WATER QUALITY MONITORING
OF THE
MIDDLE RIO GRANDE

Annual Baseline Condition and Trends of Key Water Quality Parameters

OCTOBER 2006 – JULY 2008
FINAL REPORT

Prepared by

New Mexico Environment Department
SURFACE WATER QUALITY BUREAU

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ENVIRONMENT DEPARTMENT

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ALU	Aquatic Life Use
API	Active Pharmaceutical Ingredients
AU	Assessment Unit
BEST	Biomonitoring of Environmental Status and Trends
BOR	Bureau of Reclamation
DO	Dissolved Oxygen
FHM	Fathead Minnow (*Pimephales promelas)*
MRG	Middle Rio Grande
MRGCD	Middle Rio Grande Conservancy District
MRGESACP	Middle Rio Grande Endangered Species Act Collaborative Program
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NOAA	National Oceanic and Atmospheric Administration
RGSM	Rio Grande Silvery Minnow (*Hybognathus amarus)*
STORET	Storage and Retrieval System
SquiRT	Screening Quick Reference Tables
SWQB	Surface Water Quality Bureau
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
USGS	United States Geological Service
WQS	Water Quality Standards
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY

The Middle Rio Grande Endangered Species Act Collaborative Program (MRGESACP) contracted with the New Mexico Environment Department (NMED) Surface Water Quality Bureau (SWQB) to conduct water-quality monitoring and assessment to determine if poor water-quality is contributing to the decline of Rio Grande silvery minnow (RGSM) populations in the Middle Rio Grande (MRG).

SWQB conducted quarterly sampling of water and sediment, toxicity tests, and annual fish tissue collection and analysis at ten stations in the MRG selected by the MRGESACP. The survey extended from Bosque del Apache, downstream of San Antonio, north to the Angostura Diversion, upstream of Bernalillo covering approximately 290 km (180 miles) of river. This report details the survey work completed between October 2006 and September 2008. In addition to the sampling conducted specifically for this grant, SWQB solicited and compiled water chemistry data for sites on the MRG within the study area from other sources and earlier SWQB studies conducted between 2000 through 2008.

SWQB assessed the data against water quality standards criteria contained within the State of New Mexico Standards for Interstate and Intrastate Surface Waters (20.6.4 NMAC). Analysis of the data indicate dissolved oxygen levels below the water quality criteria in two areas “Rio Grande (non-pueblo Alameda Bridge to Angostura Div)” and “Rio Grande (Isleta Pueblo bnd to Alameda Bridge), aluminum concentrations above the chronic aquatic life criteria in several locations, and exceedences of water quality criteria for bacteria (*E. coli*) in most of the area. A 2005 microbial tracking study indicated the bacteria are primarily from dogs and wildlife. Sediment chemistry, fish tissue contaminant concentrations and sediment toxicity data were not used for water quality assessments, but were summarized in this report to provide additional information on chemical pollutants in the MRG that may affect RGSM.

In general the results of the extensive water, sediment and fish tissue analyses performed for this study identified few water quality issues – notably elevated *E coli*, one sample with an ammonia concentration of 9.12 mg/L - 5 times the acute criteria, low DO during brief periods of time, and some samples elevated in metals such as Al, Cu, Cr. While the ammonia concentration and periods of low DO reached levels where large fish kills would be expected, none were observed, possibly because the fish were able to avoid areas of poor water quality. Other documented water quality issues are at levels where RGSM are exposed to conditions that may impact reproduction and respiration, further stressing the fish and reducing the likelihood for recovery. These findings would indicate that, while water chemistry maybe a contributing factor, it is not likely to be the most critical issue affecting the RGSM especially compared to a lack/timing of adequate flows to maintain the needed habitat.

This final report is submitted in partial fulfillment of work plan commitments for Federal Grant 06-FG-40-2551. All data from this study and data compiled from 2000 to 2008 will be supplied to the MRGESACP via CD and is available upon request for other parties.

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1.0 INTRODUCTION

This study was established to provide baseline condition and trends for key water quality parameters in the Middle Rio Grande (MRG) (see **Figure 1**) as part of a comprehensive water-quality monitoring and assessment program to elucidate relationships between water-quality and declines in RGSM populations. To complement the numerous projects in the MRG focusing on the biological components of the river, this study provides the foundation for a long-term water quality monitoring and assessment program by adding to the total number of water quality samples being collected by other agencies within the MRG. By providing a framework of water quality data, future research may be able to focus on specific chemical and physical parameters impacting RGSM.

Figure 1. Map of Middle Rio Grande sampling area

SWQB conducted quarterly sampling of water and sediment, toxicity tests, and annual fish tissue collection and analysis at ten stations in the MRG as selected by the MRGESACP. The survey extended from Bosque del Apache, downstream of San Antonio, north to the Angostura Diversion Works, upstream of Bernalillo, covering approximately 290 km (180 miles) of river. This report describes work completed between October 2006 and September 2008. In addition to the sampling conducted specifically for this grant, SWQB compiled water chemistry data for sites within the study area from other sources collected between 2000 through 2008. SWQB also solicited recent (2000-2006) water quality data from external sources from the MRG in July-August 2007, as part of the overall data solicitation for the 2008-2010 CWA Section §303(d)/§305(b) Integrated Report and List, and in October-November 2007, through a targeted email notice specifically for this project.

To complement the water quality data, SWQB compiled daily average discharge data of the MRG measured at USGS stations for the period October 1, 2006 to September 1, 2008 to capture the flows during the period of this study. Sampling runs have been indicated on the graph generated from this compilation (**Figure 2**) to allow visual estimation of discharge at the times samples were collected. SWQB also compiled daily average discharge from selected USGS gages in the MRG from January 2000 to April 2008 to capture flows during the entire period associated with data collected for use in water quality assessments (**Figure 3**).

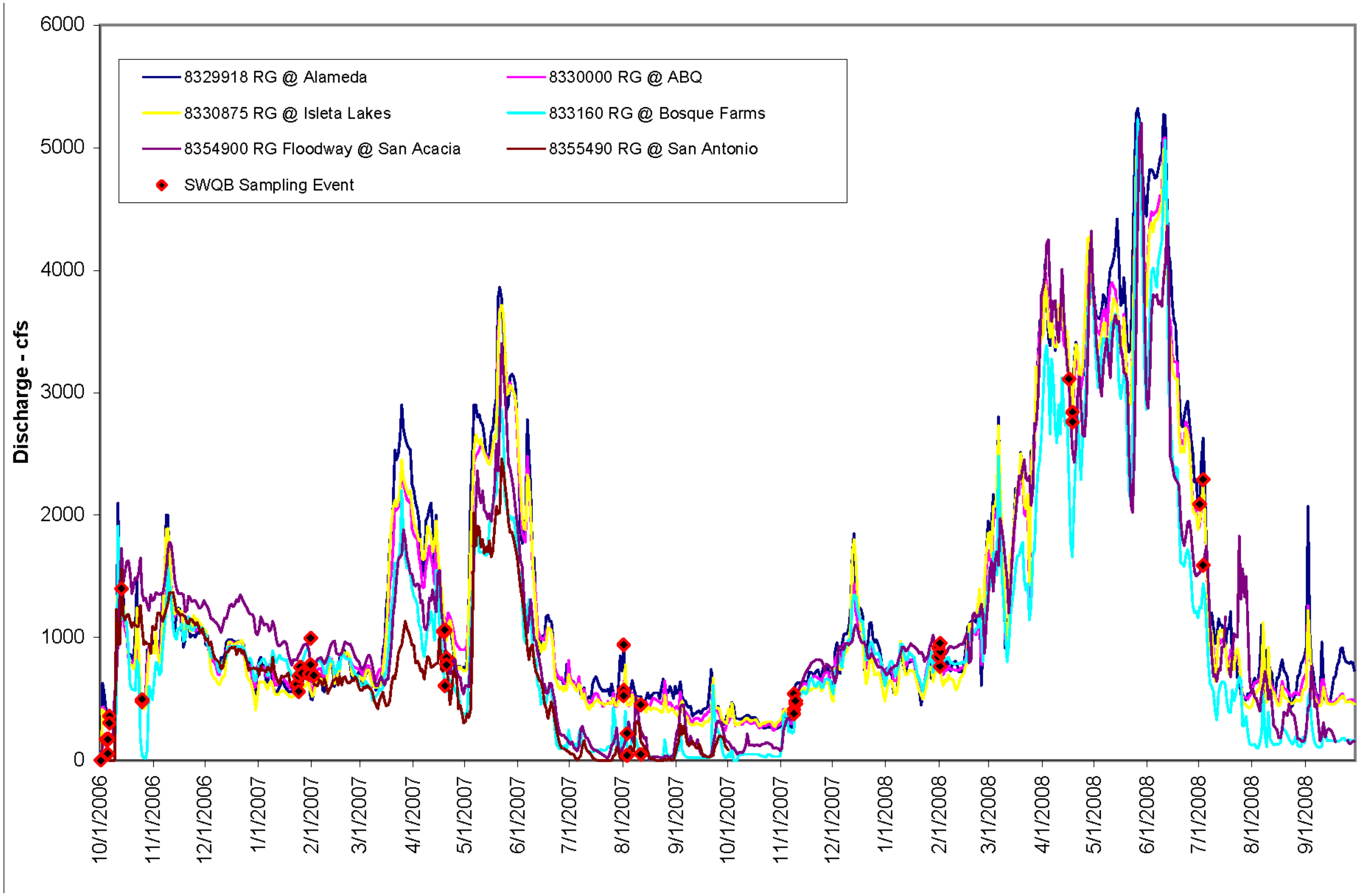

Figure 2. Middle Rio Grande discharge at USGS gages during the 2006-2008 MRGESACP Water Quality Monitoring Survey. Data in the spring of 2008 was missing for Bosque Farms and Isleta gages.

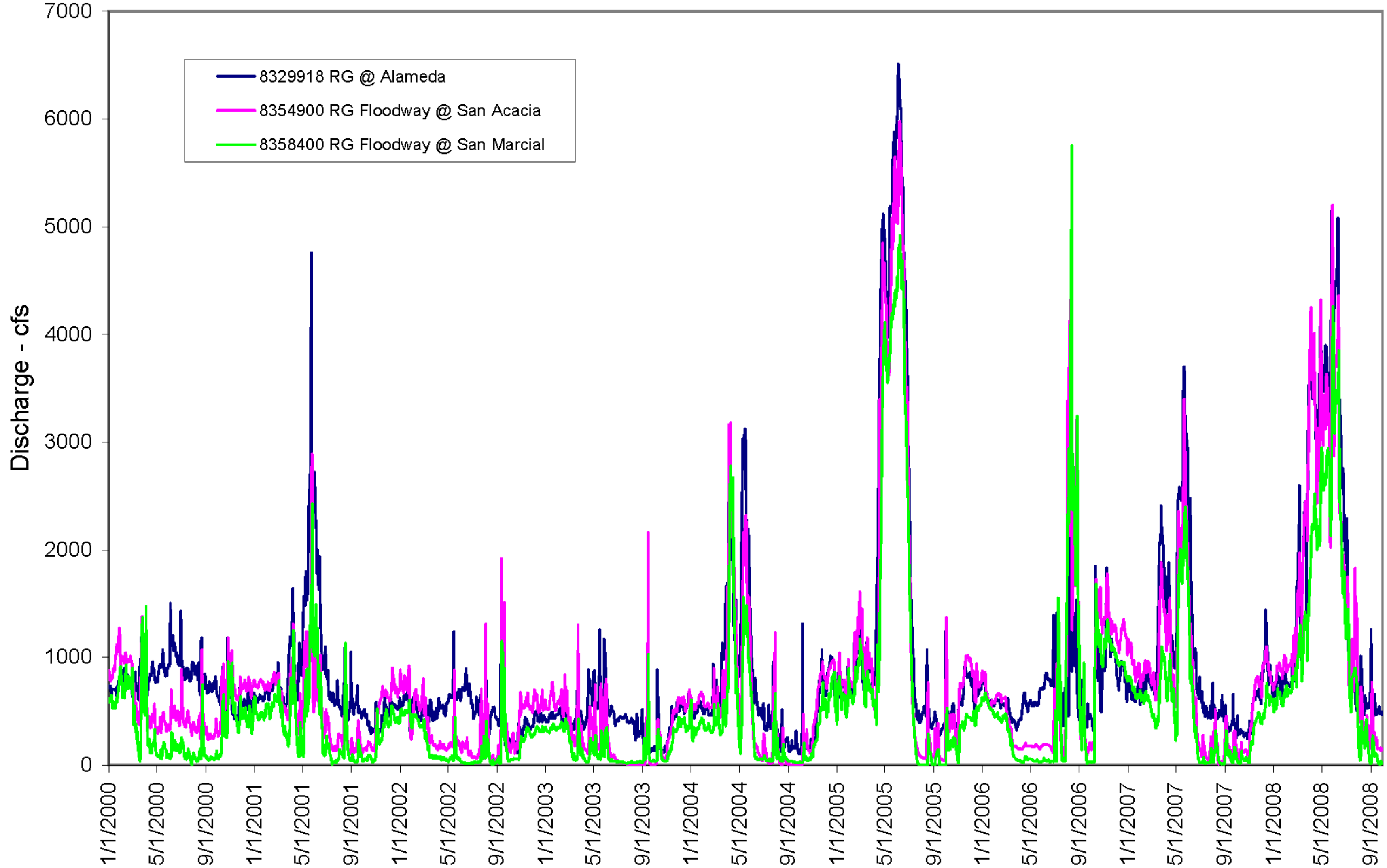

Figure 3. Middle Rio Grande discharge at select USGS gages from January 2000 – September 2008.

2.0 NEW MEXICO WATER QUALITY STANDARDS

MRG water quality data collected in this study were evaluated relative to the *State of New Mexico Standards for Interstate and Intrastate Surface Waters* (20.6.4 NMAC. Sections 20.6.4.105 and 20.6.4.106 NMAC describe the general water quality criteria applicable to designated uses for the Middle Rio Grande Basin surveyed in this study:

20.6.4.105 RIO GRANDE BASIN - The main stem of the Rio Grande from the headwaters of Elephant Butte reservoir upstream to Alameda bridge (Corrales bridge) and intermittent water below the perennial reaches of the Rio Puerco that enters the main stem of the Rio Grande.

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

B. **Criteria**:

(1) In any single sample: pH within the range of 6.6 to 9.0 and temperature 32.2°C (90°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).

(3) At mean monthly flows above 100 cfs, the monthly average concentration for: TDS l,500 mg/L or less, sulfate 500 mg/L or less and chloride 250 mg/L or less.

[20.6.4.105 NMAC - Rp 20 NMAC 6.1.2105, 10-12-00; A, 05-23-05]

20.6.4.106 RIO GRANDE BASIN - The main stem of the Rio Grande from Alameda bridge (Corrales bridge) upstream to the Angostura diversion works and intermittent water in the Jemez river below the Jemez pueblo boundary that enters the main stem of the Rio Grande.

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

B. **Criteria**:

(1) In any single sample: dissolved oxygen greater than 5.0 mg/L, pH within the range of 6.6 to 9.0 and temperature less than 32.2°C (90°F). 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).

(3) At mean monthly flows above 100 cfs, the monthly average concentration for: TDS 1,500 mg/L or less, sulfate 500 mg/L or less and chloride 250 mg/L or less.

[20.6.4.106 NMAC - Rp 20 NMAC 6.1.2105.1, 10-12-00; A, 05-23-05]

Section 20.6.4.900 NMAC (see Appendix A), as referenced above, provides a list of additional water quality parameters and the associated numeric criteria for protecting various designated uses. SWQB, as part of the development of the CWA §303(d)/§305(b) Integrated Report and List, compares water quality data to applicable criteria using the most current *Assessment Protocol* (NMED/SWQB 2008a) to determine whether waters are attaining designated uses. Based on previous assessments conducted for the Middle Rio Grande, two segments of the Middle Rio Grande have been listed as impaired for fecal coliform and one for toxicity since the 2000-2002 CWA Section §303(d)/§305(b) Integrated Report and List (Table 1). A total maximum daily load (TMDL) strategy document has been developed for fecal coliform for the two Assessment Units (NMED/SWQB 2002).

Table 1. Summary of 2006-2008 Integrated List impairments and existing TMDLs – Middle Rio Grande

Assessment Unit (AU)	2006-2008 Integrated List Impairments	Probable Sources	Existing TMDLs (date)
Rio Grande (Elephant Butte to San Marcial)	None	N/A	None
Rio Grande (San Marcial to Rio Puerco)	None	N/A	None
Rio Grande (Rio Puerco to Isleta Pueblo Boundary)	None	N/A	None
Rio Grande (Isleta Pueblo Boundary to Alameda Bridge)	Fecal Coliform	• Impervious Surface/Parking Lot Runoff • Municipal (Urbanized High Density Area) • Municipal Point Source Discharges • On-site Treatment Systems (Septic Systems and • Similar Decentralized Systems)	Fecal Coliform (2002)
Rio Grande (Alameda Bridge to Angostura Diversion)	• Fecal Coliform • Ambient Bioassays* – Acute Aquatic Toxicity • Ambient Bioassays* – Chronic Aquatic Toxicity	• Impervious Surface/Parking Lot Runoff • Municipal (Urbanized High Density Area) • Municipal Point Source Discharges • On-site Treatment Systems (Septic Systems and similar decentralized systems)	Fecal Coliform (2002)

*This listing is based on toxicity testing below the Bernalillo WWTP between 2002 and 2004. The NPDES permit for Bernalillo WWTP was renewed in January 2004, including an implementation schedule for de-chlorination.

3.0 METHODS

All water quality and sediment data were collected according to the procedures set forth in the *SWQB Quality Assurance Project Plan* (NMED/SWQB 2006 or 2007) and *SWQB Standard Operating Procedures for Data Collection* (NMED/SWQB 2004 or 2007a) for the applicable year. Additional data collection methods, not outlined in these documents, generally followed those detailed in Abeyta and Lusk (2004).

When possible, water column samples were collected using equal width increment (EWI) sampling across macrohabitat transects during wadeable conditions. If wading was not possible and a bridge was present at the sampling site, the sample was collected from a bridge with a sampler suspended from a bridgeboard. If wading was not possible and no bridge was at the station, grab samples were collected by wading a safe distance from the bank. Sediment samples were collected from recently deposited sediments in depositional areas. For fish tissue analysis common carp (*Cyprinus carpio*) were collected based on recommendations from the MRGESACP.

All chemical analyses followed methods published in *Annual Book of ASTM Standards* (2005), *Standard Methods for the Examination of Water and Wastewater* (2005), *Methods for Chemical Analysis of Water and Wastes* (1983 and subsequent revisions), and *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater* (1986 and subsequent revisions). Fish tissue analyses were conducted by GEL, Paragon, and AXYS Labs.

The data collected as part of this study were later combined with all other readily available or submitted data that meet State quality assurance/quality control requirements to form the basis for designated use attainment determinations. These data were assessed according to protocols set forth 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 2008a). Fish tissue contaminant levels were evaluated using guidelines developed by USGS-BEST and USFWS (Eisler, 1993; Schmitt, 2004).

4.0 SAMPLING SUMMARY

SWQB staff sampled water and sediment quarterly at selected stations determined by the MRGESACP and detailed in the 2006 Request for Proposal (RfP). A map of the study area (**Figure 4)** indicates station locations whereas station names and corresponding USEPA Storage and Retrieval database (STORET) identification codes for sites specified in the work plan are provided in **Table 2**.

Table 2. Sampling Stations – Middle Rio Grande, 2006-2008.

STATION NAME	STORET CODE	CORRESPONDING SITE NAME FROM CONTRACT WORKPLAN
Bosque del Apache	32RGrand286.9	"Rio Grande near Lemitar or, Rio Grande at Bosque del Apache National Wildlife Refuge"
Rio Grande near San Antonio	32RGrand292.1c	
Rio Grande near Lemitar	32RGrand323.4	
Rio Grande upstream of San Acacia Dam	32RGrand332.5	"Upstream of San Acacia Dam"
Rio Grande below the confluence with Rio Puerco – La Joya	32RGrand341.2	"Rio Grande below confluence with the Rio Puerco"
Rio Grande at Los Lunas	32RGrand394.8	"Rio Grande at Los Lunas"
Rio Grande at the I-25 Bridge	32RGrand413.2	"At the I-25 bridge"
Rio Grande downstream of the AMAFCA South Diversion Channel – Los Padillas	32RGrand416.5	"From near the mouth to about 0.4 km (0.25 miles) downstream, as access permits, of the AMAFCA South Diversion Channel"
Rio Grande downstream of Albuquerque Wastewater Treatment Plant	32RGrand421.2	"From near the mouth to about 0.4 km (0.25 miles) downstream, as access permits, of the City's Southside Water Reclamation Plant discharge (careful consideration shall be made of sample location as depending on flow, Plant discharge tends to hug the east bank of the channel and may not mix for several miles downstream)."
Rio Grande at Alameda Bridge	32RGrand445.4	"From near the mouth to about 0.4 km (0.25 miles) downstream, as access permits, of the AMAFCA North Diversion Pilot Channel."
Rio Grande downstream of Rio Rancho Wastewater Treatment Plant	32RGrand455.0	"From near the mouth to about 0.4 km (0.25 miles) downstream, as access permits, of Rio Rancho Waste Water Treatment Plant discharge (careful consideration shall be made of sample location as depending on flow, Plant discharge tends to hug the west bank of the channel for about 0.8 km (0.5 miles) downstream)"
Rio Grande at Angostura Dam	30RGrand473.7	"At Angostura Dam"

This report collates field and water chemistry data from the MRG collected from 2000 to 2008 by NMED and other various sources. **Figures 4 and 5** depict the sampling locations for these data. The stations and the affiliated studies are summarized in **Table 3** and available USGS data are summarized in **Table 4**.

Table 5 summarizes the number of sampling events in each assessment unit (AU) and at each station (excluding USGS data). **Table 6** contains the number of times each parameter (or suite of parameters) was sampled at each station during the MRGESACP water quality monitoring study. Monitoring site locations and timing of data collection was coordinated to the extent possible with the Fish Health study also funded by the MRGESACP.

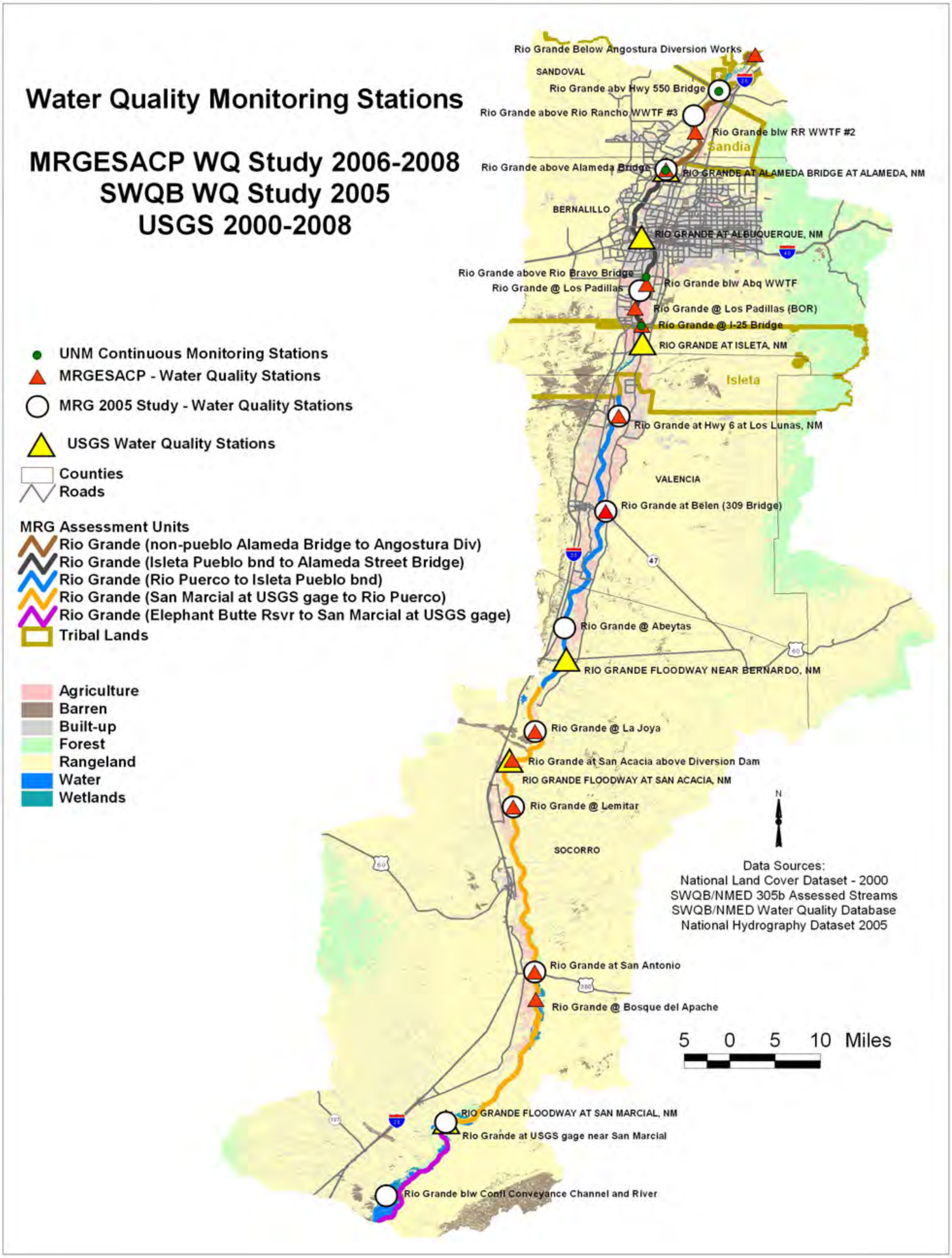

Figure 4. Water quality monitoring stations in Middle Rio Grande, 2000 – 2008.

Table 3. Water quality monitoring stations in the MRG for data from 2000-2008 (non-USGS)

Assessment Unit	Station Name	STORET ID	Study
Rio Grande (Elephant Butte Reservoir to San Marcial at USGS gage)	Rio Grande below Confl Conveyance Channel and River	40RGrand243.4	MRG (2005)
Rio Grande (San Marcial at USGS gage to Rio Puerco)	Rio Grande @ USGS gage near San Marcial	32RGrand258.0	MRG (2005)
	Rio Grande @ Bosque del Apache	32RGrand286.9	BOR (2006-07)
	Rio Grande @ San Antonio*	32RGrande 292.1	MRG (2005) BOR (2006-07)
	Rio Grande @ Lemitar	32RGrand323.4	MRG (2005) BOR (2006-07)
	Rio Grande at San Acacia above Diversion Dam	32RGrand332.7	BOR (2006-07)
	Rio Grande @ La Joya* [t]	32RGrand341.2	MRG (2005) BOR (2006-07)
Rio Grande (Rio Puerco to Isleta Pueblo bnd)	Rio Grande @ Abeytas [s]	32RGrand361.7	MRG (2005)
	Rio Grande at Belen (309 Bridge)*	32RGrand385.5	MRG (2005), BOR (2007)
	Rio Grande at Hwy 6 at Los Lunas*	32RGrand394.8	BOR (2006-07)
Rio Grande (Isleta Pueblo bnd to Alameda Street Br)	Rio Grande @ I-25 Bridge [a]	32RGrand413.1	BOR (2006-07)
	Rio Grande @ Los Padillas [t s] Rio Grande @ Los Padillas (BOR)	32RGrand419.6 32RGrand416.4	MRG (2005) BOR (2006-07)
	Rio Grande blw Abq WWTF	32RGrand421.1	BOR (2006-07)
	Rio Grande above Rio Bravo bridge [a]	32RGrand422.5	None
Rio Grande (non-pueblo Alameda Bridge to Angostura Div)	Rio Grande above Alameda Bridge* [a t]	32RGrand445.3	MRG (2005) BOR (2006-07)
	Rio Grande blw RR WWTF #2	32RGrand455.0	BOR (2006-07)
	Rio Grande above Rio Rancho WWTF #3	32RGrand458.0	MRG (2005)
	Rio Grande abv Hwy 550 Bridge* [a]	32RGrand464.1	MRG (2005)
	Rio Grande Below Angostura Diversion Works	30RGrand473.7	MRG (2005)

* = composite samples also collected
[a] = UNM sonde data
[t] = SWQB thermograph deployed
[s] = SWQB sonde deployed

Table 4. USGS gage sites in the Middle Rio Grande

USGS Gage Number	USGS Gage Name	Available data
8358400	RIO GRANDE FLOODWAY AT SAN MARCIAL, NM	Water quality
8355490	RIO GRANDE ABOVE US HWY 380 NR SAN ANTONIO, NM	Flow
8354900	RIO GRANDE FLOODWAY AT SAN ACACIA, NM	Flow and water quality
8332010	RIO GRANDE FLOODWAY NEAR BERNARDO, NM	Water quality (field data)
8331160	RIO GRANDE NEAR BOSQUE FARMS, NM	Flow
8331000	RIO GRANDE AT ISLETA, NM **	Water quality
8330875	RIO GRANDE AT ISLETA LAKES NR ISLETA, NM	Flow
8330000	RIO GRANDE AT ALBUQUERQUE, NM	Flow and water quality
8329918	RIO GRANDE AT ALAMEDA BRIDGE AT ALAMEDA, NM	Flow and water quality

** = Not used for assessment purposes

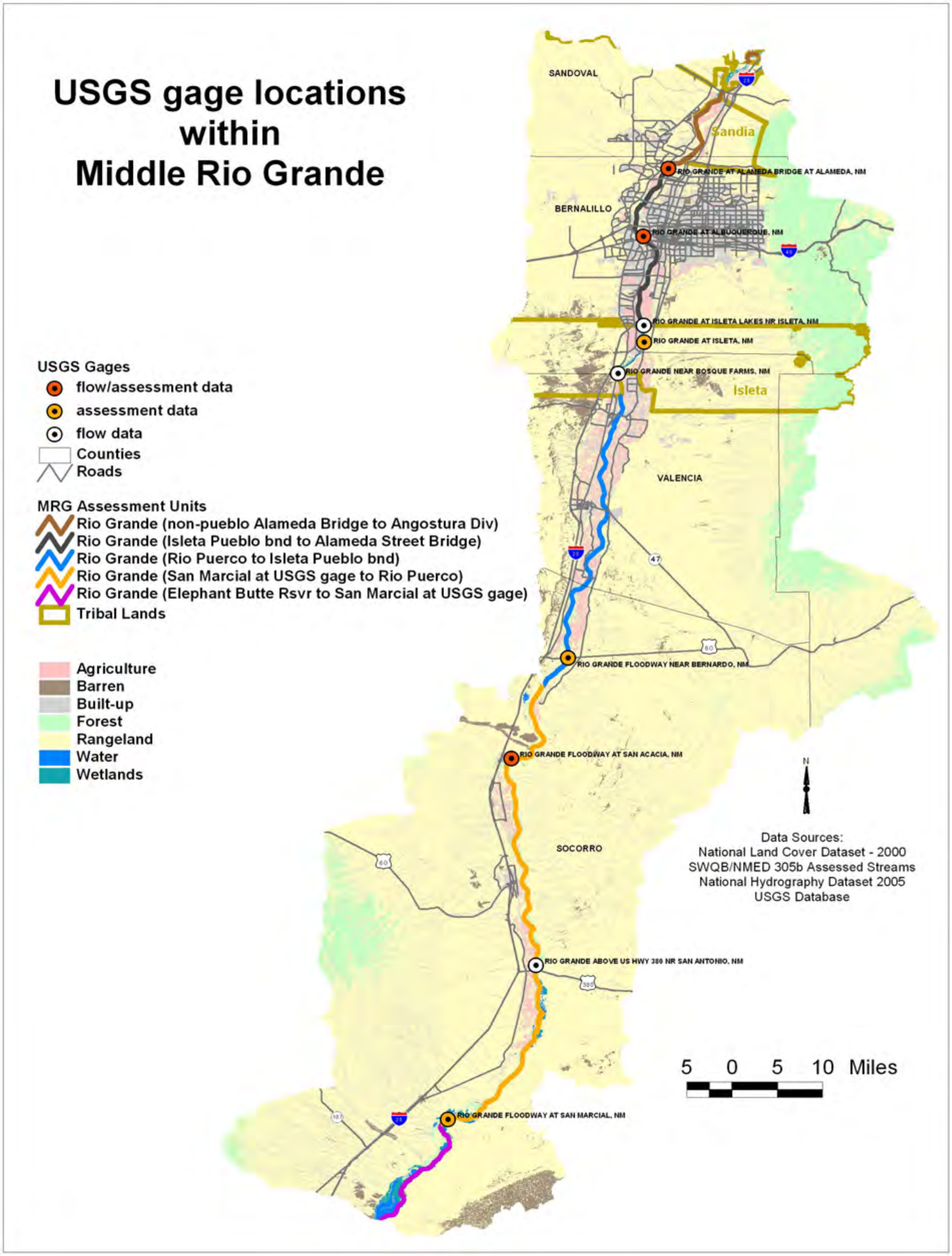

Figure 5. USGS sites within the MRG study area.

Table 5. Summary of the number of data collection events per data type in the Middle Rio Grande – 2000-2008 (non-USGS)

Assessment Unit / Station	Field Data	Ions/TDS/TSS/ Hardness	Nutrients	Total Organic Carbon	Total Metals	Dissolved Metals	*E. coli*	Cyanide, Total	Radionuclides	Pesticides	Herbicides	Semivolatile Organics	Perchlorate	PCBs	BOD/COD	Sediment	Ambient Toxicity
Rio Grande (Elephant Butte to San Marcial)																	
Rio Grande below confluence of conveyance channel and river										1						1	
Rio Grande (Rio Puerco to San Marcial)																	
Rio Grande at San Marcial near USGS gage	27	26	24	25	3	3	3		1								
Rio Grande @ Bosque del Apache	6	6	6	6	6	6		6		6	6		6		6	6	1
Rio Grande @ San Antonio	11	9	9	4	7	7	7	1		1	1		1		1	1	
Rio Grande @ Lemitar	10	9	9	4	9	9	7	1	1	1	1		1		1	1	
Rio Grande @ San Acacia above Diversion	7	7	7		7	7		7		7	7		7		7	7	1
Rio Grande @ La Joya	16	16	16	4	16	16	6	8		8	8		8		8	8	1
Rio Grande (Isleta Pueblo Boundary to Rio Puerco)																	
Rio Grande @ Abeytas	10	7	8	4	8	8	7	4	1	4	4	1	4	1	4	4	1
Rio Grande @ Belen (Hwy 309 Bridge)	9	8	8		8	8	7					1					
Rio Grande @ Hwy 6 at Los Lunas	15	15	15	4	15	15	6	8	1	8	8	1	6	1	8	8	1
Rio Grande (Isleta Pueblo Boundary to Alameda Street Bridge)																	
Rio Grande @ I-25 Bridge	8	8	8	8	8	8		8		8	8		8		8	8	1
Rio Grande @ Los Padillas (BOR)	8	8	8	8	8	8		8		8	8		8		8	8	1
Rio Grande @ Los Padillas	10	8	8		1	1	7					1		1			
Rio Grande below Albuquerque WWTF	8	8	8	8	8	8		8		8	8		8		8	8	1
Rio Grande above Rio Bravo Bridge	Sonde Deployment Only																
Rio Grande (non-pueblo Alameda Bridge to Angostura Div)																	
Rio Grande above Alameda Bridge	19	9	9	4	9	9	10	8		8	8		8	1	8	8	1
Rio Grande above Rio Rancho WWTF #2	8	9	8		6	8		8		8	8	1	8		8	8	1
Rio Grande above Rio Rancho WWTF #3	9	8	8	4	1	1	7					1					
Rio Grande above Hwy 550 Bridge	8	7	7		1	1	7										
Rio Grande on Sandia Pueblo																	1
Rio Grande below Angostura Diversion	18	19	16	4	7	9	11	8	1	8	8		8	1	8	8	1

Table 6. Summary of the number of data collection events per data type for Middle Rio Grande monitoring for this study, 2006-2008.

Assessment Unit / Station	Nutrients, Sediment	Metals, Sediment	Pesticides & PAHs Sediment	Nutrients, Water	Total Metals, Water	Dissolved Metals (full suite), Water	BOD, Water	COD, Water	Herbicides, Water	Pesticides, Water	Percholorate, Water	Cyanide, Total, Water	Sonde grab data	Sonde Deployment [a]	Thermograph Deployment	Ambient Toxicity	Fish Tissue [b]
Rio Grande (San Marcial to Rio Puerco)																	
Bosque del Apache[c]	6	6	6	6	6	6	6	6	6	6	6	6	6	-	-	1	-
Rio Grande near San Antonio[c]	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-
Rio Grande near Lemitar[c]	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-
Rio Grande upstream of San Acacia Dam [d]	7	7	7	7	7	7	7	7	7	7	7	7	7	-	- -	1	-
Rio Grande below the confluence with Rio Puerco – La Joya	8	8	8	8	8	8	8	8	8	8	8	8	8	-	1	1	-
Rio Grande (Rio Puerco to Isleta Pueblo bnd)																	
Rio Grande at Belen [e]	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Rio Grande at Los Lunas [f]	8	8	8	10	8	8	8	8	8	8	8	8	8	-	1	1	1
Rio Grande (Isleta Pueblo bnd to Alameda Street Bridge)																	
Rio Grande at the I-25 Bridge	8	8	8	8	8	8	8	8	8	8	8	8	8	1	-	1	-
Rio Grande downstream of the AMAFCA South Diversion Channel – Los Padillas	8	8	8	8	8	8	8	8	8	8	8	8	8	1	-	1	-
Rio Grande downstream of Albuquerque WWTP	8	8	8	8	8	8	8	8	8	8	8	8	8	1	-	1	2
Rio Grande (non-pueblo Alameda Bridge to Angostura Div)																	
Rio Grande at Alameda Bridge	8	8	8	8	8	8	8	8	8	8	8	8	8	1	-	1	2
Rio Grande downstream of Rio Rancho WWTP	8	8	8	8	8	8	8	8	8	8	8	8	8	1	1	1	2
Rio Grande at Angostura Dam	8	8	8	8	8	8	8	8	8	8	8	8	8	-	-	1	2

[a] Seven day sonde data were not collected at all sites. Continuous data were received for sites indicated. Temperature data were collected from the sonde and thermograph data loggers.
[b] All sites were sampled, but not enough fish could be collected to composite a complete sample.
[c] These three sites were treated as one site – samples were collected at the Lemitar site in October 2006, from the Bosque del Apache site in January 2007 and August 2007, and from the San Antonio site in April 2007.
[d] Data from one sampling event were not collected due to access problems.
[e] Belen site was sampled for nutrients due to high pH values observed by USFWS and USACE.
[f] Extra nutrient sampling was conducted due to high pH values observed by USFWS and USACE.

The specific parameters included in the analytical suites listed in Tables 5 and 6 are as follows:

- **Field Data**: pH, temperature, Dissolved Oxygen, Specific Conductance and turbidity.
- **Ions/TDS/TSS/Hardness**: alkalinity, bicarbonate, bromide, calcium, carbonate, chloride, fluoride, iron, magnesium, manganese, potassium, sodium, sulfate, total dissolved solids, total suspended solids, hardness.
- **Nutrients**: ammonia, nitrate, nitrite, nitrate + nitrite (N), orthophosphate, phosphorus, total kjehldal nitrogen.
- **Total Organic Carbon**
- **Total Metals**: aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, lead, lithium, mercury, molybdenum, nickel, selenium, silicon, silver, strontium, thallium, tin, titanium, , vanadium, zinc
- **Dissolved Metals**: aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, zinc
- **Cyanide**
- **Radionuclides**: gross alpha, gross beta, radium-226, radium-228, uranium
- **Pesticides**: Anilazine, Atrazine, Azinphos-methyl, Chlorpyrifos, Coumaphos, Demeton, (total), Diazinon, Dibrom (Naled), Dichlorvos, Dimethoate, Disulfoton, EPN, Ethyl parathion, Famphur, Fensulfothion, Fenthion, Malathion, Merphos,, Methyl parathion, Mevinphos, O,O,O-Triethyl phosphorothioate, Phorate, Propazine, Ronnel, Simazine, Sulfotepp, Tetrachlorvinphos (Stirophos), Thionazin, Trichloronate, Tokuthion
- **Herbicides**: 2,4,5-T, 2,4,5-TP (Silvex), 2,4-D, 2,4-DB, Dalapon, Dicamba, Dichlorprop, Dinoseb, MCPA, MCPP.
- **Semivolatile Organics**: 1-Methylnaphthalene, 2-Methylnaphthalene, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, Acenaphthene, Acenaphthylene, Aldrin, alpha-BHC, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(ghi)perylene, Benzo(k)fluoranthene, beta-BHC, Chlordane, Chrysene, delta-BHC, Dibenzo(a,h)anthracene, Dieldrin, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin aldehyde, Fluoranthene, Fluorene, gamma-BHC (Lindane), Heptachlor, Heptachlor epoxide, Indeno(1,2,3-cd)pyrene, Methoxychlor, Naphthalene, Phenanthrene, Pyrene, Toxaphene
- **Perchlorate**
- **PCBs**
- **BOD – biological oxygen demand**
- **COD – chemical oxygen demand**
- **Ambient Toxicity**
- **Fish tissue**: Arsenic, Cadmium, Chromium, Copper, Lead, Nickel, Selenium, Zinc, Mercury, p,p'-DDE, p,p'-DDD (TDE), p,p'-DDT, o,p'-DDE, o,p'-DDD (TDE), o,p'-DDT, Total Polychlorinated Biphenyls (PCBs), Dieldrin, Endrin, Heptachlor epoxide, cis-Chlordane, trans-Chlordane, cis-Nonachlor, trans-Nonachlor, Oxychlordane (octachlor epoxide), Toxaphene, α-Hexachlorocyclohexane (HCH), β-HCH, δ-HCH, γ-HCH (Lindane), Hexachlorobenzene (HCB), Mirex

5.0 EVALUATION OF WATER CHEMISTRY AND FIELD DATA

5.1 WATER CHEMISTRY AND GRAB FIELD DATA EVALUATION

Numeric water quality criteria, exist for many water quality parameters (NMAC 2007). **Table 7** identifies all magnitude exceedences of numeric water quality criteria identified in this study.

Data from each AU were assessed for attainment of the specified designated uses for both numeric and narrative water quality criteria by applying the *Assessment Protocol*

(NMED/SWQB 2008a). This process occurs biannually. To date only data collected from 2000-2007 has been formally assessed as part of the 2008-2010 CWA §303(d)/§305(b) Integrated Report and List (NMED/SWQB, 2008b). The assessments and resulting impairments presented in this report were generated using all available data from 2000 to 2007. This resulted in the evaluation of a much larger dataset than would usually be available from a typical SWQB survey, which is usually conducted in a single year. A summary of the impairment decisions by AU is provided in **Table 8**. A complete dataset and assessment worksheets can be obtained by contacting SWQB. Data collected in 2008 will be assessed in 2009 for the 2010-2012 §303(d)/§305(b) Integrated Report and List.

The 2008-2010 CWA Section 303(d)/305(d) Integrated List identified four of five AUs in this study as impaired for *E. coli*. In two of the four AUs the impairment replaces a preexisting fecal coliform listing (see **Table 1**), which reflect a change in the WQS and subsequent sampling strategy. A TMDL was written in 2002 to address these impairments (NMED/SWQB, 2002a). In addition, data collected after 2006 as part of the MRGESACP survey identified exceedences for chronic aluminum criterion. SWQB determined that one AU, the Rio Grande (San Marcial to Rio Puerco), is impaired while two AUs; the Rio Grande (non-pueblo Alameda Bridge to Angostura Div) and the Rio Grande (Isleta Pueblo Boundary to Alameda Bridge) only had a single exceedence of the criterion. In accordance with SWQB's current *Assessment Protocol*, more than one exceedence of this parameter is required to list a waterbody as impaired. For a complete list of parameters that exceeded criterion see **Table 7.**

Table 7. Middle Rio Grande water quality criteria exceedences, 2000-2008. Ratios represent the number of exceedences/total number of samples.

Assessment Unit / Station	Analyte (applicable NM water quality criterion)											
	Aluminum, Acute (750 µg/L)	Aluminum, Chronic (87 µg/L)	Ammonia (varies by pH and temperature)	Copper, Chronic (varies as a function of hardness)	Copper, Acute (varies as a function of hardness)	*E. coli* (410 cfu/mL)	Gross a Radiation (15 pCi/L)	Nitrate + Nitrite (N) (132 mg/L)	Selenium, Total (5 µg/L)	Temperature (32.2 °C)	pH (6.6-9.0 s.u.)	PCB (0.00064 ug/L)
Rio Grande Elephant Butte to San Marcial												
Rio Grande below confluence of conveyance channel and river	No exceedences											
Rio Grande (San Marcial to Rio Puerco)												
Rio Grande at San Marcial (near USGS gage) - 32RGrand258.0	1/3	1/3	0/24	0/3	0/3	1/3	1/1	1/24	0/6	0/27	0/27	
Rio Grande Floodway at San Marcial, NM USGS Gage 8358400			0/28	0/30	0/30	6/19			1/30	2/303	0/303	
Rio Grande at San Antonio - 32RGrand292.1	0/8	2/8	0/12	0/10	0/10	0/6		0/11	0/19	0/14	0/14	
Rio Grande @ Lemitar - 32RGrand323.4	0/8	2/8	0/9	0/9	0/9	1/7	0/1	0/8	0/10	0/10	0/10	
Rio Grande Floodway at San Acacia - USGS Gage 8354900			0/17	0/18	0/18	8/19			0/18	0/128	0/128	
Rio Grande at San Acacia Above diversion Dam - 32RGrand332.5	0/4	2/4	0/6	0/6	0/6	0/0		0/4	0/4	0/8	0/8	
Rio Grande @ La Joya - 32RGrand341.2	1/8	3/8	0/16	1/16	0/16	2/6		0/12	0/10	0/19	0/19	

Assessment Unit / Station	Analyte (applicable NM water quality criterion)											
	Aluminum, Acute (750 µg/L)	Aluminum, Chronic (87 µg/L)	Ammonia (varies by pH and temperature)	Copper, Chronic (varies as a function of hardness)	Copper, Acute (varies as a function of hardness)	*E. coli* (410 cfu/mL)	Gross a Radiation (15 pCi/L)	Nitrate + Nitrite (N) (132 mg/L)	Selenium, Total (5 µg/L)	Temperature (32.2 °C)	pH (6.6-9.0 s.u.)	PCB (0.00064 ug/L)
Rio Grande (Rio Puerco to Isleta Pueblo Boundary)												
Rio Grande Floodway Near Bernardo - USGS Gage 8332010										2/107	0/107	
Rio Grande at Belen (309 Bridge) 32RGrand385.5	0/10	2/10	0/11	0/7	0/7	1/9		0/7	0/9	0/15	0/15	
Rio Grande at HWY 6 Los Lunas 32RGrand394.8	0/15	1/15	0/20	1/19	1/19	2/9		0/18	0/13	2/24	2/14	1/1
Rio Grande (Isleta Pueblo Boundary to Alameda Bridge)												
Rio Grande @ I-25 Bridge - 32RGrand413.2	0/4	1/4	0/8	1/8	1/8			0/4	0/2	0/9	0/9	
Rio Grande @ Los Padillas (BOR) - 32RGrand416.5	0/4	0/4	0/8	1/8	0/8			0/5	0/2	0/10	0/10	
Rio Grande @ Los Padillas - 32RGrand419.8	0/1	0/1	0/8	0/1	0/1	1/7		0/8	0/1	0/10	2/11	
Rio Grande below Albuquerque WWTF - 32RGrand421.2	0/4	0/4	0/8	1/8	0/8			0/5	0/11	0/11	1/11	
Rio Grande at Albuquerque, NM - USGS Gage 8330000			1/8	0/11	0/11	4/10			0/8	0/139	0/138	
Rio Grande (Alameda Bridge to Angostura)												
Rio Grande at Alameda Bridge at Alameda, NM - USGS Gage 8329918			0/1	0/11	0/11	5/11			0/6	0/11	0/11	
Rio Grande above Alameda Bridge - 32RGrand445.4	0/5	1/5	1/19	0/9	0/9	0/10		0/15	0/3	0/25	1/25	
Rio Grande near Dixon Rd.**										0/9	2/9	
Rio Grande at Lomitas Negro**										0/5	2/5	
Rio Grande below Rio Rancho WWTF #2 - 32RGrand455.0	0/4	0/4	1/8*	1/8	1/8			0/4	0/2	0/11	0/11	
Rio Grande above Rio Rancho WWTF #3 - 32RGrand458.0	0/1	0/8	0/8	0/1	0/1	0/7			0/1	0/9	0/9	
Rio Grande at PNM Gas Line**										0/11	2/11	
Rio Grande at Sandia Line 14**										0/11	1/11	
Rio Grande above Hwy 550 Bridge - 32RGrand464.2	0/1	1/1	0/11	0/1	0/1	1/10		0/11	0/1	0/13	0/13	
Rio Grande below Angostura Diversion Works - 30RGrand473.7	0/5	1/5	0/16	0/9	0/9	0/7	0/1	0/12	0/3	1/20	1/20	

* Both acute and chronic levels were exceeded

Table 8. Summary of SWQB Water Quality Impairments for Middle Rio Grande included in the 2008-2010 CWA §303(d)/§305(b) Integrated Report and List (NMED/SWQB, 2008b).

Assessment Unit	Parameter(s)	New or Continued	Comments
Rio Grande (Elephant Butte to San Marcial)	None	None	
Rio Grande (San Marcial to Rio Puerco)	Chronic Aluminum	New	
	E.coli	New	
Rio Grande (Rio Puerco to Isleta Pueblo Boundary)	*E.coli*	New	
Rio Grande (Isleta Pueblo Boundary to Alameda Bridge)	*E.coli*	New	*E.coli* replaces Fecal Coliform as the cause of impairment
Rio Grande (Alameda Bridge to Angostura Diversion)	*E.coli*	New	*E.coli* replaces Fecal Coliform as the cause of impairment

5.2 Long-term Water Quality Dataset Evaluation

5.2.1 Temperature

Temperature data collected from 2005 to 2008 was obtained from a USGS gages as well as SWQB deployed thermographs and sondes. **Table 9** contains a summary of the SWQB assessment conclusions based on this combined dataset.

In SWQB's 2005 survey, thermographs were not deployed until early August due to prohibitively high flow. They were removed after high summer air temperatures abated (September), which resulted in a relatively short data collection interval. Exceedences of the 32.2°C criterion were few and the magnitude of exceedences was never greater than 3°C. The only exceedences recorded were at San Marcial (32RGrand258.0) with a rate of 2.3% and La Joya (32RGrand341.2) with a rate of 2.6%. Neither constituted impairment for inclusion on the CWA §303(d)/§305(b) Integrated List.

During 2006-2007, temperature data were recorded using multi-parameter sondes at four stations, from NM Hwy 550 downstream to the I-25 bridge. Exceedences were few (e.g. at I-25 bridge site 1.7% of the time during June, July, and August) and occurred only at the lower two stations. The maximum magnitude of the exceedences was 1.5°C (Van Horn, 2008).

For the MRGESCP study, SWQB deployed temperature and multi-parameter sondes at project sampling stations during the 2008 sampling. Only 3 out of the 9 thermographs had usable data; the others were lost, stolen, or buried. Exceedences of the 32.2°C criterion were few and the magnitude of exceedence was never greater than 1°C. The only exceedences recorded were at Los Lunas (32RGrand394.8) with a rate of 1.4%. Temperature data, collected by the USGS was also obtained from the Alameda Bridge (32RGrand445.4) USGS station. No exceedences were measured at this site.

Table 9. Summary of temperature data from data loggers deployed in MRG, 2005-2008.

Station (Station ID)	Designated Use	NM WQS Criterion (°C)	Data Collection Interval	Max Temp (°C)	Total Data Points	Number of Exceedences/% Exceedences
Rio Grande (Elephant Butte Reservoir to San Marcial) MWWAL[1] ≤32.2						
Rio Grande at San Marcial (32RGrand258.0)			5 Aug - 27 Sep 05	35.2	1265	29/2.3
Rio Grande (San Marcial to Rio Puerco) MWWAL ≤32.2						
Rio Grande @ San Antonio (32RGrand292.1)			5 Aug - 8 Sep 05	31.3	815	0/0
Rio Grande @ La Joya (32RGrand341.2)			5 Aug - 8 Sep 05	34.5	814	21/2.6
Rio Grande @ La Joya (32RGrand341.2)			29 Jul-11Sep 08	28.4	802	0/0
Rio Grande (Rio Puerco to Isleta Pueblo) MWWAL ≤32.2						
RG @ Los Lunas (32RGrand394.8)			7 Aug-11 Sep 08	33.1	584	8/1.4
Rio Grande (Isleta Pueblo bnd to Alameda Street Bridge) MWWAL ≤32.2						
Rio Grande @ I-25 Bridge (32RGrand413.2)[2]			2 Jun 06-15 Oct 07	33.7	34806	149/0.4
Rio Grande @ Los Padillas (32RGrand419.7)			5 Aug - 7 Sep 05	31.5	796	0/0
Rio Grande above Rio Bravo Bridge (32RGrand422.6)[2]			2 Jun 06-2 Nov 07	33.1	48172	39/0.08
Rio Grande (Alameda Bridge to Angostura) MWWAL ≤32.2						
Rio Grande @ Alameda Bridge[3]			27 Jul – 25 Sep 08	29.2	3450	0/0
Rio Grande above Alameda Bridge (32RGrand445.4)			5 Aug - 7 Sep 05	30.9	790	0/0
Rio Grande above Alameda Bridge (32RGrand445.4)[2]			2 Jun 06-20 Oct 07	31.7	37743	0/0
Rio Grande blw RR WWTP #2 (32Grand455.0)			30 Jul - 15 Sep 08	27.2	781	0/0
Rio Grande abv Hwy 550 Bridge (32RGrand464.2)[2]			18 Jun-16 Oct 07	27	11454	0/0

[11] MWWAL = marginal warmwater aquatic life.
[2] These data were provided by UNM graduate student David Van Horn
[3] This data was provided by USGS

5.2.2 pH

Table 10 contains a summary of the SWQB assessment conclusions for pH data collected from 2005 to 2008 from data loggers. In 2005, SWQB deployed sondes for approximately one week at Abeytas (32RGrand361.7) and Los Padillas (32RGrand419.7). For pH, no exceedences were documented at either location. For this MRGESCP study, in 2008 SWQB also deployed data loggers for about a week at RR blw WWTP #2 (32RGrand455.0), Los Padillas (32RGrand416.5), and ABQ WWTP (32RGrand421.2). For pH, no exceedences were documented from deployed data loggers at all locations. Finally the for the 2006-2007 dataset (Van Horn, 2008), exceedences of the pH criterion were documented only at the NM Hwy 550 bridge The exceedence rate was 1.8%, with a maximum exceedence duration of 6.3 hours. The maximum value was 9.14 s.u., which occurred on July 26, 2007.

5.2.3 Dissolved Oxygen

Table 11 contains a summary of the SWQB assessment conclusions for DO data collected from 2005 to 2008. In the 2005 survey, SWQB deployed sondes for approximately one week at Abeytas (32RGrand361.7) and Los Padillas (32RGrand419.7). No exceedences were documented at Los Padillas, and only 2 contiguous data points exceeded criteria at Abeytas on September 26, 2005 (i.e., exceedence duration was < 2 hours). In 2008, as part of the MRGESCP study, SWQB deployed sondes for approximately one week at RR blw WWTP#2 (32RGrand455.0), Los Padillas (32RGrand416.5), and ABQ WWTP (32RGrand421.2). No exceedences were documented at any of the stations monitored in 2008. In the 2006-2007 dataset (Van Horn, 2008), exceedences were recorded at three of four stations (all except NM Hwy 550) with maximum durations of:

- 16 hours at Alameda bridge, 20 hours at I-25 bridge and 298 hours at Rio Bravo bridge, for percent saturation less than 75.
- 10 hours at Alameda bridge, 14 hours at I-25 bridge and 66 hours at Rio Bravo bridge for DO concentrations less that 5.0 mg/L

One episode of 53.5 contiguous hours of DO concentrations of less than 2 mg/L was recorded at the Rio Bravo station (10-12 July 06), however this could be erroneous (e.g., due to instrument burial) as no large fish kill was reported as would be expected with an event of this magnitude. Nevertheless, the magnitude and duration of exceedences at these three stations are severe enough to warrant concern and further investigation would be prudent (Van Horn, pers. com.). It should be noted that this dataset was not submitted to SWQB with sufficient time for it to be included in the 2008-2010 CWA §303(d)/§305(b) Integrated Report and List (NMED/SWQB, 2008b). The data will, however, be assessed for 2010-2012 CWA §303(d)/§305(b) Integrated Report and if the exceedences reported here are validated will result in an impairment determination.

Table 10. Summary of pH data from data loggers deployed in the MRG, 2005-2008

Assessment Unit Station (Station ID)	**Desig-nated Use**	**NM WQS Criterion (s.u.)**	**Data Collection Interval**	**Min/Max**	**Total Data Points**	**Number of Exceedences/% Exceedences**	**Frequency Violation (≥ 15% exceedences)**	**Magnitude Violation (≥ 0.5 units above criterion)**	**Duration Violation (≥ 24 hrs exceedence)**
Rio Grande (San Marcial to Rio Puerco)	**MWWAL**	**6.6-9.0**							
Rio Grande @ Bosque del Apache (32RGrand286.9)			10-19 Oct 07	7.48/8.48	874	0/0	No	No	No
Rio Grande (Rio Puerco to Isleta Pueblo bnd)	**MWWAL**	**6.6-9.0**							
Rio Grande @ Abeytas (32RGrand361.7)			21 Sep-27 Sep 05	7.80/8.52	147	0/0	No	No	No
Rio Grande (Isleta Pueblo bnd to Alameda St Bridge)	**MWWAL**	**6.6-9.0**							
Rio Grande @ I-25 (32RGrand413.2)[1]			2 Jun 06-15 Oct 07	7.57/8.45	34806	0/0	No	No	No
Rio Grande @ Los Padillas (32RGrand419.7)			21 Sep-01 Oct 05	7.22/7.94	237	0/0	No	No	No
Rio Grande @ Los Padillas (32RGrand419.7)			15 Sep-22 Sep 08	8.04-8.22	169	0/0	No	No	No
Rio Grande above Rio Bravo Bridge (32RGrand422.6)[1]			2 Jun 06-2 Nov 07	7.17/8.84	48172	0/0	No	No	No
Rio Grande blw ABQ WWTP (32RGrand421.2)			19 Aug-26 Aug 08	6.72-7.22	164	0/0	No	No	No
Rio Grande (Alameda Bridge to Angostura)	**MWWAL**	**6.6-9.0**							
Rio Grande above Alameda Bridge (32RGrand445.4)[1]			2 Jun 06-20 Oct 07	7.39/8.94	37743	0/0	No	No	No
Rio Grande blw RR WWTP#2 (32RGrand455.0)			11 Aug-19 Aug 08	7.51-8.23	189	0/0	No	No	No
Rio Grande abv Hwy 550 Bridge (32RGrand464.2)[1]			7 Jun-16 Oct 07	7.86/9.14	11454	201/1.8	No	No	No

[1] These data were provided by UNM graduate student David Van Horn

Table 11. Summary of dissolved oxygen data from data loggers deployed in the MRG, 2005-2008

Assessment Unit Station (Station ID)	Desig-nated Use	NM WQS Criterion (mg/L)	Data Collection Interval	Min Conc. (mg/L)	Min Sat. (% local)	Assessment Criterion (Combined; % Sat.)	Total Data Points	Combined Conc./% Sat. Exceedences (# / % / >3 hrs)	% Sat. Exceedences (# / % / >3 hrs)
Rio Grande (San Marcial to Rio Puerco)	**MWWAL**	**≥5**				**< 5 mg/L and < 90%; or < 75%**			
Rio Grande @ Bosque del Apache (32RGrand286.9)			10-19 Oct 07	6.06	80.2		874	0/0/No	0/0/No
Rio Grande (Rio Puerco to Isleta Pueblo bnd)	**MWWAL**	**≥5**				**< 5 mg/L and < 90%; or < 75%**			
Rio Grande @ Abeytas (32RGrand361.7)			21 Sep-27 Sep 05	4.36	67.6		147	2/1.3/No	1/0.6/No
Rio Grande (Isleta Pueblo bnd to Alameda Street Bridge)	**MWWAL**	**≥5**				**< 5 mg/L and < 90%; or < 75%**			
Rio Grande @ I-25 Bridge (32RGrand413.2)[1]			2 Jun 06-15 Oct 07	0.12	1.7		34806	178/0.5/Yes	258/0.7/Yes
Rio Grande @ Los Padillas (32RGrand419.7)			21 Sep-01 Oct 05	6.69	98.8		237	0/0/No	0/0/No
Rio Grande above Rio Bravo Bridge (32RGrand422.6)[1]			2 Jun 06-2 Nov 07	0.04	0.6		48172	2214/4.6/Yes	2550/5.3/Yes
Rio Grande blw ABQ WWTP (32RGrand421.2)			19 Aug-26 Aug 08	5.69	82.8		164	0/0/No	0/0/No
Rio Grande (Alameda Bridge to Angostura)	**MWWAL**	**≥5**				**< 5 mg/L and < 90%; or < 75%**			
Rio Grande above Alameda Bridge (32RGrand445.4)[1]			2 Jun 06-20 Oct 07	0.43	6.4		37743	208/0.6/Yes	602/1.6/Yes
Rio Grande @ Los Padillas (32RGrand416.5)			15 Sep-22 Sep 08	7.6	104.1		169	0/0/No	0/0/No
Rio Grande blw RR WWTP#2 (32RGrand455.0)			11 Aug-19 Aug 08	6.25	85.2		189	0/0/No	0/0/No
Rio Grande abv Hwy 550 Bridge (32RGrand464.2)[1]			7 Jun-16 Oct 07	5.93	81		11454	0/0/No	0/0/No

[1] These data were provided by UNM graduate student David Van Horn

6.0 OTHER DATA FROM THE MRG

Sediment, fish tissue and sediment toxicity (performed by EPA) data were collected as part of the MRGESACP study (2006-2008). NM has not adopted water quality criteria for sediment nor ambient toxicity and only has a fish-tissue based criteria for methylmercury. As such, sections 6.1 through 6.2 contain summaries of the data and comparisons to guidelines from other agencies to help evaluate the quality of water and sediment in the MRG and the potential for it to contribute to the decline of RGSM populations. Section 6.3 provides results of EPA sediment toxicity testing. Finally, during the 2005 MRG study, SWQB staff collected water chemistry data at conveyance channels, sites on Isleta Pueblo and from MRGCD drains to the MRG. Data from these stations are summarized in Section 6.4 of this report. Additional data related to testing of MRG wastewater effluent for estrogenicity and pharmaceutical and personal care products (PPCP) conducted by USEPA are provided in Appendix B.

6.1 SEDIMENT SAMPLING SUMMARIES

Samples were collected quarterly between October 2006 and September 2008 from recently deposited sediments. SWQB researched various agencies to determine a potential screening level and found freshwater sediment criteria for a variety of parameters developed by the National Oceanic and Atmospheric Administration (NOAA) as part of their Screening Quick Reference Tables (SQuiRT). These tables are intended for preliminary screening purposes and do not represent official NOAA policy or clean-up levels. SWQB found the SQuiRT reference table to be the most complete source for sediment chemical concentration screening levels that could be obtained, and therefore compared the sediment results to the SQuiRT levels. SQuiRT screening levels, generally from lowest to highest predicted toxicity, include:

- Lowest Assessment and Remediation of Contaminated Sediments (ARCS)
- Threshold Effect Level (lowest TEL) = Concentration below which adverse effect are expected to occur only rarely to *H. azteca*.
- Threshold Effects Level (TEL) = Concentration below which adverse effect are expected to occur only rarely.
- Probable Effect Level (PEL) = Concentration where adverse effects are frequently expected.
- Upper Effects Level (UET) = Highest non-toxic sample. Represents a concentration above which adverse biological impact would always be expected.

The levels provided in SQuiRT tables were designed for preliminary screening and are not meant to be used as criteria (Buchman, 1999). Information for parameters that were detected and compared to SQuiRT screening levels are provided in **Tables 12 and 13**. Summary tables only include data for analytes for which the screening levels or guidance levels could be found. Results less than detection are not summarized in this report however a complete dataset from quarterly sediment sampling is available upon request.

Sediment was analyzed for semivolatile/ organochlorines, metals, cyanide and semivolatile/ polycyclic aromatic hydrocarbons (PAHs). All sediment semivolatile/ organochlorines results were below detection levels for all sampling events. Many metals were detected in sediment samples during the first year of the survey. Arsenic at the Bosque del Apache site was the only metal to exceed the SQuiRT lowest screening level, the Threshold Effect Level (see **Table 12**).

Table 12. Summary of MRG sediment data for metals and cyanide compared to NOAA SQuiRT, 2006-2008. Results are reported as minimum and maximum values in ppm.

Sediment Elements	Arsenic	Cadmium	Chromium	Copper	Cyanide (WA State guideline)	Lead	Manganese	Mercury	Nickel	Silver	Zinc
NOAA SQuiRT Lowest Effects Level → Highest Effects Level ppm	5.9 (TEL) - 17.0 (PEL/UET)	0.583 (Lowest TEL) -3.54 (PEL)	36.3 (Lowest TEL) - 95 (UET)	28.01 (Lowest TEL) - 197 (PEL)	0.1 (LEL)	35 (TEL) -127 (UET)	630 (Lowest TEL) – 1100 (UET)	0.174 (TEL) – 0.561 (UET)	19.514 (Lowest TEL) – 43 (UET)	4.5 (UET)	98 (TEL) - 520 (UET)
Assessment Unit / Station											
Rio Grande (San Marcial to Rio Puerco)											
Bosque del Apache	1.5-7.09	0.155-0.355	8.7-12.4	2.4-16.1	ND	4.0-15.7	150-354	0.0036-0.0286	4.9-13.2	0.041-0.210	14-57.6
Rio Grande near San Antonio	2.47	ND	13.1	5.15	ND	6.59	233	ND	8.24	0.227	24.2
Rio Grande near Lemitar	2.7-3.79	0.237-0.35	14.3	6.34-12.3	ND	6.87	179-288	0.0113-0.014	7.52-13.5	0.054-0.065	26.6-38.7
Rio Grande upstream of San Acacia Dam	2.6-8.62	0.1-0.5	7.9-21.0	6.2-25.7	ND	6.7-22.3	160-446	.0131-0.0419	7.3-17.2	0.074-0.270	20.0-48.8
Rio Grande below the confluence with Rio Puerco - La Joya	1.8-5.09	0.055-0.25	4.0-12.3	3.7-13.8	ND	4.3-11.1	179-379	0.0058-0.0147	4.1-9.68	0.073-0.198	15.0-40.8
Rio Grande (Rio Puerco to Isleta Pueblo bnd)											
Rio Grande at Los Lunas	1.70-5.03	0.16-0.19	2.38-11.2	4.57-13.2	0.448*	5.6-8.88	150-314	0.0099-0.0164	5.1-10.6	0.17-0.19	20.0-37.7
Rio Grande (Isleta Pueblo bnd to Alameda Street Bridge)											
Rio Grande at the I-25 Bridge	1.50-3.46	0.052-0.346	1.6-11.8	1.6-9.08	ND	2.4-8.35	81-230	0.0042-0.013	1.8-9.54	0.062-0.093	7.3-37.1
Rio Grande downstream of the AMAFCA South Diversion Channel - Los Padillas	2.10-3.91	0.084-0.27	4.1-9.86	3.3-8.63	ND	4.6-9.47	82-260	0.0043-0.0152	4.1-9.96	0.064-0.160	15.0-36.9
Rio Grande downstream of Albuquerque WWTP	1.7-4.34	0.073-0.267	2.33-8.33	1.73-9.8	0.402*	2.79-9.8	129-210	0.0024-0.0146	2.4-8.2	0.075-0.240	9.0-31.66
Rio Grande (non-pueblo Alameda Bridge to Angostura Div)											
Rio Grande at Alameda Bridge	2.6-5.14	0.162-0.272	7.56-11.0	5.86-10.5	ND	4.4-11.4	150-341	0.0102-0.0182	3.7-9.16	0.054-0.190	10.0-34.7
Rio Grande downstream of Rio Rancho WWTP	1.5-4.08	0.114-0.180	3.3-8.41	3.3-6.39	ND	3.1-6.7	111-226	0.0035-0.0087	2.5-6.3	0.042-0.170	9.2-23.6
Rio Grande at Angostura Dam	1.92-3.63	0.085-0.225	2.98-9.13	3.5-9.01	ND	4.02-8.59	146-306	0.0037-0.0127	3.0-8.8	0.089-0.140	13.7-30.1

Red	=	Exceed the Washington State review of criteria lowest effect level or NOAA Squirt screening levels.
LEL	=	"Level of sediment contamination that can be tolerated by most benthic organisms" (Batts 1993, Washington State).
Lowest TEL	=	Lowest Assessment and Remediation of Contaminated Sediments *H. azteca* (SQuiRT).
TEL	=	Threshold Effect Level – concentration below which adverse effect are expected to occur only rarely (SQuiRT).
PEL	=	Probable Effect Level – concentration where adverse effects are frequently expected (SQuiRT).
UET	=	Upper Effects Threshold – Highest non-toxic sample. Represents a concentration above which adverse biological impact would always be expected (SQuiRT)
ND	=	Analyte not detected.
*	=	No range, only one out of four samples was detected.

Table 13. Summary of sediment data for semivolatile/PAHs compared to NOAA SQuiRT, 2006-2008. Results are reported as minimum and maximum values in ppb when more than one detection per site was observed.

Semivolatile/ PAHS	Benzo(a) - pyrene	Benzo(a)anth-racene	Chrysene	Dibenz(a,h)-anthracene	Fluoranthene	Flurene	Indeno(1,2,3-cd)pyrene	Phenanthrene	Pyrene
NOAA SQuiRT Lowest Effects Level → Highest Effects Level ppb	31.9 (TEL) - 700 (UET)	15.72 (Lowest TEL) - 500 (UET)	26.83 (Lowest TEL) - 800 (UET)	10 (Lowest TEL)- 100 (UET)	31.46 (Lowest TEL) - 2355 (UET)	10 (Lowest TEL) - 300 (UET)	17.3 (Lowest TEL) - 330 (UET)	18.73 (Lowest TEL) - 800 (UET)	44.27 (Lowest TEL)- 1000 (UET)
Assessment Unit / Station									
Rio Grande (San Marcial to Rio Puerco)									
Bosque del Apache	ND	1.9-3.2	2.9-4.6	ND	5.5-9.5	ND	2.1-7.18	1.2-6.4	4.2-7.3
Rio Grande near San Antonio	ND	ND	ND	ND	ND	ND	ND	ND	ND
Rio Grande near Lemitar	ND	ND	ND	ND	ND	ND	ND	ND	ND
Rio Grande upstream of San Acacia Dam6	1.2-6.8	1.5-5.2	1.5-6.5	ND	2.1-7.5	ND	1.3-**19.6**	1.4-4.7	4.2-7.3
Rio Grande below the confluence with Rio Puerco - La Joya	5.0-15.8	3.5-7.8	5.6-17.9	2.5	12.6-24.0	ND	16.5	3.3-7.1	6.3-16.1
Rio Grande (Rio Puerco to Isleta Pueblo bnd)									
Rio Grande at Los Lunas	2.7-28.0	2.6-20.0	16.0-**31.0**	1.9-4.3	4.9-**46.0**	ND	7.5-17.0	1.6-15.0	3-**37.0**
Rio Grande (Isleta Pueblo bnd to Alameda Street Bridge)									
Rio Grande at	9.3-**44.0**	7.5-29	11.0-**48.0**	2-6.2	15.0-**75.0**	1.6	6.3-9.8	4.3-**26**	11.0-**58.0**

Semivolatile/ PAHS	Benzo(a) - pyrene	Benzo(a)anth-racene	Chrysene	Dibenz(a,h)-anthracene	Fluoranthene	Flurene	Indeno(1,2,3-cd)pyrene	Phenanthrene	Pyrene
the I-25 Bridge									
Rio Grande downstream of the AMAFCA South Diversion Channel - Los Padillas	5.4-**38**	5.3-24.0	9.0-**34.0**	1.4-5.6	20.0-**70.0**	1.5	3.9-**19.2**	4.1-**23**	10-**60**
Rio Grande downstream of Albuquerque Wastewater Treatment Plant	4.3-12.0	3.4-8.6	4.3-12.0	1.7-2.3	1.6-23.0	ND	3.0-**31.4**	2.8-6.3	4.8-16.0
USGS Gage Rio Grande at Albuquerque	20	10-**30**	10-**70**		20-**100**		**50**	**30**	20
Rio Grande (non-pueblo Alameda Bridge to Angostura Div)									
Rio Grande at Alameda Bridge	5.5-**96.0**	4.0-**71.0**	7.4-**120**	2.5-**18.9**	13-**190**	3.9	5.3-**60.0**	3.4-**74.0**	9.8-**150**
Rio Grande downstream of Rio Rancho Wastewater Treatment Plant	1.5-**64.8**	1.9-**47.1**	1.6-**40.7**	**40.5**	1.6-3.1	**56.9**	**54.9**	1.3-1.6	1.8-**47.1**
Rio Grande at Angostura Dam	2.7-7.89	3.0-8.88	2.6 8.21	ND	7.1	ND	ND	1.7-6.7	6.5

LEL = "Level of sediment contamination that can be tolerated by most benthic organisms" (Batts 1993, Washington State).
Lowest TEL = Lowest Assessment and Remediation of Contaminated Sediments *H. azteca* (SQuiRT).
TEL = Threshold Effect Level – concentration below which adverse effect are expected to occur only rarely (SQuiRT).
PEL = Probable Effect Level – concentration where adverse effects are frequently expected (SQuiRT).
UET = Upper Effects Threshold – Highest non-toxic sample. Represents a concentration above which adverse biological impact would always be expected (SQuiRT)..
ND = Analyte not detected.
Range given if more than one detection at that location.
Red = Exceeded NOAA SQuiRT guidelines.

Cyanide is not listed in the NOAA SQuiRT tables. Instead, SWQB used screening levels summarized by the State of Washington Department of Ecology (Batts and Cubbage, 1995). The levels of cyanide found in the sediment samples exceeded these guidelines for the Lowest Effect Level (LEL), defined as the level of sediment contamination that can be tolerated by most benthic organisms

Several semivolatile/PAHs parameters were detected in the sediment samples at levels that exceeded SQuiRT screening guidelines. The areas with sampling results above the SQuiRT levels were mainly urban sites, most notably at the Rio Grande below the Rio Rancho WWTP #2 and above the Alameda Bridge. No semivolatile/PAH parameters were detected above SQuiRT screening levels in sediment samples collected downstream of the Los Padillas station. Summary tables only include data for PAH analytes with available screening levels or guidance. Numerous other PAHs were detected in sediment samples. All data are available upon request.

6.2 FISH TISSUE

Fish tissue samples were collected with the assistance of the New Mexico Department of Game and Fish (DGF) on May 8-9, 2007 and on June 9-10, 2008. DGF and SWQB staff electroshocked fish from a raft while drifting with the current. Common carp (*Cyprinus carpio)* were submitted for analysis from each of 5 longitudinal reaches: Highway 550 Bridge to Rio Rancho WWTP #2; Rio Rancho WWTP #2 to North AMAFCA channel; North AMAFCA channel to Alameda Bridge; Rio Bravo Bridge to Los Padillas; and Upstream of HWY 6 in Los Lunas to HWY 6 bridge in Los Lunas (See **Table 14**). Reach descriptions are general areas of sampling. See **Figure 6** exact sampling locations. Reach lengths were approximately 3.2 km (2 miles) long. These reaches include five water quality sampling stations: Rio Grande (RG) below North AMAFCA (Alameda), RG below HWY 550 (Angostura), RG below Rio Rancho WWTP, and RG below Albuquerque WWTP (which included RG below South AMAFCA), and Los Lunas at Hwy 6. A sixth reach was also sampled from La Joya to San Acacia diversion, but no fish were captured. Fish sampling was conducted along this reach using both hoop nets and electroshocking, but did not yield enough fish and/or fish big enough to use for the MRGESACP survey.

Electrofishing was most efficient along the banks and in the floodplain in shallow water in cover. Fish caught included white bass (*Morone chrysops*), common carp, river carpsucker (*Carpiodes carpio*), channel catfish (*Ictalurus punctatus*), brown trout (*Salmo trutta*), and northern pike (*Esox lucius*). The most common fish found was river carpsucker. Many carp had lesions, with some containing shortened opercula or missing opercula altogether. All fish tissue chemistry results were from composite samples of whole fish, wet weight, in mg/kg (ppm). All fish samples collected in this survey contained concentrations above method detection limits.

Table 14. MRG fish collection information, 2007-2008.

Assessment Unit / Station	Number of Common Carp	Size Range (mm)	Date
Rio Grande (Rio Puerco to Isleta Pueblo bnd)			
Rio Grande at Los Lunas	2	250-365	10 JUN 2008
Rio Grande (Isleta Pueblo bnd to Alameda Street Bridge)			
Rio Grande downstream of Albuquerque Wastewater Treatment Plant	5	535-655	9 MAY 2007
Rio Grande downstream of Albuquerque Wastewater Treatment Plant	5	450-555	10 JUN 2008
Rio Grande (non-pueblo Alameda Bridge to Angostura Div)			
Rio Grande at Alameda Bridge	3	435-570	8 MAY 2007
Rio Grande at Alameda Bridge	5	450-590	9 JUN 2008
Rio Grande downstream of Rio Rancho Wastewater Treatment Plant	5	388-500	9 MAY 2007
Rio Grande downstream of Rio Rancho Wastewater Treatment Plant	5	425-520	9 JUN 2008
Rio Grande at Angostura Dam (downstream near 550 bridge)	5	405-535	9 MAY 2007
Rio Grande at Angostura Dam (downstream near 550 bridge)	5	425-520	9 JUN 2008

New Mexico has adopted only one fish tissue based criterion (methylmercury) in its WQS. For other parameters SWQB used the USGS Biomonitoring of Environmental Status and Trends (BEST) Program (Schmitt 2004) screening levels for evaluation (see **Tables 15 – 17**). Zinc was the only metal that exceeded concentration limits that have been shown to affect American flagfish (*Jordanella floridae*) growth and survival. Zinc exceeded these concentration limits at all sites for both years (see **Table 16**). Current literature reviews have not resulted in any information showing concentrations of PCB and pesticide pollutants that impact fish health except for total DDT. All of the studies that were reviewed report concentrations in fish tissue that impact wildlife or human health and not fish health. The Angostura and Albuquerque WWTP sites both contained levels of total DDT (mainly consisting of 4,4, DDE) that were above levels reviewed by the USGS BEST Program that have been shown to have toxic effects on fish (Schmitt 2004, see **Table 15**).

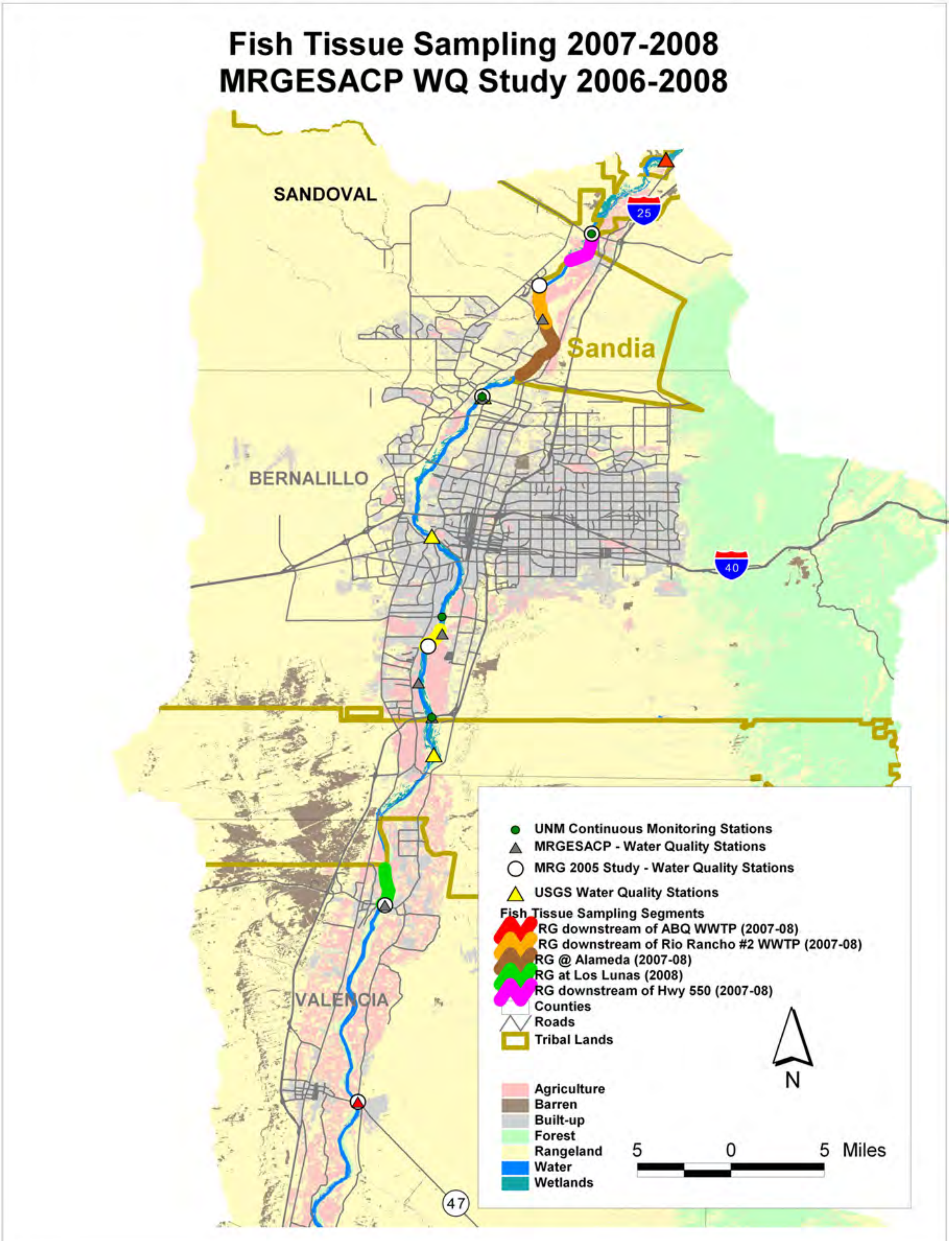

Figure 6. Fish sampling reaches 2007-2008.

Table 15. MRG fish tissue results for total PCB and pesticides, 2007-2008.

Analyte	Year	2,4'-DDE	4,4'-DDE	2,4'-DDD	4,4'-DDD	2,4'-DDT	4,4'-DDT	Total DDT			Total PCB
Source		NA	NA	NA	NA	NA	NA	USGS BEST			NA
Analyte Effects on Fish Health								Toxic Effects	Reduced Egg Survival	Reduced Survival	
Units		ng/g	ng/g	ng/g	ng/g	ng/g	ng/g	50.0 ng/g	1270.0 ng/g	24,000 ng/g	ng/g
Assessment Unit/Station	**Rio Grande (Rio Puerco to Isleta Pueblo bndy)**										
Rio Grande at Los Lunas	2008	0.184	12.8	0.474	1.69	0.059	0.174	15.381			56.1
Assessment Unit/Station	**Rio Grande (Isleta Pueblo bnd to Alameda Street Bridge)**										
Rio Grande downstream of Albuquerque WWTP	2007	0.445	31.5-51.7	1.1	3.46	0.165	0.907	**58**			98
Rio Grande downstream of Albuquerque WWTP	2008	0.396	31.5	2.4	2.93	ND	ND	37.3			12.4
Assessment Unit/Station	**Rio Grande (non-pueblo Alameda Bridge to Angostura Div)**										
Rio Grande at Alameda Bridge	2007	0.348	23.4	1.32	2.18	0.22	0.668	28			97
Rio Grande at Alameda Bridge	2008	0.285	30.2	0.672	2.91	0.074	0.106	34.25			72.6
Rio Grande downstream of Rio Rancho WWTP	2007	0.492	25.7	2.79	2.21	0.508	1.62	33			76
Rio Grande downstream of Rio Rancho WWTP	2008	0.095	12.4	0.279	1.02	ND	ND	13.79			17.1
Rio Grande at Angostura Dam	2007	0.289-0.533	33.5-54.4	0.758-2.67	2.48-3.04	0.566	0.638	40-**58.47**			120.2
Rio Grande at Angostura Dam	2008	0.289	54.4	0.758	3.04	ND	ND	58.49			67.3

RED = Exceeded guidelines.
ND = Non-detect NA = No criteria or guidelines could be found relating to fish health.

Table 16. MRG fish tissue results for metals, 2007-2008. Effects compared to USGS BEST concentration limits (2004).

Analyte*	Year	Arsenic		Cadmium	Lead**		Mercury		Selenium		Zinc
Analyte Effects on Fish Health		Loss of Equilibrium	Increased Mortality	Reduced Reproduction	Reduced Reproduction	Reduced Growth	Behavioral	Reduced Reproduction	Toxicity to Fish	Reproductive Failure	Growth and Survival
Type of sample/Fish		Whole Body - Rainbow Trout		Whole Body –Flagfish	Embryos - Brook Trout	Brook Trout	Whole Body Fish	Whole Body Concentration	Whole Body	Fathead Minnow	Flagfish
USGS BEST Concentrations That Affect Fish Health - Wet Weight		8.1-13.5 mg/kg	5.4 mg/kg	>2.8mg/kg	0.4 mg/kg	4.0-8.8 mg/kg	0.7-5.4 mg/kg	4.47 mg/kg	0.8 mg/kg	1.6-3.2 mg/kg	40-64 mg/kg
Assessment Unit/Station		**Rio Grande (Rio Puerco to Isleta Pueblo bndy)**									
Rio Grande At Los Lunas	2008	0.022		0.014	0.14		0.029		0.52		**53**
Assessment Unit/Station		**Rio Grande (Isleta Pueblo bnd to Alameda Street Bridge)**									
Rio Grande downstream of Albuquerque WWTP	2007	0.62		0.102	0.239**		0.025		0.573**		**59.1**
Rio Grande downstream of Albuquerque WWTP	2008	0.024		0.036	0.22		0.057		0.44		**75**
Assessment Unit/Station		**Rio Grande (non-pueblo Alameda Bridge to Angostura Div)**									
Rio Grande at Alameda Bridge	2007	0.76		0.0958**	0.239**		0.03		0.575**		**52**
Rio Grande at Alameda Bridge	2008	0.026		0.045	0.22		0.012		0.47		**49**
Rio Grande downstream of Rio Rancho WWTP	2007	0.74		0.096**	0.24**		0.047		0.576**		**42.2**
Rio Grande downstream of Rio Rancho WWTP	2008	0.044		0.073	0.16		0.093		0.51		**59**
Rio Grande at Angostura Dam	2007	1.09		0.114	0.242**		0.046		0.581**		**52.2**
Rio Grande at Angostura Dam	2008	0.023		0.048	0.2		0.092		0.45		**45**

Bold w/Red = Exceeded concentration levels that have been shown to cause negative impacts to fish
* = Chromium, nickel, and copper were omitted due to lack of information on concentrations and effects on fish (Schmitt 2004).
** = Samples were below detection limits.

Table 17. USGS BEST data compared against SWQB 2006-2008 data. Values are reported as whole fish wet weight in mg/kg.

Chemical		As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
BEST Max. Concentration Observed All Rio Grande Basin Stations		0.55	0.12	71.8	1.8	0.46	4.2	4.2	1.87	83.6
BEST Max. Concentration @ Elephant Butte Res.		0.25	0.08	71.76	1.16	0.46	2.14	0.1	0.54	75.2
BEST Geometric Mean Concentration @ Elephant Butte Res.		0.17	0.02	9.51	0.67	0.24	1.06	0.04	0.45	22.8
Actual Site Values 20007 SWQB Data	ABQ WWTP	***0.623***	***0.102***	0.941	***1.41***	0.025	0.451	0.121*	0.29*	***59.1***
	Alameda	***0.763***	***0.048***	0.631	***1.64***	0.03	0.295	0.12*	0.287 *	***52***
	RR WWTP	***0.736***	***0.048***	1.22	***1.41***	0.047	0.642	0.12*	0.29*	***42.2***
	Angostura	***1.09***	***0.114***	0.838	***1.49***	0.046	0.392	0.12*	0.29*	***52.2***
Actual Site Values 2008 SWQB Data	Los Lunas	0.022	0.014	0.13	**1.1**	0.029	0.05	**0.140**	**0.520**	**53**
	ABQ WWTP	0.024	**0.036**	0.17	**1.7**	0.057	0.05	**0.220**	0.440	**75**
	Alameda	0.026	**0.045**	0.16	**1.2**	0.12	0.059	**0.220**	**0.470**	**49**
	RR WWTP	0.044	**0.073**	0.11	**1.3**	0.093	0.064	**0.160**	**0.510**	**59**
	Angostura	0.023	**0.048**	0.13	**1.4**	0.092	0.081	**0.200**	**0.450**	**45.0**

Red (w/ Bold/Italic) = Project sampling detected chemicals at higher levels than the geometric mean of data from Elephant Butte Reservoir 1997-98 BEST study (Schmitt 2004).

* = All samples were below quantification limits.

6.3 EPA AMBIENT SEDIMENT TOXICITY TESTING

Sediment samples for toxicity testing were collected July 16, 23 and 30, 2007 and sent to the EPA Region 6 Laboratory in Houston for analysis. At the lab, sediment and water are combined in a sediment-to-water ratio of 1:4. After mixing and settling, the elutriate is siphoned off and then filtered. *Ceriodaphnia dubia* and *Pimephales promelas* were then exposed to the water mixture for seven days.

Most of the samples did not have a significant effect on the test organisms. Significant effects were noticed in only three of the tests which included two samples of reduced reproduction for *Ceriodaphnia dubia* and 1 sample of FHM that had 20% of the embryo/larvae affected. A summary of the results is included in **Table 18**.

Table 18. Results of MRG sediment toxicity testing by USEPA, 2007.

Species	*Ceriodaphnia dubia*		*Pimephales promelas*
Test	Survival and Reproduction		7-Day Embryo/Larval
	Mortality %	Reproduction - Young per Female	Organisms Affected % (% of embryo/larvae affected)
Assessment Unit / Station			
Rio Grande (San Marcial to Rio Puerco)			
Bosque del Apache	10	15.6	0
Rio Grande upstream of San Acacia Dam6	0	16.6	3
Rio Grande below the confluence with Rio Puerco - La Joya	0	11.7*	3
Rio Grande (Rio Puerco to Isleta Pueblo bnd)			
Rio Grande at Los Lunas	0	15.1	3
Rio Grande (Isleta Pueblo bnd to Alameda Street Bridge)			
Rio Grande at the I-25 Bridge	0	17.3	20*
Rio Grande downstream of the AMAFCA South Diversion Channel - Los Padillas	0	16.6	0
Rio Grande downstream of Albuquerque Wastewater Treatment Plant	0	13.6*	0
Rio Grande (non-pueblo Alameda Bridge to Angostura Div)			
Rio Grande at Alameda Bridge	0	18.4	0
Rio Grande downstream of Rio Rancho Wastewater Treatment Plant	0	17.6	0
Rio Grande at Angostura Dam	0	17.1	7

***** Significant effect in test organisms exposed to eluate as determined by Region 6 EPA Laboratory statistical analysis. Copies of EPA reports can be provided upon request.

6.4 ADDITIONAL DATA FROM STATIONS IN MRG

SWQB collected water samples at a number of sites during the SWQB MRG (2005) survey for which the resulting data will not be assessed but will be used in discussions regarding sources during subsequent TMDL development. These sites are displayed in **Table 19** and **Figure 7** and include drains, diversion channels, the MRG conveyance channel, Pueblo sites, and wastewater treatment facilities in the MRG study area. Water chemistry data collection included nutrients, metals, major ions, and *E. coli* in addition to total organic carbon, PCBs, pesticides, semi-volatile organics, sediment, and ambient toxicity.

Table 19. List of other water quality monitoring sites from 2005 SWQB water sampling efforts.

Station Name	Station Type	STORET ID	Study
Rio Grande Conveyance Channel at San Marcial near USGS gage 0858300	Conveyance	32RGrand261.0	MRG (2005)
Socorro WWTP effluent	WWTP Effluent	NM0028835	MRG (2005)
Belen WWTP effluent	WWTP Effluent	NM0020150	MRG (2005)
Los Lunas WWTP effluent	WWTP Effluent	NM0020303	MRG (2005)
Bosque Farms WWTP effluent	WWTP Effluent	NM0030279	MRG (2005)
Rio Grande above Isleta Diversion	Pueblo	32RGrand407.8	MRG (2005)
Rio Grande abv BNSF RR Bridge on Isleta Pueblo	Pueblo	32RGrand411.6	MRG (2005)
Confl Abq Riverside Drain and Barr Interior Drain	Drain	32AbqR&BarrDr	MRG (2005)
Confl Los Padillas Drain and Isleta Drain @ I-25	Drain	32Pad&IsletDr	MRG (2005)
Albuquerque WWTP effluent	WWTP Effluent	NM0022250	MRG (2005)
San Jose Drain	Drain	32SaJoseDrain	MRG (2005)
North Diversion Channel blw El Camino Real	Drain (on Pueblo)	32AlbNDiv00.7	MRG (2005)
Rio Rancho #2 WWTP effluent	WWTP Effluent	NM0027987	MRG (2005)
Rio Rancho #3 WWTP effluent	WWTP Effluent	NM0029602	NPDES monitoring
Rio Grande on Sandia Pueblo	Pueblo	32RGrand458.9	MRG (2005)
Bernalillo WWTP effluent	WWTP Effluent (on Pueblo)	NM0023485	MRG (2005)

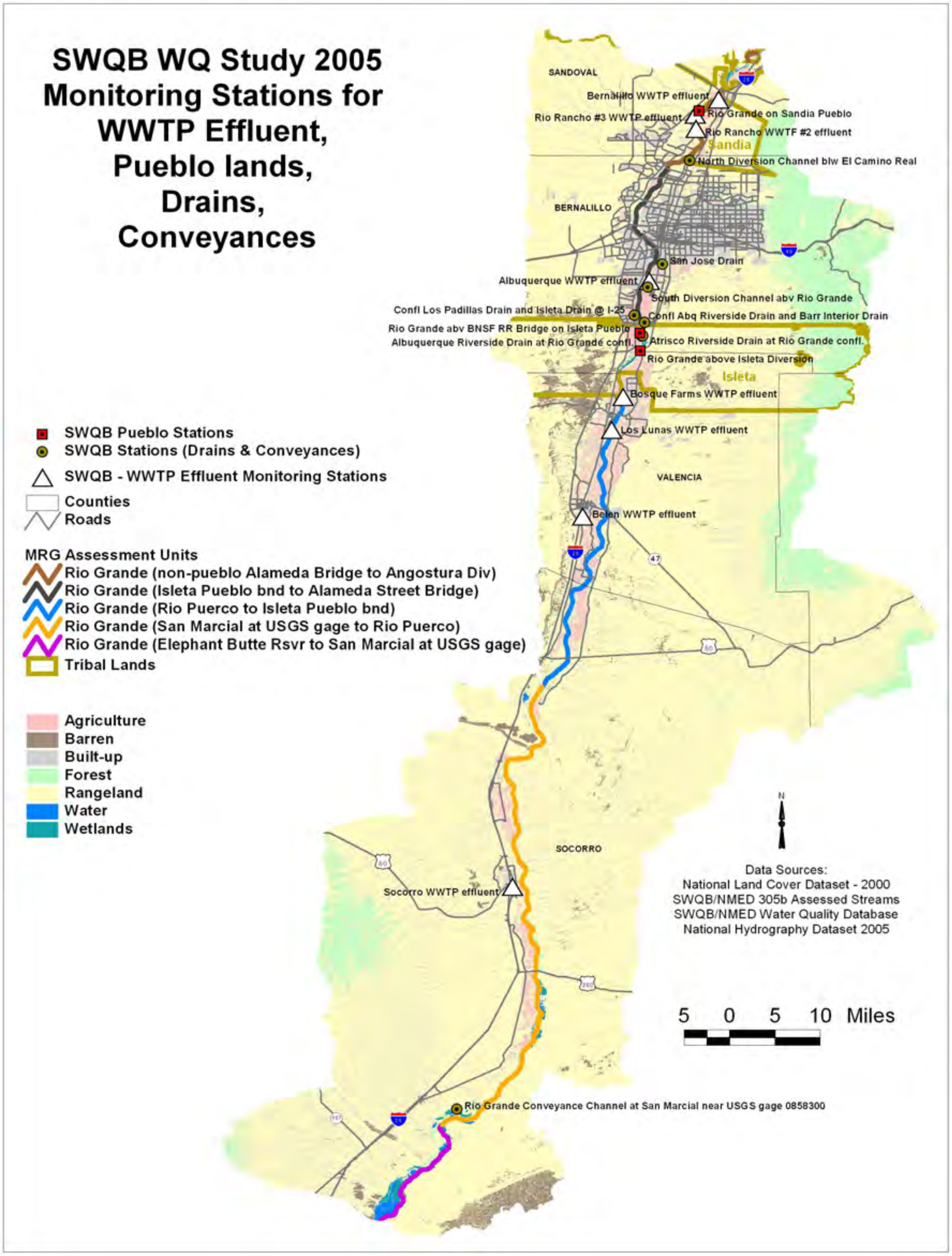

Figure 7. Additional stations with SWQB collected water quality data, 2005.

7.0 DISCUSSION

7.1 WATER QUALITY RESULTS

Assessment of data from the MRG for the 2008-2010 CWA Section 303(d)/305(d) Integrated List identified four of five AUs in this study as impaired for *E. coli*. In two of the four AUs the impairment replaces a preexisting fecal coliform listing (see **Table 1**), which reflect a change in the WQS and subsequent sampling strategy. Subsequent to the fecal coliform listing, SWQB, Albuquerque Metropolitan Arroyo Flood Control Authority and Bernalillo County contracted with Parsons Water & Infrastructure, Inc. to conduct a Microbial Source Tracking (MST) study (NMED/SWQB, 2005). The MST study concluded that birds, dogs, and humans are the top three contributors of *E.coli* to the MRG. In the Rio Grande assessment units downstream of Albuquerque, the source of *E.coli* contamination remains to be determined as it was outside of the MST study area.

The only other impairment determination in the MRG was for chronic aluminum. Data collected after 2006 as part of the MRGESACP survey identified exceedences for chronic aluminum criterion with one AU, the Rio Grande (San Marcial to Rio Puerco), listed as impaired while two AUs, the Rio Grande (non-pueblo Alameda Bridge to Angostura Div) and the Rio Grande (Isleta Pueblo Boundary to Alameda Bridge), only had a single exceedence of the criterion. Aluminum concentrations are known to be high in waters originating in the Jemez Mountains to the north of Albuquerque. As such the Jemez River and Rio Puerco, which drain this region, are two potential sources of elevated aluminum to the Rio Grande. The Jemez River joins the Rio Grande just below the Angostura Diversion and the Rio Puerco, which has its headwaters on the west slope of the Jemez Mountains, flows into the Rio Grande above Belen. A TMDL for chronic aluminum was completed in 2007 for the Rio Puerco (Arroyo Chijuilla to northern boundary Cuba) (NMED/SWQB, 2007). However, one exceedence of the chronic aluminum criterion was found just below the Angostura Diversion, upstream of both the Jemez River and the Rio Puerco, indicating that other sources exist along the Rio Grande upstream of the survey area.

In summary, despite far more data and a much larger suite of analyses than would normally be available, very few WQS impairments were found from the monitoring data discussed in this report. Most notably, the nearly complete absence of detectable organic chemicals in this dataset is surprising given the urbanization of the middle portions of the study area. However, there were parameters that exceeded water quality standards criterion for individual samples that did not result in impairment determinations. Perhaps most significant was an ammonia concentration of 9.12 mg/L (pH 8.83, 12.84ºC) below the Rio Rancho #2 WWTP, which exceeded the acute criteria by almost 5 times and exceeded the chronic levels by almost 14 times. Buhl (2002) determined the 72 hour LC50 (pH 8.2-8.5) for 2-day old larvae of RGSM and FHM exposed to ammonia to be 0.78 mg/L. FHM exposed to ammonia for 96h in water at 6ºC with a pH of 8.2 had an LC50 of 1.01-1.12 mg/L (Buhl, 2002).

Other samples of note include one collected at USGS Gage, Rio Grande at Albuquerque, on 25 Jun. 2007 which had a 0.21 μg/L cadmium concentration with a hardness adjusted criteria of 0.22 μg/L. The elevated concentration of this sample would support the suggestion of Marcus et al. (2005) that cadmium should be monitored on at least quarterly. Although not part of the work plan, SWQB staff also collected nutrient samples once at the Rio Grande at Belen (32RGrand385.5) and twice at Los Lunas (32RGrand394.8) on August 17, 2007 due to a report of high pH values observed by U.S. Fish and Wildlife Service personnel. During the extra sampling, pH values of 9.10 and 9.22 s.u. at Los Lunas were observed, resulting in an exceedence of the water quality standards. Finally, USGS sampling detected low concentrations of the herbicides Prometon twice (0.01 μg/L and 0.02 μg/L) and Pendimethalin once (0.049 μg/L) at USGS Gage Rio Grande Floodway at San Marcial. While New Mexico does not have water quality standards for either compound both are considered to be contaminants and Pendimethalin in particular is highly toxic to fish and aquatic (Meister 1992, USEPA 1985). The 96-hour LC50 for pendimethalin in bluegill sunfish is 0.199 ppm, and for rainbow trout is 0.138 ppm. The 48-hour LC50 in Daphnia magna, a small freshwater crustacean, is 0.28 ppm (USEPA 1985).

The grab sampling performed during the course of this study provides data for approximately one percent of the days per year per site, leaving open the possibility that other exceedences of water quality may have occurred. The MRGESACP may want to consider using other monitoring approaches, such as semi-permeable membrane devices (SPMDs), or expand the list of parameters for fish tissue analyses to include organophosphates to determine the levels of organics that are concentrating/accumulating in the fat tissues of fish. The problem with using fish tissue alone is that fish can metabolize and excrete some organic pollutants and therefore do not yield accurate information in terms of overall exposure. Finally, the MRGESACP should consider expanding or amending the sampling scheme to include analyses for dissolved aluminum and weak acid dissociable cyanide. Currently, the work plan includes analysis for total aluminum and total cyanide whereas NM WQS are for dissolved aluminum and weak acid dissociable and dissolved cyanide. Most of the total cyanide data collected was below detection; however, total cyanide was measured at 14.1 μg/L and 144 μg/L in two samples. While the weak acid dissociable is a fraction of this total cyanide, it is not possible with accuracy to estimate the actual concentrations for these samples.

7.2 Sediment and Fish Tissue Results

Chemical sediment concentrations may impact fish and aquatic life. Based on the data collected in 2006-2008, the concentrations in the MRG are not at levels where fish health issues would be expected due to any one chemical, however several chemicals were found above levels where adverse effects are expected to occur only rarely (see **Tables 12 and 13**). It is unclear what the synergistic effects of all chemicals found in sediment may have on aquatic life. Further studies could be conducted to determine the cumulative effects of sediment contaminates to RGSM and to determine any trends as to why the Rio Rancho and Alameda sites contained higher levels of PAHs when compared to downstream sites.

Likewise fish tissue results from this study found that most analytes at levels unlikely to be lethal to fish by themselves. Zinc and DDT were the only analytes that exceeded concentrations that negatively affect fish. However, little is known about possible synergistic effects these contaminants may have on fish. When combined with other chemicals, zinc may exhibit synergistic effects, such as changes in accumulation, metabolism, and toxicity to organisms, resulting in detrimental health effects (Eisler, 1993). Further studies could be conducted to determine sources and effects of zinc and DDT and impacts to RGSM.

Fish tissue data from SWQB monitoring can be compared to concentrations detected from the 1997-98 BEST study for some of the chemicals tested (see **Table 17**) however it should be noted that all but one of the BEST sample sites were located downstream of the SWQB project area. This results of this comparison shows approximately 50–100% of the sites showing increases in As, Cd, Cu, Ni, Se, and Zn whereas Cr, Hg, and Ni, showed decreases compared to the 1997-98 data used in the BEST study. All of the 2007 samples had higher concentrations of arsenic than the maximum observed level from the BEST study and all levels of cadmium, copper, and zinc were higher than geometric means reported from Elephant Butte Reservoir from the BEST study. In 2008, lower detection limits resulted in lead being detected at levels higher than maximum values that were observed in the Elephant Butte BEST study and selenium concentrations were found to be higher than the mean concentrations found in that study. The BEST study found that fish from the lower Rio Grande contained greater amounts of some chemicals and appeared to be less healthy (Schmitt 2004). Further monitoring should be done to characterize any trends in fish tissue contaminants and possible impacts to the RGSM.

Sampling during 2008 also included human health consumption sampling of white bass and channel catfish. These samples used composites from filets only, thus they are not directly comparable to whole fish analyses. Analysis of the tissue resulted in fish consumption advisories for white bass and channel catfish due to the PCB concentrations that were found. The 2009 New Mexico Fish Consumption Advisories recommend no consumption of white bass 14 inches and smaller (no larger fish were available for analysis) and no more than 3 meals a month of catfish in the 14-18 inch size class.

7.3 WATER QUALITY IMPLICATIONS FOR RGSM

The purpose of this study was to identify potential water-quality issues that may impact RGSM heath and result in declines in RGSM populations. Along with water-quality monitoring SWQB also sampled sediment, fish tissue, and compiled data from outside sources. (e.g. USGS, UNM) to provide a comprehensive evaluation of potential chemical stressors in the MRG and the effect on the fish community.

The results of the extensive water, sediment and fish tissue analyses performed for this study identified few water quality issues and seldom exceeded levels known to have negative impacts on fish health. Of the hundreds of parameters that were monitored, only *E. coli*, some samples elevated in metals such as Al, Cu, Cr, ammonia, DO and pH exceeded WQS standards criterion. While the ammonia concentration (9.12 mg/L - 5 times the acute criteria) and periods of low DO reached levels where large fish kills would be expected, none were observed, possibly because the fish were able to avoid areas of poor water quality. Other documented water quality issues are at levels where RGSM are exposed to conditions that may impact reproduction and respiration, and are likely producing local conditions that fish must avoid for survival, further stressing the fish and reducing the likelihood for recovery. In addition to direct measurements of water quality, results from two indirect tests, induction of Vtg synthesis in adult FHM exposed to WWTP effluent (see appendix B) and increased mortality in FHM embryos/larvae and reduced

Ceriodaphnia dubia reproduction following exposure to an eluate from sediments, suggest that water quality in some areas of the MRG could be impacting RGSM health.

Fish tissue concentrations of mercury and PCB’s in the adult carp collected during this study are at levels of concern for the protection of wildlife   It should be noted however, that the estimated average age of these carp was 4-5 years while RGSM live to approximately 1.5 years, making it unlikely that they accumulate mercury and PCBs to the same extent. Nevertheless, it may be worthwhile to conduct a screen of RGSM tissue to better understand the role bioaccumulated pollutants may have in RGSM health

The specific effect of these chemicals in the water, sediment, and fish tissue for the survival of the RGSM is difficult to directly ascertain. However, certain impacts to the ecosystem that the RGSM interacts with and that acts on the RGSM could be evaluated. For instance, low dissolved oxygen can be tolerated by certain life stages of the RGSM but can the larvae or fry tolerate dissolved oxygen at levels below 1.0 mg/L? What does low dissolved oxygen do to the diatom community that the RGSM depend on for dietary resources or to the microinvertebrate community that RGSM may depend on in early life stages? Are there levels of PCBs, particularly congener 190, in the RGSM sufficient to cause cranial deformities such as opercule shortening? Are PAH levels in the fine sediment ingested by foraging RGSM high enough to have an impact on health and/or fecundity? Given the xenestrogens entering the MRG via WWTPs, are their intersexing issues with the RGSM?

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APPENDIX A

Numeric Criteria from New Mexico Water Quality Standards (20.6.4.900 NMAC)

20.6.4.900 CRITERIA APPLICABLE TO ATTAINABLE OR DESIGNATED USES UNLESS OTHERWISE SPECIFIED IN 20.6.4.97 THROUGH 20.6.4.899 NMAC.

A. Fish Culture, Water Supply and Storage: Fish culture and municipal and industrial water supply and storage are designated uses in particular classified waters of the state where these uses are actually being realized. However, no numeric criteria apply uniquely to these uses. Water quality adequate for these uses is ensured by the general criteria and numeric criteria for bacterial quality, pH and temperature that are established for all classified waters of the state listed in 20.6.4.97 through 20.6.4.899 NMAC.

B. Domestic Water Supply: Surface waters of the state designated for use as domestic water supplies shall not contain substances in concentrations that create a lifetime cancer risk of more than one cancer per 100,000 exposed persons. Those criteria listed under domestic water supply in Subsection J of this section apply to this use.

C. Irrigation and Irrigation Storage: The following numeric criteria and those criteria listed under irrigation in Subsection J of this section apply to this use:

(1)	dissolved selenium	0.13	mg/L
(2)	dissolved selenium in presence of >500 mg/L SO_4	0.25	mg/L

D. Primary Contact: The monthly geometric mean of E. coli bacteria of 126 cfu/100 mL and single sample of 410 cfu/100 mL, apply to this use and pH shall be within the range of 6.6 to 9.0.

E. Secondary Contact: The monthly geometric mean of E. coli bacteria of 548 cfu/100 mL and single sample of 2507 cfu/100 mL apply to this use.

F. Livestock Watering: The criteria listed in Subsection J for livestock watering apply to this use.

G. Wildlife Habitat: Wildlife habitat shall be free from any substances at concentrations that are toxic to or will adversely affect plants and animals that use these environments for feeding, drinking, habitat or propagation; can bioaccumulate; or might impair the community of animals in a watershed or the ecological integrity of surface waters of the state. The discharge of substances that bioaccumulate, in excess of levels listed in Subsection J for wildlife habitat is allowed if, and only to the extent that, the substances are present in the intake waters that are diverted and utilized prior to discharge, and then only if the discharger utilizes best available treatment technology to reduce the amount of bioaccumulating substances that are discharged. The numeric criteria listed in Subsection J for wildlife habitat apply to this use except when a site-specific or segment-specific criterion has been adopted under 20.6.4.101 through 20.6.4.899 NMAC.

H. Aquatic Life: Surface waters of the state with a designated, existing or attainable use of aquatic life shall be free from any substances at concentrations that can impair the community of plants and animals in or the ecological integrity of surface waters of the state. Except as provided in paragraph 6 below, the acute and chronic aquatic life criteria set out in subsections I and J of this section are applicable to this use. In addition, the specific criteria for aquatic life subcategories in the following paragraphs shall apply to waters classified under the respective designations

(1) High Quality Coldwater: Dissolved oxygen 6.0 mg/L or more, temperature 20°C (68°F) or less, pH within the range of 6.6 to 8.8 and specific conductance a limit varying between 300 µmhos/cm and 1,500 µmhos /cm depending on the natural background in particular surface waters of the state (the intent of this criterion is to prevent excessive increases in dissolved solids which would result in changes in community structure). The total ammonia criteria set out in Subsections K, L and M of this section and the human health criteria for pollutants listed in Subsection J of this section are applicable to this use.

(2) Coldwater: Dissolved oxygen 6.0 mg/L or more, temperature 20°C (68°F) or less and pH within the range of 6.6 to 8.8. The total ammonia criteria set out in Subsections K, L and M of this section and the human health criteria listed in Subsection J of this section are applicable to this use.

(3) Marginal Coldwater: Dissolved oxygen than 6 mg/L or more, on a case by case basis maximum temperatures may exceed 25°C (77°F) and the pH may range from 6.6 to 9.0. The total ammonia criteria set out in Subsections K, L and M of this section and the human health criteria listed in Subsection J of this section are applicable to this use.

(4) Warmwater: Dissolved oxygen 5 mg/L or more, temperature 32.2°C (90°F) or less, and pH within the range of 6.6 to 9.0. The total ammonia criteria set out in Subsections K, L and M of this section and the human health criteria listed in Subsection J of this section are applicable to this use.

(5) Marginal Warmwater: Dissolved oxygen 5 mg/L or more, pH within the range of 6.6 to 9.0 and on a case by case basis maximum temperatures may exceed 32.2°C (90°F). The total ammonia criteria set out in Subsections K, L and M of this section and the human health criteria listed in Subsection J of this section are applicable to this use.

(6) Limited Aquatic Life: Criteria shall be developed on a segment-specific basis. The acute aquatic life criteria of Subsections I and J of this section shall apply. Chronic aquatic life criteria do not apply unless adopted on a segment specific basis.

I. The following schedule of equations for the determination of numeric criteria for the substances listed and those criteria listed in Subsection J for aquatic life shall apply to the subcategories of aquatic life identified in this section.

(1) Acute criteria:

(a) dissolved silver $0.85\ e^{(1.72(\ln(hardness))-6.59)}$ µg/L

(b) dissolved cadmium $(e^{(1.0166(\ln(hardness))-3.924)})cf$ µg/L, the hardness-dependent formulae for cadmium must be multiplied by a conversion factor (cf) to be expressed as dissolved values; the acute factor for cadmium is cf = 1.136672 - ((ln hardness)(0.041838))

(c) dissolved chromium $0.316\ e^{(0.819(\ln(hardness))+3.7256)}$ µg/L

(d) dissolved copper $0.960\ e^{(0.9422(\ln(hardness))-1.700)}$ µg/L

(e) dissolved lead $(e^{(1.273(\ln(hardness))-1.46)})cf$ µg/L, the hardness-dependent formulae for lead must be multiplied by a conversion factor (cf) to be expressed as dissolved values; the acute and chronic factor for lead is cf = 1.46203 - ((ln hardness)(0.145712))

(f) dissolved nickel $0.998\ e^{(0.8460(\ln(hardness))+2.255)}$ µg/L

(g) dissolved zinc $0.978\ e^{(0.8473(\ln(hardness))+0.884)}$ µg/L

(2) Chronic criteria:

(a) dissolved cadmium $(e^{(0.7409(\ln(hardness))-4.719)})cf$ µg/L, the hardness-dependent formulae for cadmium must be multiplied by a conversion factor (cf) to be expressed as dissolved values; the chronic factor for cadmium is cf = 1.101672 - ((ln hardness)(0.041838))

(b) dissolved chromium $0.860\ e^{(0.819(\ln(hardness))+0.6848)}$ µg/L

(c) dissolved copper $0.960\ e^{(0.8545(\ln(hardness))-1.702)}$ µg/L

(d) dissolved lead $(e^{(1.273(\ln(hardness))-4.705)})cf$ µg/L, the hardness-dependent formulae for lead must be multiplied by a conversion factor (cf) to be expressed as dissolved values; the acute and chronic factor for lead is cf = 1.46203 - ((ln hardness)(0.145712))

(e) dissolved nickel $0.997\ e^{(0.846(\ln(hardness))+0.0584)}$ µg/L

(f) dissolved zinc $0.986\ e^{(0.8473(\ln(hardness))+0.884)}$ µg/L

J. **Numeric criteria.** The following table sets forth the numeric criteria adopted by the commission to protect existing, designated and attainable uses. Additional criteria that are not compatible with this table are found in Subsections A through I of this section.

Pollutant total, unless indicated	**CAS Number**	**Domestic Water Supply** µg/L unless indicated	**Irrigation** µg/L unless indicated	**Livestock Watering** µg/L unless indicated	**Wildlife Habitat** µg/L unless indicated	**Aquatic Life**		**Human Health** µg/L	**Cancer Causing (C) or Persistent (P)**
						Acute µg/L	**Chronic** µg/L		
Aluminum, dissolved	7429-90-5		5,000			750	87		
Antimony, dissolved	7440-36-0	5.6						640	P
Arsenic, dissolved	7440-38-2	2.3	100			340	150	9.0	C,P
Asbestos	1332-21-4	7,000,000 fibers/L							
Barium, dissolved	7440-39-3	2,000							
Beryllium, dissolved	7440-41-7	4							
Boron, dissolved	7440-42-8		750	5,000					
Cadmium, dissolved	7440-43-9	5	10	50		see 20.6.4.900.I	see 20.6.4.900.I		
Chlorine residual	7782-50-5				11	19	11		
Chromium, dissolved	18540-29-9	100	100	1,000		see 20.6.4.900.I	see 20.6.4.900.I		
Cobalt, dissolved	7440-48-4		50	1,000					
Copper, dissolved	7440-50-8	1300	200	500		see 20.6.4.900.I	see 20.6.4.900.I		
Cyanide, dissolved	57-12-5	200							
Cyanide, weak acid dissociable	57-12-5	700			5.2	22.0	5.2	220,000	

Pollutant total, unless indicated	**CAS Number**	**Domestic Water Supply** µg/L unless indicated	**Irrigation** µg/L unless indicated	**Livestock Watering** µg/L unless indicated	**Wildlife Habitat** µg/L unless indicated	**Aquatic Life**		**Human Health** µg/L	**Cancer Causing (C) or Persistent (P)**
						Acute µg/L	**Chronic** µg/L		
Lead, dissolved	7439-92-1	50	5,000	100		see 20.6.4.900.I	see 20.6.4.900.I		
Mercury	7439-97-6	2		10					
Mercury, dissolved	7439-97-6				0.77	1.4	0.77		
Methymercury	22967-92-6							0.3 mg/kg in fish tissue	P
Molybdenum, dissolved	7439-98-7		1,000						
Nickel, dissolved	7440-02-0	100				see 20.6.4.900.I	see 20.6.4.900.I	4,600	P
Nitrate as N		10 mg/L							
Nitrite + Nitrate				132 mg/L					
Selenium, dissolved	7782-49-2	50	see 20.6.4.900.C	50				4,200	P
Selenium, total recoverable	7782-49-2				5.0	20.0	5.0		
Silver, dissolved	7440-22-4					see 20.6.4.900.I			
Thallium, dissolved	7440-28-0	1.7						6.3	P
Uranium, dissolved	7440-61-1	5,000							
Vanadium, dissolved	7440-62-2		100	100					
Zinc, dissolved	7440-66-6	7,400	2,000	25,000		see 20.6.4.900.I	see 20.6.4.900.I	26,000	P
Adjusted gross alpha (see 20.6.4.900.B and .F)		15 pCi/L		15 pCi/L					
Radium 226 + Radium 228		5 pCi/L		30.0 pCi/L					
Strontium 90		8 pCi/L							
Tritium		20,000 pCi/L		20,000 pCi/L					
Acenaphthene	83-32-9	670						990	
Acrolein	107-02-8	190						290	
Acrylonitrile	107-13-1	0.51						2.5	C
Aldrin	309-00-2	0.00049				3.0		0.00050	C,P
Anthracene	120-12-7	8,300						40,000	
Benzene	71-43-2	22						510	C
Benzidine	92-87-5	0.00086						0.0020	C
Benzo(a)anthracene	56-55-3	0.038						0.18	C
Benzo(a)pyrene	50-32-8	0.038						0.18	C,P
Benzo(b)fluoranthene	205-99-2	0.038						0.18	C
Benzo(k)fluoranthene	207-08-9	0.038						0.18	C

Pollutant total, unless indicated	CAS Number	Domestic Water Supply µg/L unless indicated	Irrigation µg/L unless indicated	Livestock Watering µg/L unless indicated	Wildlife Habitat µg/L unless indicated	Aquatic Life		Human Health µg/L	Cancer Causing (C) or Persistent (P)
						Acute µg/L	Chronic µg/L		
alpha-BHC	319-84-6	0.026						0.049	C
beta-BHC	319-85-7	0.091						0.17	C
Gamma-BHC (Lindane)	58-89-9	0.19				0.95		0.63	C
Bis(2-chloroethyl) ether	111-44-4	0.30						5.3	C
Bis(2-chloroisopropyl) ether	108-60-1	1,400						65,000	
Bis(2-ethylhexyl) phthalate	117817	12						22	C
Bromoform	75-25-2	43						1,400	C
Butylbenzyl phthalate	85-68-7	1,500						1,900	
Carbon tetrachloride	56-23-5	2.3						16	C
Chlordane	57-74-9	0.0080				2.4	0.0043	0.0081	C,P
Chlorobenzene	108-90-7	680						21,000	
Chlorodibromomethane	124-48-1	4.0						130	C
Chloroform	67-66-3	57						4,700	C
2-Chloronaphthalene	91-58-7	1,000						1,600	
2-Chlorophenol	95-57-8	81						150	
Chrysene	218-01-9	0.038						0.18	C
4,4'-DDT and derivatives		0.0022			0.001	1.1	0.001	0.0022	C,P
Dibenzo(a,h)anthracene	53-70-3	0.038						0.18	C
Dibutyl phthalate	84-74-2	2,000						4,500	
1,2-Dichlorobenzene	95-50-1	2,700						17,000	
1,3-Dichlorobenzene	541-73-1	320						960	
1,4-Dichlorobenzene	106-46-7	400						2,600	
3,3'-Dichlorobenzidine	91-94-1	0.21						0.28	C
Dichlorobromomethane	75-27-4	5.5						170	C
1,2-Dichloroethane	107-06-2	3.8						370	C
1,1-Dichloroethylene	75-35-4	0.57						32	C
2,4-Dichlorophenol	120-83-2	77						290	
1,2-Dichloropropane	78-87-5	5.0						150	C
1,3-Dichloropropene	542-75-6	10						1,700	
Dieldrin	60-57-1	0.00052				0.24	0.056	0.00054	C,P
Diethyl phthalate	84-66-2	17,000						44,000	
Dimethyl phthalate	131-11-3	270,000						1,100,000	
2,4-Dimethylphenol	105-67-9	380						850	
2,4-Dinitrophenol	51-28-5	69						5,300	
2,4-Dinitrotoluene	121-14-2	1.1						34	C
2,3,7,8-TCDD Dioxin	1746-01-6	5.0E-08						5.1E-08	C,P

Pollutant total, unless indicated	CAS Number	Domestic Water Supply µg/L unless indicated	Irrigation µg/L unless indicated	Livestock Watering µg/L unless indicated	Wildlife Habitat µg/L unless indicated	Aquatic Life		Human Health µg/L	Cancer Causing (C) or Persistent (P)
						Acute µg/L	Chronic µg/L		
1,2-Diphenylhydrazine	122-66-7	0.36						2.0	C
alpha-Endosulfan	959-98-8	62				0.22	0.056	89	
beta-Endosulfan	33213-65-9	62				0.22	0.056	89	
Endosulfan sulfate	1031-07-8	62						89	
Endrin	72-20-8	0.76				0.086	0.036	0.81	
Endrin aldehyde	7421-93-4	0.29						0.30	
Ethylbenzene	100-41-4	3,100						29,000	
Fluoranthene	206-44-0	130						140	
Fluorene	86-73-7	1,100						5,300	
Heptachlor	76-44-8	0.00079				0.52	0.0038	0.00079	C
Heptachlor epoxide	1024-57-3	0.00039				0.52	0.0038	0.00039	C
Hexachlorobenzene	118-74-1	0.0028						0.0029	C,P
Hexachlorobutadiene	87-68-3	4.4						180	C
Hexachlorocyclopentadiene	77-47-4	240						17,000	
Hexachloroethane	67-72-1	14						33	C
Ideno(1,2,3-cd)pyrene	193-39-5	0.038						0.18	C
Isophorone	78-59-1	350						9,600	C
Methyl bromide	74-83-9	47						1,500	
2-Methyl-4,6-dinitrophenol	534-52-1	13						280	
Methylene chloride	75-09-2	46						5,900	C
Nitrobenzene	98-95-3	17						690	
N-Nitrosodimethylamine	62-75-9	0.0069						30	C
N-Nitrosodi-n-propylamine	621-64-7	0.050						5.1	C
N-Nitrosodiphenylamine	86-30-6	33						60	C
PCBs	1336-36-3	0.00064			0.014		0.014	0.00064	C,P
Pentachlorophenol	87-86-5	2.7				19	15	30	C
Phenol	108-95-2	21,000						1,700,000	
Pyrene	129-00-0	830						4,000	
1,1,2,2-Tetrachloroethane	79-34-5	1.7						40	C
Tetrachloroethylene	127-18-4	6.9						33	C,P
Toluene	108-88-3	6,800						200,000	
Toxaphene	8001-35-2	0.0028				0.73	0.0002	0.0028	C
1,2-Trans-dichloroethylene	156-60-5	700						140,000	
1,2,4-Trichlorobenzene	120-82-1	260						940	

Pollutant total, unless indicated	CAS Number	Domestic Water Supply µg/L unless indicated	Irrigation µg/L unless indicated	Livestock Watering µg/L unless indicated	Wildlife Habitat µg/L unless indicated	Aquatic Life		Human Health µg/L	Cancer Causing (C) or Persistent (P)
						Acute µg/L	Chronic µg/L		
1,1,2-Trichloroethane	79-00-5	5.9						160	C
Trichloroethylene	79-01-6	25						300	C
2,4,6-Trichlorophenol	88-06-2	14						24	C
Vinyl chloride	75-01-4	20						5,300	C

K. Acute Criteria, Total Ammonia (mg/L as N)

pH	Salmonids Present	Salmonids Absent
6.5	32.6	48.8
6.6	31.3	46.8
6.7	29.8	44.6
6.8	28.1	42.0
6.9	26.2	39.1
7.0	24.1	36.1
7.1	22.0	32.8
7.2	19.7	29.5
7.3	17.5	26.2
7.4	15.4	23.0
7.5	13.3	19.9
7.6	11.4	17.0
7.7	9.65	14.4
7.8	8.11	12.1
7.9	6.77	10.1
8.0	5.62	8.40
8.1	4.64	6.95
8.2	3.83	5.72
8.3	3.15	4.71
8.4	2.59	3.88
8.5	2.14	3.20
8.6	1.77	2.65
8.7	1.47	2.20
8.8	1.23	1.84
8.9	1.04	1.56
9.0	0.885	1.32

L. Chronic Criteria, Total Ammonia (mg/L as N), Fish Early Life Stages Present

pH	Temperature (°C)										
	0	14	15	16	18	20	22	24	26	28	30
6.5	6.67	6.67	6.46	6.06	5.33	4.68	4.12	3.62	3.18	2.80	2.46
6.6	6.57	6.57	6.36	5.97	5.25	4.61	4.05	3.56	3.13	2.75	2.42
6.7	6.44	6.44	6.25	5.86	5.15	4.52	3.98	3.50	3.07	2.70	2.37
6.8	6.29	6.29	6.10	5.72	5.03	4.42	3.89	3.42	3.00	2.64	2.32
6.9	6.12	6.12	5.93	5.56	4.89	4.30	3.78	3.32	2.92	2.57	2.25
7.0	5.91	5.91	5.73	5.37	4.72	4.15	3.65	3.21	2.82	2.48	2.18
7.1	5.67	5.67	5.49	5.15	4.53	3.98	3.50	3.08	2.70	2.38	2.09
7.2	5.39	5.39	5.22	4.90	4.31	3.78	3.33	2.92	2.57	2.26	1.99
7.3	5.08	5.08	4.92	4.61	4.06	3.57	3.13	2.76	2.42	2.13	1.87
7.4	4.73	4.73	4.59	4.30	3.78	3.32	2.92	2.57	2.26	1.98	1.74
7.5	4.36	4.36	4.23	3.97	3.49	3.06	2.69	2.37	2.08	1.83	1.61
7.6	3.98	3.98	3.85	3.61	3.18	2.79	2.45	2.16	1.90	1.67	1.47
7.7	3.58	3.58	3.47	3.25	2.86	2.51	2.21	1.94	1.71	1.50	1.32
7.8	3.18	3.18	3.09	2.89	2.54	2.23	1.96	1.73	1.52	1.33	1.17

pH	Temperature (°C)										
	0	14	15	16	18	20	22	24	26	28	30
7.9	2.80	2.80	2.71	2.54	2.24	1.96	1.73	1.52	1.33	1.17	1.03
8.0	2.43	2.43	2.36	2.21	1.94	1.71	1.50	1.32	1.16	1.02	0.897
8.1	2.10	2.10	2.03	1.91	1.68	1.47	1.29	1.14	1.00	0.879	0.773
8.2	1.79	1.79	1.74	1.63	1.43	1.26	1.11	0.973	0.855	0.752	0.661
8.3	1.52	1.52	1.48	1.39	1.22	1.07	0.941	0.827	0.727	0.639	0.562
8.4	1.29	1.29	1.25	1.17	1.03	0.906	0.796	0.700	0.615	0.541	0.475
8.5	1.09	1.09	1.06	0.990	0.870	0.765	0.672	0.591	0.520	0.457	0.401
8.6	0.920	0.920	0.892	0.836	0.735	0.646	0.568	0.499	0.439	0.386	0.339
8.7	0.778	0.778	0.754	0.707	0.622	0.547	0.480	0.422	0.371	0.326	0.287
8.8	0.661	0.661	0.641	0.601	0.528	0.464	0.408	0.359	0.315	0.277	0.244
8.9	0.565	0.565	0.548	0.513	0.451	0.397	0.349	0.306	0.269	0.237	0.208
9.0	0.486	0.486	0.471	0.442	0.389	0.342	0.300	0.264	0.232	0.204	0.179

M. Chronic Criteria, Total Ammonia (mg/L as N), Fish Early Life Stages Absent

pH	Temperature (°C)									
	0	7	8	9	10	11	12	13	14	15
6.5	10.8	10.8	10.1	9.51	8.92	8.36	7.84	7.35	6.89	6.46
6.6	10.7	10.7	9.99	9.37	8.79	8.24	7.72	7.24	6.79	6.36
6.7	10.5	10.5	9.81	9.20	8.62	8.08	7.58	7.11	6.66	6.25
6.8	10.2	10.2	9.58	8.98	8.42	7.90	7.40	6.94	6.51	6.10
6.9	9.93	9.93	9.31	8.73	8.19	7.68	7.20	6.75	6.33	5.93
7.0	9.60	9.60	9.00	8.43	7.91	7.41	6.95	6.52	6.11	5.73
7.1	9.20	9.20	8.63	8.09	7.58	7.11	6.67	6.25	5.86	5.49
7.2	8.75	8.75	8.20	7.69	7.21	6.76	6.34	5.94	5.57	5.22
7.3	8.24	8.24	7.73	7.25	6.79	6.37	5.97	5.60	5.25	4.92
7.4	7.69	7.69	7.21	6.76	6.33	5.94	5.57	5.22	4.89	4.59
7.5	7.09	7.09	6.64	6.23	5.84	5.48	5.13	4.81	4.51	4.23
7.6	6.46	6.46	6.05	5.67	5.32	4.99	4.68	4.38	4.11	3.85
7.7	5.81	5.81	5.45	5.11	4.79	4.49	4.21	3.95	3.70	3.47
7.8	5.17	5.17	4.84	4.54	4.26	3.99	3.74	3.51	3.29	3.09
7.9	4.54	4.54	4.26	3.99	3.74	3.51	3.29	3.09	2.89	2.71
8.0	3.95	3.95	3.70	3.47	3.26	3.05	2.86	2.68	2.52	2.36
8.1	3.41	3.41	3.19	2.99	2.81	2.63	2.47	2.31	2.17	2.03
8.2	2.91	2.91	2.73	2.56	2.40	2.25	2.11	1.98	1.85	1.74
8.3	2.47	2.47	2.32	2.18	2.04	1.91	1.79	1.68	1.58	1.48
8.4	2.09	2.09	1.96	1.84	1.73	1.62	1.52	1.42	1.33	1.25
8.5	1.77	1.77	1.66	1.55	1.46	1.37	1.28	1.20	1.13	1.06
8.6	1.49	1.49	1.40	1.31	1.23	1.15	1.08	1.01	0.951	0.892
8.7	1.26	1.26	1.18	1.11	1.04	0.976	0.915	0.858	0.805	0.754
8.8	1.07	1.07	1.01	0.944	0.855	0.829	0.778	0.729	0.684	0.641
8.9	0.917	0.917	0.860	0.806	0.756	0.709	0.664	0.623	0.584	0.548
9.0	0.790	0.790	0.740	0.694	0.651	0.610	0.572	0.536	0.503	0.471
At 15º C and above, the criterion for fish early life stages absent is the same as the criterion for fish early life stages present (refer to Subsection L of 20.6.4.900 NMAC).										

N. Dissolved oxygen saturation based on temperature and elevation.

(1) Elevation 5,000 feet or less:

		Elevation (feet)										
		0	**500**	**1,000**	**1,500**	**2,000**	**2,500**	**3,000**	**3,500**	**4,000**	**4,500**	**5,000**
Temperature (°C)	**0**	14.6	14.3	14.1	13.8	13.6	13.3	13.1	12.8	12.6	12.3	12.1
	1	14.2	13.9	13.7	13.4	13.2	12.9	12.7	12.5	12.2	12.0	11.8
	2	13.8	13.6	13.3	13.1	12.8	12.6	12.4	12.1	11.9	11.7	11.5
	3	13.4	13.2	13.0	12.7	12.5	12.3	12.0	11.8	11.6	11.4	11.1
	4	13.1	12.8	12.6	12.4	12.2	11.9	11.7	11.5	11.3	11.1	10.9
	5	12.7	12.5	12.3	12.1	11.8	11.6	11.4	11.2	11.0	10.8	10.6

	Elevation (feet)										
	0	**500**	**1,000**	**1,500**	**2,000**	**2,500**	**3,000**	**3,500**	**4,000**	**4,500**	**5,000**
6	12.4	12.2	12.0	11.8	11.5	11.3	11.1	10.9	10.7	10.5	10.3
7	12.1	11.9	11.7	11.5	11.3	11.1	10.8	10.6	10.4	10.2	10.1
8	11.8	11.6	11.4	11.2	11.0	10.8	10.6	10.4	10.2	10.0	9.8
9	11.5	11.3	11.1	10.9	10.7	10.5	10.3	10.1	9.9	9.8	9.6
10	11.3	11.1	10.9	10.7	10.5	10.3	10.1	9.9	9.7	9.5	9.4
11	11.0	10.8	10.6	10.4	10.2	10.0	9.9	9.7	9.5	9.3	9.1
12	10.8	10.6	10.4	10.2	10.0	9.8	9.6	9.5	9.3	9.1	8.9
13	10.5	10.3	10.1	9.9	9.8	9.6	9.4	9.2	9.1	8.9	8.7
14	10.3	10.1	9.9	9.7	9.6	9.4	9.2	9.0	8.9	8.7	8.5
15	10.1	9.9	9.7	9.5	9.3	9.2	9.0	8.8	8.7	8.5	8.4
16	9.8	9.7	9.5	9.3	9.2	9.0	8.8	8.7	8.5	8.3	8.2
17	9.6	9.5	9.3	9.1	9.0	8.8	8.6	8.5	8.3	8.2	8.0
18	9.4	9.3	9.1	8.9	8.8	8.6	8.5	8.3	8.1	8.0	7.8
19	9.3	9.1	8.9	8.8	8.6	8.4	8.3	8.1	8.0	7.8	7.7
20	9.1	8.9	8.7	8.6	8.4	8.3	8.1	8.0	7.8	7.7	7.5
21	8.9	8.7	8.6	8.4	8.3	8.1	8.0	7.8	7.7	7.5	7.4
22	8.7	8.6	8.4	8.2	8.1	8.0	7.8	7.7	7.5	7.4	7.2
23	8.6	8.4	8.2	8.1	7.9	7.8	7.7	7.5	7.4	7.2	7.1
24	8.4	8.2	8.1	7.9	7.8	7.7	7.5	7.4	7.2	7.1	7.0
25	8.2	8.1	7.9	7.8	7.7	7.5	7.4	7.2	7.1	7.0	6.8
26	8.1	7.9	7.8	7.7	7.5	7.4	7.2	7.1	7.0	6.8	6.7
27	7.9	7.8	7.7	7.5	7.4	7.2	7.1	7.0	6.8	6.7	6.6
28	7.8	7.7	7.5	7.4	7.2	7.1	7.0	6.9	6.7	6.6	6.5
29	7.7	7.5	7.4	7.3	7.1	7.0	6.9	6.7	6.6	6.5	6.4
30	7.5	7.4	7.3	7.1	7.0	6.9	6.7	6.6	6.5	6.4	6.3

(2) Elevation greater than 5,000 feet:

		Elevation (feet)									
		5,500	**6,000**	**6,500**	**7,000**	**7,500**	**8,000**	**8,500**	**9,000**	**9,500**	**10,000**
Temperature (°C)	**0**	11.9	11.6	11.4	11.2	11.0	10.8	10.6	10.3	10.1	9.9
	1	11.5	11.3	11.1	10.9	10.7	10.5	10.3	10.1	9.9	9.7
	2	11.2	11.0	10.8	10.6	10.4	10.2	10.0	9.8	9.6	9.4
	3	10.9	10.7	10.5	10.3	10.1	9.9	9.7	9.5	9.3	9.1
	4	10.7	10.4	10.2	10.0	9.8	9.7	9.5	9.3	9.1	8.9
	5	10.4	10.2	10.0	9.8	9.6	9.4	9.2	9.0	8.9	8.7
	6	10.1	9.9	9.7	9.5	9.4	9.2	9.0	8.8	8.6	8.5
	7	9.9	9.7	9.5	9.3	9.1	8.9	8.8	8.6	8.4	8.2
	8	9.6	9.4	9.3	9.1	8.9	8.7	8.6	8.4	8.2	8.0
	9	9.4	9.2	9.0	8.9	8.7	8.5	8.3	8.2	8.0	7.8
	10	9.2	9.0	8.8	8.7	8.5	8.3	8.1	8.0	7.8	7.7
	11	9.0	8.8	8.6	8.5	8.3	8.1	8.0	7.8	7.6	7.5
	12	8.8	8.6	8.4	8.3	8.1	7.9	7.8	7.6	7.5	7.3
	13	8.6	8.4	8.2	8.1	7.9	7.8	7.6	7.5	7.3	7.2
	14	8.4	8.2	8.1	7.9	7.7	7.6	7.4	7.3	7.1	7.0
	15	8.2	8.0	7.9	7.7	7.6	7.4	7.3	7.1	7.0	6.8
	16	8.0	7.9	7.7	7.6	7.4	7.3	7.1	7.0	6.8	6.7
	17	7.9	7.7	7.6	7.4	7.3	7.1	7.0	6.8	6.7	6.6
	18	7.7	7.5	7.4	7.3	7.1	7.0	6.8	6.7	6.6	6.4
	19	7.5	7.4	7.2	7.1	7.0	6.8	6.7	6.6	6.4	6.3
	20	7.4	7.2	7.1	7.0	6.8	6.7	6.6	6.4	6.3	6.2
	21	7.2	7.1	7.0	6.8	6.7	6.6	6.4	6.3	6.2	6.0
	22	7.1	7.0	6.8	6.7	6.6	6.4	6.3	6.2	6.1	5.9
	23	7.0	6.8	6.7	6.6	6.4	6.3	6.2	6.1	5.9	5.8
	24	6.8	6.7	6.6	6.4	6.3	6.2	6.1	5.9	5.8	5.7
	25	6.7	6.6	6.5	6.3	6.2	6.1	6.0	5.8	5.7	5.6
	26	6.6	6.5	6.3	6.2	6.1	6.0	5.8	5.7	5.6	5.5

	27	6.5	6.3	6.2	6.1	6.0	5.9	5.7	5.6	5.5	5.4
	28	6.4	6.2	6.1	6.0	5.9	5.8	5.6	5.5	5.4	5.3
	29	6.2	6.1	6.0	5.9	5.8	5.7	5.5	5.4	5.3	5.2
	30	6.1	6.0	5.9	5.8	5.7	5.6	5.4	5.3	5.2	5.1

[20.6.4.900 NMAC - Rp 20 NMAC 6.1.3100, 10-12-00; A, 10-11-02; A, 05-23-05; A, 07-17-05]

APPENDIX B
Middle Rio Grande Effluent Studies

B1. Pharmaceutical and Personal Care Product (PPCP) Testing

SWQB collaborated in 2007 with the USEPA, National Exposure Research Laboratory (NERL) in the Ecological Exposure Research Division (EERD) to test for PPCPs in WWTP effluents in the MRG. It should be noted that these analyses were performed on treatment plant effluent only and the results presented do not provide information about concentration in the river and potential implications for the RGSM. While this effort was not funded by MRGSMCP, given the relevancy to water quality in the MRG and the grant obligation to summarize existing water quality data, a summary is provided here. A complete dataset is available upon request.

SWQB collected effluent samples from seven MRG WWTPs: Rio Rancho, Bernalillo, Albuquerque, Bosque Farms, Los Lunas, Belen, and Socorro. These samples were then sent to the USEPA NERL for analyses. Results found that 36 of the 54 PPCP analytes were detected in at least one of the 7 WWTP effluents. A total of 20 Active pharmaceutical ingredients (APIs) were quantified in all 7 WWTP effluents.

Table B1. Results of PPCP analysis of seven effluents from New Mexico. Concentrations are in ng/L. Red highlights indicates pharmaceutical was found in one or more effluents. Red bold highlights indicates that pharmaceutical was detected in all effluents.

Pharmaceutical	Albuquerque	Belen	Bosque Farms	Los Lunas	Socorro	Bernalillo	RR2
atenolol	**960**	**390**	**120**	**440**	**890**	**730**	**530**
albuterol	nd	38	55	48	60	38	41
clonidine	nd	nd	nd	nd	nd	nd	nd
oxycodone	**120**	**140**	**53**	**89**	**150**	**76**	**93**
amphetamine	det	det	det	det	det	det	det
hydrocodone	**28**	**190**	**120**	**100**	**73**	**67**	**120**
triamterene	**130**	**190**	**440**	**240**	**184**	**250**	**370**
metoprolol	**430**	**150**	**650**	**320**	**300**	**390**	**230**
enalipril	nd	nd	nd	nd	nd	nd	nd
propanolol	**46**	**32**	**63**	**77**	**50**	**50**	**64**
diltiazem	**28**	**140**	**180**	**200**	**124**	**160**	**170**
diltiazem-desmethyl	**65**	**110**	**93**	**91**	**76**	**81**	**70**
verapamil	**14**	**54**	**112**	**190**	**70**	**40**	**110**
norverapamil	**46**	**51**	**71**	**62**	**51**	**42**	**46**
propoxyphene	det	det	65	7	nd	det	nd
amlodipine	nd	nd	nd	nd	nd	nd	nd
ranitidine	nd	nd	220	530	nd	550	450
cimitedine	nd	14	410	250	12	nd	210
trimethoprim	**40**	**39**	**39**	**96**	**69**	**140**	**120**

Pharmaceutical	Albuquerque	Belen	Bosque Farms	Los Lunas	Socorro	Bernalillo	RR2
sulfamethoxazole	**98**	**1300**	**310**	**2200**	**1400**	**920**	**1500**
amitriptyline-10-OH	nd	nd	nd	13	42	64	3
promethazine	det	det	det	det	16	det	det
paroxetine	det	det	det	det	13	det	nd
amitriptyline	**25**	**44**	**57**	**77**	**79**	**79**	**86**
benztropine	nd	nd	nd	nd	det	nd	nd
alprazolam	10	15	12	14	14	18	nd
norfluoxetine	nd	nd	nd	nd	nd	nd	nd
fluoxetine	**40**	**44**	**71**	**40**	**42**	**73**	**62**
sertraline-desmethyl	nd	nd	nd	nd	nd	nd	nd
sertraline	**57**	**57**	**85**	**74**	**63**	**75**	**87**
betamethasone	nd	nd	nd	nd	nd	nd	nd
methyprednisone	nd	nd	nd	nd	nd	nd	nd
prednisolone	nd	nd	nd	nd	nd	nd	nd
prednisone	nd	nd	nd	nd	nd	nd	nd
hydrocortisone	nd	nd	nd	nd	nd	nd	nd
fluticasone	nd	nd	nd	nd	nd	nd	nd
fluocinonide	nd	nd	nd	nd	nd	nd	nd
progesterone	nd	nd	nd	nd	nd	nd	nd
norethindrone	nd	nd	nd	nd	nd	nd	nd
testosterone	nd	nd	nd	nd	nd	nd	nd
acetaminophen	nd	nd	nd	nd	260	nd	nd
carbamazepine	**430**	**800**	**675**	**620**	**70**	**220**	**450**
valsartan	**81**	**120**	**60**	**150**	**250**	**1500**	**160**
atorvastatin	nd	14	42	det	nd	30	nd
simvastatin	nd	nd	nd	nd	nd	nd	nd
hydrochorothiazide	**1300**	**2000**	**2950**	**2670**	**1460**	**1640**	**2420**
theophylline	nd	nd	nd	nd	nd	nd	nd
glipizide	nd	nd	nd	nd	nd	30	nd
furosemide	**180**	**190**	**930**	**760**	**570**	**710**	**340**
warfarin	nd	nd	50	nd	nd	nd	det
ibuprofen-2-hydroxy	nd	nd	nd	nd	200	67	nd
ibuprofen	nd	nd	nd	nd	88	72	nd
glyburide	nd	93	nd	nd	120	87	nd
gemifbrozil	**77**	**78**	**380**	**320**	**150**	**1220**	**47**

Table B2. Pharmaceutical compound trade names and class.

Pharmaceutical	Trade Name	Use	Class	CAS Number
atenolol	Tenormin	Hypertension	Beta Blocker	29122-68-7
albuterol	Ventolin	Asthma, Chronic Obstructive Pulmonary Disease	Beta2-adrenergic agonists	18559-94-9
oxycodone	OxyContin, Endone, OxyIR, OxyNorm, Percolone, OxyFAST, Supeudol, and Roxicodone	Pain relief	Opioid analgesic	76-42-6
amphetamine	Adderall, Dexedrine	Stimulant	amphetamine	300-62-9 405-41-4 (hydrochloride), 60-13-9 (sulfate)
hydrocodone	Vicodin	Pain relief	semi-synthetic opioid	125-29-1
triamterene	Dyrenium	Hypertension, edema	diuretic	396-01-0
metoprolol	Lopressor or Lopresor	diseases of the cardiovascular system, especially hypertension	beta receptor blocker	37350-58-6
propanolol	Inderal, Inderal LA, Avlocardyl, Avlocardyl, Deralin, Dociton, Inderalici, InnoPran XL, Sumial	Hypertension; migraines in children	beta receptor blocker	525-66-6
diltiazem	Herben, Cardizem, Cartia XT, and Many others	hypertension, angina pectoris, and some types of arrhythmia	calcium channel blockers	42399-41-7
diltiazem-desmethyl				
verapamil	Isoptin, Verelan, Calan, Bosoptin	hypertension, angina pectoris, cardiac arrhythmia, and most recently, cluster headaches	calcium channel blockers	52-53-9
norverapamil				
propoxyphene	Darvocet-N, Darvon-N with ASA	Pain relief	opioid	469-62-5
ranitidine	Zinetac and Zantac	peptic ulcer disease (PUD) and gastroesophageal reflux disease	histamine H_2-receptor antagonist	66357-35-5
cimitedine				
trimethoprim	Proloprim, Monotrim and Triprim	urinary tract infections	bacteriostatic antibiotic	738-70-5
sulfamethoxazole	Bactrim, Septrin, or Septra	urinary tract infections, sinusitis	sulfonamide bacteriostatic antibiotic	723-46-6

Pharmaceutical	Trade Name	Use	Class	CAS Number
amitriptyline-10-OH				
promethazine	Phenergan, Promethegan, Romergan, Fargan, Farganesse, Prothiazine, Avomine, Atosil, RhinathioL	Sedative, decongestant, anaphylactoid, cough medicine, motion sickness	H1 receptor antagonist antihistamine and antiemetic	60-87-7
paroxetine	Seroxat, Paxil, Parotin, Aropax, Xetanor, ParoMerck, Rexetin)	antidepressant	selective serotonin reuptake inhibitor (SSRI) antidepressant	61869-08-7
amitriptyline	Elavil, Tryptanol, Endep, Elatrol, Tryptizol, Trepiline, Laroxyl	antidepressant	selective serotonin and noradrenaline reuptake inhibitor antidepressant	50-48-6
benztropine	Cogentin	Drug-induced parkinsonism, akathisia and acute dystonia; Parkinson disease; and Idiopathic or secondary dystonia	anticholinergic	86-13-5
alprazolam	Xanax and Niravam	moderate to severe anxiety disorders, panic attacks, and as an adjunctive treatment for anxiety associated with clinical depression	benzodiazepin e	28981-97-7
fluoxetine	Prozac	treatment of clinical depression (including pediatric depression), obsessive-compulsive disorder (in both adult and pediatric populations), bulimia nervosa, anorexia nervosa, panic disorder and premenstrual dysphoric disorder	selective serotonin reuptake inhibitor (SSRI) antidepressant	54910-89-3
sertraline	Zoloft, Lustral	treat clinical depression, obsessive-compulsive, panic and social anxiety disorders	selective serotonin reuptake inhibitor (SSRI) antidepressant	79617-96-2
carbamazepine	Tegretol, Biston, Calepsin, Carbatrol, Epitol, Equetro, Finlepsin, Sirtal, Stazepine,	treatment of epilepsy and bipolar disorder. It is also used to treat ADD, ADHD, schizophrenia, Phantom limb syndrome and trigeminal neuralgia.	anticonvulsant and mood stabilizing	298-46-4 85756-57-6 (dihydrate)

Pharmaceutical	Trade Name	Use	Class	CAS Number
	Telesmin,Teril, Timonil, Trimonil, Epimaz			
valsartan	Diovan	treatment of high blood pressure, of congestive heart failure (CHF), and post-myocardial infarction (MI)	angiotensin II receptor antagonist	137862-53-4
atorvastatin	Lipitor	lowering cholesterol	statin	134523-00-5
hydrochorothiazide	Apo-Hydro, Aquazide H, Dichlotride, Hydrodiuril, HydroSaluric, Microzide, Oretic	treatment of hypertension, congestive heart failure, symptomatic edema and the prevention of kidney stones, nephrogenic diabetes insipidus, hypercalciuria and Dent's Disease	thiazide diuretic	58-93-5
glipizide	Glucotrol	anti-diabetic	sulfonylurea	29094-61-9
furosemide	Lasix	treatment of congestive heart failure and edema; prevent thoroughbred and standardbred race horses from bleeding through the nose during races	loop diuretic	54-31-9
warfarin	Coumadin, Jantoven, Marevan, and Waran	prevention of thrombosis and embolism	anticoagulant	81-81-2
ibuprofen-2-hydroxy				
ibuprofen	Advil and many others	arthritis, primary dysmenorrhea, fever, and as an analgesic	non-steroidal anti-inflammatory	15687-27-1
glyburide	Diabeta, Glynase and Micronase	anti-diabetic	sulfonylureas	10238-21-8
gemifbrozil				

B2. FATHEAD MINNOW (FHM) ENDOCRINE DISRUPTION TESTING

In 2007, SWQB collaborated with the USEPA, National Exposure Research Laboratory (NERL) in the Ecological Exposure Research Division (EERD) to test for Vitellogenin (Vtg) production, a measure of the estrogenicity, in WWTP effluents in the MRG. Production of Vtg protein impacts gonad development and leads to intersexing of male fish and altered oogenesis in female fish. It should be noted that these analyses were performed on treatment plant effluent only and the results presented do not directly provide information river water quality and potential implications for the RGSM. While this effort was not funded by MRGSMCP, given the relevancy to water quality in the MRG and the grant obligation to summarize existing water quality data, a summary is provided here. A complete dataset is available upon request.

SWQB collected effluent samples from seven MRG WWTPs: Rio Rancho, Bernalillo, Albuquerque, Bosque Farms, Los Lunas, Belen, and Socorro. These samples were then sent to the Environmental Protection Agency, National Exposure Research Laboratory (EPA, NERL) aquatic toxicology facility in Cincinnati, OH. FHM, were exposed to samples from five of the WWTP effluents and Vtg synthesis was measured.

Fish exposed to effluent from Los Lunas, Belen , and Socorro WWTPs had increased production of Vtg mRNA and protein compared to the DMSO control. To samples, Los Lunas and Socorro, had average Vitellogenin/18s expression was 0.1536 and 0.1772 , respectively. The results from the remaining WWTP effluents were below the EPA level of concern. Given that these two WWTPs discharge into a reach of the MRG that is at certain times of the year effluent dominated and can even go dry, endocrine disruption may be a seasonal water quality concern for RGSM.

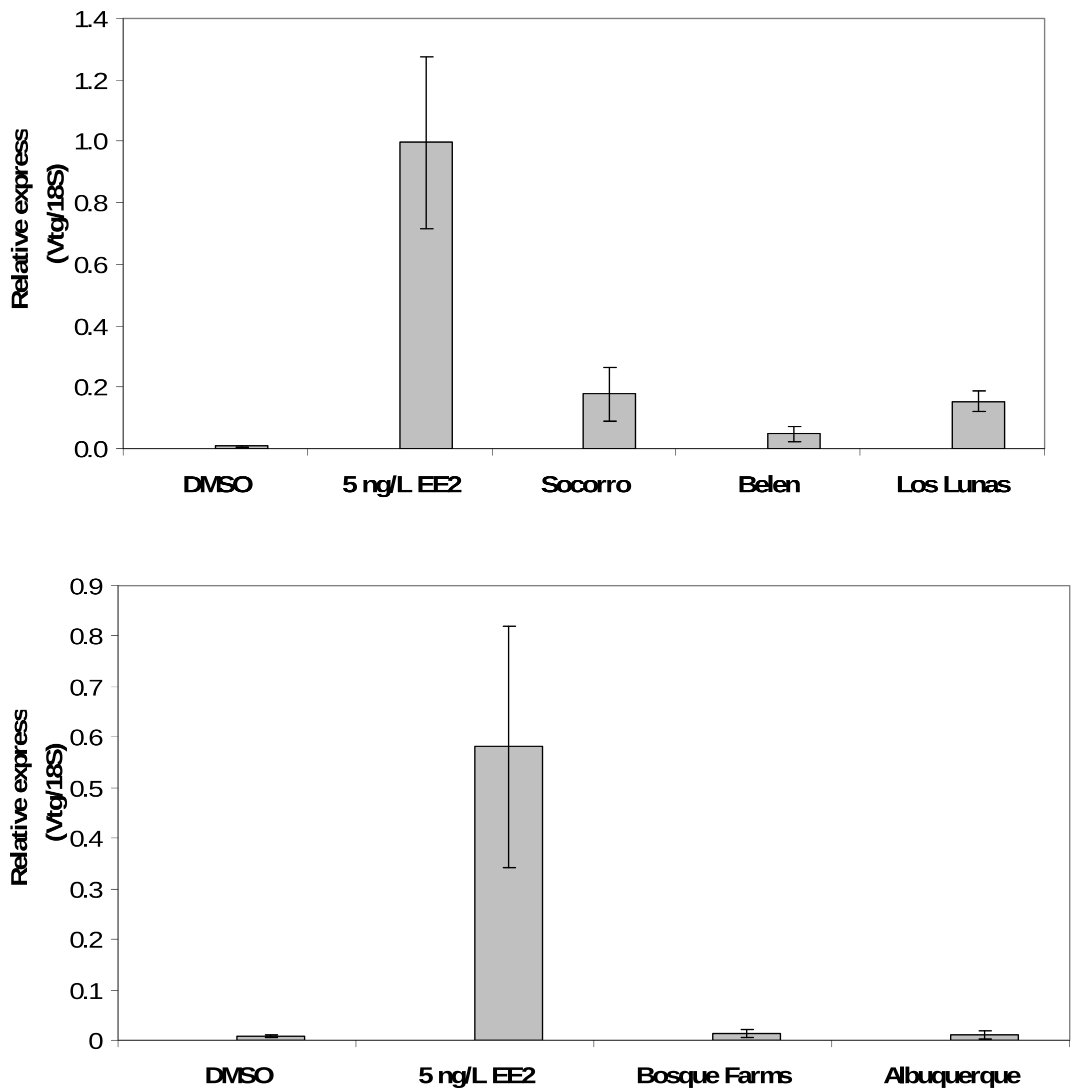

Figure B1. Vitellogenin expression in FHM adult males exposed to New Mexico WWTP effluents. Values are the average of five replicates with errors bars representing standard error. Data are compared to a DMSO negative control and the positive control is 5 ng/L of 17α-ethynylestradiol (EE2) the synthetic estrogen used in birth control pills. EPA's level of concern is 0.1 (Jim Lazorchak, pers. comm. Sept. 2007).