 sampling events at stations included in the 2005 MAS survey.

^ = Fluvial geomorphology measurements based on Rosgen 1996 were taken every year from 2001-2004. These data are not summarized in this report. Contact SWQB for data as needed.

* = Fish community data were also collected at these three stations in 2001, 2002, 2003, and 2004.

## 5.0 WATER QUALITY IMPAIRMENTS

For many water quality analytes, the State of New Mexico maintains numeric water quality standards, whereas standards for other parameters such as plant nutrients and bottom deposits are narrative. Data are assessed for designated use attainment status for both numeric and narrative water quality standards by application of the *State of New Mexico Procedures for Assessing Standards Attainment for the Integrated §303(d)/§305(b) Water Quality Monitoring and Assessment Report [Assessment Protocols]* (NMED/SWQB 2008b, 2009b). When available, outside sources of data that meet quality assurance requirements are combined with data collected by SWQB during the watershed survey 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 CWA §303(d)/§305(b) Integrated Report* (NMED/SWQB 2010).

### 5.1 Water Quality Impairments For Numeric Criteria

#### *5.1.1 Physicochemical Grab Data*

Water samples were analyzed for major ions, nutrients, total and dissolved metals, bacteria, radionuclides, and anthropogenic organic compounds. Variables such as temperature, dissolved oxygen (DO), pH, turbidity, and specific conductance were measured in the field. Results from the water quality data assessment of grab data indicated designated use impairments due to turbidity, aluminum, *E. coli*, and PCBs. **Table 3** provides designated use attainment decisions based on assessment of these physicochemical grab data. SWQB's *Assessment Protocol* details the assessment and listing procedures (NMED/SWQB 2008b, 2009b). A complete dataset can be obtained by contacting the SWQB.

**Table 3. Summary of physicochemical assessments**

| Assessment Unit | Turbidity | Aluminum (dissolved) | *E. coli* | PCBs |
|---|---|---|---|---|
| Abo Arroyo (Rio Grande to headwaters) | * | FS | FS | n/a |
| Cienega Creek (Santa Fe River to headwaters) | FS | FS | FS | n/a |
| Las Huertas Creek (perennial portion R Grande to headwaters) | **NS** | FS | FS | n/a |
| Rio Salado (Rio Grande to Alamo Navajo bnd) | * | FS | FS | n/a |
| San Pedro Creek (San Felipe bnd to headwaters) | * | FS | FS | n/a |
| Santa Fe River (Nichols Rsvr to headwaters) | FS | FS | FS | n/a |
| Santa Fe R (Santa Fe WWTP to Nichols Rsvr) | * | **NS** | **NS** | **NS** |
| Santa Fe River (Paseo del Canon to Santa Fe WWTP) | FS | FS | FS | n/a |
| Santa Fe River (non-pueblo, Cochiti Rsvr to Paseo del Canon) | **NS** | FS | FS | FS |
| Tijeras Arroyo (Rio Grande to headwaters) | * | FS | FS | n/a |

**NOTES:**
n/a = not assessed either due to no data or lack of adequate data (i.e., only one data point).
**NS** = **Not Supporting**; FS = Fully Supporting
* = no applicable criterion of assessment protocol

### 5.1.2 Data from Continuous Monitoring Devices

Temperature data loggers (thermographs) were deployed at selected stations within the study area. YSI multi-parameter sondes were also deployed at selected stations to examine diurnal fluxes in pH and dissolved oxygen (DO). The thermographs and sondes were programmed to record temperature, DO, and/or pH once per hour over their respective collection intervals.

Large datasets generated from data loggers (e.g., sondes and thermographs) are assessed according to protocols developed specifically for such datasets (NMED/SWQB 2009b). This is because, unlike a typically small grab sample data set, it is not reasonable to list as not supporting on the basis of a few exceedences out of several hundred data points.

Temperature (given in °C) and pH 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 the presence of sensitive, *i.e.* early life stages, aquatic organisms and designated use such as coldwater aquatic life use. **Table 4** summarizes the assessment conclusions based on thermograph and sonde data.

**Table 4. Summary of thermograph and sonde assessment conclusions**

| Assessment Unit | Aquatic Life Use | Temperature Criterion (°C) | Temperature Assessment | pH Criterion (SU) | pH Assessment | DO Criterion (mg/L) | DO Assessment |
|---|---|---|---|---|---|---|---|
| Abo Arroyo (Rio Grande to headwaters) | MWWAL | ≤25 | FS | 6.6 – 9.0 | no data | ≥6 | no data |
| Cienega Creek (Santa Fe River to headwaters) | MCWAL | ≤30 | no data | 6.6 – 9.0 | no data | ≥4, and ≥5 as 24-hr avg | no data |
| Las Huertas Creek (perennial portion R Grande to headwaters) | HQCWAL | ≤25 | FS | 6.6 – 9.0 | no data | ≥6 | no data |
| Rio Salado (Rio Grande to Alamo Navajo bnd) | MWWAL | ≤32.2 | no data | 6.6 – 9.0 | no data | ≥5 | no data |
| San Pedro Creek (San Felipe bnd to headwaters) | CWAL | ≤25 | FS | 6.6 – 9.0 | FS | ≥6 | FS |
| Santa Fe River (Nichols Rsvr to headwaters) | HQCWAL | ≤20 | FS | 6.6 – 9.0 | no data | ≥6 | no data |
| Santa Fe R (Santa Fe WWTP to Nichols Rsvr) | MWWAL | ≤32.2 | no data | 6.6 – 9.0 | no data | ≥5 | no data |
| Santa Fe River (Paseo del Canon to Santa Fe WWTP) | MCWAL | ≤30 | FS | 6.6 – 9.0 | FS | ≥4, and ≥5 as 24-hr avg | no data * |
| Santa Fe River (non-pueblo, Cochiti Rsvr to Paseo del Canon) | MCWAL | ≤30 | FS | 6.6 – 9.0 | FS | ≥4, and ≥5 as 24-hr avg | **NS**** |
| Tijeras Arroyo (Rio Grande to headwaters) | WWAL | ≤32.2 | FS | 6.6 – 9.0 | FS | ≥6 | **NS**** |

**NOTES:**

"no data" = no long term data set available to assess

**NS** = **Not Supporting**; FS = Fully Supporting;

* = previously listed for DO based on data from a station in the now lower AU before the AU between Cochiti Reservoir and the WWTP was split. SWQB plans to deploy a sonde in this assessment unit August 2010

** = low levels of DO likely due to nutrient impairment

## 5.2 Water Quality Impairments For Narrative Criteria

### 5.2.1 Sedimentation Assessment and Macroinvertebrate Community

Since the narrative standard for bottom deposits (i.e., sedimentation/siltation) is dependent on biological condition, the assessment of this physically-based narrative sedimentation criteria is determined using a biological response variable that links excess settled sediment levels to aquatic life use attainment. The macroinvertebrate community is generally the first to show a response to certain stressors such as the fine sediment that settles to the bottom of the channel.

**Substrate Composition**

It is essential to characterize the physical habitat in order to relate stream biological condition to land use impacts and potential anthropogenic disturbances. The physical habitat components most directly impacting aquatic communities are the stream geomorphology (physical structure), the riparian corridor that supports and protects aquatic life, and the composition of the substrate where the aquatic communities live. Streams existing in similar landscapes express similar compositions of these three attributes and can be compared to a reference site within that group. A reference site is a stream reach that has been exposed to the least amount of human disturbance within a certain landscape.

Habitat surveys were conducted at eight study sites and one reference site to collect data for sedimentation/siltation impairment determinations. **Table 5** describes the watershed size, elevation, and ecoregion of each station where a habitat survey was conducted. These are the minimal data necessary to categorize the sites by landscape. The reference site indicated was chosen as the least disturbed by the professional judgment of the Monitoring and Assessment staff familiar with sites around the state.

**Table 5. Watershed characteristics of reference and study sites**

| Station # | Station Name* | Watershed Area ($km^2$) | Elevation (m) | Omernick Ecoregion |
|---|---|---|---|---|
| ***20*** | Las Huertas Creek at Tres Amigos Rd. | 51 | 1768 | AZ/NM Mountains (23) |
| ***24*** | San Pedro Creek at Conservation Easement | 118 | 1897 | AZ/NM Mountains (23) |
| ***1*** | Santa Fe River at USGS Gage | 589 | 1676 | AZ/NM Plateau (22) |
| ***2*** | Santa Fe River above CRd 56 | 141 | 1809 | AZ/NM Plateau (22) |
| 12 | Santa Fe River above Nichols Reservoir | 34 | 2356 | Southern Rockies (21) |
| 13 | Santa Fe River above McClure Reservoir | 27 | 2422 | Southern Rockies (21) |
| 14 | Santa Fe River at wilderness boundary | 9.2 | 2558 | Southern Rockies (21) |
| ***22*** | Tijeras Arroyo below Deadmans Curve | 166 | 1829 | AZ/NM Mountains (23) |
| | *Rio de los Pinos at NMDG&F Fishing Area* | 381 | 2474 | Southern Rockies (21)** |

**NOTES:**

* = *Italic* indicate reference site for station #1

** = The Reference site is in transitional zone between Mountains and Xeric bioregions and considered best available.

Pebble counts in representative riffles were conducted as part of the habitat surveys. The size of sediment within a stream system is one of the most important physical attributes in determining the health of aquatic communities. There are two components to sediment load that impact aquatic life: suspended load and bed load. Suspended load is quantified through the measurement of turbidity and total suspended solids. Bed load describes the particles that settle to or roll along the bottom (saltation) of the

channel. Larger bed load particles provide increased interstitial space between particles, thus allowing for different aquatic communities than those found among small particles with little or no space. The size of sediment within a stream has a natural progression from course, large particles in sections at high elevation with smaller watershed size, gradually decreasing to sand in low elevation streams with large watersheds. Therefore, to determine whether a stream exhibits an unnaturally fine bed load, knowledge of the location of the stream segment within the watershed is necessary. Particles smaller than 2mm are considered "fines", and "percent fines" are considered for assessment purposes (see 20.6.4.13(A) NMAC and NMED/SWQB 2009b). The percent fines is calculated by adding the % sand and % silt-clay fractions (**Table 6**). Other metrics in Table 6 describe the size classes found in the reach, including the size of the median of the cumulative frequency distribution (D50) and the D84.

**Table 6. Substrate composition data from the Middle Rio Grande Tributaries**

| Station Name* | % Fines (>2mm) | D50 (mm) | D84 (mm) |
|---|---|---|---|
| Las Huertas Creek at Tres Amigos Rd. | 8 | 24.6 | 57 |
| San Pedro Creek at Conservation Easement | 14 | 16.0 | 28 |
| Santa Fe River at USGS Gage | 32 | 12.2 | 128 |
| Santa Fe River above CRd 56 | 5 | 24.3 | 50 |
| Santa Fe River above Nichols Reservoir (2004) | 10 | 59.3 | 193 |
| Santa Fe River above McClure Reservoir (2004) | 26 | 23.2 | 152 |
| Santa Fe River at wilderness boundary (2003) | 16 | 69.7 | 258 |
| Tijeras Arroyo below Deadmans Curve | 12 | 13.5 | 58 |
| *Rio de los Pinos at NMDG&F Fishing Area* | 3 | 48.3 | 128 |

**NOTES:**
* = *Italic* indicate reference site

Other habitat measurements taken during the 2005 survey year in the Middle Rio Grande tributaries are summarized in Appendix A. In addition, fluvial geomorphology measurements based on Rosgen 1996 were taken every year from 2001-2004 at three stations in the upper Santa Fe River watershed to measure BMP effectiveness. These data are not summarized in this report. Contact SWQB for these data if needed.

### Macroinvertebrate Sampling

By collecting data on the macroinvertebrate communities that are present in a stream reach SWQB can identify changes that indicate stress on the community. Depending on the ecoregion of the study site, this is done by utilizing either the Rapid Bioassessment Protocol (RBP) (Plafkin et. al 1989, Barbour et. al 1999) or Mountain Stream Condition Index (M-SCI) (Jacobi et al., 2006) as described in SWQB's main assessment protocol (NMED/SWQB 2009b). The RBP or M-SCI score is a percentage comparison of the sum of selected metric scores derived from the macroinvertebrate communities and used to compare the study site to the selected reference site or reference condition in order to determine the degree of impairment. For example, when the macroinvertebrate community at a study site in ecoregion 23 (AZ/NM Mountains) has an M-SCI score less than 56.70% of the reference condition, it can be concluded that there is stress on that community and it would be deemed impaired (i.e. non-support) (Table 7).

**Table 7. Biological integrity attainment matrix using M-SCI[1] for mountain sites**

| M-SCI Index | Biological Condition Category[2] |
|---|---|
| > 78.36% | Very Good (Full Support) |
| 78.35 – 56.70% | Good (Full Support) |
| 56.69 – 37.20% | Fair (Non-Support) |
| 37.19 – 18.90% | Poor (Non-Support) |
| < 18.89% | Very Poor (Non-Support) |

**NOTES:**

1. M-SCI Index and percentages based on Jacobi, *et al.* (2006)
2. New Mexico has combined the "very good" and "good" categories into "Full Support," while the remaining categories define "Non-Support."

## Sedimentation/Siltation Assessment

In order to assess for excess sedimentation, the biological index score and the percent fines in the stream reach are first assessed independently for their support of the aquatic life use. Reference sites are currently used to determine the amount of fines appropriate for each stream reach. If a low biological index score coincides with percent fines greater than 20% and this value exceeds a 28% increase from the associated reference site, excess fine sediment is indicated as a cause of impairment. If only the biological index score is low, excess fine sediment is not indicated as a cause of impairment because it is assumed that something other than fine sediment is causing the benthic macroinvertebrate community to be suboptimal.

Macroinvertebrate and sediment data were assessed at the eight sites (Table 8). The Mountain – Stream Condition Index (M-SCI) of 56.70 was used to determine biological impairment. All three upper Santa Fe River sites had biological assessment scores in the "good" or "very good" range indicating no substantial biological impairment. Four study sites had biological assessment scores in the "fair" or "poor" range indicating the biological communities in those reaches are stressed. Six sites exhibited low fine sediment (i.e., less than 20% fines in a representative riffle). According to Appendix D of the Assessment Protocol (NMED/SWQB 2009b), raw percent values of ≤ 20% fine sediment at a study site are evaluated as "Full Support" for sedimentation/siltation regardless of the condition of the benthic community. However, because the macroinvertebrate communities scored low at two of these sites, these associated assessment units were listed for unidentified benthic-macroinvertebrate impairment until the exact cause of the biological impairment is determined. An exception is Las Huertas Creek because the above-noted turbidity impairment in Table 4 is likely the reason for this "fair" benthic macroinvertebrate community score.

**Table 8. Sediment evaluations for the Middle Rio Grande Tributaries**

| Station Name | Biological Index Score | Biological Assessment | % Fine Sediment | Sediment Assessment |
|---|---|---|---|---|
| Las Huertas Creek at Tres Amigos Rd. | 47.07 | FS^ | 8 | FS |
| San Pedro Creek at Conservation Easement | 39.87 | **NS** | 14 | FS |
| Santa Fe River at USGS Gage | 46.08 | **NS**** | 32 (>28% increase over reference) | **NS** |
| Santa Fe River above CRd 56 | 43.02 | not assessed^^ | 5 | FS |
| Santa Fe River above Nichols Reservoir (2006) | 74.05 | FS | 10 | FS |
| Santa Fe River above McClure Reservoir (2004) | 82.60 | FS | 26++ | FS |
| Santa Fe River at wilderness boundary (2004) | 79.17 | FS | 16 | FS |
| Tijeras Arroyo below Deadmans Curve | 34.97 | **NS** | 12 | FS |

**NOTES**:

**NS = Not Supporting**; FS = Fully Supporting;

^ Unidentified biological impairment not noted on Integrated List because excessive turbidity is likely the reason for the sub optimal biological community

** Study site is very close to border of Mountain bioregion (21) and is more similar to that than the NM/AZ Plateau (Xeric bioregion), so it is reasonable to use the M-SCI to assess.

^^ Data were collected in October 2009 so taxonomy data were not available in time for development of the 2010 Integrated List. These data should be used with caution because the sample collection may have taken place too soon after a scouring event which did not allow enough time for re-colonization of the benthic macroinvertebrate community as called for in SWQB's standard operating procedures (NMED/SWQB 2007).

++ Comparison to reference %fines not needed because M-SCI score > 56.70.

### 5.2.2 Nutrient Assessment and Periphyton Community

New Mexico's water quality standards contain a narrative standard for plant nutrients (20.6.4.13E - NMAC 2007). A Level 1 nutrient screen is performed at each survey station to determine if excess nutrients may be an issue for the reach. If necessary, additional data are collected during a nutrient Level 2 survey to determine impairment status.

#### Periphyton Sampling

The periphyton community is another biological indicator that can express aquatic ecosystem stress in ways that the macroinvertebrate community may not reveal. The use of periphyton community data is still in early stages of development and does not provide conclusive information on stream health at this time. Periphyton is collected in biological surveys for a community composition analysis and for the quantification of chlorophyll *a* for the second level of nutrient assessments.

#### Nutrient Level 2 Assessment

Level 2 nutrient surveys were conducted at sites that were previously listed as impaired due to plant nutrients or where the Level 1 nutrient assessment indicated the possibility of nutrient impairment. For more information on this process refer to the *Nutrient Assessment Protocol for Wadeable, Perennial Streams* (NMED/SWQB 2009b). The Level 2 nutrient survey consists of data collection on a number of indicators including total phosphorus, total nitrogen, dissolved oxygen, pH, and periphyton chlorophyll *a* concentration in order to perform a weight-of-evidence based impairment determination. Chlorophyll *a* is

a quantitative measure of algal biomass which is the direct or indirect cause of most problems associated with nutrient impairment. The indicators are compared to the applicable criterion or threshold value to generate an exceedence ratio, or the number of exceedences divided by the total number of times the parameter was measured (**Table 9**). For total phosphorus, total nitrogen, and chlorophyll *a*, the threshold values are dependent on the ecoregion and designated aquatic life use.

**Table 9. Nutrient Level 2 Assessment Data for Middle Rio Grande Tributaries**

| Assessment Unit | Ecoregion – Aquatic Life Use | DO & pH – long term datasets | DO %Sat. – grab (# and % of exceedences) | DO conc – grab (# and % of exceedences) | pH – grab (# and % of exceedences) | Total Nitrogen (# and % of exceedences) | Total Phosphorus (# and % of exceedences) | Chlorophyll *a* exceedence? | Nutrient Assessment |
|---|---|---|---|---|---|---|---|---|---|
| **Las Huertas Creek** (perennial portion Santa Ana Pueblo bnd to headwaters) | AZ/NM Mountains -- HQCWAL | supports HCWAL* | 1/16 = 6% | 0/16 = 0% | 0/16 = 0% | **12/15 = 80%** | **3/15 = 20%** | **yes** | **NS** |
| **San Pedro Creek** (San Felipe bnd to headwaters) | AZ/NM Mountains -- CWAL | supports CWAL | 2/3 = 66% | 0/4 = 0% | 0/4 = 0% | **4/4 = 100%** | **2/4 = 50%** | no | FS |
| **Santa Fe River** (Paseo del Canon to Santa Fe WWTP) | AZ/NM Plateau – MCAL/WWAL | No data | **4/18 = 22%** | 0/17 = 0% | 1/18 = 6% | **12/12 =100%** | **13/13 =100%** | no | **NS**** |
| **Santa Fe River** (non-pueblo, Cochiti Rsvr to Paseo del Canon) | AZ/NM Plateau -- MCAL/WWAL | **DO = NS**; pH = FS | **2/10 = 20%** | 0/10 = 0% | 0/10 = 0% | **8/9 = 88%** | **9/9 = 100%** | **yes** | **NS** |
| **Tijeras Arroyo** (Rio Grande to headwaters) | AZ/NM Mountains -- WWAL | **DO = NS**; pH = FS | 1/12 = 8% | 0/12 = 0% | 0/12 = 0% | **11/11 = 100%** | **3/11 = 27%** | **yes** | **NS** |

**NOTES:**

**Bolded Cells** indicate parameters that exceed the threshold value, or >15% exceedence rate of threshold value when more than one data point available.

HQCWAL = High Quality Coldwater Aquatic Life; CWAL = Coldwater Aquatic Life
MCWAL = Marginal Coldwater Aquatic Life
FS = Fully Supporting
**NS = Not Supporting**
* = Based on sonde data from 2008 re-deployment.
** = Sonde data needed to confirm impairment (re-deployment planned for August 2010).

Level 2 nutrient surveys were conducted in five assessment units. Three of these AUs were determined impaired for nutrients because three or more indicators were present as noted in Table 9. It is noteworthy that the ecoregional thresholds for total nitrogen and total phosphorus were exceeded in more than 15% of available data for all assessment units.

### 5.2.3 Fish Community Data

Fish community data are collected for one or more of the following reasons:

- Development and/or refinement of water quality standards, particularly for designated aquatic life uses and/or temperature criteria;
- Development of fish-based biocriteria and/or bioassessment procedures; or
- To document and characterize a given water's fish community for comparison with future or past records.

The characteristics and habits of fish species (**Table 10**) can be correlated with physical habitat to provide information about how changes may be impacting the fish community.

**Fish community data** were collected in the upper Santa Fe River, using a backpack electroshocker, above Nichols Reservoir, above McClure Reservoir, and at the Wilderness boundary in each of 2001, 2002, 2003, and 2004. Almost all fish collected were rainbow trout (*Oncorhynchus mykiss*), with the exception of seven individuals in 2002 (two above Nichols and five at the Wilderness boundary). These seven were identified as hybrid rainbow and cutthroat (*O. mykiss* × *clarki*) as they exhibited the characteristic "slash" in the gill folds. Without performing any sort of genetic testing, it is assumed that these individuals are hybrids, not pure cutthroat trout. The length of stream sampled on all occasions was approximately 100 m. All habitat types (riffles, runs, pools) were sampled. All individuals were counted, identified to species, and total length was measured. **Table 11** provides the results of fish collection in the upper Santa Fe River upper watershed.

**Table 10. Characteristics of fish species found in the upper Santa Fe River**

| Species | Common Name | Native | Temperature | Gravel Spawner | Feeding Guild | Water Quality Tolerance |
|---|---|---|---|---|---|---|
| *Oncorhynchus mykiss* | Rainbow trout | No | Cold | Yes | Insectivore, Piscivore | Sensitive |
| *Oncorhynchus mykiss* × *clarki* | Cutbow | No | Cold | Yes | Insectivore, Piscivore | Sensitive |

**Table 11. Fish community data from Santa Fe River above Nichols Reservoir**

| Station: | | | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|
| Scientific name | Common name | Temperature | | | | |
| *Oncorhynchus mykiss* | Rainbow trout | Cold | 58 | 119 | 81 | 102 |
| *Oncorhynchus mykiss* × *clarki* | Cutbow | Cold | 0 | 2 | 0 | 0 |
| | | *# of Individuals* | 58 | 121 | 81 | 102 |
| | | *Total # of Taxa* | 1 | 2 | 1 | 1 |
| | | *% Native* | 0 | 0 | 0 | 0 |
| | | *% Non-native* | 100 | 100 | 100 | 100 |
| | | *% Coldwater* | 100 | 100 | 100 | 100 |
| | | *% Coolwater* | 0 | 0 | 0 | 0 |
| | | *%Warmwater* | 0 | 0 | 0 | 0 |

## 6.0 CONCLUSION

Water quality monitoring stations were located within primary Middle Rio Grande tributaries during the intensive watershed survey to evaluate ambient water quality conditions. Data collected in the Middle Rio Grande tributaries and mentioned in this report are not included due to the large volume. To acquire specific data, contact the SWQB or search EPA's WQX/STORET databases. As a result of assessing data generated primarily during the 2005 SWQB MAS survey in combination with additional monitoring efforts mentioned in this report, the following is a list of water quality concerns for each tributary watershed:

- **Abo Arroyo** -- No water quality impairments were determined based on available data.
- **Cienega Creek** -- No water quality impairments were determined based on available data.
- **Las Huertas Creek** – This creek was determined to be impaired for nutrients and turbidity.
- **Rio Salado** -- No water quality impairments were determined based on available data.
- **San Pedro Creek** – The benthic macroinvertebrate community in this creek was determined to be impaired due to unidentified causes.
- **Santa Fe River** – This tributary watershed contained the most sampling stations and data of the seven Middle Rio Grande tributaries discussed in this report. No impairments were determined for the perennial upper most reach (Nichols Reservoir to headwaters). The intermittent reach through the city of Santa Fe (WWTP to Nichols Reservoir) was determined to be impaired for aluminum, *E. coli*, and PCBs. The effluent-dominated reach immediately below the WWTP effluent channel (Paseo del Canon to the WWTP) was determined to be impaired for nutrients. Sonde re-deployment in this area scheduled for August 2010 is needed to confirm this conclusion. The most downstream still reach (Cochiti Reservoir to Paseo del Canon) was determined to be impaired for nutrients, dissolved oxygen, sedimentation/siltation, and turbidity.
- **Tijeras Arroyo** – This creek was determined to be impaired for nutrients. The benthic macroinvertebrate community in this creek was also determined to be impaired due to unidentified causes. Excessive nutrients in this reach may be negatively impacting the benthic macroinvertebrate community.

Total Maximum Daily Load (TMDL) documents will be prepared or updated by the SWQB to address the above noted impairments. Additional water quality data will be collected by the SWQB during the standard rotational period for intensive stream surveys. As a result, targets will be re-examined and potentially revised. When water quality standards have been achieved, the reach will be moved to the appropriate category on the Integrated Clean Water Act §303(d)/§305(b) list of waters.

## 7.0 REFERENCES


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**APPENDIX A: Additional habitat data for Middle Rio Grande Tributaries**

| STATION NAME | Date | Rapid Geomorphic Assessment* (0 – 36) | Rapid Habitat Assessment2** (0 – 200) | Xsection | Biological Sampling Location | Habitat Type |
|---|---|---|---|---|---|---|
| SANTA FE RIVER above Cochiti AT USGS GAGE | 10/25/2005 | 10 | 155 | 1 | | Glide |
| | | | | 2 | x | Riffle |
| | | | | 3 | | Riffle |
| Tijeras Arroyo blw Deadmans Curve | 9/7/2005 | 16.5 | 136 | 1 | | Glide |
| | | | | 2 | x | NC |
| | | | | 3 | | Riffle |
| San Pedro Creek @ Conservation Easement | 10/15/2005 | NC | NC | 1 | | Pool |
| | | | | 2 | x | Riffle |
| | | | | 3 | | Pool |
| Las Huertas Creek @ Tres Amigos Rd | 9/7/2005 | NC | NC | 1 | | Riffle |
| | | | | 2 | x | Riffle |
| | | | | 3 | | Riffle |

| | | Right Bank Characteristics | | | | Left Bank Characteristics | | | |
|---|---|---|---|---|---|---|---|---|---|
| STATION NAME | Date | Bank Angle | Veg. Cover (%) | Height (m) | Bank Material | Bank Angle | Veg. Cover (%) | Height (m) | Bank Material |
| SANTA FE RIVER above Cochiti AT USGS GAGE | 10/25/2005 | 15 | >80 | 1-2 | Sand | 15 | <20 | <1 | Silt |
| | | 50 | >80 | 2-3 | Sand | 20 | >80 | 2-3 | Sand |
| | | 30 | >80 | 1-2 | Sand | 45 | >80 | 2-3 | Sand |
| Tijeras Arroyo blw Deadmans Curve | 9/7/2005 | 85 | >80 | 1-2 | Silt | 25 | 50-80 | 1-2 | Sand |
| | | 40 | 20-50 | 1-2 | Gravel Sand | 50 | 50-80 | 1-2 | Boulder Cobble |
| | | 35 | 50-80 | 1-2 | Silt | 90 | >80 | <1 | Boulder Cobble |
| San Pedro Creek @ Conservation Easement | 10/15/2005 | 90 | >80 | >4 | Bed Rock | 90 | >80 | >4 | Bed Rock |
| | | 7 | >80 | <1 | Gravel Sand | 15 | >80 | <1 | Gravel Sand |
| | | 15 | 50-80 | <1 | Gravel Sand | 15 | 20-50 | <1 | Bed Rock/Gravel/Sand |
| Las Huertas Creek @ Tres Amigos Rd | 9/7/2005 | 25 | 20-50 | <1 | Sand | 30 | 50-80 | 1-2 | Silt/Sand |
| | | 70 | 20-50 | <1 | Gravel Sand | 25 | <20 | <1 | Gravel Sand |
| | | 60 | <20 | <1 | Gravel Sand | 65 | 50-80 | <1 | Gravel Sand |

| | | | Densiometer Reading Center | | Densiometer Reading from Left Bank | | Densiometer Reading from Right Bank | |
|---|---|---|---|---|---|---|---|---|
| STATION NAME | Date | Xsection | Looking Upstream | Looking Downstream | Looking at Bank | Looking Toward Center | Looking at Bank | Looking Toward Center |
| SANTA FE RIVER above Cochiti AT USGS GAGE | 10/25/2005 | 1 | 4 | 4 | 12 | 10 | 9 | 17 |
| | | 2 | 2 | 2 | 13 | 12 | 4 | 6 |
| | | 3 | 6 | 4 | 5 | 3 | 16 | 17 |
| Tijeras Arroyo blw Deadmans Curve | 9/7/2005 | 1 | 14 | 13 | 17 | 16 | 17 | 17 |
| | | 2 | 17 | 17 | 17 | 17 | 17 | 17 |
| | | 3 | 16 | 16 | 17 | 17 | 17 | 17 |
| San Pedro Creek @ Conservation Easement | 10/15/2005 | 1 | 0 | 0 | 9 | 8 | 0 | 8 |
| | | 2 | 0 | 0 | 2 | 0 | 0 | 3 |
| | | 3 | 0 | 0 | 17 | 1 | 2 | 6 |
| Las Huertas Creek @ Tres Amigos Rd | 9/7/2005 | 1 | 14 | 10 | 12 | 10 | 17 | 17 |
| | | 2 | 11 | 7 | 14 | 13 | 7 | 9 |
| | | 3 | 13 | 6 | 11 | 13 | 1 | 4 |

**NOTES:**

**Xsection** ---> 1 = downstream, 2 = mid-reach, 3 = upstream

NC = not collected

* = The Rapid Geomorphic Assessment is used to identify stable reaches and the destabilizing processes that are active in the reach. A channel stability score is determined by observing a number of channel characteristics and the stage of channel evolution based on the National Sedimentation Lab empirical model (Simon 1989). **Higher scores indicate a more unstable channel**.

** = The Rapid Habitat Assessment (Barbour, *et al.* 1999) provides a qualitative aquatic habitat score that is based primarily on observation of the quality and diversity of in stream habitats. **Higher scores indicate better habitat quality**.