MIDDLE RIO GRANDE TOTAL MAXIMUM DAILY LOAD (TMDL) FOR FECAL COLIFORM

New Mexico Environment Department
Surface Water Quality Bureau

November 2001

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Summary Table

New Mexico Standards Segment	Rio Grande, 20.6.4.105 Rio Grande, 20.6.4.106
Waterbody Identifier	Rio Grande MRG3-30000
Parameters of Concern	Fecal Coliform Bacteria/Pathogens
State Uses Affected Tribal Uses Affected	Secondary Contact Recreation, Irrigation Primary Contact Ceremonial, Primary Contact Recreation, Secondary Contact Recreation, Warmwater Fishery, Agricultural Water Supply
State Priority	1
Threatened or Endangered Species	Silvery Minnow
Geographic Location	Rio Grande River Basin
Scope/size of watershed	3,204 mi^2
Land type	Arizona/New Mexico Plateau
Land use/cover	59% Rangeland 23% Forest 7% Agricultural 6% Urban 3% Barren 1% Wetlands <1% Water
Identified Individual NPDES Permitted Point Source Dischargers City of Albuquerque NPDES Municipal Separate Storm Sewer (MS4) NPDES Permit Pending	Bernalillo WWTF (NM0023485) Rio Rancho #2 WWTF (NM0027987) Rio Rancho #3 WWTF (NM0029602) Albuquerque WWTF (NM0022250) PNM (Reeves Station) (NM0000124) Sandia Peak Ski Area WWTF (NM0027863) Delta Environmental/Diamond Shamrock (NM0029807) Wylie Corporation (NM0029009) Rio Grande Portlant Cement Corp (NM0000116) Corrales Chevron (NM0029696) Duke City Distributing (DRT Consultants) (NM0029688) Rio Grande Resources, Inc. (NM0028100) Storm Water
Watershed Ownership	66% Private 13% Bureau of Land Management 10% Tribal 9% United States Forest Service 2% United States Military

TMDLs for: **Fecal Coliform**	**LA + WLA + MOS = TMDL**
Discharge is to Sandia Pueblo Tribal waters.	**Bernalillo WWTF** $0 + 3.030 \times 10^{9} + 0 = 3.030 \times 10^{9}$ cfu/day
Discharge is to Sandia Pueblo Tribal waters.	**North Diversion Channel** $0 + 6.438 \times 10^{11} + 0 = 6.438 \times 10^{11}$ cfu/day
	Rio Rancho #3 WWTF $0 + 3.219 \times 10^{9} + 0 = 3.219 \times 10^{9}$ cfu/day
	Rio Rancho #2 WWTF $0 + 2.083 \times 10^{10} + 0 = 2.083 \times 10^{10}$ cfu/day
	City of Albuquerque WWTF $0 + 2.878 \times 10^{11} + 0 = 2.878 \times 10^{11}$ cfu/day
	San Jose Drain $0 + 1.068 \times 10^{10} + 0 = 1.068 \times 10^{10}$ cfu/day
	South Diversion Channel $0 + 1.444 \times 10^{11} + 0 = 1.444 \times 10^{11}$ cfu/day
	Tijeras Arroyo $0 + 1.199 \times 10^{11} + 0 = 1.199 \times 10^{11}$ cfu/day
	Load Allocations for Arroyos and Drains
	La Cueva Arroyo 6.435×10^{11}cfu/day
	Pino Arroyo 6.166×10^{11} cfu/day
	Grant Line Arroyo 6.156×10^{11} cfu/day
	North Fork Hahn Arroyo 6.146×10^{11} cfu/day
	South Fork Hahn Arroyo 5.729×10^{11} cfu/day
	Hahn Arroyo 3.453×10^{11} cfu/day
	Embudo Arroyo 3.450×10^{11} cfu/day
	Academy Acres Drain 3.421×10^{11} cfu/day
	Tramway Floodway 3.127×10^{11} cfu/day

List of Abbreviations

BMP	Best Management Practice
CFS	Cubic Feet per Second
CWA	Clean Water Act
CWAP	Clean Water Action Plan
CWF	Cold Water Fishery
DMR	Discharge Monitoring Report
EPA	Environmental Protection Agency
CFU	Colony Forming Unit
LWWF	Limited Warm Water Fishery
LA	Load Allocation
MGD	Million Gallons per Day
mg/L	Milligrams per Liter
MOS	Margin of Safety
NMED	New Mexico Environment Department
NPDES	National Pollution Discharge Elimination System
NPS	Nonpoint Sources
SWQB	Surface Water Quality Bureau
TMDL	Total Maximum Daily Load
UWA	Unified Watershed Assessment
WLA	Waste Load Allocation
WQLS	Water Quality Limited Segment
WQCC	New Mexico Water Quality Control Commission
WQS	Water Quality Standards
WWTF	Waste Water Treatment Facility

EXECUTIVE SUMMARY

Section 303(d) of the Federal Clean Water Act requires states to develop TMDL management plans for water bodies determined to be water quality limited. A TMDL documents the amount of a pollutant a water body can assimilate without violating a State's or Tribe's water quality standards. It also allocates that load capacity to known point sources and nonpoint sources. TMDLs are defined in 40 CFR Part 130 as the sum of the individual Waste Load Allocations (WLA) for point sources and Load Allocations (LA) for nonpoint sources, including a margin of safety and natural background conditions.

The middle Rio Grande, for the purposes of this document, is defined as the Rio Grande from the northern boundary of Isleta Pueblo to the southern boundary of Santa Ana Pueblo. The Pueblo of Sandia also has jurisdiction over a portion of the Rio Grande. The New Mexico 1998-2000 §303(d) report, *"State of New Mexico §303(d) List for Assessed Stream and River Reaches,"* lists this segment as being water quality limited for the following pollutants: fecal coliform, total ammonia and chlorine. Subsequent sampling conducted in three seasons in 1999 resulted in a re-evaluation of these listings. Based on this sampling, the listings were modified to include only fecal coliform. The 2000-2002 §303(d) reflects these changes. This Total Maximum Daily Load (TMDL) document addresses only fecal coliform specifically in storm water. The land use/land cover for the middle Rio Grande is 59% Rangeland, 23% Forest, 7% Agricultural, 6% Urban, 3% Barren, 1% Wetlands and <1% Water **(Figure 1)**.

State of New Mexico Standards for Interstate and Intrastate Surface Waters (New Mexico Water Quality Control Commission, 20.6.1 NMAC, February 23, 2000 Standards) identify and designate this part of the Rio Grande as a limited warmwater fishery with other designated uses of irrigation, livestock watering, wildlife habitat and secondary contact. The Standards specify specific constituent criteria levels to be maintained so that the water body can support these designated uses. TMDL targets specified in this document are based on these water quality standards criteria. TMDL numeric targets are calculated so as to provide protection of designated uses. Load capacities are estimated as a function of these water quality targets and the assimilative capacity of the middle Rio Grande. Load allocations presented in this TMDL are based on the load capacities developed using these targets. Targets, loading analyses, and load allocations are presented for fecal coliform. These load analyses show that the estimated load capacities are currently exceeded, and therefore require reductions.

Included in this document is a general plan outlining activities which, when implemented in the middle Rio Grande storm water drainage area, would result in a reduction of fecal coliform bacteria inputs in the river. The Phase II Storm Water Management Program which is supposed to be approved and in place by March 10, 2003 will further delineate the approaches to be taken to abate pollutant loads to the river. The New Mexico Environment Department, Surface Water Quality Bureau, local municipalities, USEPA Region 6 and Tribal Governments along this reach will assist in the development of these and other storm water abatement controls in order to reduce the pollutant loads to the system. Implementation of recommendations in this document will be done with full participation of all interested and affected parties. It is recognized that this document is a living document and will be modified to reflect the dynamics of the area when adjustments are warranted.

Background Information

Eight ambient water quality monitoring stations and four effluent discharges were sampled in 1999. Results of this effort are listed in **Appendix B**. These data were used to characterize water quality of the stream reach. Station locations were selected to evaluate impacts of the wastewater discharge to the system and storm water inputs into the river **(Figure 2)**. This monitoring effort documented several exceedances of New Mexico water quality standards for fecal coliform. All exceedances for fecal coliform in the river were observed after summer rain events. Historically, as far back as 1979, the New Mexico Environment Department, then known as the New Mexico Health and Environment Department, has studied this issue. In a report titled**, *"Pollutant Loads in Stormwater Runoff from Albuquerque, New Mexico"***, David F. Tague and Anthony Drypolcher document fecal coliform exceedances in storm water **(see Appendix D)**. The following is an excerpt from the 1979 report:

"Fecal coliform loading from storm water runoff, approximately 49 times greater than that attributable to the WWTF, is probably the principal cause of fecal coliform counts ranging between 10,000 and 100,000 colonies/100ml routinely observed in the river during June through September. Fecal coliform/fecal streptococci ratios indicate feces of domestic animals are an important source of fecal bacteria contained in runoff from the watershed (Geldreich et al. 1968; Geldreich 1971; Geldreich 1976). The fecal coliform standard for this reach that specifies a logarithmic mean of less than 1,000 fecal coliforms/100ml on a monthly basis was adopted prior to an understanding of the effect of urban runoff. Seasonal water quality standards that allow for a decline in bacterial quality during the summer thunderstorm season (discussed under Work Element 5.1 of New Mexico's Statewide Water Quality Management Plan) seem reasonable in view of these data. We believe that impounding and disinfecting runoff waters to reduce bacteria densities to levels compatible with the existing stream standards is not a reasonable alternative".[1]

In a 1988 report titled, "***Intensive Water Quality Survey of The Rio Grande from Angostura to U.S. 85 Bridge, Sandoval and Bernalillo Counties, New Mexico***, Steven T. Pierce, Surveillance and Standards Section, Surface Water Quality Bureau, New Mexico Environmental Improvement Division, noted that:

"Violations of the single-sample numeric standard for fecal coliform bacteria occurred at stations 1, 3, 5 and 7 but only after the runoff event. The fecal coliform count at station 7 was greater than 600,000 per 100ml. This appears to be the result of runoff waters from a major thunderstorm entering the Rio Grande above station 7 from the North Floodway Channel near Alameda, which drains runoff from over 60 percent of the land in Albuquerque. At peak runoff, the flow from the North floodway channel near Alameda was approximately six times the flow of the Rio Grande at the Central Avenue Bridge.

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1 New Mexico Health and Environment Department, Water Pollution Control Section, Surveillance Unit, ***Pollutant loads in Stormwater Runoff from Albuquerque, New Mexico*****,** June 1979, p. 14.

Three separate series of fecal coliform samples were collected during the survey, but only samples collected after the runoff event from the four stations listed above violated the numeric standards. Average counts at stations 1, 3, 5, and 7 before the runoff event were 133, <74, <95 and <370, well within the single sample standard of 2,000 per 100ml".[2]

In a recent study conducted by Camp Dresser & McKee, Inc., in association with Janet Yagoda Shagam, Ph.D. and commissioned by the City of Albuquerque Wastewater Division, findings indicate that there are elevated levels of fecal coliform both above and below Albuquerque's Southside Wastewater Reclamation Plant (SWRP).

In addition to the 1999 NMED/SWQB study, historical storm water flow data provided by the United States Geological Survey (USGS) from discreet conveyances and the City of Albuquerque's storm water sampling program **(see Appendix C)** will be used in the development of this TMDL.

Looking east at a full Rio Grande.
(Photo provided by the City of Albuquerque)

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2 Steven T. Pierce, ***Intensive Water Quality Survey of the Rio Grande from Angostura to U.S. 85 Bridge, Sandoval and Bernalillo Counties, New Mexico, July 25-28***, 1988, Surveillance and Standards Section, Surface Water Quality Bureau, New Mexico Environmental Improvement Division, January 1989, p. 25.

Figure 1.

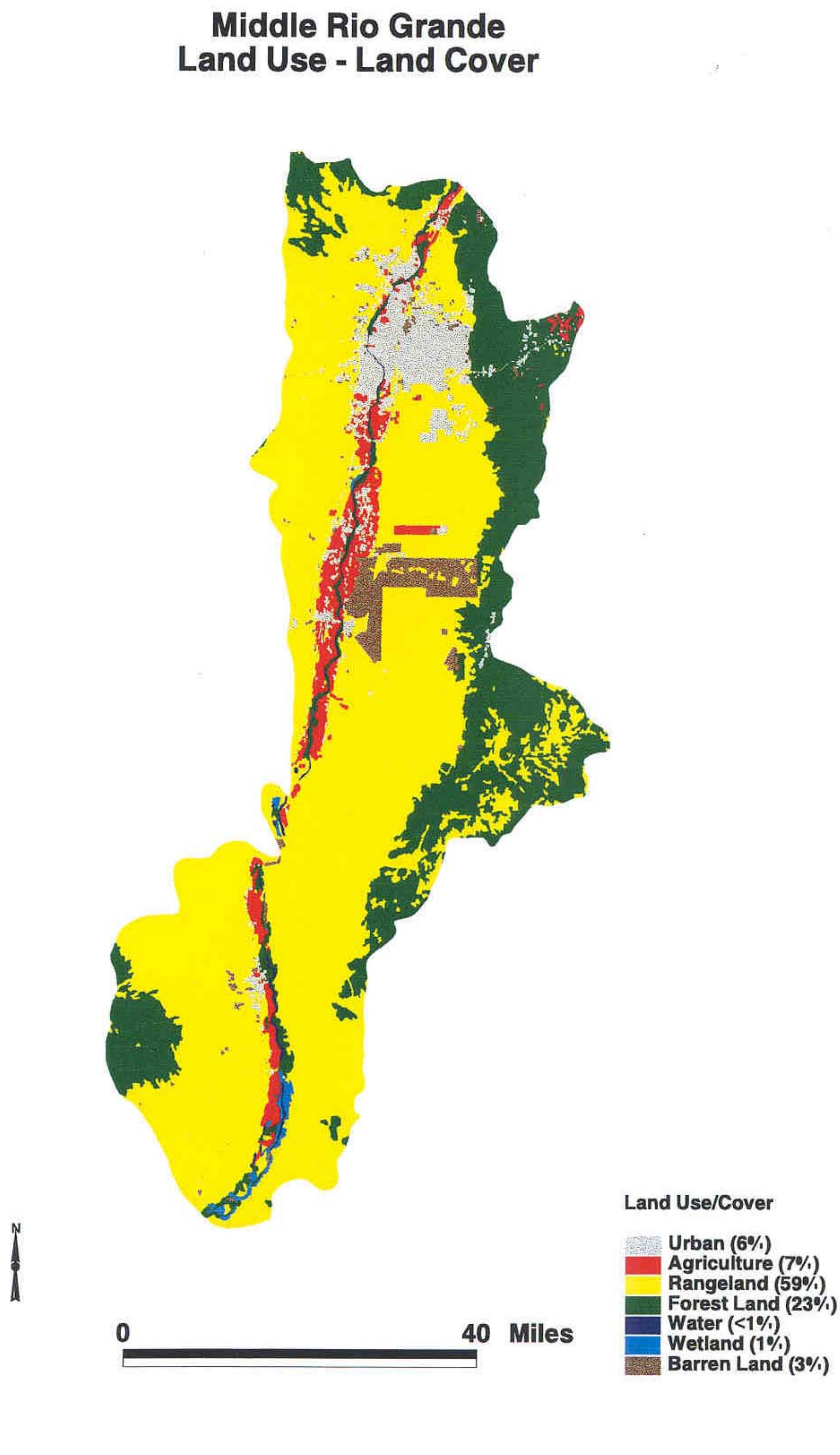
Middle Rio Grande
Land Use - Land Cover
Land Use/Cover
Urban (6%)
Agriculture (7%)
Rangeland (59%)
Forest Land (23%)
Water (<1%)
Wetland (1%)
Barren Land (3%)
N
0
40 Miles

Figure 2. 1999 Middle Rio Grande Sampling Stations (See Appendix A)

(This map delineates the sampling stations and indicates their proximity to tribal lands and waters. This map is not meant to be geographically exact.)

Applicable Standards and Designated Uses

The middle Rio Grande is classified in the Standards as having designated uses of limited warmwater fishery (LWWF), secondary contact recreation (SCR) and irrigation (IR) and is broken into two standard segments. Segment specific standards for fecal coliform are found under standards segment 20.6.4.105 and 20.6.4.106 **(Figure 3).** It is recognized that this document is a living document and will be modified to reflect the dynamics of the area when adjustments are warranted.

Segment 20.6.4.105 is defined as follows: The main stem of the Rio Grande from the headwaters of Elephant Butte Reservoir upstream to Alameda Bridge (Corrales Bridge), the Jemez River from the Jemez Pueblo boundary upstream to the Rio Guadalupe, and intermittent flow below the perennial reaches of Rio Puerco and Jemez River which enters the main stem of the Rio Grande.

Designated uses: irrigation, limited warmwater fishery, livestock watering, wildlife habitat and secondary contact.

Fecal coliform standards: The monthly geometric mean of fecal coliform bacteria shall not exceed 1,000/100ml; no single sample shall exceed 2,000/100ml.

Segment 20.6.4.106 is defined as follows: The main stem of the Rio Grande from Alameda Bridge (Corrales Bridge) upstream to the Angostura Diversion Works.

Designated uses: irrigation, limited warmwater fishery, livestock watering, wildlife habitat and secondary contact.

Fecal coliform standards: The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100ml; no single sample shall exceed 400/100ml.

Pueblo of Sandia Applicable Tribal Surface Water Quality Standards and Designated Uses[3]

Designated uses: primary contact ceremonial, primary contact recreation, secondary contact recreation, warmwater fishery and agricultural water supply.

Fecal coliform standards:

Primary Contact Ceremonial: geometric mean maximum of 100 colonies/100ml (geometric mean calculation based on a minimum of five samples taken over a maximum of 30 days.

Single sample maximum of 200 colonies/100ml.

Primary Contact Recreation:

a. April 1 to September 30

1. **geometric mean maximum** of 100 colonies/100ml (geometric mean calculation based on a minimum of five samples taken over a maximum of 30 days.

2. **Single sample maximum** of 200 colonies/100ml.

b. October 1 to March 31

Fecal coliform standards for secondary contact recreation use apply.

Secondary Contact Recreation:

a. **geometric mean maximum** of 200 colonies/100ml (geometric mean calculation based on a minimum of five samples taken over a maximum of 30 days.

b. **Single sample maximum** of 400 colonies/100ml.

Agricultural Water Supply:

a. **geometric mean maximum** of 1000 colonies/100ml (geometric mean calculation based on a minimum of five samples taken over a maximum of 30 days.

b. **Single sample maximum** of 2000 colonies/100ml.

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[3] These standards apply to all tribal surface waters, that is, all waters within the exterior boundaries of the Pueblo of Sandia Indian Reservation, including water situated wholly or partly within, or bordering upon, the Reservation, whether public or private, except for private waters that do not combine with other surface waters. (Pueblo of Sandia Water Quality Standards, August 10, 1993)

Warmwater Fishery:

a. **geometric mean maximum** of 100 colonies/100ml (geometric mean calculation based on a minimum of five samples taken over a maximum of 30 days.

b. **Single sample maximum** of 200 colonies/100ml.

The Pueblo of Isleta has jurisdiction downstream of this segment. The uses and criteria in the Pueblo of Isleta standards are identical to the Pueblo of Sandia's standards.

Identification of Sources

The middle Rio Grande is listed on the 2000-2002 State of New Mexico §303(d) list with fecal coliform as a pollutant of concern. Presence of fecal coliform bacteria is an indicator of the possible presence of bacteria or other microbial pathogens that may limit beneficial uses and present human health concerns. There are three significant sources of fecal coliform bacteria in the middle Rio Grande. This reach of the Rio Grande contains National Pollutant Discharge Elimination System (NPDES) permitted dischargers which discharge fecal coliform daily to the river under their permits.

Penned animals along waterbodies are a potential source of fecal contamination. (Photo provided by the City of Albuquerque)

However, periodic spills and end of pipe violations of permits having been historically documented. There are nonpoint sources of fecal coliform bacteria from livestock rearing, livestock operations, wildlife contributions, pet waste from urban runoff and other domestic animals that enter side canals and can eventually make it to the river as well as limited seasonal inputs from wild birds which use the Rio Grande as a migratory flyway.

The Rio Grande valley is a major bird fly through for migratory waterfowl. (Photo provided by the City of Albuquerque)

Failing or ill sited septic systems, leaks in sanitary sewer collection systems, overflows from surcharged sanitary sewers, illicit connections of sanitary sewers to storm sewer collection systems and unidentified broken sewer lines do not appear to be a large contributor to the fecal coliform exceedences. The main transport of fecal coliform and the focus of this document are storm water conveyances **(see Appendix C)**.

There are four discreet concrete transports of storm water that enter the middle Rio Grande. During the annual monsoon rain season (May-September) high levels of fecal coliform are collected from neighborhoods including parks, and vacant lots then transported to the river unfiltered. These pulse events directly lead to elevated levels of fecal coliform in the surface water.

Storm Water Discharges

Albuquerque Storm Water Conveyance System

Point source storm water discharges from municipal separate storm sewer systems (MS4s) are regulated under the national Pollutant Discharge Elimination System (NPDES). MS4s serving a population of 100,000, or more, currently require NPDES storm water permits. Smaller MS4s, in urbanized areas will require NPDES permits starting in March 2003. Therefore, storm water discharges in this TMDL will be assigned a waste load allocation. Numerical targets for storm water conveyances are established by this TMDL. However, EPA has recognized that numeric limitations for storm water permits can be very difficult to develop at this time because of the existing state of knowledge about the intermittent and variable nature of these types of discharges and their effects on receiving waters during storm events (EPA 1998).

EPA has found that although NPDES permits must contain conditions to ensure that water quality standards are met, this does not necessarily require the use of numeric water quality-based effluent limitations and therefore the permitting authority has some flexibility in establishing permit conditions.

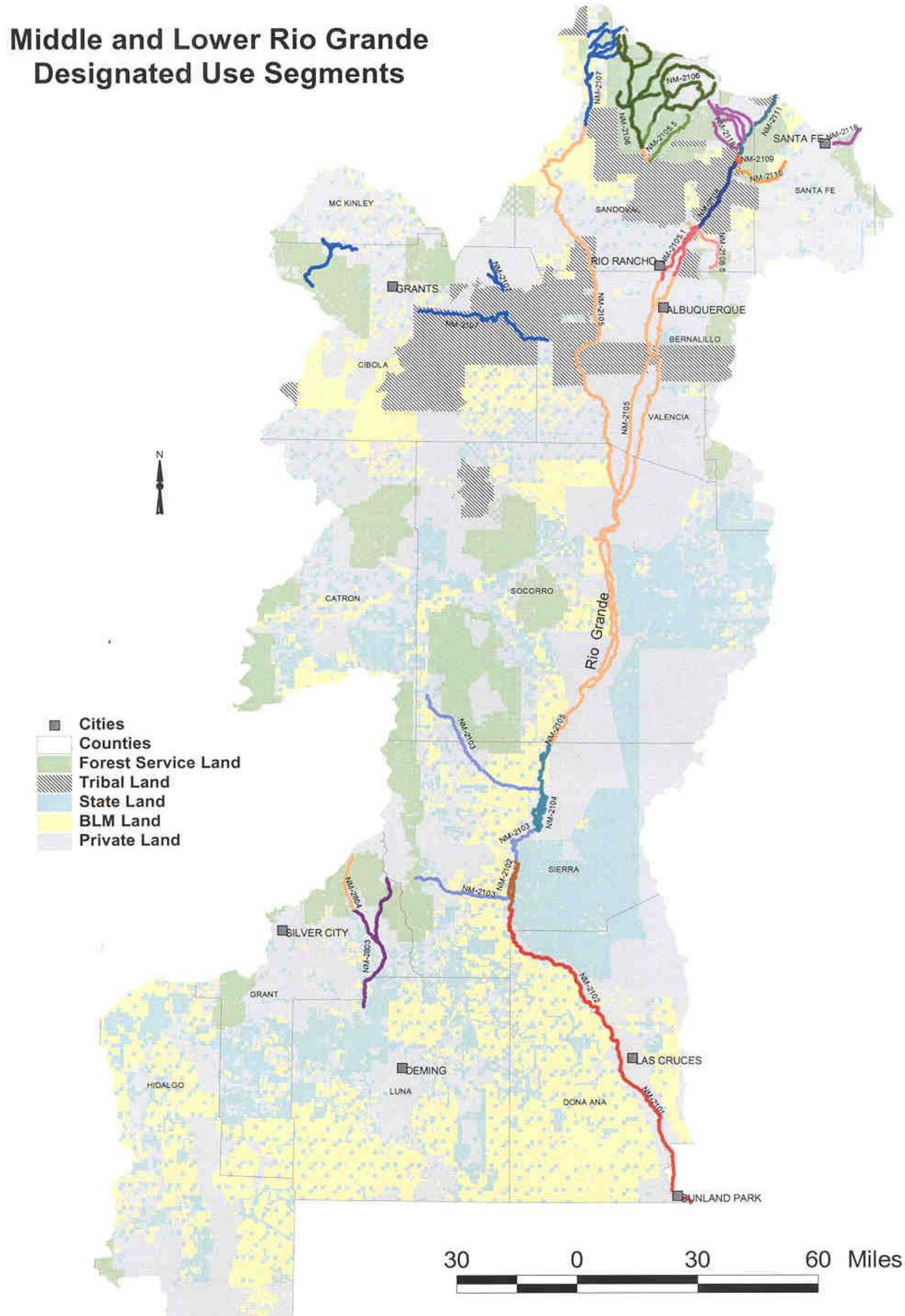
Storm water discharges are highly variable both in terms of flow and pollutant concentrations, and the relationship between discharges and water quality can be complex (EPA 1998). EPA's interim permitting approach for NPDES storm water permits establishes the use of best management practices to provide for the attainment of water quality standards through a combination of source reductions and structural controls.

In addition, storm water permits include coordinated monitoring efforts to gather necessary information to determine the extent to which the permit provides for attainment of applicable water quality standards and to determine the appropriate requirements of subsequent permits.

This monitoring may include ambient receiving stream water assessments in addition to discharge monitoring to gather this information.

Aerial View of Arroyo de la Barranca Storm Water Conveyance to the Rio Grande
Rio Rancho, New Mexico
(Photo provided by the City of Albuquerque)

Figure 3.


Middle and Lower Rio Grande
Designated Use Segments
Cities
Counties
Forest Service Land
Tribal Land
State Land
BLM Land
Private Land
SANTA FE
RIO RANCHO
ALBUQUERQUE
GRANTS
SILVER CITY
DEMING
LAS CRUCES
SUNLAND PARK
Rio Grande
30 0 30 60 Miles

Fecal coliform sampling in the middle Rio Grande is extensive. The most recent NMED/SWQB data was collected during the summer of 1999 by the Surveillance and Standards Section. **Table 1** summarizes this information.

Table 1. Results of the 1999 fecal coliform sampling by date, north to south in the middle Rio Grande corridor.

Site **(Yellow denotes State standard exceedence)**	**Date**	**Time**	**Fecal Coliform Col/100ml Membrane filter**	**Fecal Coliform Col/100ml Most Probable Number (MPN)**
Rio Grande Below Angostura Diversion Works	990628	1010	20	
Rio Grande Above Highway 44 Bridge	990628	1025	34	
Rio Grande at Bernalillo WWTF discharge	990628	1035	23	
Rio Grande Above Rio Rancho WWTF #3	990628	1055	37	
Rio Rancho WWTF #3 discharge	990628	1100	12B	
Rio Grande Above Rio Rancho WWTF #2	990628	1125	49	
Rio Rancho WWTF #2 discharge	**990628**	**1130**	**5300**	
Rio Grande Above Alameda Bridge	**990628**	**1200**	**2400**	
Rio Grande Above Alameda Bridge	990628	1200	50 QA REP	
Rio Grande Above Rio Bravo Bridge	990628	1230	180B	
Albuquerque WWTF discharge	990628	1245	19B	
Rio Grande Above I-25 Bridge	990628	1300	540	
Rio Grande Above Isleta Diversion	990628	1315	400B	
Rio Grande Below Angostura Diversion Works	990706	0800		300
Rio Grande Above Highway 44 Bridge	**990706**	**0820**		**900**
Rio Grande at Bernalillo WWTF discharge	990706	0835	1K	
Rio Grande Above Rio Rancho WWTF #3	**990706**	**0855**		**1600L**
Rio Rancho WWTF #3 discharge	990706	0905	15J	
Rio Grande Above Rio Rancho WWTF #2	**990706**	**0925**		**500**
Rio Rancho WWTF #2 discharge	**990706**	**0935**	**3500**	
Rio Grande Above Alameda Bridge	990706	0955	1000	
Rio Grande Above Rio Bravo Bridge	**990706**	**1030**	**2400B**	
Albuquerque WWTF discharge	990706	1045	11B	
Rio Grande Above I-25 Bridge	**990706**	**1100**	**2100B**	
Rio Grande Above Isleta Diversion	990706	1115	1800B	
Rio Grande Above Isleta Diversion	990706	1115	1600B QA REP	
Rio Grande Below Angostura Diversion Works	990712	0855	110B	
Rio Grande Above Highway 44 Bridge	990712	0920	160B	
Rio Grande at Bernalillo WWTF discharge	990712	0935	10KB	
Rio Grande Above Rio Rancho WWTF #3	990712	0955	200	
Rio Rancho WWTF #3 discharge	**990712**	**1000**	**2100**	
Rio Grande Above Rio Rancho WWTF #2	990712	1030	330	
Rio Rancho WWTF #2 discharge	**990712**	**1035**	**7300B**	
Rio Grande Above Alameda Bridge	990712	1055	250	
Rio Grande Above Alameda Bridge	990712	1055	280 QA REP	
Rio Grande Above Rio Bravo Bridge	990712	1200	170B	
Albuquerque WWTF discharge	990712	1215	30B	
Rio Grande Above I-25 Bridge	990712	1235	170B	
Rio Grande Above Isleta Diversion	990712	1245	290	
Rio Grande Below Angostura Diversion Works	990719	0830		300
Rio Grande Above Highway 44 Bridge	990719	0850	340	
Rio Grande Above Highway 44 Bridge	990719	0850	360 QA REP	

Site (Yellow denotes standard exceedence)	Date	Time	Fecal Coliform Col/100ml Membrane filter	Fecal Coliform Col/100ml MPN
Rio Grande at Bernalillo WWTF discharge	990719	0905	10K	
Rio Grande Above Rio Rancho WWTF #3	**990719**	**0925**		**1600**
Rio Rancho WWTF #3 discharge	990719	0926	50B	
Rio Grande Above Rio Rancho WWTF #2	**990719**	**1000**		**2400**
Rio Rancho WWTF #2 discharge	**990719**	**1005**	**8500**	
Rio Grande Above Alameda Bridge	990719	1030		1300
Rio Grande Above Rio Bravo Bridge	**990719**	**1105**		**5000**
Albuquerque WWTF discharge	990719	1115	180	
Rio Grande Above I-25 Bridge	**990719**	**1130**		**16000**
Rio Grande Above Isleta Diversion	**990719**	**1145**		**5000**
Rio Grande Below Angostura Diversion Works	990726	0850	80B	
Rio Grande Above Highway 44 Bridge	**990726**	**0910**	**400**	
Rio Grande at Bernalillo WWTF discharge	990726	0920	10KB	
Rio Grande Above Rio Rancho WWTF #3	990726	0945	110B	
Rio Rancho WWTF #3 discharge	990726	0946	50B	
Rio Grande Above Rio Rancho WWTF #2	990726	1010	90B	
Rio Rancho WWTF #2 discharge	**990726**	**1015**	**20000**	
Rio Rancho WWTF #2 discharge	990726	1015	16000B QA REP	
Rio Grande Above Alameda Bridge	990726	1040	350	
Rio Grande Above Rio Bravo Bridge	990726	1120		500
Albuquerque WWTF discharge	990726	1130	30B	
Rio Grande Above I-25 Bridge	990726	1150		500
Rio Grande Above Isleta Diversion	990726	1200	240	
Rio Grande Above Rio Rancho WWTF #2	990729	1000	82B	
Rio Rancho WWTF #2 discharge	**990729**	**1005**	**3000**	
Rio Grande Above Alameda Bridge	990729	1035	81B	
Rio Grande Above Rio Bravo Bridge	990729	1115	70B	
Albuquerque WWTF discharge	990729	1145	3B	
Rio Grande Above I-25 Bridge	990729	1200	150B	
Rio Grande Above Isleta Diversion	990729	1215	140B	
Rio Grande Above Rio Rancho WWTF #2	**990802**	**0840**		**1600L**
Rio Rancho WWTF #2 discharge	**990802**	**0845**	**410**	
Rio Rancho WWTF #2 discharge	990802	0845	210 QA REP	
Rio Grande Above Alameda Bridge	990802	0910		1600L
Rio Grande Above Rio Bravo Bridge	990802	0945		1600L
Albuquerque WWTF discharge	990802	0955	3	
Rio Grande Above I-25 Bridge	990802	1010		1600L
Rio Grande Above Isleta Diversion	990802	1020		1600L

"L" Remark Code = Off scale high. Actual value not known, but known to be greater than value shown
"B" Remark Code = Results based upon colony counts outside the acceptable range
"K" Remark Code = Off scale low. Actual value not known, but known to be less than value shown

Fecal Coliform TMDLs

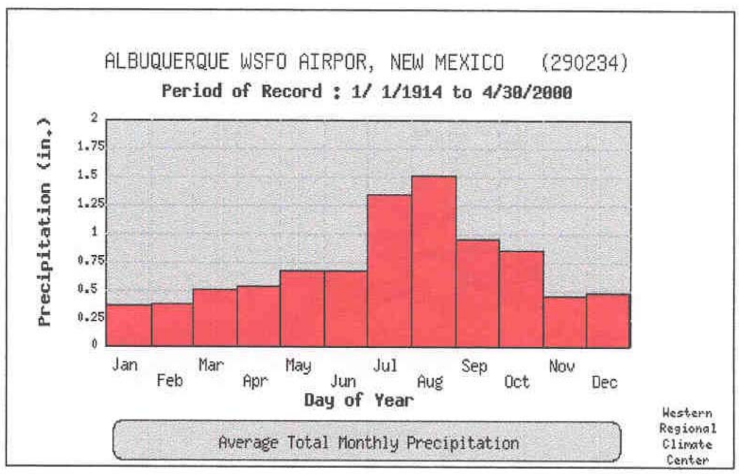
Precipitation

Historical (1914-July, 2000) monthly mean precipitation amounts (in inches) are provided in **Table 2** below.

Table 2

MONTH	May	June	July	August	September
MEAN	0.66	0.64	1.36	1.50	0.96
ANNUAL MEAN: 8.62					

POR - Monthly Average Total Precipitation



● - Average precipitation recorded for the month.

Future Growth

Future growth in the middle Rio Grande valley is also of concern when it comes to storm water and storm water impacts on surface water quality. Phase II of the federal Storm water Regulations requires municipalities to develop a storm water management program that addresses impacts from future growth and how those impacts will be handled Bernalillo County contains two of the largest and fastest growing cities in the State, Albuquerque and Rio Rancho. The following table shows the projections for the next twenty years in Bernalillo County **(Table 3)**:

Table 3
POPULATION PROJECTIONS FOR
BERNALILLO COUNTY

YEAR	MALE	FEMALE	TOTAL	% INCREASE
2000	259,171	276,490	535,661	NA
2010	278,529	299,335	577,864	7.8
2015	287,830	309,311	597,141	3.3
2020	296,278	317,987	614,265	2.9

River Hydrology

The United States Geological Survey (USGS) Gage, **Rio Grande at Albuquerque (08330000)**, was used in this document to calculate the critical low flow condition or 4Q3 of the peak flow, from 1992-1999 and for the months of May through September. The critical low flow of a stream at a particular site shall be the minimum average four consecutive day flow which occurs with a frequency of once in three years (4Q3). Critical low flow values may be determined on an annual, a seasonal or monthly basis, as appropriate, after due consideration of site-specific conditions. The Hydrotec© computer program was used to calculate the 4Q3 of the peak seasonal flow (May through September) value of 376 cubic feet per second (cfs). The reason this value was used was to be protective of the lowest flow during the peak flow season. The USGS gage at Albuquerque is above the discharge of the Albuquerque WWTF therefore, an additional 117 cfs will added to the river below the WWTF discharge to bring the 4Q3 value to 493 cfs from the WWTF discharge down to the Isleta Diversion Dam. The additional cfs were derived using the following equation:

76 million gallons/day (Alb. WWTF Design Capacity) x 1.54723 (conversion factor) = 117 cfs

This gage has a water history starting in 1975 but a 1992 agreement between City of Albuquerque and Middle Rio Grande Conservancy District guaranteed a minimum flow in the Rio Grande between the Central Avenue Bridge and the Isleta Diversion Dam of at least 250 cfs for a period of 10 years starting January 1, 1992 and expiring December 31, 2001.

Storm Water Hydrology

The City of Albuquerque, Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) in cooperation with the USGS have established storm water flow gaging sites and water quality sites throughout the middle Rio Grande area (**see Appendix C**). Where data was available, the annual maximum flow condition was calculated. The Hydrotec© computer program was used to calculate these values in cfs.

Calculations of River Loading Capacity

Given that fecal coliform standards are expressed as colonies per unit volume, using 30-day geometric mean criterion of 1,000 cfu/100 ml for river segment 20.6.4.105 and 100 cfu/100 ml for river segment 20.6.4.105.1, river loading capacity can be calculated. This is accomplished through application of the following conversion calculations:

Cubic feet per second (Cfs) into Million gallons per day (MGD)

Cfs x 0.646317(conversion factor) = MGD

and

C as cfu/100 ml x 1000ml/1 L x 1 L/ 0.264 gallons x Q in million gallons / day = cfu/day

Where: C = State water quality standard criterion
Q = river flow in gallons

River Loading Capacity for Segment 20.6.4.105

Applying the above conversion using the 1,000 cfu/100 ml criterion, adding an additional 117 cfs below the Albuquerque WWTF to account for their discharge, two loading capacities can be calculated. The first, waters below Alameda Bridge down to the Albuquerque WWTF (376 cfs) will be calculated as follows:

1,000 cfu/100 ml x 1000ml/1 L x 1 L/ 0.264 gallons x 243,015,192 flow in gallons / day

The load may be expressed as:

The assimilative loading limit in the river is 9.205×10^{12} cfu/day at the 4Q3 low flow.

The second, waters below the Albuquerque WWTF (493 cfs) and a protective standard of 100cfu/100ml will be calculated as follows:

100 cfu/100 ml x 1000ml/1 L x 1 L/ 0.264 gallons x 318,634,281 flow in gallons / day

The load may be expressed as:

The assimilative loading limit in the river is 1.206×10^{12} cfu/day at the 4Q3 low flow.

River Loading Capacity for Segment 20.6.4.106

Applying the above conversion using the 100 cfu/100 ml (Sandia Tribal standard) criterion and using the previously determined river critical low flow (376 cfs) 243,015,192 gallons per day the load may be expressed as:

100 cfu/100 ml x 1000ml/1 L x 1 L/ 0.264 gallons x 243,015,192 flow in gallons / day

The assimilative loading limit in the river is 9.205×10^{11} cfu/day at the 4Q3 low flow.

North Diversion Channel Loading Capacity

Applying the above conversion using the 100 cfu/100 ml criterion and using the previously determined North Diversion Channel mean annual maximum flow (263 cfs) 169,981,371 gallons per day the load may be expressed as:

100 cfu/100 ml x 1000ml/1 L x 1 L/ 0.264 gallons x 169,981,371 flow in gallons / day

The assimilative loading limit in the North Diversion Channel is 6.438 x 10^{11} cfu/day at the mean annual maximum flow.

Fecal Coliform Background Levels

The upper station of the Bureau's 1999 study was the Rio Grande below Angostura Diversion Works. The 30-day geometric mean for fecal coliform at this station was 110 cfu/100ml. While this level is currently meeting the State water quality standard of 200 cfu/100ml it is 10 cfu above the Sandia Pueblo fecal coliform standard of 100 cfu/100ml. Therefore, Sandia Pueblo standards are not being met as the Rio Grande exits Sandia Pueblo land and flows into the reach for which the TMDL is being drafted.

The allowable fecal coliform load is over 100% of the standard at the Angostura Diversion Works and the Rio Grande downstream is over allocated for fecal coliform.

Angostura Irrigation Diversion Works

The assimilative loading limit in Segment 20.6.4.106 of the river is 9.205×10^{11} cfu/day at the 4Q3 low flow.

❖ Bernalillo WWTF (NM0023485)

Bernalillo WWTF Discharge

Waste Load Allocation

Under the conditions of the TMDL the permittee will be required to meet segment specific fecal coliform standards after final treatment. The limits will be 100 cfu/100 ml as a 30-day geometric mean and a single sample maximum of 200 cfu/100 ml. Applying these values to the formula above the waste load allocations may be determined as follows:

Design Capacity: .8 MGD

100 cfu/100 ml x 1000ml/1 L x 1 L/ 0.264 gallons x 800,000 flow in gallons/day

Thus yielding a 30-day geometric mean waste load allocation of 3.030×10^9 cfu/day.

TMDL

Load Allocation, LA + Waste Load Allocation, WLA + Margin of Safety, MOS

$$0 + 3.030 \times 10^9 + 0 = 3.030 \times 10^9$$

Remaining River Loading Capacity for Segment 20.6.4.106

$$9.205 \times 10^{11} - 3.030 \times 10^9 = 9.174 \times 10^{11}$$

❖ North Diversion Channel (Discharge is to Sandia Pueblo Tribal Waters)

Aerial view of the North Diversion Channel as it enters the Rio Grande (Photo provided by the City of Albuquerque)

Waste Load Allocation

The limit targets for this conveyance will be the ambient (instream) criteria of 100 fcu/100 ml as a 30-day geometric mean and a single sample maximum of 200 fcu/100ml. Using these values in the WLA formula, the target loads for the conveyances' waste load allocations may be determined as follows:

Annual Maximum Flow: 263 cfs

100 cfu/100 ml x 1000ml/1 L x 1 L/ 0.264 gallons x 169,981,371 flow in gallons/day

Thus yielding a 30-day geometric mean waste load allocation of 6.438×10^{11} cfu/day.

TMDL

Load Allocation, LA + Waste Load Allocation, WLA + Margin of Safety, MOS

$$0 + 6.438 \times 10^{11} + 0 = 6.438 \times 10^{11}$$

Remaining River Loading Capacity for Segment 20.6.4.106

$$9.174 \times 10^{11} - 6.438 \times 10^{11} = 2.736 \times 10^{11}$$

❖ Rio Rancho WWTF #3 (NM0029602)

Rio Rancho WWTF #3 Discharge

Waste Load Allocation

Under the conditions of the TMDL the permittee will be required to meet segment specific fecal coliform standards after final treatment. The limits will be 100 cfu/100 ml as a 30-day geometric mean and a single sample maximum of 200 cfu/100 ml. Applying these values to the formula above the waste load allocations may be determined as follows:

Design Capacity: .85 MGD

100 cfu/100 ml x 1000ml/1 L x 1 L/ 0.264 gallons x 850,000 flow in million gallons/day

Thus yielding a 30-day geometric mean waste load allocation of 3.219×10^9 cfu/day.

TMDL

Load Allocation, LA + Waste Load Allocation, WLA + Margin of Safety, MOS

$$0 + 3.219 \times 10^9 + 0 = 3.219 \times 10^9$$

Remaining River Loading Capacity for Segment 20.6.4.106

$$2.736 \times 10^{11} - 3.219 \times 10^9 = 2.704 \times 10^{11}$$

❖ Rio Rancho WWTF #2 (NM0027987)

Rio Rancho WWTF #2 Discharge

Waste Load Allocation

Under the conditions of the TMDL the permittee will be required to meet segment specific fecal coliform standards after final treatment. The limits will be 100 cfu/100 ml as a 30-day geometric mean and a single sample maximum of 200 cfu/100 ml. Applying these values to the formula above the waste load allocations may be determined as follows:

Design Capacity: 5.5 MGD

100 cfu/100 ml x 1000ml/1 L x 1 L/ 0.264 gallons x 5,500,000 flow in gallons/day

Thus yielding a 30-day geometric mean waste load allocation of 2.083×10^{10} cfu/day.

TMDL

Load Allocation, LA + Waste Load Allocation, WLA + Margin of Safety, MOS

$$0 + 2.083 \times 10^{10} + 0 = 2.083 \times 10^{10}$$

Remaining River Loading Capacity for Segment 20.6.4.106

$$2.704 \times 10^{11} - 2.083 \times 10^{10} = 2.496 \times 10^{11}$$

The assimilative loading limit in the river for Segment 20.6.4.105 is 9.205×10^{12} cfu/day at the 4Q3 low flow.

❖ Albuquerque WWTF (NM0022250)

Albuquerque WWTF Discharge

Waste Load Allocation

Under the conditions of the TMDL the permittee will be required to meet segment specific fecal coliform standards after final treatment. The limits will be 100 cfu/100 ml as a 30-day geometric mean and a single sample maximum of 200 cfu/100 ml. Applying these values to the formula above the waste load allocations may be determined as follows:

Design Capacity: 76 MGD

100 cfu/100 ml x 1000ml/1 L x 1 L/ 0.264 gallons x 76,000,000 flow in gallons/day

Thus yielding a 30-day geometric mean waste load allocation of 2.878×10^{11} cfu/day.

TMDL

Load Allocation, LA + Waste Load Allocation, WLA + Margin of Safety, MOS

$$0 + 2.878 \times 10^{11} + 0 = 2.878 \times 10^{11}$$

Remaining River Loading Capacity for Segment 20.6.4.105

$$9.205 \times 10^{12} - 2.878 \times 10^{11} = 8.917 \times 10^{12}$$

The assimilative loading limit in the river Segment 20.6.4.105 below the Albuquerque WWTF is 1.206×10^{12} cfu/day at the 4Q3 low flow.

❖ San Jose Drain

Waste Load Allocation

The limit targets for this conveyance will be the ambient (instream) criteria of 100 fcu/100 ml as a 30-day geometric mean and a single sample maximum of 200 fcu/100ml. Using these values in the WLA formula, the target loads for the conveyances' waste load allocations may be determined as follows:

Mean Annual Maximum Flow: 4.37 cfs

100 cfu/100 ml x 1000ml/1 L x 1 L/ 0.264 gallons x 2,820,000 flow in million gallons/day

Thus yielding a 30-day geometric mean waste load allocation of 1.068×10^{10} cfu/day.

TMDL

Load Allocation, LA + Waste Load Allocation, WLA + Margin of Safety, MOS

$$0 + 1.068 \times 10^{10} + 0 = 1.068 \times 10^{10}$$

Remaining River Loading Capacity for Segment 20.6.4.105 below the Albuquerque WWTF

$$1.206 \times 10^{12} - 1.068 \times 10^{10} = 1.195 \times 10^{12}$$

❖ South Diversion Channel

Waste Load Allocation

The limit targets for this conveyance will be the ambient (instream) criteria of 100 fcu/100 ml as a 30-day geometric mean and a single sample maximum of 200 fcu/100ml. Using these values in the WLA formula, the target loads for the conveyances' waste load allocations may be determined as follows:

Aerial View of the South Diversion Channel as it enters the Rio Grande

Mean Annual Maximum Flow: 59 cfs

100 cfu/100 ml x 1000ml/1 L x 1 L/ 0.264 gallons x 38,132,703 flow in million gallons/day

Thus yielding a 30-day geometric mean waste load allocation of 1.444×10^{11} cfu/day.

TMDL

Load Allocation, LA + Waste Load Allocation, WLA + Margin of Safety, MOS

$$0 + 1.444 \times 10^{11} + 0 = 1.444 \times 10^{11}$$

Remaining River Loading Capacity for Segment 20.6.4.105 below the Albuquerque WWTF

$$1.195 \times 10^{12} - 1.444 \times 10^{11} = 1.050 \times 10^{12}$$

❖ Tijeras Arroyo

Waste Load Allocation

The limit targets for this conveyance will be the ambient (instream) criteria of 100 fcu/100 ml as a 30-day geometric mean and a single sample maximum of 200 fcu/100ml. Using these values in the WLA formula, the target loads for the conveyances' waste load allocations may be determined as follows:

Mean Annual Maximum Flow: 49 cfs

100 cfu/100 ml x 1000ml/1 L x 1 L/ 0.264 gallons x 31,669,533 flow in million gallons/day

Thus yielding a 30-day geometric mean waste load allocation of 1.199×10^{11} cfu/day.

TMDL

Load Allocation, LA + Waste Load Allocation, WLA + Margin of Safety, MOS

$$0 + 1.199 \times 10^{11} + 0 = 1.199 \times 10^{11}$$

Remaining River Loading Capacity for Segment 20.6.4.105 below the Albuquerque WWTF

$$1.050 \times 10^{12} - 1.199 \times 10^{11} = 9.310 \times 10^{11}$$

The following section of arroyo and drain calculations are being made to set loads associated with their storm water inputs. The calculations will provide a target for BMP implementation and a number to reduce to when data indicate that the load has been exceeded. These calculations are not meant to establish TMDLs for the individual arroyos and drains.

Load Allocations for Arroyos and Drains

- **La Cueva Arroyo**

Annual Maximum Flow: .110 cfs

100 cfu/100 ml x 1000ml/1 L x 1 L/ 0.264 gallons x 71,095 flow in gallons/day

Thus yielding a 30-day geometric mean load of 269,299,242 cfu/day.

Load Allocation

The nonpoint source load allocation is calculated by subtracting the waste load allocation from the final allowable capacity.

$$LA = 6.438 \times 10^{11} - 269{,}299{,}242$$
$$LA = 6.435 \times 10^{11}$$

- **Pino Arroyo**

Mean Annual Maximum Flow: 11 cfs

100 cfu/100 ml x 1000ml/1 L x 1 L/ 0.264 gallons x 7,109,487 flow in gallons/day

Thus yielding a 30-day geometric mean load of 2.69×10^{10} cfu/day.

Load Allocation

The nonpoint source load allocation is calculated by subtracting the waste load allocation from the final allowable capacity.

$$LA = 6.435 \times 10^{11} - 2.69 \times 10^{10}$$
$$LA = 6.166 \times 10^{11}$$

- **Grant Line Arroyo**

Mean Annual Maximum Flow: .37 cfs

100 cfu/100 ml x 1000ml/1 L x 1 L/ 0.264 gallons x 239,137 flow in gallons/day

Thus yielding a 30-day geometric mean load of 905,821,969 cfu/day.

Load Allocation

The nonpoint source load allocation is calculated by subtracting the waste load allocation from the final allowable capacity.

$$LA = 6.166 \times 10^{11} – 905{,}821{,}969$$
$$LA = 6.156 \times 10^{11}$$

- **North Fork of the Hahn Arroyo**

Mean Annual Maximum Flow: .38 cfs

100 cfu/100 ml x 1000ml/1 L x 1 L/ 0.264 gallons x 245,600 flow in gallons/day

Thus yielding a 30-day geometric mean load of 930,303,030 cfu/day.

Load Allocation

The nonpoint source load allocation is calculated by subtracting the waste load allocation from the final allowable capacity.

$$LA = 6.156 \times 10^{11} – 930{,}303{,}030$$
$$LA = 6.146 \times 10^{11}$$

- **South Fork of the Hahn Arroyo**

Mean Annual Maximum Flow: 17 cfs

100 cfu/100 ml x 1000ml/1 L x 1 L/ 0.264 gallons x 10,987,389 flow in gallons/day

Thus yielding a 30-day geometric mean load of 4.161×10^{10} cfu/day.

Load Allocation

The nonpoint source load allocation is calculated by subtracting the waste load allocation from the final allowable capacity.

$$LA = 6.146 \times 10^{11} – 4.161 \times 10^{10}$$
$$LA = 5.729 \times 10^{11}$$

- **Hahn Arroyo**

Mean Annual Maximum Flow: 93 cfs

100 cfu/100 ml x 1000ml/1 L x 1 L/ 0.264 gallons x 60,107,481 flow in gallons/day

Thus yielding a 30-day geometric mean load of 2.276×10^{11} cfu/day.

Load Allocation

The nonpoint source load allocation is calculated by subtracting the waste load allocation from the final allowable capacity.

$$LA = 5.729 \times 10^{11} – 2.276 \times 10^{11}$$
$$LA = 3.453 \times 10^{11}$$

- **Embudo Arroyo**

NOTE: Very limited flow data set.

Mean Annual Maximum Flow: 0.12 cfs

100 cfu/100 ml x 1000ml/1 L x 1 L/ 0.264 gallons x 77,558 flow in gallons/day

Thus yielding a 30-day geometric mean load of 293,780,303 cfu/day.

Load Allocation

The nonpoint source load allocation is calculated by subtracting the waste load allocation from the final allowable capacity.

$$LA = 3.453 \times 10^{11} – 293,780,303$$
$$LA = 3.450 \times 10^{11}$$

- **Academy Acres Drain**

Mean Annual Maximum Flow: 1.16 cfs

100 cfu/100 ml x 1000ml/1 L x 1 L/ 0.264 gallons x 749,727 flow in gallons/day

Thus yielding a 30-day geometric mean load of 2,839,875,000 cfu/day.

Load Allocation

The nonpoint source load allocation is calculated by subtracting the waste load allocation from the final allowable capacity.

$$LA = 3.450 \times 10^{11} – 2,839,875,000$$
$$LA = 3.421 \times 10^{11}$$

- **Tramway Floodway Channel**

Mean Annual Maximum Flow: 12 cfs

100 cfu/100 ml x 1000ml/1 L x 1 L/ 0.264 gallons x 7,755,799 flow in gallons/day

Thus yielding a 30-day geometric mean load of 2.937×10^{10} cfu/day.

Load Allocation

The nonpoint source load allocation is calculated by subtracting the waste load allocation from the final allowable capacity.

$$LA = 3.421 \times 10^{11} - 2.937 \times 10^{10}$$
$$LA = 3.127 \times 10^{11}$$

Seasonal Variability

The critical season for this reach of the Rio Grande is the May through September time period. The typical monsoon rainy season is captured in these months. It is possible that the criterion may be exceeded during a low flow condition when there are spills from point source dischargers and other unforeseen impacts to the river but for the most part the greatest fecal loads appear in the abovementioned months. Evaluation of seasonal variability for potential nonpoint sources is difficult due to limited available data. However, some general observations may be made about nonpoint source pollution. Domestic animal penning and rearing along drainage ditches, irrigation canals and in floodplains can be a direct conduit to the river during rainy periods in the summer months. This allows inference that seasonal inputs may account, in part, for the elevated fecal counts in this reach of the river.

Margin of Safety (MOS)

Significant conservative assumptions have been used in developing these loading limits. These include:

- use of the 4Q3 minimum peak flow for river loading assumptions,
- treating fecal coliform as a conservative pollutant, that is a pollutant that does not readily degrade in the environment,
- use of the design flow for calculation of WWTF contributions,
- use of the mean annual maximum flows and extremes for the period of record for storm water inputs

No additional explicit margin of safety will be applied in calculation of this TMDL.

Implementation Approaches

Storm Water BMP Approaches and Cost Estimates

This section is meant to highlight approaches and estimated costs associated with the implementation of certain BMPs. The entire section was taken from a newsletter titled, ***ASCE, Stormwater Runoff Water Quality Science/Engineering Newsletter, Urban Stormwater Runoff Water Quality Management Issues***, Volume 3, Number 2, May 19, 2000. The New Mexico Environment Department, Surface Water Quality Bureau does not endorse nor does it take any position in favor of one BMP over another for storm water management.

The cost and effectiveness of structural or treatment control BMPs is becoming the subject of increased interest as storm water dischargers face permit requirements that include "BMP ratcheting down" clauses and TMDL waste load allocations. Storm water's high volume, intermittent nature and variable quality make treatment a tremendous challenge. Conventional structural BMPs can be a useful element in the management of storm water quality but they are not a panacea to achieve water quality standards.

Structural BMPs should be used when it is determined that they will be 'cost effective'. A cost effective application is one that accomplishes the project goals for the least cost while also providing a benefit that exceeds the cost.

Most current conventional structural BMPs will not remove the dissolved fraction of a constituent-potential pollutant. In most instances it is the dissolved form of the constituent that can be responsible for beneficial use impairment in downstream receiving waters.

Consequently, the conventional structural BMP 'tool kit' available to the storm water manager cannot independently achieve the goal of compliance with water quality standards.

Storm water runoff water quality management programs must be a carefully crafted combination of non-structural and structural BMPs designed to address targeted constituents control requirements. Routine achievement of water quality standards will require more receiving water quality monitoring and evaluation to provide the basis for BMP development. Changes in urban planning and design will also be required to address peak flow and volume increases that occur with urbanization.

Example of a storm water and sediment detention basin

Structural BMPs

The primary structural BMPs currently in use in the southwest are:

Drain inlet inserts
Extended detention basins
Biofilters
Media filters
Infiltration

There are also other proprietary BMPs that use the principles of settling and filtration to remove chemical constituents and gross pollutants. Some of the benefits and pitfalls for each type of BMP are discussed below.

Drain Inlet Inserts

Drain inlet inserts are a proprietary BMP that is generally easily installed in a drain inlet or catch basin to treat storm water runoff. Three basic types of inlet inserts are available, the tray type, bag type and basket type. The tray type allows flow to pass through filter media residing in a tray located around the perimeter of the inlet.

Runoff enters the tray and leaves via weir flow under design conditions. High flows pass over the tray and into the inlet unimpeded.

The bag type of insert is constructed from a fabric and is placed in the drain inlet around the perimeter of the grate. Storm water runoff must pass through the 'bag' prior to discharging to the drain outlet pipe. Overflow holes are usually provided to pass larger flows without causing a backwater at the grate.

The basket type of inlet consists of a wire mesh that is placed around the perimeter of the inlet in an installation similar to the tray type device. The wire mesh operates similar to the bag type insert, screening larger materials from the runoff. Some basket type inserts also incorporate filter media similar to the tray type insert.

Drain inlet inserts have generally performed poorly in tests for several reasons. First, the detention or contact time with the insert 'media' is very short. Second, there is little storage area available for material that is removed from the flow.

The device can act as temporary storage location, retaining solids as flow decreases, but then may allow re-suspension when flow (and velocity) subsequently increases. Lastly, inserts require a high degree of maintenance and must be monitored closely during rain events to ensure that the unit is not clogged or bypassing flow. Such a level of maintenance is not practical for most installations.

Bag and basket type drain inlet inserts can be effective in removing gross pollutants (trash), but must be well maintained.
For areas with a limited number of inlets where trash removal is the desired objective, inserts can be a useful BMP. Tray type inserts are generally not effective in trash or solids removal.

Extended Detention

Extended detention basins are a relatively popular BMP since the design is well documented from flood control engineering, and extended detention may be incorporated as an element into flood control detention basins. Extended detention employs a relatively longer drain time than conventional detention used for peak flow control. An average hydrograph detention time of 24 hours is desired. This can be achieved by using a full basin drain time of at least 48 hours, with no more than 50 percent of the water quality volume draining in the first 24 hours (Barrett, 1999). Sedimentation in the basin is the primary removal mechanism.

Extended detention basins can be relatively effective in removing solids (including gross pollutants) but are relatively ineffective in removing dissolved constituents and bacteria. The application of extended detention must include a review of the downstream receiving channel to ensure that problems are not created by their use through increased erosion of the channel.

Careful consideration should be given when installing extended detention basins upstream of an alluvial channel. The stability of an alluvial channel depends in large part on the quantity of bed material load that is transported by the stream, as well as the frequency and duration of the bankfull discharge. Extended detention basins are effective in removing the bed material load from natural channels. Channel stability problems and channel scour can result from the misapplication of this BMP. Extended detention is a useful BMP where particulate removal is a desired objective for the downstream receiving water. Extended detention requires moderate maintenance as compared to other BMPs.

Biofilters

Biofilters consist of dense vegetation designed to 'filter' runoff as it passes through the BMP. The detention or 'residence' time is generally insufficient for a significant portion of the runoff volume to be infiltrated, however, infiltration can be significant for storms smaller than the design storm for biofilters in soils with good infiltration characteristics. Biofilters can be effective in removing particulates from runoff.

Biofilters are an attractive BMP in that they can be incorporated into many projects with relatively little site modification. Conveyance structures that are normally paved can sometimes be replaced with vegetation. Buffer 'strips' can be provided where sheet flow leaves paved areas. Biofilter swales are generally designed with a flow velocity of less than 1 foot per second and are installed in a location with enough length to provide a residence time of at least 5 minutes (the length of the swale divided by the average flow velocity) (WEF/ASCE, 1998). Biofilter strips treat sheet flow and their width is a function of the contributing drainage area, but the strips should be at least 12 feet wide (Barrett, 1999).

Swales and strips must be designed to withstand flow rates that exceed the water quality design velocity to ensure they are not damaged during high flows, or cause upstream flooding.

Certain types of well-established vegetation can be sustained in flow velocities of up to about 8 feet per second with a more typical value being 4 to 5 feet per second. In the southwest, vegetation that does not require irrigation may be prudent to reduce water consumption.

Biofilters can serve as a pretreatment device prior to infiltration or in situations where extended detention is desirable but insufficient area is available. Biofilters require a moderate maintenance schedule as compared to other BMPs.

Media Filters

There are a variety of media filters currently in use including sand, compost, sand peat and perlite/zeolite. Perlite/zeolite and compost filters are proprietary. The use of compost has declined since nutrients are released from this media. Sand filters enjoy the most widespread application. Slow sand filtration is a relatively old technology largely abandoned by the US water industry several decades ago in favor of rapid sand filtration. Sand filters are generally limited to low turbidity waters and operate through a combination of straining and adsorption. Sand filters are among the most efficient conventional treatment devices achieving good removal of particulates and modest removals of bacteria and dissolved metals.

Sand filters are designed with a sedimentation chamber to store all or part of the water quality volume, followed by the sand bed. The purpose of the sedimentation chamber is to remove the settleable solids that could otherwise rapidly clog the filter. The sand bed is designed for a filtration rate of about 3.5 ft/day (Barrett, 1999) but generally operates at the rate limited by the release from the sedimentation chamber. Various configurations are available including the Austin design, the Delaware design and the Washington D.C. design. Sand filters require relatively higher maintenance as compared to other BMPs.

Infiltration

Infiltration of storm water is a zero discharge solution infiltrating the entire design water quality volume to the surrounding soil. Infiltration is a popular BMP in areas that have relatively permeable soils.

Significant questions remain as to the potential impacts on groundwater quality from the infiltration of storm water (EPA NURP (1983) study concluded that most pollutants of importance in urban runoff are intercepted during the process of infiltration and quite effectively prevented from reaching the groundwater aquifers underlying recharge basins).

Consequently, storm water infiltration devices should always include a groundwater monitoring element. Soils that are conducive to infiltration are also relatively poor in filtering and adsorbing contaminates that could otherwise enter an aquifer.

Infiltration devices have a poor performance record due to clogging. Current guidelines call for minimum soil permeability rates of about 0.52in/hr (Schueler and Claytor, 1998) for infiltration to be considered feasible. Generous safety factors should be used (by increasing surface area) and the depth to the groundwater table, seasonally adjusted, must be well documented (10 feet separation to the invert of the infiltration device is recommended).
If soil permeability does not allow the use of infiltration, retention and irrigation may be considered. The design water quality volume is stored and subsequently pumped through an irrigation system. Additional information on infiltration as a storm water BMP has been provided by Lee et al. (1998) and Taylor and Lee (1998).

Conventional Structural BMP Performance

The volume of available performance data (constituent removal) for conventional structural BMPs is rapidly increasing. Removals of commonly monitored constituents can be estimated with good accuracy using tools such as ASCE's BMP database (ASCE, 2000). **Table 4** provides estimated removals for selected categories of constituents for the BMPs discussed above. Note that the values are generalized and total (particulate and dissolved) for nutrients, pesticides and metals.

Table 4
Percentage Reduction in Storm water Load by BMP

Runoff Control	Solids	Nutrients	Pesticides	Metals	Bacteria
Drain Inlet Insert	10	5	5	5	5
Extended Detention Basin	75	25	25	50	40
Vegetated Swales	70	30	30	50	0
Filter Strips	85	40	40	63	0
Media Filters	85	40	40	70	55

Source: Barrett, (1999)

Capital Cost

The capital cost of conventional BMP installation varies widely depending on site conditions. The primary factor is whether the BMP will be implemented as a part of new construction or is a retrofit project. Generalized costs for selected BMPs are provided in **Table 5** for new construction and retrofit on a dollar per tributary acre basis assuming a 1-inch capture from the contributing watershed.

Construction cost data is site specific, and the values given in **Table 5** are based on one inch capture volume and should be considered valid for planning purposes only. Future versions of the ASCE BMP (2000) database will include cost data for various devices.

Table 5
Generalized Capital Cost for Conventional BMPs

Runoff Control	**New Construction**	**Retrofit Construction**
Drain Inlet Insert	1,000 $/Acre	1,000 $/Acre
Extended Detention Basin	10,000 $/Acre	25,000 $/Acre
Vegetated Swales	10,000 $/Acre	30,000 $/Acre
Filter Strips	17,000 $/Acre	37,000 $/Acre
Infiltration Basin	20,000 $/Acre	38,000 $/Acre
Media Filters	27,000 $/Acre	55,000 $/Acre

Source: Barrett, (1999)

Operation and maintenance costs are also difficult to estimate on a general basis since variables such as maintenance access and constituent load are site specific**. Table 6** gives general maintenance costs for conventional BMPs on an annual basis.

Table 6
Generalized Maintenance Cost for Conventional BMPs

Runoff Control	**Maintenance Cost (per year)**
Drain Inlet Insert	$500
Extended Detention Basin	3% of construction cost
Vegetated Swales	$5/foot
Filter Strips	$1/square foot
Infiltration Basin	3% of construction cost
Media Filters	5% of construction cost

Widespread Implementation

Structural Best Management Practices (BMPs) and non-structural BMPs are applied to various types of land uses according to their compatibility with the given land use, and the type of constituents of concern in the runoff. Numerous studies have been completed discussing siting criteria and constituent removal efficiencies for BMPs. There are fewer works assessing BMP effectiveness on a watershed basis, specifically in relationship to the ability of a conventional BMP system to achieve compliance with water quality standards. There is even less research defining the relationship between structural BMPs and receiving water quality. Currently, compliance with water quality standards is presumptive, given a "comprehensive" BMP installation program and adequate maintenance for the program.

Receiving Water Impacts

There is very little published evaluations of the benefits of conventional BMPs for receiving waters water quality-beneficial uses.

Maxted and Shaver (1997) published a work entitled, *The Use of Retention Basins to Mitigate Storm water Impacts on Aquatic Life.* In this paper, the authors reviewed eight watersheds, two of which had been retrofitted with 'storm water' controls.

The study looked at watersheds with either detention or retention ponds. The facility generally had to control peak flows from storms with recurrance intervals of 2, 10 and 100-years, as well as provide detention or retention of the first inch of runoff from the watershed. Further, the BMPs had to be a least 2-years old to avoid construction-related stream impacts. Watersheds with at least 20% impervious cover were studied.

Advanced Treatment

Advanced treatment controls for storm water are becoming a source of greater interest with the advent of water quality-based effluent limits (WQBELs). Advanced treatment controls may include ion-exchange, reverse osmosis, disinfection, or ultrafiltration. None of these technologies has been tested on a prototype scale for storm water and their cost and effectiveness is unknown with respect to application to urban area storm water runoff treatment. Ozone and UV disinfection systems have been developed for storm water runoff applications but limited data on their effectiveness has been published.

Advanced treatment may be a last resort option in existing urban areas faced with Total Maximum Daily Load (TMDL) waste load allocations (WLAs), as well as when compliance with water quality standards in the storm water runoff is required. Further study will need to be done to determine the capital and operation and maintenance cost for these devices, as well as the impacts to downstream receiving waters as a result of their operation. Many advanced treatment processes, such as reverse osmosis and ion exchange result in a brine that must be disposed of to the sanitary sewer or other location. Flow equalization and pretreatment would also be a necessity for these processes.[4]

Management Measures

Management measures are "economically achievable measures for the control of the addition of pollutants from existing and new categories and classes of nonpoint sources of pollution, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint pollution control practices, technologies, processes, siting criteria, operating methods, or other alternatives" (USEPA, 1993).

A combination of best management practices (BMPs) will be used to implement this TMDL. Public outreach and stakeholder involvement in implementation of this TMDL will be ongoing.

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4 Scott Taylor, PE and G. Fred Lee, PhD, PE, DEE, ***Stormwater Runoff Water Quality Science/Engineering Newsletter, Urban Stormwater Runoff Water Quality Management Issues***, Volume 3, Number 2, May 19, 2000.

Timeline

Implementation Action	Year 1	Year 2	Year 3	Year 4	Year 5
Public Outreach and Involvement	X	X	X	X	X
Establish Milestones	X				
Secure Funding	X				
Implement Management Measures (BMPs)		X	X		
Monitor BMPs		X	X	X	X
Determine BMP Effectiveness				X	X
Re-evaluate Milestones				X	X
Achieve compliance with the MS4 Permit Requirements and Language					X

Assurances

New Mexico's Water Quality Act (Act) does authorize the Water Quality Control Commission to "promulgate and publish regulations to prevent or abate water pollution in the state" and to require permits. The Act authorizes a constituent agency to take enforcement action against any person who violates a water quality standard. Several statutory provisions on nuisance law could also be applied to nonpoint source water pollution. The Water Quality Act also states in §74-6-12(a):

> *The Water Quality Act (this article) does not grant to the commission or to any other entity the power to take away or modify the property rights in water, nor is it the intention of the Water Quality Act to take away or modify such rights.*

In addition, the State of New Mexico Surface Water Quality Standards (Sections 20.6.4.6.C and 20.6.4.10.C NMAC) states:

> *These water quality standards do not grant the Commission or any other entity the power to create, take away or modify property rights in water.*

New Mexico policies are in accordance with the federal Clean Water Act §101(g):

> *It is the policy of Congress that the authority of each State to allocate quantities of water within its jurisdiction shall not be superseded, abrogated or otherwise impaired by this Act. It is the further policy of Congress that nothing in this Act shall be construed to supersede or abrogate rights to quantities of water which have been established by any State.*
>
> *Federal agencies shall co-operate with State and local agencies to develop comprehensive solutions to prevent, reduce and eliminate pollution in concert with programs for managing water resources.*

New Mexico's Clean Water Action Plan has been developed in a coordinated manner with the State's 303(d) process. All Category I watersheds identified in New Mexico's Unified Watershed Assessment process are totally coincident with the impaired waters lists for 1996 and 1998 as approved by EPA. The State has given a high priority for funding, assessment, and restoration activities to these watersheds.

The description of legal authorities for regulatory controls/management measures in New Mexico's Water Quality Act does not contain enforceable prohibitions directly applicable to nonpoint sources of pollution. The Act does authorize the Water Quality Control Commission to "promulgate and publish regulations to prevent or abate water pollution in the state" and to require permits. Several statutory provisions on nuisance law could also be applied to nonpoint source water pollution.

NMED nonpoint source water quality management utilizes a voluntary approach. The state provides technical support and grant monies for implementation of BMPs and other NPS prevention mechanisms through §319 of the Clean Water Act. Since portions of this TMDL will be implemented through NPS control mechanisms, the New Mexico Nonpoint Source Program will target efforts to this and other watersheds with TMDLs. The Nonpoint Source Program coordinates with the Nonpoint Source Taskforce. The Nonpoint Source Taskforce is the New Mexico statewide focus group representing federal and state agencies, local governments, tribes and pueblos, soil and water conservation districts, environmental organizations, industry, and the public. This group meets on a quarterly basis to provide input on the §319 program process, to disseminate information to other stakeholders and the public regarding nonpoint source issues, to identify complementary programs and sources of funding, and to help review and rank §319 proposals.

In order to obtain reasonable assurances for implementation in watersheds with multiple landowners, including Federal, State and private land, NMED has established Memoranda of Understanding (MOUs) with various Federal agencies, in particular the Forest Service and the Bureau of Land Management. MOUs have also been developed with other State agencies, such as the New Mexico State Highway and Transportation Department. These MOUs provide for coordination and consistency in dealing with nonpoint source issues. The time required to attain standards in this case is estimated to be five years.

Milestones

Milestones will be used for determining if control actions are being implemented and standards attained. For this TMDL several milestones will be established including the following:

- Develop BMPs to reduce fecal coliform loading in storm water
- Implementation of BMPs
- Post implementation monitoring of BMP effectiveness
- Re-assessment of BMP effectiveness
- New BMP approaches if original approach proves ineffective

Milestones will be re-evaluated periodically, depending on what BMPs were implemented. Further implementation of this TMDL will be revised based on this re-evaluation.

Monitoring Plan

Pursuant to Section 106(e)(1) of the Federal Clean Water Act (33U.S.C. §1251 et seq.), the SWQB has established appropriate monitoring methods, systems, and procedures in order to compile and analyze data on quality of surface waters of New Mexico. In accordance with the New Mexico Water Quality Act (NMSA, 1978, §74-6-1 et seq.), the SWQB has developed and implemented a comprehensive water quality monitoring strategy for surface waters of the State. The monitoring strategy establishes methods of identifying and prioritizing water quality data needs, specifies procedures for acquiring and managing water quality data, and describes how these data are used to progress toward three basic monitoring objectives. These objectives are: development of water quality-based controls, to evaluate the effectiveness of such controls, and to conduct water quality assessments.

The SWQB utilizes a rotating basin system approach to water quality monitoring. In this system, a select number of watersheds are intensively monitored each year with an established return frequency of five to seven years.

The SWQB maintains current EPA approved quality assurance and quality control plans to cover all monitoring activities. This document, the "Quality Assurance Project Plan for Water Quality Management Programs" (QAPP), is updated annually. The QAPP identifies data quality objectives required to provide information of sufficient quality to meet established goals of the program. Additional site specific QAPP documents are prepared for each stream survey to assure these objectives are being met.

Current priorities for monitoring surface waters are driven by the CWA §303(d) list of streams requiring TMDLs. Short-term efforts will be directed toward those waters that are on the TMDL consent decree list (Forest Guardians, 1997) and that are due within the first two years of the monitoring schedule. Once assessment monitoring is completed, those reaches still showing impacts and requiring a TMDL will be targeted for more intensive monitoring.

Methods of data acquisition include; fixed-station monitoring, intensive surveys of priority water bodies including biological assessments, and compliance monitoring of industrial, federal, and municipal dischargers, and are specified in the SWQB assessment protocol.

Long term monitoring for assessments will be accomplished through establishment of sampling sites that are representative of the water body and which can be revisited every five to seven years.

This gives an unbiased assessment of the water body and establishes a long term monitoring record for simple trend analyses. This information will provide time relevant information for use in CWA §305(b) assessments and to support the need for developing TMDLs.

This approach provides:

- a systematic, detailed review of water quality data and allows for a more efficient use of valuable monitoring resources,
- information at a scale where implementation of corrective activities is feasible,

- an established order of rotation and predictable sampling in each basin that allows coordinated efforts with other programs,
- for enhanced efficiency and improves the basis for management decisions.

It should be noted that a basin is not ignored during its sampling hiatus. The rotating basin program will be supplemented with other data collection efforts that will be classified as field studies. This time will be used to analyze data collected, to conduct field studies to further characterize identified problems, to develop TMDLs, and implement corrective actions. Both types of monitoring, long term and field studies, can contribute to the CWA §305 and §303 listing processes, but they should be stored in the primary database with distinguishing codes that will allow for separate data retrievals.

The following schedule is a draft of the sampling seasons through 2004 and will be done in a consistent manner to support the New Mexico Unified Watershed Assessment (UWA) and the Nonpoint Source Management Program. This sampling regime will reflect seasonal variation by sampling in spring, summer, and fall for each of the watersheds.

- 1998 Jemez Watershed, Upper Chama Watershed (above El Vado), Cimarron Watershed, Santa Fe River, San Francisco Watershed
- 1999 Lower Chama Watershed, Red River Watershed, Middle Rio Grande, Gila River Watershed (summer and fall), Santa Fe River
- 2000 Gila River Watershed (spring), Dry Cimarron Watershed, Upper Rio Grande 1 (Pilar north to the NM/CO border), Shumway Arroyo
- 2001 Upper Rio Grande 2 (Pilar south to Cochiti Reservoir), Upper Pecos Watershed (Ft Sumner north to the headwaters)
- 2002 Canadian River Watershed, San Juan River Watershed, Mimbres Watershed
- 2003 Lower Pecos Watershed (Ft. Sumner south to the NM/TX border including Ruidoso), Lower Rio Grande (southern border of Isleta Pueblo south to the NM/TX border)
- 2004 Rio Puerco Watershed, Closed Basins, Zuni Watershed

In addition to the regularly scheduled instream monitoring, NPDES compliance monitoring will be conducted. NPDES discharge monitoring will include regular monitoring requirements for each of the TMDL parameters to assure continued compliance. Regularly scheduled inspections, conducted by the PSRS will also be conducted to assure compliance with permit requirements. As used in this strategy, "compliance monitoring" is a generic term that includes all activities conducted by the SWQB to verify compliance or non-compliance with effluent limitations and other conditions of NPDES permits.

The SWQB routinely conducts two types of compliance monitoring activities: compliance evaluation inspections (CEI) and compliance sampling inspections (CSI).

As part of the terms of the reissued NPDES permit the permittee will be required to conduct regular compliance monitoring and report this information to the SWQB and EPA through quarterly Discharge Monitoring Reports.

Middle Rio Grande Bacteria Sources Identification and Tracking (MRGBSI&T) Study

The SWQB has sought and received additional grant monies from the USEPA to fund the MRGBSI&T study for this segment of river tentatively set for the monsoon season of 2002.

The development of this TMDL has been very complex involving NPDES permitting issues, State and Tribal standards, NPDES Storm Water Regulations and has involved the participation of the following entities: New Mexico Environment Department, Surface Water Quality Bureau, United States Environmental Protection Agency, Region 6, City of Albuquerque, Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA), City of Rio Rancho, Southern Sandoval County Arroyo Flood Control Authority (SSCAFCA), Pueblo of Sandia, Pueblo of Isleta, Town of Bernalillo, Village of Corrales, University of New Mexico, private consultants, private citizens and other interested entities. The TMDL was written to be protective of Tribal standards and designated uses on this reach of river. The MRGBSI&T study is seen as one of the final pieces to this puzzle before any kind of implementation can be pursued.

This effort will be used to develop a MRGBSI&T study to target sources of bacteria so that monies can be better spent on those known sources of fecal coliform. Over time the targeting will result in reductions in order to attain the designated uses and associated water quality standards. As part of a comprehensive and coordinated approach to Surface Water Quality Bureau (SWQB) activities, this watershed has been identified in New Mexico's Clean Water Action Plan Unified Watershed Assessment as a Category I.

NPDES Storm Water Management Program

As a result of the 1987 amendments to section 402(p) of the federal Clean Water Act, the United States Environmental Protection Agency (USEPA) recently promulgated regulations under Phase II of the National Pollutant Discharge Elimination System (NPDES) storm water permitting program. These regulations significantly impact small (located in municipalities <100,000 population) Municipal Separate Storm Sewer Systems (MS4s) and small (<1 acre) construction sites. The USEPA has tentatively scheduled a release date of August 25, 2001 for the draft Municipal Separate Storm Sewer System (MS4) permit for Albuquerque and it's co-permittees AMAFCA, Sandia National Laboratory, UNM and the New Mexico State Highway & Transportation Department. In New Mexico, some of the other major impacts to small MS4s are as follows:

- All MS4 operators (regardless of size or location and including cities, towns, counties, districts, associations, state and federal facilities, etc.) will have to comply with NPDES industrial storm water permitting requirements (including construction > 1 acre) by March 10, 2003.

- Operators of small MS4s located in urbanized areas (UAs): must develop, implement, and enforce a storm water management program to reduce the discharge of pollutants from its MS4 to the "maximum extent practicable" (MEP) and protect water quality.

    - Currently includes (will be expanded after each census) in New Mexico:

Bernalillo County, Village of Corrales, Doña Ana County, City of Las Cruces, Los Village of Ranchos de Albuquerque, Town of Mesilla, Rio Rancho city, Sandoval County, City of Santa Fe, Santa Fe County, and City of Sunland Park as well as other public entities such as military bases, federal, state, etc. facilities located in Uas which operate storm sewer systems, subject to limited waivers;

- March 10, 2003 - operators of "regulated" MS4s must obtain NPDES permit coverage;
- Application (Notice of Intent [NOI]) must include six "minimum control measures" (using BMPs) and measurable goals;
- Must be fully implemented within 5 years of permit issuance;
- Must submit yearly progress reports to USEPA;
- May become limited co-permittee with large MS4 if in same urbanized area, if large MS4 agrees, and the large phase I MS4 permit is modified appropriately; and
- May file NOI individually or jointly with other operators.

- Operators of small MS4s located outside the urbanized areas (includes all >10,000 but may include others at the discretion of USEPA): must develop, implement, and enforce a storm water management program to reduce the discharge of pollutants from its MS4 to the "maximum extent practicable" (MEP) and protect water quality;

  - Currently includes (will be expanded after each census) in New Mexico: Alamogordo, Artesia, Clovis, Deming, Farmington, Gallup, Hobbs, Las Vegas, Portales, Roswell, Silver City, and probably Carlsbad;
  - Must be examined by USEPA for potential designation within 2 years; and
  - Must apply within 180 days of notification.

NPDES Storm Water Management Measures

The following measures may be included in a storm water management program noting that these measures are for only one constituent (fecal coliform) of many that will be in the permit:

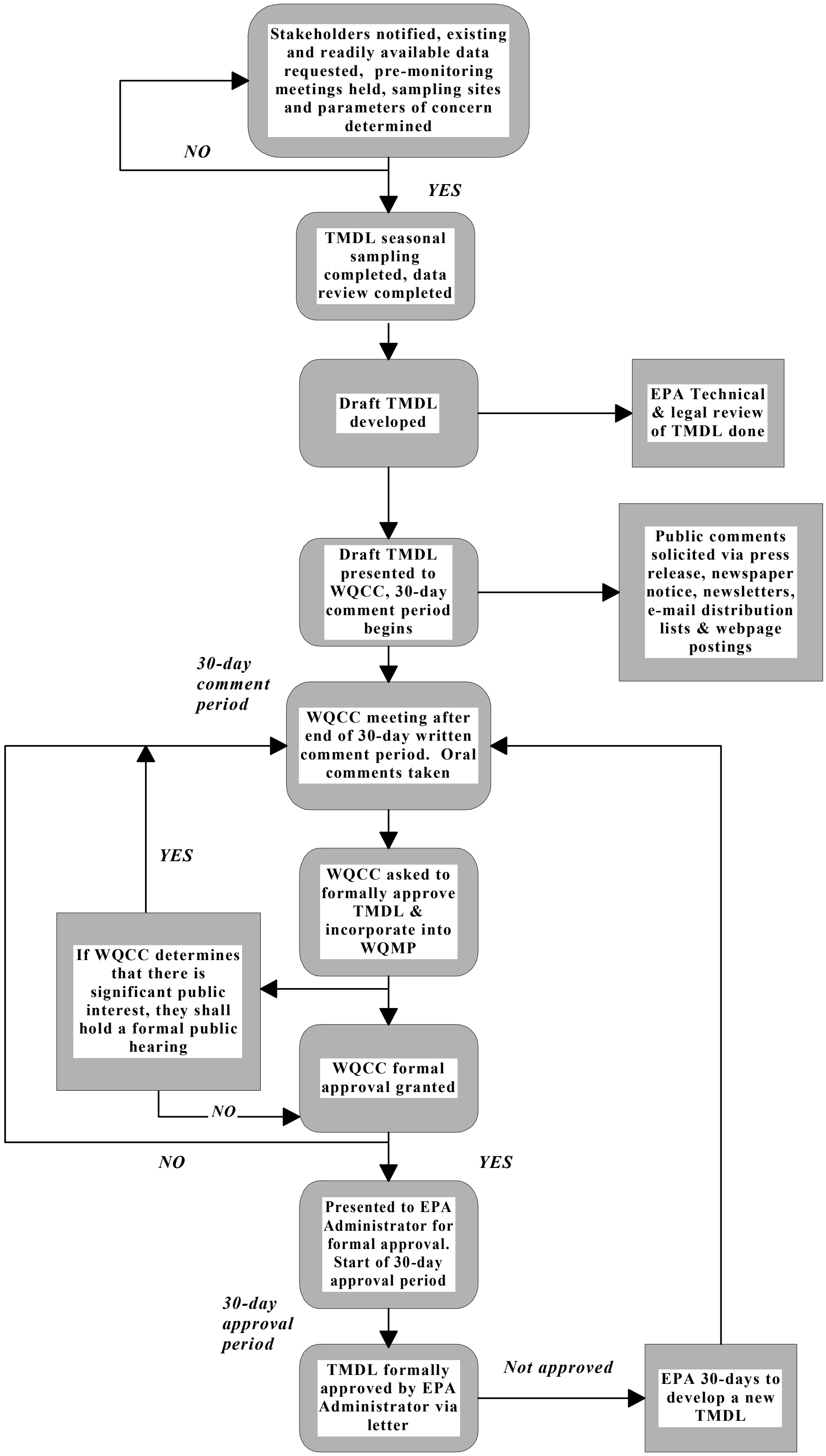
1). Characterize potential fecal sources by watershed and watershed density (undeveloped, low, moderate, high).
2). Develop and implement a dry weather field investigation program, by watershed, to identify and isolate exact locations of individual fecal coliform sources so that they can be corrected.
3). Develop and implement a wet weather field investigation program, by watershed, to identify and isolate exact locations of individual fecal coliform sources so that they can be corrected.
4). Develop and implement a program for eliminating or treating existing fecal coliform sources, by watershed.
5). Develop and implement a program for preventing future fecal sources, by watershed.

6). Develop and implement a monitoring to assess BMP effectiveness and to compare loadings to target values.
7). Develop and implement a monitoring program to track trends in fecal coliform discharges over time.

Public Participation

Public participation in development of this TMDL has been extensive. A flow chart of this process is shown in **Figure 4**. Response to comments is attached as Appendix G. All meetings and the draft document notice of availability were extensively advertised via newsletters, email distribution lists, webpage postings, and press releases to area newspapers

Figure 4. Public Participation Flow Chart.



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Appendices

Appendix A Middle Rio Grande River Sampling Sites & Parameters

From the southern border of the Santa Ana Pueblo down to the northern border of the Isleta Pueblo

SITE	SAMPLES TO BE COLLECTED
1 MRG 105005770 Rio Grande below Angostura diversion works	Total ammonia, fecal coliform, nitrate/nitrite, TKN, TOC, total phosphorus, DO, temperature, pH, turbidity, conductivity, total chlorine residual
2 MRG 105005765 Rio Grande@Highway 44 bridge in Bernalillo	Total ammonia, fecal coliform, nitrate/nitrite, TKN, TOC, total phosphorus, DO, temperature, pH, turbidity, conductivity, total chlorine residual
3 MRG 105005760 Bernalillo WWTF discharge	Total ammonia, fecal coliform, nitrate/nitrite, TKN, TOC, total phosphorus, DO, temperature, pH, turbidity, conductivity, total chlorine residual
4 MRG 105005755 Rio Grande upstream from Rio Rancho Utility Company (RRUC) WWTF #3	Total ammonia, fecal coliform, nitrate/nitrite, TKN, TOC, total phosphorus, DO, temperature, pH, turbidity, conductivity, total chlorine residual
5 MRG 105005750 Effluent discharge from RRUC WWTF #3	Total ammonia, fecal coliform, nitrate/nitrite, TKN, TOC, total phosphorus, DO, temperature, pH, turbidity, conductivity, total chlorine residual
6 MRG 105005749 Rio Grande upstream from RRUC WWTF #2	Total ammonia, fecal coliform, nitrate/nitrite, TKN, TOC, total phosphorus, DO, temperature, pH, turbidity, conductivity, total chlorine residual
7 MRG 105005747 Effluent discharge from RRUC WWTF #2	Total ammonia, fecal coliform, nitrate/nitrite, TKN, TOC, total phosphorus, DO, temperature, pH, turbidity, conductivity, total chlorine residual
8 MRG 105005745 Rio Grande upstream from Alameda bridge	Total ammonia, fecal coliform, nitrate/nitrite, TKN, TOC, total phosphorus, DO, temperature, pH, turbidity, conductivity, total chlorine residual
9 MRG 105005740 Rio Grande@Rio Bravo bridge	Total ammonia, fecal coliform, nitrate/nitrite, TKN, TOC, total phosphorus, DO, temperature, pH, turbidity, conductivity, total chlorine residual
10 MRG 105005735 Effluent discharge from Albuquerque South- Side Water Reclamation Plant	Total ammonia, fecal coliform, nitrate/nitrite, TKN, TOC, total phosphorus, DO, temperature, pH, turbidity, conductivity, total chlorine residual
11 MRG 105005730 Rio Grande@I-25 bridge	Total ammonia, fecal coliform, nitrate/nitrite, TKN, TOC, total phosphorus, DO, temperature, pH, turbidity, conductivity, total chlorine residual
12 MRG61C Rio Grande upstream from the Isleta Diversion works	Total ammonia, fecal coliform, nitrate/nitrite, TKN, TOC, total phosphorus, DO, temperature, pH, turbidity, conductivity, total chlorine residual

Appendix B Results of 1999 NMED/SWQB Middle Rio Grande Surface Water Quality Survey

CHEMISTRY

SITE	DATE	TIME	QA Rep INFO	Water Temp (C)	Cond Field Corr to 25 deg C (uhmo)	DO (mg/L)	pH Field (S.U.)	Turb Field (NTU)	Total P (mg/L)	Nitrate + ite N (mg/L)	Total NH3 (mg/L)	T I N 630 + 610 (mg/L)	Kjeldahl N (mg/L)	T O N 625 - 610 (mg/L)	Total N 625+630 (mg/L)	Total Org C (mg/L)	Total Cl residual $\mu g/L$
Rio Grande Below Angostura Diversion Works	990614	0945		16.4	303.2	8.03	7.94	1000L	3.01	0.1K	0.1K	0.2KC	4.81	4.71LC	4.91KC	6.90	
Rio Grande Below Angostura Diversion Works	990615	0720		16.7	273	7.94	7.73		0.09	0.1K	0.1K	0.2KC	0.50	0.40LC	0.60KC	5K	
Rio Grande Below Angostura Diversion Works	990616	0745		17.2	268.8	7.73	7.67		0.07	01K	0.1K	0.2KC	0.44	0.34LC	0.54KC	5K	
Rio Grande Below Angostura Diversion Works	990617	1115		18.1	287.4	7.91	8.04		2.16	0.1K	0.1K	0.2KC	5.42	5.32LC	5.52KC	9.70	
Rio Grande Below Angostura Diversion Works	991101	0800		9.3	308.5	9.15	8.1		0.05	0.1K	0.1K	0.2KC	0.41	0.31LC	0.51KC	13.00	0
Rio Grande Below Angostura Diversion Works	991101	0800	QA Rep						0.05	0.1K	0.1K	0.2KC	0.28	0.18LC	0.38KC	9.57	
Rio Grande Below Angostura Diversion Works	991102	0730		8.8	317.3	9.05	8.21		0.04	0.1K	0.1K	0.2KC	0.39	0.29LC	0.49KC	10.10	1
Rio Grande Below Angostura Diversion Works	991103	0730		8.5	313	9.32	8.24		0.03	0.1K	0.1K	0.2KC	0.39	0.29LC	0.49KC	7.88	2
Rio Grande Below Angostura Diversion Works	991104	0730		8.6	312	9.44	8.08		0.07	0.1K	0.1K	0.2KC	0.39	0.29LC	0.49KC	5.90	2
Rio Grande Above Highway 44 Bridge	990614	1020		17.2	308.1	7.84	7.96	1000L	1.87	0.1K	0.1K	0.2KC	2.64	2.54LC	2.74KC	6.70	
Rio Grande Above Highway 44 Bridge	990614	1020	QA Rep						1.85	0.1K	0.1K	0.2KC	2.68	2.58LC	2.78KC	5.30	
Rio Grande Above Highway 44 Bridge	990615	0750		16.8	274.4	7.30	8.02		0.08	0.1K	0.1K	.2KC	0.66	0.56LC	0.76KC	5K	
Rio Grande Above Highway 44 Bridge	990616	0815		17.4	270.3	7.68	8.06		0.05	0.1K	0.1K	0.2KC	0.36	0.26LC	0.46KC	5K	
Rio Grande Above Highway 44 Bridge	990617	1140		18.4	XXXXX	7.53	7.99		0.49	0.1K	0.1K	0.2KC	1.05	0.95LC	1.15KC	5K	
Rio Grande Above Highway 44 Bridge	991101	0900		10.1	315.7	7.78	8.25		0.04	0.1K	0.1K	0.2KC	0.31	0.21LC	0.41KC	8.55	3
Rio Grande Above Highway 44 Bridge	991102	0815		9.2	921.3	8.79	8.43		0.04	0.1K	0.1K	.02KC	0.33	0.23LC	0.43KC	9.24	0
Rio Grande Above Highway 44 Bridge	991103	0820		8.7	318.8	8.45	8.52		0.03K	0.1K	0.1K	0.2KC	0.31	0.21LC	0.41KC	7.29	0
Rio Grande Above Highway 44 Bridge	991104	0800		8.8	316.5	8.79	8.25		0.04	0.1K	0.1K	0.2KC	0.30	0.20LC	0.40KC	7.54	0
Bernalillo WWTF discharge	990614	1045		27.5	1383		7.27	5.55	4.40	18.80	0.125	18.925C	1.55	1.425	20.35	8.50	
Bernalillo WWTF discharge	990614	1045	QA Rep						4.36	19.30	0.133	19.433C	1.89	1.757	21.19	10.40	
Bernalillo WWTF discharge	990615	0810		22.4	1395		7.41		3.91	18.20	0.1K	18.3KC	1.56	1.46LC	19.76	6.20	
Bernalillo WWTF discharge	990616	0830		22.7	1394		7.36		3.52	18.30	0.1K	18.4KC	1.35	1.25LC	19.65	6.06	
Bernalillo WWTF discharge	990617	1200		23.2	1368		7.25		3.82	16.50	0.1K	16.6KC	1.21	1.11LC	17.71	7.40	
Bernalillo WWTF discharge	991101	0945		18.3	1346		7.2		3.06	20.50	0.1K	20.6KC	1.33	1.23LC	21.83	14.60	436L
Bernalillo WWTF discharge	991101	0945	QA Rep						3.06	20.00	0.1K	20.1KC	1.33	1.23LC	21.33	15.90	
Bernalillo WWTF discharge	991102	0845		17.7	1366		7.58		3.26	19.80	0.1K	19.9KC	1.36	1.26LC	21.16	14.90	477L
Bernalillo WWTF discharge	991103	0850		17.2	1355		7.56		2.92	19.70	0.1K	19.8KC	1.33	1.23LC	21.03	15.10	455L
Bernalillo WWTF discharge	991104	0840		17	1306		7.37		3.14	2.10	0.1K	2.2KC	1.14	1.04LC	4.28	16.70	95

SITE	DATE	TIME	QA Rep INFO	Water Temp (C)	Cond Field Corr to 25 deg C (uhmo)	DO (mg/L)	pH Field (S.U.)	Turb Field (NTU)	Total P (mg/L)	Nitrate + ite N (mg/L)	Total NH3 (mg/L)	T I N 630 + 610 (mg/L)	Kjeldahl N (mg/L)	T O N 625 - 610 (mg/L)	Total N 625+630 (mg/L)	Total Org C (mg/L)	Total Cl residual μg/L
Rio Grande Above Rio Rancho WWTF #3	990614	1115		21.1	285	7.60	7.91	250.00	0.19	0.1K	0.1K	0.2KC	0.52	0.42LC	0.62KC	5K	
Rio Grande Above Rio Rancho WWTF #3	990615	0905		18.2	274.6	7.71	7.96		0.13	0.1K	0.1K	0.2KC	0.44	0.34LC	0.54KC	5K	
Rio Grande Above Rio Rancho WWTF #3	990616	0900		18.4	271	7.79	8.06		0.07	0.1K	0.1K	0.2KC	0.38	0.28LC	0.48KC	5K	
Rio Grande Above Rio Rancho WWTF #3	990616	0900	QA Rep						0.06	0.1K	0.1K	0.2KC	0.39	0.29LC	0.49KC	5K	
Rio Grande Above Rio Rancho WWTF #3	990617	1225		20.3	265	7.43	7.75		0.32	0.1K	0.1K	0.2KC	0.77	0.67LC	0.87KC	6.10	
Rio Grande Above Rio Rancho WWTF #3	991101	1030		11.9	316	9.26	8.2		0.03K	0.1K	0.1K	0.2KC	0.32	0.22LC	0.42KC	9.07	1
Rio Grande Above Rio Rancho WWTF #3	991102	0930		10.2	320.5	9.28	8.51		0.03K	0.1K	.01K	.02KC	0.35	0.25LC	0.45KC	11.10	0
Rio Grande Above Rio Rancho WWTF #3	991103	0935		9.5	316	9.67	8.32		0.06	0.1K	0.1K	0.2KC	0.38	0.28LC	0.48KC	9.20	4
Rio Grande Above Rio Rancho WWTF #3	991104	0925		9.6	315	9.72	8.25		0.04	0.1K	0.1K	0.2KC	0.22	0.12LC	0.42KC	8.91	1
Rio Rancho WWTF #3 discharge	990614	1125		24.5	1156		7.36	3.08	4.22	9.09	0.1K	9.19KC	1.41	1.31LC	10.5	5.20	
Rio Rancho WWTF #3 discharge	990615	0915		24.5	1147		7.54		3.75	8.94	0.1K	9.04KC	1.47	1.37LC	10.41	8.00	
Rio Rancho WWTF #3 discharge	990616	0915		24.4	1109		7.6		3.97	9.34	0.1K	9.44KC	1.15	1.05LC	10.49	6.15	
Rio Rancho WWTF #3 discharge	990616	0915	QA Rep						4.02	9.43	0.1K	9.53KC	1.19	1.09LC	10.62	5.06	
Rio Rancho WWTF #3 discharge	990617	1235		24.9	1130		7.3		4.47	10.50	0.1K	10.6KC	1.37	1.27LC	11.87	6.60	
Rio Rancho WWTF #3 discharge	991101	1040		23.3	1067		7.2		3.01	10.80	0.1K	10.9KC	1.69	1.59LC	12.49	15.60	0
Rio Rancho WWTF #3 discharge	991102	0945		22.8	1071		7.64		3.74	5.46	0.1K	5.56KC	4.38	4.28LC	9.84	18.50	2
Rio Rancho WWTF #3 discharge	991102	0945	QA Rep						3.86	10.80	0.1K	10.9KC	4.73	4.63LC	15.53	18.30	
Rio Rancho WWTF #3 discharge	991103	0945		21.9	1071		7.53		3.47	11.60	0.1K	11.7KC	1.71	1.61LC	13.31	16.40	3
Rio Rancho WWTF #3 discharge	991104	0940		21.5	1057		7.39		3.99	12.50	0.1K	12.6KC	1.72	1.62LC	14.22	16.20	1
Rio Grande Above Rio Rancho WWTF #2	990614	1145		18.6	278	7.94	7.89	235.00	0.22	0.1K	0.1K	0.2KC	0.58	0.48LC	0.68KC	5K	
Rio Grande Above Rio Rancho WWTF #2	990615	1020		18.2	275.2	8.05	7.84		0.15	0.1K	0.1K	0.2KC	0.38	0.28LC	0.48KC	5K	
Rio Grande Above Rio Rancho WWTF #2	990616	1010		18.5	269.6	7.67	7.97		0.11	0.1K	0.1K	0.2KC	0.37	0.27LC	0.47KC	5.00	
Rio Grande Above Rio Rancho WWTF #2	990617	1300		19.5	264.5	7.32	7.54		0.47	0.1K	0.1K	0.2KC	0.97	.087LC	1.07KC	5.10	
Rio Grande Above Rio Rancho WWTF #2	990617	1300	QA Rep						0.44	0.1K	0.1K	0.2KC	0.99	0.89LC	1.09KC	5.80	
Rio Grande Above Rio Rancho WWTF #2	991101	1150		12.4	316.4	8.98	8.2		0.05	0.1K	0.1K	0.2KC	0.31	0.21LC	0.41KC	9.47	0
Rio Grande Above Rio Rancho WWTF #2	991102	1100		11.2	320.2	9.12	8.36		0.04	0.1K	0.1K	0.2KC	0.35	0.25LC	0.45KC	10.80	1
Rio Grande Above Rio Rancho WWTF #2	991103	1100		10.7	318	9.56	8.34		0.03	0.1K	0.1K	0.2KC	0.36	0.26LC	0.46KC	7.80	0
Rio Grande Above Rio Rancho WWTF #2	991104	1050		10.8	315.9	9.72	8.31		0.05	0.1K	0.1K	0.2KC	0.22	0.12LC	0.32KC	9.72	1
Rio Rancho WWTF #2 discharge	990614	1155		24.7	834		7.57	2.95	1.71	11.90	0.1K	12.0KC	1.09	0.99LC	12.99	6.30	
Rio Rancho WWTF #2 discharge	990615	1030		24.6	830		7.54		1.05	11.40	0.1K	11.5KC	1.48	1.38LC	12.88	9.33	
Rio Rancho WWTF #2 discharge	990616	1020		24.4	822		7.48		1.25	12.60	0.1K	12.7KC	1.07	0.97LC	13.67	5.70	
Rio Rancho WWTF #2 discharge	990617	1310		25	820		7.17		2.05	12.50	0.1K	12.6KC	1.04	0.94LC	13.54	6.80	

SITE	DATE	TIME	QA Rep INFO	Water Temp (C)	Cond Field Corr to 25 deg C (uhmo)	DO (mg/L)	pH Field (S.U.)	Turb Field (NTU)	Total P (mg/L)	Nitrate + ite N (mg/L)	Total NH3 (mg/L)	T I N 630 + 610 (mg/L)	Kjeldahl N (mg/L)	T O N 625 - 610 (mg/L)	Total N 625+630 (mg/L)	Total Org C (mg/L)	Total Cl residual μg/L
Rio Rancho WWTF #2 discharge	991102	1110		22.2	812		8.53		0.30	12.60	0.1K	12.7KC	1.29	1.19LC	13.89	15.10	1
Rio Rancho WWTF #2 discharge	991103	1110		22.2	810		7.49		0.70	14.10	0.1K	14.2KC	1.37	1.27LC	15.47	13.80	2
Rio Rancho WWTF #2 discharge	991104	1110		21.8	814		7.37		1.46	15.60	0.1K	15.7KC	0.90	0.80LC	16.5	15.90	0
Rio Grande Above Alameda Bridge	990614	1315		19.4	281	7.75	7.45	363.00	0.23	0.1K	0.1K	0.2KC	0.60	0.50LC	0.70KC	5K	
Rio Grande Above Alameda Bridge	990615	1130		18.8	274.7	7.83	8.14		0.19	0.1K	0.1K	0.2KC	0.59	0.49LC	0.69KC	5K	
Rio Grande Above Alameda Bridge	990616	1110		18.8	270.1	7.07	7.25		0.11	0.1K	0.1K	0.2KC	0.37	0.27LC	0.47KC	5K	
Rio Grande Above Alameda Bridge	990617	1335		19.5	252	7.08	7.54		2.73	0.1K	0.1K	0.2KC	5.77	5.47LC	5.67KC	10.10	
Rio Grande Above Alameda Bridge	991101	1320		15.5	369.8	7.96	8.0		0.13	0.1K	0.1K	0.2KC	0.50	0.40LC	0.60KC	10.30	0
Rio Grande Above Alameda Bridge	991102	1215		13.4	392.3	8.38	8.18		0.06	0.1K	0.1K	0.2KC	0.35	0.25LC	0.45KC	13.30	5
Rio Grande Above Alameda Bridge	991102	1215	QA Rep						0.09	0.1K	0.1K	0.2KC	0.47	0.37LC	0.57KC	12.10	
Rio Grande Above Alameda Bridge	991103	1210		13.2	393.3	8.71	8.35		0.05	0.1K	0.1K	0.2KC	0.36	0.26LC	0.46KC	6.00	2
Rio Grande Above Alameda Bridge	991104	1205		13.1	384.7	8.89	8.23		0.07	0.1K	0.1K	0.2KC	0.25	0.15LC	0.35KC	7.24	4
Rio Grande Above Rio Bravo Bridge	990614	1515		21.4	287.9	7.47	7.99	1000L	0.48	0.1K	0.1K	0.2KC	0.93	0.83LC	1.03KC	5K	
Rio Grande Above Rio Bravo Bridge	990615	1240		20.6	282.6	7.21	8.05		0.50	0.1K	0.1K	0.2KC	0.95	0.85LC	1.05KC	5K	
Rio Grande Above Rio Bravo Bridge	990615	1240	QA Rep						0.50	0.1K	0.1K	0.2KC	1.04	0.94LC	1.04KC	5K	
Rio Grande Above Rio Bravo Bridge	990616	1245		21	273.9	7.01	8.04		0.14	0.1K	0.1K	0.2KC	0.40	0.30LC	0.50KC	5.20	
Rio Grande Above Rio Bravo Bridge	990617	0820		18.8	252.9	6.56	8.13		0.40	0.1K	0.1K	0.2KC	1.01	0.91LC	1.11KC	7.73	
Rio Grande Above Rio Bravo Bridge	991101	1415		14.8	339.4	7.92	8.2		0.09	0.1K	0.1K	0.2KC	0.45	0.35LC	0.55KC	9.05	0
Rio Grande Above Rio Bravo Bridge	991102	1315		13	336.8	8.62	8.39		0.08	0.1K	0.1K	0.2KC	0.38	0.28LC	0.48KC	12.60	2
Rio Grande Above Rio Bravo Bridge	991103	1305		12.3	356.7	9.24	8.43		0.06	0.1K	0.1K	0.2KC	0.36	0.26LC	0.46KC	6.30	0
Rio Grande Above Rio Bravo Bridge	991104	1300		12.6	342.7	8.52	8.28		0.07	0.1K	0.1K	0.2KC	0.18	0.08LC	0.28KC	7.00	0
Albuquerque WWTF discharge	990614	1450		26.2	785	6.72	6.84	5.41	3.63	12.30	0.1K	12.4KC	1.67	1.57LC	13.97	7.30	
Albuquerque WWTF discharge	990615	1300		26.3	807		7.06		3.78	10.30	0.1K	10.4KC	1.81	1.71LC	12.11	7.81	
Albuquerque WWTF discharge	990615	1300	QA Rep						3.79	10.30	0.1K	10.4KC	1.81	1.71LC	12.11	6.62	
Albuquerque WWTF discharge	990616	1300		26.5	827		6.85		3.74	10.50	0.1K	10.6KC	1.62	1.52LC	12.12	10.60	
Albuquerque WWTF discharge	990617	0810		25.5	827		7.06		3.36	9.85	0.1K	9.95KC	1.76	1.66LC	11.61	7.37	
Albuquerque WWTF discharge	991101	1445		24.4	769		7.0		2.98	12.80	0.1K	12.9KC	1.38	1.28LC	14.18	14.20	461L
Albuquerque WWTF discharge	991102	1400		23.5	807		7.0		3.18	13.30	0.1K	13.4KC	1.38	1.28LC	14.68	17.10	455L
Albuquerque WWTF discharge	991103	1345		23.9	826		7.01		3.26	12.00	0.1K	12.1KC	1.35	1.25LC	13.35	14.30	455L
Albuquerque WWTF discharge	991104	1330		24.0	811		6.79		3.22	13.50	0.1K	13.6KC	0.84	0.74LC	14.34	11.90	467L
Rio Grande Above I-25 Bridge	990614	1430		21.4	317.2	7.37	7.76	1000L	0.73	0.1K	0.1K	0.2KC	1.48	1.38LC	1.58KC	5K	
Rio Grande Above I-25 Bridge	990615	1330		21.5	259.9	7.26	7.97		0.92	0.1K	0.1K	0.2KC	1.58	1.48LC	1.68KC	5K	
Rio Grande Above I-25 Bridge	990616	1330		22.3	295.2	7.17	7.55		0.25	0.1K	0.1K	0.2KC	0.72	0.62LC	0.82KC	5K	

SITE	DATE	TIME	QA Rep INFO	Water Temp (C)	Cond Field Corr to 25 deg C (uhmo)	DO (mg/L)	pH Field (S.U.)	Turb Field (NTU)	Total P (mg/L)	Nitrate + ite N (mg/L)	Total NH3 (mg/L)	T I N 630 + 610 (mg/L)	Kjeldahl N (mg/L)	T O N 625 - 610 (mg/L)	Total N 625+630 (mg/L)	Total Org C (mg/L)	Total Cl residual µg/L
Rio Grande Above I-25 Bridge	991102	1430		13.7	381.7	7.95	8.1		0.34	1.18	0.1K	1.28KC	0.48	0.38LC	1.66	13.60	4
Rio Grande Above I-25 Bridge	991103	1415		13.1	389.6	8.72	8.14		0.40	1.21	0.1K	1.31KC	0.51	0.41LC	1.71	10.50	5
Rio Grande Above I-25 Bridge	991104	1415		14.0	370	8.81	7.92		0.33	0.92	0.1K	1.02KC	0.41	0.31LC	1.33	7.93	4
Rio Grande Above Isleta Diversion	990614	1410		20.9	306	7.60	7.93	109.00	0.21	0.1K	0.1K	0.2KC	0.77	0.67LC	0.87KC	5K	
Rio Grande Above Isleta Diversion	990615	1340		21.5	310	7.10	7.98		1.20	0.21	0.1K	0.313KC	2.09	1.99LC	2.30	5.09	
Rio Grande Above Isleta Diversion	990616	1345		21.9	297.2	7.17	7.73		0.23	0.12	0.1K	0.221KC	0.60	0.50LC	0.72	5K	
Rio Grande Above Isleta Diversion	990617	0730		19.6	288	6.90	7.48		0.44	0.14	0.1K	0.241KC	0.94	0.84LC	1.08	5K	
Rio Grande Above Isleta Diversion	991101	1600		15.6	359.6	7.36	8.1		0.28	0.55	0.1K	0.65KC	0.42	0.32LC	0.97	9.35	1
Rio Grande Above Isleta Diversion	991102	1500		13.4	360	8.61	8.26		0.21	0.51	0.1K	0.61KC	0.44	0.34LC	0.95	13.10	0
Rio Grande Above Isleta Diversion	991103	1450		13.4	368.6	8.62	8.31		0.23	0.62	0.1K	0.72KC	0.39	0.29LC	1.01	6.10	0
Rio Grande Above Isleta Diversion	991104	1450		14.8	364.8	8.76	8.12		0.25	0.62	0.1K	0.72KC	0.31	0.21LC	0.93	7.90	0
Rio Grande Above Isleta Diversion	991104	1450	QA Rep						0.25	0.63	0.1K	0.73KC	0.37	0.27LC	1.00	8.33	
Method Blank	990614	0945							0.03K	0.1K	0.1K	0.2K	0.13	0.03LC	0.23KC	5K	

"L" Remark Code = Off scale high. Actual value not known, but known to be greater than value shown
"B" Remark Code = Results based upon colony counts outside the acceptable range
"K" Remark Code = Off scale low. Actual value not known, but known to be less than value shown

FECAL COLIFORM RAW DATA

SITE	DATE	TIME	COMP INFO	31616 Fecal Coli Col/100ml mem-filt	31614 Fecal Coli Col/100ml MPN	Request ID Number	SLD Number	116 Intensive Survey Number
Rio Grande Below Angostura Diversion Works	990628	1010		20		2288561	9904056	993504
Rio Grande Above Highway 44 Bridge	990628	1025		34		2288562	9904057	993504
Rio Grande at Bernalillo WWTF discharge	990628	1035		23		2288563	9904058	993504
Rio Grande Above Rio Rancho WWTF #3	990628	1055		37		2288564	9904059	993504
Rio Rancho WWTF #3 discharge	990628	1100		12B		2288565	9904060	993504
Rio Grande Above Rio Rancho WWTF #2	990628	1125		49		2288566	9904061	993504
Rio Rancho WWTF #2 discharge	990628	1130		5300		2288567	9904062	993504
Rio Grande Above Alameda Bridge	990628	1200		2400		2486568	9904063	993504
Rio Grande Above Alameda Bridge	990628	1200	QA REP	50		2519573	9904068	993504
Rio Grande Above Rio Bravo Bridge	990628	1230		180B		2288569	9904064	993504
Albuquerque WWTF discharge	990628	1245		19B		2288570	9904065	993504
Rio Grande Above I-25 Bridge	990628	1300		540		2288571	9904066	993504
Rio Grande Above Isleta Diversion	990628	1315		400B		2288572	9904067	993504
Rio Grande Below Angostura Diversion Works	990706	0800			300	2288574	9904174	993504
Rio Grande Above Highway 44 Bridge	990706	0820			900	2288575	9904175	993504
Rio Grande at Bernalillo WWTF discharge	990706	0835		1K		2288576	9904176	993504
Rio Grande Above Rio Rancho WWTF #3	990706	0855			1600L	2288577	9904177	993504
Rio Rancho WWTF #3 discharge	990706	0905		15B		2288578	9904178	993504
Rio Grande Above Rio Rancho WWTF #2	990706	0925			500	2288579	9904179	993504
Rio Rancho WWTF #2 discharge	990706	0935		3500		2288580	9904180	993504
Rio Grande Above Alameda Bridge	990706	0955		1000		2288581	9904181	993504
Rio Grande Above Rio Bravo Bridge	990706	1030		2400B		2288582	9904182	993504
Albuquerque WWTF discharge	990706	1045		11B		2288583	9904183	993504
Rio Grande Above I-25 Bridge	990706	1100		2100B		2288584	9904184	993504
Rio Grande Above Isleta Diversion	990706	1115		1800B		2288585	9904185	993504
Rio Grande Above Isleta Diversion	990706	1115	QA REP	1600B		2288586	9904186	993504
Rio Grande Below Angostura Diversion Works	990712	0855		110B		2288587	9904374	993504
Rio Grande Above Highway 44 Bridge	990712	0920		160B		2288588	9904375	993504
Rio Grande at Bernalillo WWTF discharge	990712	0935		10KB		2288589	9904376	993504
Rio Grande Above Rio Rancho WWTF #3	990712	0955		200		2288590	9904381	993504
Rio Rancho WWTF #3 discharge	990712	1000		2100		2288591	9904382	993504
Rio Grande Above Rio Rancho WWTF #2	990712	1030		330		2288592	9904383	993504
Rio Rancho WWTF #2 discharge	990712	1035		7300B		2288593	9904384	993504
Rio Grande Above Alameda Bridge	990712	1055		250		2288594	9904385	993504
Rio Grande Above Alameda Bridge	990712	1055	QA REP	280		2288599	9904380	993504

SITE	DATE	TIME	COMP INFO	31616 Fecal Coli Col/100ml mem-filt	31614 Fecal Coli Col/100ml MPN	Request ID Number	SLD Number	116 Intensive Survey Number
Rio Grande Above Rio Bravo Bridge	990712	1200		170B		2288595	9904386	993504
Albuquerque WWTF discharge	990712	1215		30B		2288596	9907377	993504
Rio Grande Above I-25 Bridge	990712	1235		170B		2288597	9907378	993504
Rio Grande Above Isleta Diversion	990712	1245		290		2288598	9904379	993504
Rio Grande Below Angostura Diversion Works	990719	0830			300	2288600	9904601	993504
Rio Grande Above Highway 44 Bridge	990719	0850		340		2288601	9904602	993504
Rio Grande Above Highway 44 Bridge	990719	0850	QA REP	360		2288612	9904613	993504
Rio Grande at Bernalillo WWTF discharge	990719	0905		10K		2288602	9904603	993504
Rio Grande Above Rio Rancho WWTF #3	990719	0925			1600	2288603	9904604	993504
Rio Rancho WWTF #3 discharge	990719	0926		50B		2288604	9904605	993504
Rio Grande Above Rio Rancho WWTF #2	990719	1000			2400	2288605	9904606	993504
Rio Rancho WWTF #2 discharge	990719	1005		8500		2288606	9904607	993504
Rio Grande Above Alameda Bridge	990719	1030			1300	2288607	9904608	993504
Rio Grande Above Rio Bravo Bridge	990719	1105			5000	2288608	9904609	993504
Albuquerque WWTF discharge	990719	1115		180		2288609	9904610	993504
Rio Grande Above I-25 Bridge	990719	1130			16000	2288610	9904611	993504
Rio Grande Above Isleta Diversion	990719	1145			5000	2288611	9904612	993504
Rio Grande Below Angostura Diversion Works	990726	0850		80B		2288613	9904802	993504
Rio Grande Above Highway 44 Bridge	990726	0910		400		2288614	9904803	993504
Rio Grande at Bernalillo WWTF discharge	990726	0920		10KB		2288615	9904804	993504
Rio Grande Above Rio Rancho WWTF #3	990726	0945		110B		2288616	9904805	993504
Rio Rancho WWTF #3 discharge	990726	0946		50B		2288617	9904806	993504
Rio Grande Above Rio Rancho WWTF #2	990726	1010		90B		2288618	9904807	993504
Rio Rancho WWTF #2 discharge	990726	1015		20000		2288619	9904808	993504
Rio Rancho WWTF #2 discharge	990726	1015	QA REP	16000B		2288620	9904809	993504
Rio Grande Above Alameda Bridge	990726	1040		350		2288621	9904810	993504
Rio Grande Above Rio Bravo Bridge	990726	1120			500	2288622	9904811	993504
Albuquerque WWTF discharge	990726	1130		30B		2288623	9904812	993504
Rio Grande Above I-25 Bridge	990726	1150			500	2288624	9904813	993504
Rio Grande Above Isleta Diversion	990726	1200		240		2288625	9904814	993504
Rio Grande Above Rio Rancho WWTF #2	990729	1000		82B		2288626	9904961	993504
Rio Rancho WWTF #2 discharge	990729	1005		3000		2288627	9904960	993504
Rio Grande Above Alameda Bridge	990729	1035		81B		2288628	9904959	993504
Rio Grande Above Rio Bravo Bridge	990729	1115		70B		2288629	9904958	993504
Albuquerque WWTF discharge	990729	1145		3B		2288630	9904957	993504
Rio Grande Above I-25 Bridge	990729	1200		150B		2288631	9904956	993504

SITE	DATE	TIME	COMP INFO	31616 Fecal Coli Col/100ml mem-filt	31614 Fecal Coli Col/100ml MPN	Request ID Number	SLD Number	116 Intensive Survey Number
Rio Grande Above Isleta Diversion	990729	1215		140B		2288632	9904955	993504
Rio Grande Above Rio Rancho WWTF #2	990802	0840			1600L	2288640	9904984	993504
Rio Rancho WWTF #2 discharge	990802	0845		410		2288641	9904985	993504
Rio Rancho WWTF #2 discharge	990802	0845	QA REP	210		2288647	9904990	993504
Rio Grande Above Alameda Bridge	990802	0910			1600L	2288642	9904986	993504
Rio Grande Above Rio Bravo Bridge	990802	0945			1600L	2288643	9904987	993504
Albuquerque WWTF discharge	990802	0955		3		2288644	9904988	993504
Rio Grande Above I-25 Bridge	990802	1010			1600L	2288645	9904981	993504
Rio Grande Above Isleta Diversion	990802	1020			1600L	2288646	9908989	993504

“L” Remark Code = Off scale high. Actual value not known, but known to be greater than value shown
“B” Remark Code = Results based upon colony counts outside the acceptable range
“K” Remark Code = Off scale low. Actual value not known, but known to be less than value shown

FECAL COLIFORM GEOMETRIC MEANS CALCULATED WITHOUT REMARKED VALUES INCLUDED

Station	Date/result 28-Jun	Date/result 6-Jul	Date/result 12-Jul	Date/result 19-Jul	Date/result 26-Jul	Date/result 29-Jul	Date/result 2-Aug	Geometric Mean, no remarked values, No QA	Geometric Mean no remarked values, with QA
Precipitation in last 48 hours at ABQ	0.10	0.42	0	0.56	0	0	0.30		
Rio Below Angostura Diversion	20	300	110	300	80			110	110
Rio at Hiway 44 Bridge	34	900	160	340	400			232	249
Bernalillo WWTP	23	1K	10K	10K	10K			23	23
Rio Above RRUC # 3	37	1600L	200	1600	110			190	190
RRUC # 3 Discharge	12	15	2100	50	50			62	62
Rio Above RRUC # 2	49	500	330	2400	90	82B	1600L	281	281
RRUC # 2 Discharge	5300	3500	7300	8500	20000	3000	410	4325	2963
Rio Abv Alameda Bridge	2400	1000	250	1300	350	81B	1600L	771	451
Rio Abv Rio Bravo Bridge	180	2400	170	5000	500	70B	1600L	712	712
Albuquerque WWTP	19	11	30	180	30	3B	3B	32	32
Rio Above I-25 Bridge	540	2100	170	16000	500	150B	1600L	1091	1091
Rio Above Isleta Diversion	400	1800	290	5000	240	140B	1600L	758	758
Rio at Hiway 44 Bridge QA				360					
RRUC # 2 Discharge QA					16000 B		210		
Rio Abv Alameda Bridge QA	50		280						
Rio Above Isleta Diversion QA		1600 B							

"L" Remark Code = Off scale high. Actual value not known, but known to be greater than value shown
"B" Remark Code = Results based upon colony counts outside the acceptable range
"K" Remark Code = Off scale low. Actual value not known, but known to be less than value shown

FECAL COLIFORM GEOMETRIC MEANS CALCULATED WITH REMARKED VALUES TAKEN AS VALUE

	28-Jun	6-Jul	12-Jul	19-Jul	26-Jul	29-Jul	2-Aug	Geometric Mean, with remarked values	Geometric Mean with QA samples with remarked values
Rio Below Angostura Diversion	20	300	110	300	80			110	110
Rio at Hiway 44 Bridge	34	900	160	340	400			232	249
Bernalillo WWTP	23	1	10	10	10			7	7
Rio Above RRUC # 3	37	1600	200	1600	110			291	291
RRUC # 3 Discharge	12	15	2100	50	50			62	62
Rio Above RRUC # 2	49	500	330	2400	90	82	1600	302	302
RRUC # 2 Discharge	5300	3500	7300	8500	20000	3000	410	4325	3574
Rio Abv Alameda Bridge	2400	1000	250	1300	350	81	1600	620	429
Rio Abv Rio Bravo Bridge	180	2400	170	5000	500	70	1600	574	574
Albuquerque WWTP	19	11	30	180	30	3	3	16	16
Rio Above I-25 Bridge	540	2100	170	16000	500	150	1600	868	868
Rio Above Isleta Diversion	400	1800	290	5000	240	140	1600	663	740
Rio at Hiway 44 Bridge QA				360					
RRUC # 2 Discharge QA					16000		210		
Rio Abv Alameda Bridge QA	50		280						
Rio Above Isleta Diversion QA		1600							

Appendix C Table of City of Albuquerque Stormwater Sampling Sites

Station Name (site number)	USGS Station Number	Total Drainage Area (mi^2)	Percent within City Limits	Land Use within City Limits (in percent)				
				Residential	Commercial	Industrial	Open Space	Agricultural or Vacant
Maraposa Diversion of San Antonio Arroyo at Albuquerque (site 300A)	083299375	30.5	54.8	10.8	0.9	14.2	0.7	73.4
City of Albuquerque Lift Station #41 at Albuquerque (site 400A)	08330050	3.81	100.0	34.9	34.1	10.2	11.6	9.2
City of Albuquerque Lift Station #32 at Albuquerque (site 400B)	08330075	NA	NA	NA	NA	NA	NA	NA
San Jose Drain at Woodward Road at Albuquerque (site 500)	08330200	1.95	100.0	40.7	29.8	9.4	1.9	18.2
North Floodway Channel Near Alameda (site 9900)	08329900	92.2	59.9	40.7	15.1	3.9	3.7	36.6
South Diversion Channel above Tijeras Arroyo near Albuquerque (site 200)	08330775	11.0	72.5	13.0	28.5	21.3	8.3	28.9

				Land Use within City Limits (in percent)				
Station Name (site number)	USGS Station Number	Total Drainage Area (mi^2)	Percent within City Limits	Residential	Commercial	Industrial	Open Space	Agricultural or Vacant
Campus Wash at Albuquerque	08329700	3.8	NA	NA	NA	NA	NA	NA
S. Fk. Hahn Arroyo at Albuquerque	08329838	2	NA	NA	NA	NA	NA	NA
N. Fk. Hahn Arroyo at Albuquerque	08329839	1.5	NA	NA	NA	NA	NA	NA
Hahn Arroyo at Albuquerque	08329840	4.3	NA	NA	NA	NA	NA	NA
Academy Acres Drain at Albuquerque	08329880	0.13	NA	NA	NA	NA	NA	NA
La Cueva Tributary at Albuquerque	08329888	NA	NA	NA	NA	NA	NA	NA
N. Camino Arroyo at Sunset Hills in Albuquerque	08329911	2.1	NA	NA	NA	NA	NA	NA
Arroyo 19a at Albuquerque	08329935	1.62	NA	NA	NA	NA	NA	NA
Ladera Arroyo at Albuquerque	08329938	0.87	NA	NA	NA	NA	NA	NA
Tramway Floodway at Albuquerque	08330540	1.6	NA	NA	NA	NA	NA	NA
Tijeras Arroyo near Albuquerque	08330600	128	NA	NA	NA	NA	NA	NA
Embudo Arroyo at Albuquerque Background Site #1	08329720	NA	NA	NA	NA	NA	NA	NA

				Land Use within City Limits (in percent)				
Station Name (site number)	**USGS Station Number**	**Total Drainage Area (mi^2)**	**Percent within City Limits**	**Residential**	**Commercial**	**Industrial**	**Open Space**	**Agricultural or Vacant**
Pino Arroyo at Ventura at Albuquerque	08329872	5.4	NA	NA	NA	NA	NA	NA
Grant Line Arroyo at Villa Del Oso	08329860	0.08	NA	NA	NA	NA	NA	NA

City of Albuquerque Stormwater Fecal Coliform Results from the South Diversion Channel

Sampling Site Location	Sampling Site Identifier	Sampling Date	Time	Fecal Coliform CT/100ml
South Diversion Channel	UR200	7/25/92	NA	50,000
South Diversion Channel	UR200	7/31/92	23:00	60,000
South Diversion Channel	UR200	8/6/92	18:20	60,000
South Diversion Channel	UR200	8/11/92	23:45	60,000
South Diversion Channel	UR200	8/24/92	11:00	60,000
South Diversion Channel	UR200	9/15/92	12:55	600,000
South Diversion Channel	UR200	8/1/93	22:45	37,000
South Diversion Channel	UR200	8/27/93	21:15	80,000
South Diversion Channel	UR200	10/17/93	18:30	7,000
South Diversion Channel	UR200	11/13/93	17:35	5,800
South Diversion Channel	UR200	8/15/94	12:30	64,000
South Diversion Channel	UR200	10/15/94	NA	48,000
South Diversion Channel	UR200	10/26/94	5:34	8,000
South Diversion Channel	UR200	11/11/94	16:50	6,000
South Diversion Channel	UR200	7/18/95	23:05	80,000
South Diversion Channel	UR200	8/23/95	21:30	80,000
South Diversion Channel	UR200	9/28/95	14:36	80,000
South Diversion Channel	UR200	8/23/96	8:00	38,000
South Diversion Channel	UR200	8/29/96	19:30	76,000
South Diversion Channel	UR200	9/14/96	17:55	40,000
South Diversion Channel	UR200	8/25/98	19:40	58,000
South Diversion Channel	UR200	7/4/99	20:15	40,000
South Diversion Channel	UR200	3/7/00	13:30	4,900
Fecal Coliform Average at this Station: 69,248cfu/100ml				

City of Albuquerque Stormwater Fecal Coliform Results from the San Antonio Arroyo

Sampling Site Location	Sampling Site Identifier	Sampling Date	Time	Fecal Coliform CT/100ml
San Antonio Arroyo	UR300	8/7/92	17:55	15,450
San Antonio Arroyo	UR300	8/11/92	22:05	60,000
San Antonio Arroyo	UR300	9/15/92	11:15	600,000
San Antonio Arroyo	UR300	9/19/92	10:20	39,000
San Antonio Arroyo	UR300	8/1/93	20:10	7,100
San Antonio Arroyo	UR300	8/9/93	21:40	80,000
San Antonio Arroyo	UR300	8/27/93	14:45	15,000
San Antonio Arroyo	UR300	5/25/94	19:20	21,500
San Antonio Arroyo	UR300	7/28/94	20:05	50,000
San Antonio Arroyo	UR300	8/20/94	15:25	42,000
San Antonio Arroyo	UR300	9/7/95	19:15	35,000
San Antonio Arroyo	UR300	8/7/96	19:05	8,000
San Antonio Arroyo	UR300	9/14/96	15:35	26,000
San Antonio Arroyo	UR300	10/4/96	12:30	8,200
San Antonio Arroyo	UR300	8/5/97	16:55	20,000
San Antonio Arroyo	UR300	8/21/97	17:30	16,000
San Antonio Arroyo	UR300	7/8/98	20:25	66,000
San Antonio Arroyo	UR300	10/20/98	10:30	26,000
San Antonio Arroyo	UR300	8/2/99	20:50	3,600
Fecal Coliform Average at this Station: 59,939cfu/100ml				

City of Albuquerque Stormwater Fecal Coliform Results from Alcalde Pump Station

Sampling Site Location	Sampling Site Identifier	Sampling Date	Time	Fecal Coliform CT/100ml
Alcalde Pump Station	UR400	7/23/92	18:12	60,000
Alcalde Pump Station	UR400	7/31/92	19:57	60,000
Alcalde Pump Station	UR400	8/6/92	17:02	60,000
Alcalde Pump Station	UR400	8/11/92	21:35	60,000
Alcalde Pump Station	UR400	8/24/92	7:30	74,000
Alcalde Pump Station	UR400	10/28/92	15:00	50,000
Alcalde Pump Station	UR400	7/28/93	NA	80,000
Alcalde Pump Station	UR400	8/26/93	20:00	1,800
Alcalde Pump Station	UR400	5/11/94	16:30	80,000
Alcalde Pump Station	UR400	1/5/95	15:30	9,650
Alcalde Pump Station	UR400	10/26/98	17:02	60,000
Alcalde Pump Station	UR400	9/10/94	17:10	44,000
Fecal Coliform Average at this Station: 53,288cfu/100ml				

City of Albuquerque Stormwater Fecal Coliform Results from Barelas Pump Station

Sampling Site Location	Sampling Site Identifier	Sampling Date	Time	Fecal Coliform CT/100ml
Barelas Pump Station	UR400B	9/3/94	18:42	60,000
Barelas Pump Station	UR400B	9/7/95	NA	80,000
Barelas Pump Station	UR400B	1/31/96	9:12	1,600
Barelas Pump Station	UR400B	7/16/96	16:15	3,300
Barelas Pump Station	UR400B	10/4/96	11:15	80,000
Fecal Coliform Average at this Station: 44,980cfu/100ml				

City of Albuquerque Stormwater Fecal Coliform Results from San Jose Pump Station

Sampling Site Location	Sampling Site Identifier	Sampling Date	Time	Fecal Coliform CT/100ml
San Jose Pump Station	UR500	7/25/92	NA	60,000
San Jose Pump Station	UR500	8/6/92	16:20	60,000
San Jose Pump Station	UR500	8/11/92	20:55	60,000
San Jose Pump Station	UR500	9/15/92	6:15	600,000
San Jose Pump Station	UR500	9/19/92	8:15	75,000
San Jose Pump Station	UR500	10/28/92	15:01	43,000
San Jose Pump Station	UR500	7/14/93	20:05	80,000
San Jose Pump Station	UR500	7/28/93	14:50	80,000
San Jose Pump Station	UR500	8/5/93	15:00	80,000
San Jose Pump Station	UR500	5/11/94	17:35	27,000
San Jose Pump Station	UR500	8/14/94	22:45	83,000
San Jose Pump Station	UR500	9/10/94	17:10	80,000
San Jose Pump Station	UR500	7/18/95	NA	80,000
San Jose Pump Station	UR500	9/7/95	18:18	80,000
San Jose Pump Station	UR500	7/16/96	16:15	3,600
San Jose Pump Station	UR500	8/3/96	20:31	80,000
San Jose Pump Station	UR500	8/2/99	21:40	60,000
Fecal Coliform Average at this Station: 95,976cfu/100ml				

City of Albuquerque Stormwater Fecal Coliform Results from Piedra Lisa Channel East of Tramway

Sampling Site Location	Sampling Site Identifier	Sampling Date	Time	Fecal Coliform CT/100ml
Piedra Lisa Channel East of Tramway	UR600	8/27/93	14:00	80,000
Fecal Coliform Average at this Station: 80,000cfu/100ml				

City of Albuquerque Stormwater Fecal Coliform Results from Emudo Arroyo at Monte Largo Street

Sampling Site Location	Sampling Site Identifier	Sampling Date	Time	Fecal Coliform CT/100ml
Emudo Arroyo at Monte Largo Street	UR650	8/1/98	17:50	4,200
Emudo Arroyo at Monte Largo Street	UR650	7/16/00	18:33	48,000
Fecal Coliform Average at this Station: 26,100cfu/100ml				

City of Albuquerque Stormwater Fecal Coliform Results from West Side Storm, Vulcan Road

Sampling Site Location	Sampling Site Identifier	Sampling Date	Time	Fecal Coliform CT/100ml
West Side Storm, Vulcan Road	UR700	8/9/93	22:15	1,500
West Side Storm, Vulcan Road	UR700	8/27/93	15:10	1,200
Fecal Coliform Average at this Station: 1,350cfu/100ml				

City of Albuquerque Stormwater Fecal Coliform Results from Menaul Detention Basin Inflow

Sampling Site Location	Sampling Site Identifier	Sampling Date	Time	Fecal Coliform CT/100ml
Menaul Detention Basin Inflow	UR800	3/8/94	10:45	1,400
Menaul Detention Basin Inflow	UR800	2/2/95	9:30	1,200
Menaul Detention Basin Inflow	UR800	8/7/96	19:59	80,000
Menaul Detention Basin Inflow	UR800	8/23/96	22:24	70,000
Menaul Detention Basin Inflow	UR800	9/6/96	21:34	80,000
Menaul Detention Basin Inflow	UR800	9/14/96	12:19	80,000
Menaul Detention Basin Inflow	UR800	10/4/96	10:00	18,500
Menaul Detention Basin Inflow	UR800	5/19/97	15:30	14,000
Menaul Detention Basin Inflow	UR800	3/27/00	10:10	100
Menaul Detention Basin Inflow	UR800	6/29/00	10:50	80,000
Menaul Detention Basin Inflow	UR800	6/30/00	9:05	80,000
Menaul Detention Basin Inflow	UR800	7/6/00	8:50	500
Menaul Detention Basin Inflow	UR800	7/7/00	9:10	1,200
Fecal Coliform Average at this Station: 38,992cfu/100ml				

City of Albuquerque Stormwater Fecal Coliform Results from Menaul Detention Basin Outflow

Sampling Site Location	Sampling Site Identifier	Sampling Date	Time	Fecal Coliform CT/100ml
Menaul Detention Basin Outflow	UR900	7/2/96	13:00	22,100
Menaul Detention Basin Outflow	UR900	7/9/96	1:09	72,000
Menaul Detention Basin Outflow	UR900	7/10/96	22:33	25,000
Menaul Detention Basin Outflow	UR900	7/26/96	12:45	1
Menaul Detention Basin Outflow	UR900	8/3/96	21:44	80,000
Menaul Detention Basin Outflow	UR900	8/7/96	19:51	80,000
Menaul Detention Basin Outflow	UR900	8/23/96	22:43	52,500
Menaul Detention Basin Outflow	UR900	9/6/96	21:44	7,400
Menaul Detention Basin Outflow	UR900	9/14/96	13:11	80,000
Menaul Detention Basin Outflow	UR900	10/5/96	11:53	4,500
Menaul Detention Basin Outflow	UR900	5/19/97	17:45	4,200
Menaul Detention Basin Outflow	UR900	3/24/00	13:10	300
Menaul Detention Basin Outflow	UR900	3/2700	8:30	1
Menaul Detention Basin Outflow	UR900	3/29/00	8:30	1
Menaul Detention Basin Outflow	UR900	6/29/00	11:00	56,000
Menaul Detention Basin Outflow	UR900	6/30/00	9:10	80,000
Menaul Detention Basin Outflow	UR900	7/6/00	9:00	3,200
Menaul Detention Basin Outflow	UR900	7/7/00	9:15	400
Fecal Coliform Average at this Station: 31,534cfu/100ml				

City of Albuquerque Stormwater Fecal Coliform Results from Washington Business Park Runoff

Sampling Site Location	Sampling Site Identifier	Sampling Date	Time	Fecal Coliform CT/100ml
Washington Business Park Runoff	UR950	8/5/97	17:27	80,000
Washington Business Park Runoff	UR950	9/9/97	18:25	15,450
Fecal Coliform Average at this Station: 47,725cfu/100ml				

City of Albuquerque Stormwater Fecal Coliform Results from Tijeras Canyon Arroyo at I-25

Sampling Site Location	Sampling Site Identifier	Sampling Date	Time	Fecal Coliform CT/100ml
Tijeras Canyon Arroyo at I-25	TIJCAN01	8/14/93	NA	45,000
Fecal Coliform Average at this Station: 45,000cfu/100ml				

City of Albuquerque Stormwater Fecal Coliform Results from the North Diversion Channel

Sampling Site Location	Sampling Site Identifier	Sampling Date	Time	Fecal Coliform CT/100ml
North Diversion Channel	UR9900	7/23/92	16:30	60,000
North Diversion Channel	UR9900	7/31/92	22:00	22,000
North Diversion Channel	UR9900	8/6/92	17:15	60,000
North Diversion Channel	UR9900	9/19/92	9:46	80,000
North Diversion Channel	UR9900	10/28/92	15:49	28,000
North Diversion Channel	UR9900	7/20/93	4:49	90,000
North Diversion Channel	UR9900	8/1/93	19:56	17,600
North Diversion Channel	UR9900	8/14/93	15:16	80,000
North Diversion Channel	UR9900	8/26/93	20:00	12,000
North Diversion Channel	UR9900	2/8/94	3:00	1,000
North Diversion Channel	UR9900	6/21/94	20:52	56,000
North Diversion Channel	UR9900	8/8/94	17:10	69,000
North Diversion Channel	UR9900	10/14/94	21:40	15,500
North Diversion Channel	UR9900	1/5/95	15:30	1,900
North Diversion Channel	UR9900	5/29/95	15:10	6,000
North Diversion Channel	UR9900	7/16/95	17:25	80,000
North Diversion Channel	UR9900	8/22/95	19:25	23,750
North Diversion Channel	UR9900	9/7/95	19:04	66,000
North Diversion Channel	UR9900	9/28/95	12:31	29,000
North Diversion Channel	UR9900	9/17/96	19:50	18,000
North Diversion Channel	UR9900	5/20/97	15:51	66,000
North Diversion Channel	UR9900	8/4/97	14:40	24,000
North Diversion Channel	UR9900	8/25/98	18:52	48,000
North Diversion Channel	UR9900	10/20/98	11:05	21,000
North Diversion Channel	UR9900	8/10/99	11:30	25,000
North Diversion Channel	UR9900	2/22/00	9:30	900
North Diversion Channel	UR9900	6/2/00	20:45	0
Fecal Coliform Average at this Station: 37,061cfu/100ml				

Appendix D Fecal Coliform Results of the June 1979 Tague/Drypolcher Albuquerque Stormwater Study

North Floodway Channel Alameda

Date	Time	Fecal Coliform MFM-FCBR/100ml	Stream Flow INST-CFS
78/06/29	0700	120,000	300
78/06/29	0715	220,000B	280
78/06/29	0730	110,000	240
78/06/29	1000	5,000	119
78/06/29	1100	15,000	116
78/06/29	1230	3,000	86
78/07/20	2100	1,000,000	505
78/07/20	2200	4,000,000	300
78/07/21	0115	1,500,000	116
78/08/03	1725	11,000	1,000
78/08/03	1825	76,000	560
78/08/22	1840	25,000	315
78/08/22	2015	24,000	5
78/08/22	2030	42,000	740
78/08/22	2045	37,000	532
78/08/22	2100	14,000	425
78/08/22	2115	19,000	325
78/08/22	2130	45,000	300
78/08/22	2200	20,000	252
78/08/23	0030	49,000	113
78/08/23	0100	27,000	86
Fecal Coliform Average on this Study: 350,571cfu/100ml			
Flow Average on this Study: 320CFS			

Appendix E Fecal Coliform Results of the July 1988 Pierce Rio Grande Study

(Yellow denotes exceedence of the 2,000/100ml standard)

Station 1 – Rio Grande at Angostura Diversion Dam

Date	Time	Fecal Coliform MFM-FCBR/100ml
88/07/27	0915	133
88/07/28	**0730**	**24,000**

Station 2 – Jemez River Below Jemez Canyon Dam

Date	Time	Fecal Coliform MFM-FCBR/100ml
88/07/25	0855	40K
88/07/27	0835	24
88/07/28	0810	40K

Station 3 – Rio Grande at Highway 44 Bridge

Date	Time	Fecal Coliform MFM-FCBR/100ml
88/07/25	0925	80K
88/07/27	0935	67
88/07/28	**0835**	**5,900**

Station 4 – Bernalillo Wastewater Treatment Plant

Date	Time	Fecal Coliform MFM-FCBR/100ml
88/07/25	1020	40K
88/07/27	1000	1K
88/07/28	0850	2,000K

Station 5 – Rio Grande above AUC Discharge

Date	Time	Fecal Coliform MFM-FCBR/100ml
88/07/25	1210	80K
88/07/27	1055	109
88/07/28	**0930**	**3,000**

Station 6 – AUC Discharge

Date	Time	Fecal Coliform MFM-FCBR/100ml
88/07/25	1150	100
88/07/27	1045	500
88/07/28	**0920**	**4,100**

Station 7 – Rio Grande at Alameda Bridge

Date	Time	Fecal Coliform MFM-FCBR/100ml
88/07/25	1240	400K
88/07/27	1145	340
88/07/28	**1010**	**600,000L**

Station 8 – Rio Grande at Rio Bravo Bridge

Date	Time	Fecal Coliform MFM-FCBR/100ml
88/07/25	1330	640
88/07/27	1225	410
88/07/28	1040	700

Station 9 – Albuquerque Wastewater Treatment Plant

Date	Time	Fecal Coliform MFM-FCBR/100ml
88/07/25	1415	40K
88/07/27	1330	12
88/07/28	1115	2K

Station 10 – Rio Grande at I-25 Bridge

Date	Time	Fecal Coliform MFM-FCBR/100ml
88/07/25	1445	400K
88/07/27	1255	560
88/07/28	1150	400K

Appendix F Precipitation Data

ALBUQUERQUE WSFO AIRPORT, NEW MEXICO
Monthly Total Precipitation (inches)
Station (290234)

YEAR(S)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
1914	0.02	0.40	0.40	0.84	1.02	0.14	2.01	2.00	0.20	1.93	0.00 z	2.43 a	11.39
1915	0.68	0.50	0.51 a	2.05	0.00 z	0.00 z	2.92	0.83	0.00 z	0.00 z	0.00 z	0.00 z	7.49
1916	2.16 a	0.00 z	0.00	0.00 z	0.00	0.00 z	0.00 z	1.95	0.34	2.77	0.00	0.00	7.22
1917	0.35	0.73	0.00	0.12	0.50	0.18	0.25	0.56	0.60	0.00	0.00	0.00	3.29
1918	0.29	0.31	0.98	0.33	0.49	0.34	0.95	1.46	0.15	1.79	0.24	0.30	7.63
1919	0.00	0.13	1.25	1.93	1.34	0.84	4.12	0.98	1.36	1.61	0.68	0.79	15.03
1920	0.04	0.30	0.43	0.38	1.07	0.67	0.15	0.76	0.29	1.12	0.08	0.23	5.52
1921	0.12	0.18	0.86	0.00	0.28	2.46	2.77	2.60	0.37	0.37	0.00	0.28	10.29
1922	0.03	0.07	0.47	0.16	0.31	0.33	0.25	1.28	0.12	0.13	0.89	0.05	4.09
1923	0.14	0.34	0.99	0.70	0.35	0.00	0.34	2.34	0.45	0.84	1.10	0.36	7.95
1924	0.00 z	0.00 z	0.00 z	0.00 z	0.22	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.22
1925	0.52	0.00	0.07	0.26	0.22	0.57	0.58	0.49	1.13	1.23	0.26	0.15	5.48
1926	0.15	0.04	1.08	0.63	1.99	0.34	1.16	0.47	1.04	1.21	0.00	1.10	9.21
1927	0.03	0.42	0.35	0.21	0.00	1.61	1.93	1.63	1.14	0.22	0.00	0.16 a	7.70
1928	0.00	0.21	0.10	0.57	1.63	0.00	2.54	1.96	0.05	0.88	0.27	0.20	8.41
1929	0.05	0.35	0.08	0.08	3.56	0.00	1.23	1.44	3.31	1.56	0.74	0.18	12.58
1930	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00
1931	0.20	1.02	0.52	2.58	0.99	0.53	0.69	0.23	2.18	0.57	1.19	0.07	10.77
1932	0.45	0.40	0.27	0.34	1.41	0.09	2.01	2.20	0.78	1.46	0.00	0.37	9.78
1933	0.08	0.01	0.09	0.39	0.23	3.81	2.04	2.42	1.12	0.24	0.91	0.05	11.39
1934	0.06	0.04	0.01	0.13	0.72	0.37	0.61	2.10	1.08	0.24	0.84	0.78	6.98
1935	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00
1936	0.55	0.12	0.11	0.09	0.27	0.43	0.67	0.62	2.05	0.17	0.00	0.13	5.21
1937	0.21	0.11	0.63	0.42	2.78	1.91	1.02	0.22	0.87	0.79	0.01	0.48	9.45
1938	0.12	0.49	0.22	0.20	0.02	1.51	1.45	0.17	2.36	0.63	0.02	0.36	7.55
1939	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00
1940	0.52	0.58	0.48	0.21	1.71	1.32	0.62	3.25	1.99	0.36	1.45	0.87	13.36
1941	1.17	0.20	1.00	1.20	3.07	0.90	2.15	1.07	1.85	2.67	0.37	0.23	15.88
1942	0.13	0.54	0.39	1.97	0.00	0.22	0.20	1.42	1.55	0.73	0.00	1.10	8.25
1943	0.25	0.26	0.23	0.06	1.41	1.20	1.19	1.33	0.39	0.22	0.14	0.94	7.62
1944	0.00 z	0.00 z	0.49	0.91	0.57	0.85	1.58	1.44	0.65	0.86	0.56	0.76	8.67
1945	0.34	0.32	0.50	0.77	0.00	0.00	1.09	2.27	0.26	0.43	0.00	0.38	6.36
1946	0.25	0.33	1.03	0.26	0.31	0.03	2.28	1.49	0.57	1.02	0.54	0.12	8.23
1947	0.00	0.00	0.03	0.03	0.48	0.23	0.38	1.45	0.67	0.31	0.36	0.91	4.85

1948	0.00 j	1.31 e	0.41	0.33	0.94	0.57	0.46 f	0.51	0.80	0.60	0.11	0.11 a	5.69
1949	0.58 e	0.29	0.65	0.67	1.35	0.25 a	2.21	0.72	0.87	0.14	0.00	0.59	8.32
1950	0.02	0.38	0.04	0.27	0.06	0.23	2.00	0.08	1.01	0.01	0.00	0.00	4.10
1951	0.41	0.27	0.29	0.38	0.10	0.02	0.85	2.22	0.05	0.37	0.14	0.28	5.38
1952	0.20	0.17	0.59	0.76	0.65	1.64	1.91 a	1.10	0.34	0.00	0.53	0.20	8.09
1953	0.00	0.43	0.74	0.69	0.03	0.35	0.53	0.59	0.06	0.46	0.91	0.29 a	5.08
1954	0.20	0.03 a	0.24	0.00	0.51	0.01	1.45	0.65	0.77	0.25	0.22	0.14	4.47
1955	0.29	0.18	0.00	0.04	0.53	0.33	1.60	1.32	1.94	0.06	0.00	0.22	6.51
1956	0.46	0.49	0.00	0.00	0.18	0.43	1.49	0.62	0.02	0.34	0.03	0.00	4.06
1957	0.78	0.59	0.52	0.38	0.35	0.04	2.48	1.32	0.00	2.59	1.24	0.32	10.61
1958	0.21	0.27	1.71	0.62	0.43	0.22	0.14	1.74	1.34	1.72	0.37	1.35	10.12
1959	0.17	0.04	0.42	0.43	0.80	0.78	0.73	2.79	0.36	1.70	0.07	1.85	10.14
1960	0.34	0.38	0.44	0.19	0.71	0.91	0.47	0.78	0.56	2.88	0.07	0.39	8.12
1961	0.23	0.10	0.61	0.73	0.01	0.11	2.70	1.69	1.09	0.47	0.48	0.65	8.87
1962	1.01	0.11	0.18	0.07	0.01	0.19	1.24	0.00	0.71	0.75	0.61	0.51	5.39
1963	0.29	0.24	0.55	0.14	0.03	0.11	1.43	3.00	0.63	0.76	0.29	0.00	7.47
1964	0.07	1.12	0.13	0.61	0.35	0.00	1.87	0.98	1.57	0.04	0.21	0.49	7.44
1965	0.47	0.60	0.49	0.49	0.19	0.99	1.65	0.61	1.18	0.89	0.33	1.42	9.31
1966	0.42	0.30	0.00	0.04	0.02	1.66	1.63	1.06	1.04	0.54	0.09	0.01	6.81
1967	0.01	0.44	0.25	0.00	0.04	1.71	0.61	3.30	0.79	0.18	0.15	0.56	8.04
1968	0.01	0.98	1.48	0.51	0.99	0.05	3.33	1.49	0.30	0.12	0.59	0.82	10.67
1969	0.08	0.34	0.41	1.76	1.31	0.59	0.94	0.95	1.08	2.37	0.01	0.72	10.56
1970	0.00	0.27	0.42	0.05	0.33	0.40	1.22	2.24	0.79	0.25	0.08	0.23	6.28
1971	0.27	0.21	0.03	0.78	0.16	0.02	1.05	0.87	1.44	1.15	0.67	1.40	8.05
1972	0.12	0.12	0.08	0.00	0.18	0.55	1.00	2.93	1.00	3.08	0.69	0.36	10.11
1973	0.85	0.33	2.18	0.91	0.66	1.37	1.80	1.19	1.13	0.35	0.08	0.03	10.88
1974	0.88	0.11	0.85	0.14	0.01	0.22	2.40	0.79	1.58	1.96	0.38	0.51	9.83
1975	0.26	0.99	0.95	0.10	0.66	0.00	1.43	1.40	1.66	0.00	0.28	0.28	8.01
1976	0.00	0.40	0.09	0.31	0.82	0.60	1.32	0.73	0.45	0.03	0.24	0.20	5.19
1977	0.88	0.13	0.63	1.07	0.10	0.04	0.69	2.28	0.78	0.76	0.42	0.13	7.91
1978	1.32	1.02	0.54	0.05	0.69	1.05	0.24	2.49	0.59	1.22	1.00	0.76	10.97
1979	1.07	0.62	0.14	0.24	2.48	1.02	0.80	1.53	0.40	0.27	0.91	0.87	10.35
1980	0.87	0.58	0.60	0.60	0.56	0.01	0.08	2.61	1.83	0.09	0.30	0.74	8.87
1981	0.05	0.67	0.80	0.30	0.53	0.35	1.07	1.68	0.41	1.43	0.37	0.00	7.66
1982	0.32	0.20	0.84	0.05	0.52	0.09	1.32	1.09	1.34	0.26	0.60	0.78	7.41
1983	1.10	0.71	0.61	0.02	0.32	1.21	0.55	0.27	0.91	1.20	0.44	0.42	7.76
1984	0.33	0.00	0.62	0.50	0.16	0.48	1.13	2.70	1.13	3.04	0.63	1.36	12.08
1985	0.49	0.54	0.70	1.69	1.12	0.53	1.16	0.49	1.53	2.15	0.19	0.16	10.75
1986	0.22	1.01	0.17	0.33	1.11	2.57	1.51	2.26	0.53	1.54	1.29	0.44	12.98
1987	0.66	0.61	0.07	1.00	0.58	0.13	0.91	2.98	0.20	0.44	0.42	0.34	8.34
1988	0.15	0.07	0.85	1.42	0.62	1.25	2.26	3.29	2.63	0.32	0.22	0.03	13.11
1989	0.57	0.35	0.48	0.00	0.02	0.02	1.51	0.48	0.31	0.97	0.00	0.28	4.99

1990	0.21	0.49	0.41	1.71	0.45	0.27	2.36	1.79	0.96	0.15	0.86	0.59	10.25
1991	0.60	0.06	0.14	0.00	1.14	0.65	2.63	1.26	1.43	0.26	1.93	1.49	11.59
1992	0.60	0.20	0.63	0.22	1.81	0.67	2.01	2.17	0.79	0.70	1.12	1.16	12.08
1993	0.94	1.82	0.22	0.00	0.20	0.44	0.23	3.05	0.49	0.64	0.97	0.03	9.03
1994	0.02	0.26	0.59	0.07	1.87	0.28	0.61	2.70	1.21	1.54	1.38	0.62	11.15
1995	0.55	0.39	0.16	0.69	0.08	0.20	0.35	0.74	2.32	0.00	0.03	0.17	5.68
1996	0.17	0.19	0.02	0.00	0.02	2.86	1.03	1.54	1.45	1.52	0.95	0.00	9.75
1997	0.55	0.12	0.11	1.65	0.42	1.03	2.04	1.96	2.43	0.32	0.73	1.00	12.36
1998	0.14	0.66	2.34	0.64	0.00	0.17	2.37	0.88	0.15	1.80	0.46	0.22	9.83
1999	0.12	0.00	1.10	0.59	0.54	0.60	1.47	3.04	0.54	0.26	0.00	0.03	8.29
2000	0.30	0.30	1.27	0.00	0.08	0.72 a	0.02 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	2.67

Period of Record Statistics

MEAN	0.37	0.38	0.51	0.51	0.66	0.64	1.36	1.50	0.96	0.88	0.43	0.49	8.62
S.D.	0.38	0.33	0.46	0.57	0.73	0.72	0.83	0.88	0.69	0.82	0.43	0.48	2.67
SKEW	1.87	1.67	1.61	1.60	1.82	1.95	0.63	0.35	0.94	1.08	1.05	1.52	0.24
MAX	2.16	1.82	2.34	2.58	3.56	3.81	4.12	3.30	3.31	3.08	1.93	2.43	15.88
MIN	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	3.29

Appendix G Public Comments and Bureau Responses

Mr. David Hogge, TMDL Coordinator
TMDL Development Section
Surface Water Quality Bureau
New Mexico Environment Department
Post Office Box 26110
Santa Fe, NM 87502

RE: **Draft Middle Rio Grande Total Maximum Daily Load (TMDL) for Fecal Coliform in Storm Water, September 2000**

Dear Mr. Hogge:

The Middle Rio Grande Conservancy District (MRGCD) appreciates the opportunity to comment on the *Draft Middle Rio Grande Total Maximum Daily Load for Fecal Coliform in Storm Water* (Draft TMDL) issued in September 2000 by the Surface Water Quality Bureau of the New Mexico Environment Department (Department).

The Draft TMDL is of great interest to the MRGCD, since the segments of the Rio Grande addressed in the Draft TMDL fall within the boundaries of the MRGCD. The *State of New Mexico Standards for Interstate and Intrastate Surface Waters* defines segment 20.6.4.105 as the "main stem of the Rio Grande from the headwaters of Elephant Butte Reservoir upstream to Alameda Bridge (Corrales Bridge), the Jemez River from the Jemez Pueblo boundary upstream to the Rio Guadalupe, and intermittent flow below the perennial reaches of Rio Puerco and Jemez River which enters the main stem of the Rio Grande." Segment 20.6.4.105.1 is defined as the "main stem of the Rio Grande from Alameda Bridge (Corrales Bridge) upstream to the Angostura Diversion Works." Further, seven percent of the land use for the area at issue in the Draft TMDL is agricultural.

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The MRGCD is supportive of the Department's efforts in developing a TMDL for fecal coliform in storm water for the Middle Rio Grande. Like the Department, the City of Albuquerque, Bernalillo County, the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA), the Pueblos of Sandia and Isleta, and all other entities that play a role in the management of the Rio Grande, we believe it is important for there to be cooperative planning in all aspects of river management. The MRGCD is committed to being a cooperative player on issues concerning the Rio Grande, including the TMDL process.

It is important to note, though, that there are limits to the regulatory control that can be placed on the MRGCD through the TMDL process by the Department, pursuant to both New Mexico's Water Quality Act, Chapter 74, Article 6 NMSA 1978, and the federal Clean Water Act, 33 U.S.C. §1251 *et seq.*, as will be discussed below.

An understanding of New Mexico's authority to set "total maximum daily loads" (TMDLs) is instructive in understanding the MRGCD's role in the TMDL process. The Federal Water Pollution Control Act, known as the Clean Water Act (CWA), was passed by Congress in 1972 to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." 33 U.S.C. § 1251(a). This goal was to be achieved by eliminating the discharge of pollutants into navigable waters by 1985. 33 U.S.C. § 1251(a)(1). The CWA recognizes the authority of states in regulating pollution in interstate and intrastate waters within its boundaries. As stated in the CWA, "[i]t is the policy of the Congress to recognize, preserve, and protect the primary responsibilities and rights of States to prevent, reduce, and eliminate pollution . . . ." 33 U.S.C. § 1251 (b). That policy was further articulated in the CWA's provisions on water quality standards, which recognizes the states' primacy in adopting such standards. 33 U.S.C. § 1313(a)(1).

The CWA addresses two potential sources of pollution–point sources and nonpoint sources. A point source is "any discernible, confined, and discrete conveyance…from which pollutants are or may be discharged." 33 U.S.C. § 1362(14). The definition specifically excludes from the definition of point source "agricultural stormwater discharges and return flows from irrigated agriculture." Id.

Point source pollution is subject to technology-based controls imposed by the National Pollution Discharge Elimination System (NPDES) permit process, which sets quantitative limits on the amount of pollutants released from each point source. 33 U.S.C. § 1342. Nonpoint source pollution is pollution from any non-discrete source, such as urban run-off. Regulation of nonpoint sources of pollution is accomplished through voluntary compliance with "best management practices" (BMPs). 33 U.S.C. § 1329(a)(1)(C). As stated by the court in Oregon Natural Resources Council v. United States Forest Service, 834 F.2d 842, 849 (9th Cir. 1987):

> Point sources are subject to direct federal regulation and enforcement under the [CWA] [footnote omitted]. See 33 U.S.C. § 1342. Nonpoint sources, because of their very nature, are not regulated under the NPDES. Instead, Congress addressed nonpoint sources of pollution in a separate area of the Act which encourages states to develop area wide waste treatment management plans [footnote omitted]. See 33 U.S.C. § 1288.

Id. at 849.

When controls implemented through NPDES permitting are insufficient to clean up water bodies, the CWA mandates the use of a water quality based approach. 33 U.S.C. § 1313(d). Under this approach, states must adopt water quality standards based on the uses of the waters and the amount of pollution that would impair the uses. 33 U.S.C. § 1313(a)-(c). A state must then identify waters within its boundaries which do not meet these water quality standards. 33 U.S.C. § 1313(d)(1)(A). These waters are called "water quality limited segments" (WQLS). After identifying WQLSs, they must be prioritized by the state based on the severity of the pollution and the uses of the waters. Id. A state must then develop, in accordance with the priority ranking, a TMDL for each pollutant impairing each WQLS. 33 U.S.C. § 1313(d)(1)(C). A TMDL sets the maximum amount of pollutants a water body can receive on a daily basis without violating a state's water quality standards. Id. It includes best estimates of pollution from nonpoint sources and natural background sources, pollution from point sources, and a margin of safety. 40 C.F.R. § 130.2(h). See also Sierra Club v. Hankinson, 939 F.Supp. 865, 867 (N.D. Ga.1996). This is the process that resulted in the Department issuing the Draft TMDL.

The Draft TMDL identifies three significant sources of fecal coliform bacteria in the middle Rio Grande: (1) NPDES permitted dischargers with periodic spills and end of the pipe violations of permits; (2) nonpoint sources from livestock rearing, livestock operations and other domestic animals, and migratory birds; and (3) storm water. The Draft TMDL only addresses the latter source of fecal coliform. It sets load allocations for fecal coliform, and sets forth a general plan outlining activities which the Department believes will, when implemented, result in a reduction of fecal coliform bacteria inputs in the river.

The Draft TMDL states on page 5 that six discreet concrete transports of storm water enter the middle Rio Grande. David Hogge from the Department stated the conveyances referred to are, in fact, four discrete non-wastewater conveyances, and four wastewater treatment plant conveyances. The four non-wastewater treatment conveyances are the North Diversion Channel, the South Diversion Channel, the Tijeras Arroyo, and the San Jose Drain.

The North Diversion and South Diversion Channels fall within AMAFCA's jurisdiction. We believe the Tijeras Arroyo is under the control of the City of Albuquerque (City) and/or Bernalillo County (County). Flows from these specific conveyances do not meet and commingle with flows using MRGCD conveyances. In other words, there are no places where these AMAFCA, City, and County conveyances intersect with MRGCD conveyances. The San Jose Drain is an MRGCD facility, but is operated and maintained by the City through assignment by the MRGCD. Flows from the San Jose Drain can drain either directly to the river or through an outlet into the Albuquerque Riverside Drain, which also is an MRGCD facility. It is our understanding the TMDL document intends stormwater flowing through these conveyances to be regulated through the NPDES Stormwater Phase 2 regulations.

The Draft TMDL primarily addresses AMAFCA, City, County and other non-MRGCD conveyances that do not intersect with MRGCD conveyances. Nonetheless, the TMDL specifically discusses the San Jose Drain which is an MRGCD facility, but is operated and maintained by the City. Therefore, and based on the fact that MRGCD conveyances are within the TMDL area of concern, it is important to address the issue of whether the MRGCD can be regulated through an NPDES storm water permit. 33 U.S.C. § 1342(p). As will be shown below, the MRGCD believes any such regulation would clearly be in violation of the CWA and the New Mexico Water Quality Act.

The CWA states at 33 U.S.C. § 1342(l) that the United States Environmental Protection Agency (EPA) "shall not require a permit under this section for discharges composed entirely of return flows from irrigated agriculture, nor shall [EPA] direct or indirectly, require any State to require such a permit." Likewise, the Water Quality Act states the Water Quality Control Commission "shall not require a permit respecting the use of water in irrigated agriculture, except in the case of the employment of a specific practice in connection with such irrigation that documentation or actual case history has shown to be hazardous to public health or the environment . . . ." § 74-6-4(K) NMSA 1978 (2000 Repl.).

Thus, the CWA and the New Mexico Water Quality Act are clear: irrigation return flows cannot be regulated through NPDES permitting. The clear meaning of the CWA in this regard has been recognized by several courts. See Defenders of Wildlife v. Browner, 191 F.3d 1159, 1166 (9th Cir. 1999) (recognizing that the irrigation return flow exemption contained in 33 U.S.C. § 1342(l)(1) is a CWA provision that "undeniably exempt[s] certain discharges from the permit requirement altogether"); National Wildlife Federation v. Gorsuch, 693 F.2d 156, 176 (D.C. Cir. 1982) ("[W]e note that Congress chose to exempt irrigation return flows from the NPDES program even though they were amenable to point source control.")

NMED/SWQB Response

MRGCD expresses concern that the TMDL may result in a requirement for MRGCD to obtain NPDES permits for its conveyances within the TMDL area of concern. MRGCD's concern is misplaced. The EPA administers the NPDES permit program in the State of New Mexico. Whether the MRGCD is required to obtain a NPDES storm water permit for its conveyances within the TMDL area of concern will be determined by the EPA. EPA's determination must be based on the jurisdictional scope of the Clean Water Act, not whether the State of New Mexico has developed a TMDL. The State of New Mexico, through the TMDL, cannot make this determination. Moreover, the TMDL does not "intend" to make such a determination, which in any event, is beyond the scope and function of the TMDL.

Based on the CWA, in the case of any intersection between an AMAFCA, City, County or any other non-MRGCD conveyance and an MRGCD conveyance, the point of compliance under any NPDES storm water permit would have to be at the point the storm water enters the MRGCD conveyance, and not at the point the MRGCD conveyance eventually discharges into the Rio Grande. If storm water enters the MRGCD system, MRGCD cannot be required to obtain an NPDES permit because storm water intermingles with irrigation return flows.

The Draft TMDL also discusses "management measures" to control nonpoint sources of pollution. The pollutant of concern in the Draft TMDL is fecal coliform. The Department has not identified any activities related to agriculture that are a source of this pollution. Nonetheless, potential regulation of nonpoint sources of pollution is generally of great importance to MRGCD.

In Pronsolino v. Marcus, 91 F.Supp. 3d 1337, 1356 (N.D. Cal. 2000), the court found that the CWA authorized the EPA to determine TMDLs for rivers and waters polluted only by nonpoint sources rather than by point sources in the TMDL process. The court, however, recognized the roles of states in addressing nonpoint sources of pollution. As the court stated:

> Once the TMDLs were prepared, they were intended to be applied to point and nonpoint sources differently. As to point sources, the TMDLs were to be taken into account into further restricting effluent, under NPDES permits. . . . As to nonpoint sources of pollution, the TMDLs were to be incorporated into the continuing planning process of the states. This conferred a large degree of discretion on the states in how and to what extent to implement the TMDLs for nonpoint sources. A state could even refuse to implement a TMDL, eschewing best management practices if it wished, although to do so might provoke EPA to curtail or deny grant money to the state. But as to whether TMDLs were authorized in the first place for all substandard rivers and waters, there is no doubt. They plainly were and remain so today–without regard to the sources of pollution.

Id. at 1356.

We believe Pronsolino instructs that, although states may include nonpoint sources of pollution in TMDLs, they are given broad leeway into how such pollution is to be addressed. In the Draft TMDL, the Department clearly states the Department's nonpoint source water quality management utilizes a voluntary approach. MRGCD agrees and emphasizes that any attempts to control nonpoint sources of pollution should be through voluntary means.

NMED/SWQB Response

MRGCD concedes that the State of New Mexico has "broad leeway" in addressing nonpoint source pollution, but urges the adoption of voluntary approaches to reduce fecal coliform in the middle Rio Grande. The TMDL discusses different management measures for achieving this goal, but does not purport to select the measures, does not determine which entities are responsible for implementing these measures, and does not establish enforceable requirements.

While it is clear there is no regulatory basis for direct regulation of agricultural return flows, or that such flows are the source of the fecal coliform pollutant addressed in the proposed TMDL, the mission of the MRGCD goes far beyond agriculture. It includes, *inter alia,* the obligation to improve and protect the waters of the Rio Grande, flood protection, and protection of the flora and fauna of the Bosque. For these reasons, an agreement as to which standards ought to be applied and utilized to protect the quality of the waters of the Rio Grande is a subject in which the MRGCD has substantial interest. Indeed, the constituents of the MRGCD are water users who have a vested interest in any standard to be set for the waters of the Rio Grande. The setting of standards is, of course, a composite of planning, economic analysis, social policy review and investigation of any possible sources of pollutants that might violate a standard, once established. The TMDL program, unlike programs regulating point source discharges, is a program aimed at evaluating a multitude of land use issues, including state and local institutions' goals for surface water uses, and is finally designed primarily to ensure, through adaptive management and education, TMDL standards are met.

The MRGCD looks forward to playing a role in the extensive planning and education processes anticipated by the Department in developing meaningful adaptive non-regulatory solutions to these important issues and specifically, controlling fecal coliform levels at the source of generation as well as in the river itself. As you know, these issues are evolving around the country.

For example, the Colorado District Court found that a voluntary approach coupled with education was a reasonable process to conform to CWA requirements that a state adopt best management practices to meet its water quality standards. That court states:

> the discharge of pollutants from nonpoint sources – for example, the runoff of pesticides from farmlands – was not directly prohibited . . . . Section 319 does not require states to penalize nonpoint source polluters who fail to adopt best management practices; rather, it provides for grants to encourage the adoption of such practices.

American Wildlands v. Browner, 94 F. Supp.2d 1150, 1160 (D.Colo. 2000) (citing Natural Resources Defense Council v. United States Environmental Protection Agency, 915 F.2d 1314, 1316, 1318 (9th Cir. 1990)). The court added that the State of Montana did not have to regulate nonpoint sources to meet EPA's policies. Id. at 1161. Finally, the court found that Montana's active program addressing "nonpoint source pollution through education and voluntary compliance rather than regulation" complied with the CWA requirements to bring non-regulated activities into conformance with applicable water quality standards and the corresponding rulings of the Tenth Circuit Court of Appeals. Id.

Such a voluntary program firmly grounded on education comports to the MRGCD's Mission Statement. The MRGCD was organized in 1927 to protect the quality of the Rio Grande system by solving the alkali poisoning that was destroying the river's ecosystem. Although the definition of "quality" had developed over the decades to equate to state-determined water uses and standards, the MRGCD is the most appropriate entity to husband and preserve the natural riverine environment, support and preserve the farming communities dependent on water quality for their livelihoods, and preservation and protection of the water resource in the middle Rio Grande valley by its stewardship activities. The MRGCD's system provides a natural filter for the water of the hydrologic basin, which will be integral to a system to improve water quality as the water percolates through ditches and fields and returns to the aquifer and surface waters of the valley. To accomplish these missions, the MRGCD seeks collaboration with local, state, and federal government entities, and private sources to secure adequate resources to protect this critical body of water for all the middle valley's inhabitants. Thus, the MRGCD seeks to engage in developing appropriate standards and assisting in the development of voluntary and educational programs needed to meet them.

A final point the MRGCD wishes to address concerns the comments made by the City of Albuquerque and AMAFCA regarding the Draft TMDL. We believe the City and AMAFCA have raised issues that must be addressed and resolved prior to the Draft TMDL being submitted to the Water Quality Control Commission for its formal approval. Issues they raise that appear to be of particular importance are: (1) whether the Draft TMDL gives an extremely conservative estimate of the pollutant load, which makes it more difficult to proceed toward compliance with the applicable water quality standard; (2) whether, under the condition of wet weather flow where a nonpoint source plays a more important role, using low flow methodology like 4Q3 is an inappropriate approach for TMDL development; (3) the costs associated with implementing the Draft TMDL; and (4) the conflicting Pueblo and New Mexico water quality standards, and whether it is possible to meet the Pueblo standard under an economically feasible scenario.

In conclusion, we believe the Draft TMDL provides a mechanism for all parties interested in the middle Rio Grande to address the issue of fecal coliform pollution in this reach of the river. We look forward to working with all interested parties in developing a final TMDL that reasonably addresses fecal coliform pollution in the middle Rio Grande.

Very truly yours,

SHEEHAN, SHEEHAN & STELZNER, P.A.

BY: Susan C. Kery, Esq.

and

LAW & RESOURCE PLANNING ASSOCIATES,
A Professional Corporation,

BY: Charles T. Dumars, Esq.
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Albuquerque Plaza
201 3rd Street, N.W., Suite 1370
Albuquerque, NM 87102
505.346.0998

SCK:sb
cc: Subhas K. Shah (MRGCD)

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November 8, 2000

Mr. David Hogge, TMDL Coordinator
TMDL Development Section
Surface Water Quality Bureau
New Mexico Environment Department
P.O. Box 26110
Santa Fe, NM 87502

Re: Middle Rio Grande TMDL Comments

Dear Mr. Hogge:

The City of Rio Rancho is in receipt of the proposed Middle Rio Grande TMDL report.

The purpose of this document is to forward comments regarding the proposed plan. The Department of Public Works (DPW) is responsible for management of the city storm drainage system. The comments in this correspondence are primarily made from the perspective of a storm-water management entity. You may receive comments from other departments regarding their areas of responsibility.

It is our understanding that this document was prepared as a plan to bring "use impaired" reaches of the Rio Grande into conformance with existing state TMDL standards.

We believe that there is much confusion as to the purpose of this document and that many reviewers perceive it as a "rule". As a plan, shouldn't the word "plan" appear in the title somewhere?

NMED/SWQB Response

The following is the first sentence of the document's Executive Summary:

> **Section 303(d) of the Federal Clean Water Act requires states to develop TMDL management plans for water bodies determined to be water quality limited.**

With regard to the document itself, we have the following comments:

1 - The Source Identification section identified three sources of fecal coliform; municipal and industrial waste waters, livestock and wildlife, and storm-water. We see the following sources, industrial and municipal wastewater, agricultural wastewater and direct input from livestock, wildlife and human sources (henceforth, biological sources). It should be noted that the three sources of water flow in the Rio Grande are storm runoff, groundwater and direct

precipitation (into the river). The primary source is storm runoff. Therefore, storm-water should not be viewed as a fecal coliform source, but a carrier. The sources are the pet waste, livestock operations, wildlife, human sources, and etc. that are carried by the storm-water into the river. For this reason any sort of end of pipe treatment or treatment by river reach is an unreasonable proposition at best. A cost effective plan must involve the identification of pollutant sources within the watershed itself and dealing with the problem at the source.

As a hypothetical example, if the principal source of fecal coliform is a hog farm, which makes more sense, to treat the water leaving the hog farm, or to treat the storm runoff from the entire watershed? We think the answer is obvious and relevant to most sources of fecal coliform.

NMED/SWQB Response

The Identification of Sources section on page 7 of this document has been expanded to include other nonpoint sources of pollution. Although storm water conveyances are the primary conduit of overland precipitation to the river, they are not in and of themselves the source of fecal coliform bacteria.

2 - Cost effectiveness is difficult to quantify when applied to this issue. Typically, cost effectiveness is determined through some rational form of cost/benefit analysis. What are the benefits here? No one wants to see the Rio Grande become an open sewer, but the benefits of regulating fecal coliform loadings at this level are questionable. Spending millions if not billions of dollars so that a small percentage of taxpayers can fish and swim, is not a good return. We acknowledge that this plan was prepared to meet statutory requirements. The benefit seems to be that if we, including the state and other stakeholders, comply with these requirements; we will not be fined or sued. This is a very artificial benefit.

NMED/SWQB Response

This document is neither a rule nor a regulation but a plan that calculates the allowable load of fecal coliform to the river from discreet discharges that would be protective of the surface water quality standards applicable to this reach of the river. The document does not address the cost effectiveness, cost/benefit, applicability, implementation or maintenance of any abatement or education program that could result from the calculated loads. The Bureau strongly encourages the management agencies on this reach of river to coordinate any abatement or educational efforts undertaken in this process with the USEPA Region 6 Permits Section, affected municipalities, private landowners, the MRGCD as well as the Sandia and Isleta Pueblos.

3 - It seems that extravagantly expensive BMP's were evaluated. As comparison, the State of California recently gained full federal approval of a run-off pollution prevention program for the entire state. The program addresses all elements of the NPDES program. The cost of the program is estimated to be ten billion dollars. The area of California is 155,973 square miles (as per Time Almanac). This results in a cost of $100 per acre which is less than the cost of any of the BMP's discussed in the proposed plan and which addresses all elements of the NPDES program, not just fecal coliform TMDL's. Although $100 per acre is a still a significant cost, why is the State of

New Mexico considering BMP's which are an order of magnitude more expensive than are being experienced in other areas of the country?

NMED/SWQB Response

The Bureau has inserted the following language into the Implementation Plan (now Implementation Approaches) section of this document on page 27 to read as follows:

This section is meant to highlight approaches and estimated costs associated with the implementation of certain BMPs. The entire section was taken from a newsletter titled, ***Stormwater Runoff Water Quality Science/Engineering Newsletter, Urban Stormwater Runoff Water Quality Management Issues***, Volume 3, Number 2, May 19, 2000. The New Mexico Environment Department, Surface Water Quality Bureau does not endorse nor does it take any position in favor of one BMP over another for storm water management.

4 - If these costs are valid, then the BMP's considered are not BMP's. A management practice that bankrupts the practitioner cannot be considered a best management practice.

NMED/SWQB Response

See response to Question 3.

5 - The plan should be prepared in a manner that allows it to be implemented as part of the NPDES program, rather than as an independent effort. Elimination of duplication is a cost effective approach.

NMED/SWQB Response

The Phase II Storm Water Management Program will be the regulatory arm of the NPDES permitting program. The Phase II Storm Water Management Program must include the following six (6) Minimum Control Measures:

- **Public Education and Outreach**
- **Public Participation/Involvement**
- **Illicit Discharge Detection/Elimination**
- **Construction Site Runoff Control**
- **Post-Construction Runoff Control**
- **Pollution Prevention/Good Housekeeping**

Although this document does contain a suggested timeline, the important regulatory timeline will be the one included in the Phase II Storm Water Management Program which must be developed by March 10, 2003 and approved by EPA Region 6.

The Phase II Storm Water Management Program must also include the following Measurable Goals for each of the Minimum Control Measures:

- **Objectives for development and implementation of each BMP**
- **Must describe specific BMP actions, frequency and dates**
    - **Time schedules for implementation**
    - **Activity level, frequency of actions**
    - **Milestones**
    - **May include quantitative measure of BMP**

Phase II Storm Water Deadlines:

- **March 10, 2003**
    - **Operators of "regulated MS4S must obtain permit coverage"**
    - **Notice of Intent (NOI) must include six minimum control measures (BMPs) and measurable goals**
    - **Separate NPDES permits for "industrial activities"**
- **December 2007**
    - **Regulated MS4s' program must be fully developed and implemented**

6 - The plan recognizes the need to develop cost effective BMP's for reduction of fecal coliform levels. This recognition did not carry over into the implementation schedule (Time Line).

NMED/SWQB Response

The Bureau recognizes that the 5-year timeline is ambitious but also recognizes that any implementation of BMPs will be outlined and incorporated into the EPA Phase II Storm Water Management Program. The EPA has required that the Phase II Storm Water Management Program must include the following six (6) Minimum Control Measures:

- **Public Education and Outreach**
- **Public Participation/Involvement**
- **Illicit Discharge Detection/Elimination**
- **Construction Site Runoff Control**
- **Post-Construction Runoff Control**
- **Pollution Prevention/Good Housekeeping**

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  - **Operators of "regulated MS4S must obtain permit coverage**
  - **NOI must include six minimum control measures (BMPs) and measurable goals**
  - **Separate NPDES permits for "industrial activities"**
- **December 2007**
  - **Regulated MS4s' program must be fully developed and implemented**

7 - The TMDL standards seem to exclude certain sources from consideration for treatment. If these sources are truly excluded, the pollutant contribution from these sources should still be monitored and the quantities should be excluded from any allocation by reach. The entities involved in bringing the Rio Grande into compliance with TMDL standards should not be held responsible for conditions that are not within their control.

NMED/SWQB Response

The Bureau strongly encourages the management agencies on this reach of river to coordinate any abatement or educational efforts undertaken in this process with the USEPA Region 6 Permits Section, affected municipalities, private landowners, the MRGCD as well as the Sandia and Isleta Pueblos.

8 – The section on calculations of river loading capacity starting on page 11 do not appear to subtract correctly from the allowed load. Known sources are also missing.

NMED/SWQB Response

The calculations have been checked and corrections have been made. The Bureau is not sure what is meant by missing known sources. Fecal coliform is not differentiated in the State's standards as to source.

The plan as proposed has several positive elements that we would like to see included in future versions, including:

1 - The plan acknowledges the need for cost effectiveness in implementation.

2 - The plan acknowledges the need to address the issue on a watershed basis, rather than at outfalls.

3 - The plan proposed seems to be proposed as a joint approach to solving a problem (though we question the magnitude of the problem and the methodology proposed for resolving it) as opposed to a command and control approach that has been tried in other areas of the country with limited success and much acrimony.

4 - The plan emphasizes voluntary participation and support.

5 - The plan recognizes the need for Federal cooperation with state and local agencies.

6 - The plan recognizes the need for assessment and evaluation of BMP's.

7 - The plan emphasizes the need for non-structural BMP's.

In conclusion, the DPW cannot endorse a plan that views storm-water as a source of fecal coliform, rather than a carrier. Any plan for reduction of fecal coliform in the Rio Grande must focus on reducing fecal coliform at the true source of the pollutant rather than at the discharge point of storm drainage systems. We would appreciate your consideration of our other comments in reevaluating this plan.

Please feel free to contact me with questions or comments at 505-891-5016.

Sincerely,

Kenneth W. Curtis III, P.E.
Public Works Director/City Engineer

cc: Mayor John M. Jennings

James Jimenez, City Administrator

David Stoliker, PE, Executive Director
SSCAFCA

Robert C. Schulz, P.E.
Project Manager, Department of Public Works

ENVIRONMENT DEPARTMENT of the
PUEBLO OF ISLETA
P.O. Box 1270, Isleta,NM 87022
Phone 505-869-5748 FAX 505-869-4236
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MEMORANDUM

TO: David Hogge, Environmental Specialist, SWQB - NMED

FROM: Jim Platt, Director

DATE: 6 November 2000

RE: DRAFT Middle Rio Grande TMDL

There are a number of issueswhich could be raised with the DRAFT. The Pueblo has chosen, however, to draw your attention to only one glaring error in the draft, one which seemingly undermines the entire proposal.

> **"New Mexico Water Quality Act does not contain enforceable prohibitions directly applicable to nonpoint sources of pollution."**

The above quote is directly contradicted by statutory language at 74-6-10. A. and 74-6-10.1 B. In both cases the violation of State water quality standards, **REGARDLESS OF SOURCE,** is deemed sufficiently egregious to result in administrative and/or civil penalties of up to $ 10,000 per day.

Language at 74-6-9. D. requires constituent agencies to seek voluntary compliance but there is nothing in the Act which prohibits enforcement against any point, **OR NONPOINT,** source resulting in water pollution. If the Water Quality Control Commission, or the New Mexico Environment Department, do not enforce in the face of known violations, it is because they choose not to but they are not prohibited from doing so.

NMED/SWQB Response

Isleta Pueblo is correct. The Water Quality Act authorizes a constituent agency to take enforcement action against any person who violates a water quality standard. The TMDL has been revised to reflect the law.

Governor
Stuwart Paisano
Lt. Governor
Victor Montoya
Treasurer

Box 6008
Bernalillo, New Mexico87004
(505) 867-3317

PUEBLO OF SANDIA

November 8, 2000

David Hogge, TMDL Coordinator

NEW MEXICO ENVIRONMENT DEPARTMENT
TMDL Development Section - Surface Water Quality Bureau
P.O. Box 26110
Santa Fe.- New Mexico 87502

RE: Middle Rio Grande *Total Maximum Daily Load (TMDL)* for Fecal Coliform in Storm Water Draft

Dear Mr. Hogge:

On behalf of the Pueblo of Sandia, please extend our appreciation to the New Mexico Environment Department for acknowledging our tribal waters in the development of the Middle Rio Grande TMDL.

My environment staff has reviewed the TMDL, and has the following comments and/or insertions.

1. The Executive Summary states that a "TMDL documents the amount of a pollutant a water body can assimilate without violating a state's water quality standards." Please include the wording "or Tribe's" Water Quality Standards.

NMED/SWQB Response

The language has been added to the sentence on page viii.

2. In the Executive Summary, the designated uses of this part of the Rio Grande are listed as a "limited warm water fishery with other designated uses of irrigation, livestock watering, wildlife habitat and secondary contact." In.addition, the Pueblo of Sandia has designated the following uses: primary contact ceremonial use, primary contact recreational use, and secondary contact recreational use.

NMED/SWQB Response

The Tribe's designated uses and standards have been added to the document on pages 6 and 7.

3. On page: 5, the following designated uses should be included, in Segment 2105.1: primary contact ceremonial use, primary contact recreational use, and secondary contact recreational use.

NMED/SWQB Response

See response to comment 2.

4. On page 5, the following fecal coliform standards should be included in Segment 2105.1, "the monthly geometric mean of fecal coliform bacteria shall not exceed 100/100ml; no single sample shall exceed 200/100 ml."

NMED/SWQB Response

See response to comment 2.

5. On page 5, the statement is made that, "The main contributor of fecal coliform and focus of this document is storm water," but the following sources are not listed or metioned as contributing to the load of Segment 2105.1: Arroyo Venada (north of Rio Rancho), Arroyo de la Baranca (near Rio Ranch WWTP #3), and the Corrales Siphon (near Rio Rancho WWTP #2 outfall). Please explain why these sources have not been included.

NMED/SWQB Response

Those storm water conveyances where fecal coliform data was collected were listed in the document. The State recognizes that there are more conveyances in the MRG and hope that the Phase II Storm Water Mangement Program will address all of them.

6. On page 5, the following statement is made, "There are six discreet concrete transports of storm water that enter the middle Rio Grande." Please identify the names and locations.

NMED/SWQB Response

There are 4 discreet, non-waste water treatment plant, conveyances to the MRG where fecal coliform data were available, they are: North Diversion Channel, San Jose Drain, South Diversion Channel and Tijeras Arroyo.

7. On page 13, under the waste load allocaton for the Rio Rancho WWTP #3 – (NM0029602) the document states "Remaining River Loading Capacity for Segment 2105." Is this "Segment 2105" correct? The definition on page 5, for Segment 2105.1 is defined "The main stem of the Rio Grande from Alameda Bridge (Corrales Bridge) upstream to the Angostura Diversion Works." The Rio Ranch WWTP #3 is located on the Segement 2105.1 as defined above.

NMED/SWQB Response

The corrections have been made.

8. On page 14, under the waste load allocation for the Rio Rancho WWTP #2 – (NM0027987) the document states "Remaining River Loading Capacity for Segment 2105." Is this "Segment 2105" correct? The definition on page 5, for Segment 2105.1 is defined "The main stem of the Rio Grande from Alameda Bridge (Corrales Bridge) upstream to the Angostura Diversion Works." The Rio Ranch WWTP #2 is located on the Segement 2105.1 as defined above.

NMED/SWQB Response

See response to comment 7.

9. Also on page 14, under the "Remaining River Loading Capacity for 2105" for the waste load allocation for Rio Rancho WWTP #2 -(NM002,7987) the -number 8.849 x I Oj' fcu/day is given. Please explain how these numbers were derived. The only number close is the "Remaining River Loading Capacity for Segment 2105. 1 " which is 8 * 849 x 10" on page 12, under Bernalillo WWTP (NM0023485). Should the number 8.88 x 10", the assimilative limit in the river at the 4Q3 low flow for Segment 2105.1 be used? If so, this would change the "Remaining River Loading Capacity for Rio Rancho WWTP #2 - (N-M0027987) to 8.873 x 10^{12}."

NMED/SWQB Response

See response to comment 7.

10. For segment 2105.1, the Pueblo of Sandia Water Quality Standards, "particular to a use, shall be protected at all times at low flow rates," as stated on page 2, of our EPA - approved Water Quality Standards. We do not need to recognize the 4Q3 low flow rate.

NMED/SWQB Response

The document recognizes that the Pueblo of Sandia Water Quality Standards must be met at all flow rates as do New Mexico's Surface Water Quality Standards. In order to calculate the assimilative capacity of the river, the State used the 4Q3 of the monsoon season in other words the lowest critical flow of the peak flow season.

11. On page 15, - under the "Remaining River Loading Capacity for 2105" for the waste load allocation for Albuquerque WWTP - (NM0022250) the number 8.568 x 10^{12} fcu/day is given. Please explain how this number was derived.

NMED/SWQB Response

See response to comment 7.

12. The pictures on pages 50, 53, and 60, are not identified. A caption would be helpful to those persons unfamiliar with the area. Such as, "aerial view of .....," would suffice.

NMED/SWQB Response

Captions have been added to the pictures where the description is not evident.

13. On page 59, the sample result for the sample taken on June 2, 2000 is zero (0). Was this value actually zero (0) as stated or was the value below the laboratory detection limit for fecal coliform? If it was below the fecal coliform detection limit, this zero (0) value should be stated or expressed as less that (<) the fecal coliform detection limit or as a data qualifier with the detection limit.

NMED/SWQB Response

The Bureau is assuming that the actual count was zero since no other values have been entered as less than on any of the reporting sheets.

Your attention to this matter is greatly appreciated. If you have any questions or concerns, please contact Beth Janello, environment director of my staff at (505) 867-4533.

Sincerely,

Stuwart Paisano
Governor

BJ/ect

cc: Bill Hathaway, Bureau Chief, Surface Water Division, USEPA Region 6
Jim Davis, Surface Water Bureau Chief, NM Environment Department
Scott Bulgrin, Pueblo of Sandia, Water Quality Officer
Diane Evans, U.S. EPA Region 6
Beth Janello, Pueblo of Sandia, Environment Director
File

Middle Rio Grande Water
Assembly, Meetings : 24
July and 8 August.

These Meetings were excellent and we have discussed a multitude of problems related to our limited water supply. NOW we need : STATE, COUNTY, and CITY LEGISLATORS to attend and TAKE ACTION to prevent a WATER DISASTER !

NOW it is time to put forward SOLUTIONS:

THE MIDDLE RIO GRANDE VALLEY COMMUNITIES HAVE A NUMBER

OF SERIOUS PROBLEMS

1. WATER SHORTAGE !

2. WATER POLUTION !

3. AIR POLUTION !

4. TRAFFIC CONGESTION !

ALL AGGREVATED BY UNCONTROLLED GROWTH ! AND

5. THE NEW MEXICO STATE HIGHWAY and TRANSPORTATION DEPT., THE FEDERAL HIGHWAY ADMINISTRATION, PARSONS BRINCKERHOFF CORPORATION AND LAND SPECULATORS APPEAR INTENT ON BUILDING A UNNEEDED $ 52,000,000. EAST-WEST ROADWAY AND BRIDGE.

WHEREAS

6. THERE IS A TREMENDOUS NEED FOR NORTH-SOUTH HIGHWAY IMPROVEMENT !

A good start on item #6 would be to widen 314 and 45 from Los Lunas to Old Coors, and 47 from Rio Communities to the junction of 6 and 47,(some of this is already in progress).

There are number of ways to attack problem #1:

a. Pass laws to Contol Growth to match the available Water.

b. Limit density by reducing the number of dwellings per acre in all new construction.

c. Limit new Business / Industry to water efficient Co.

d. Provide Tax incentives to Businesses that significantly reduce their water consumption.

e. Provide stiff fines on Water Wasters!

f. Fund projects that cut water consumption by 50% or more. (Such as pipe irrigation systems vice open dirt ditch).

g. Provide Tax break or rebate to home owners that replace inefficient washing machines and dish washer that use large amounts of water, (50 gal per load), with new 30 gal or less per load units. Old toilets could fall into this catagory.

h. New golf courses must use only Reclamed Water. Existing golf courses should be checked to see if it is economically possible to convert them to reclamed water.

i. Many Restrooms in Albuquerque and surounding Communities have running toilets and or leeking faucets these should be found and corrected when ever they occur !

This Would Be A Good Beginning ---- STILL MUCH TO DO !!

NMED/SWQB Response

The Bureau appreciates the time and effort that you have put into local water issues and would encourage you to continue to voice your concerns.

Evelyn Salce Curtis Losack
5606 Corrales Road
Corrales, New Mexico
87048

October 6, 2000
New Mexico Environment Department
726 East Michigan Drive
Hobbs, New Mexico 88240

Dear Sirs: SURFACE WATER QUALITY BUREAU

Please take into account a sense of the history of the people who have lived near the Rio Grande.

All things change, yes, but in the case of water, to whose advantage?

People's welfare we should all honor. New Mexico's desert we should all accept. Overpopulation of this desert we should and must curtail.

We all need to make sacrifices to share our limited water - people with their wasteful water appliances and facilities. Industry that doesn't recycle enough yet brings in more people for more houses (i.e., Intel in. Rio Rancho), recreational facilities, poorly planned parks that don't use recycled (gray) water (especially golf courses). The bosque's growth of noxious trees and weeds (elms and cedar) that use a larger percentage of water than the few remaining farmers of New Mexico, and foremost, the exploitive developers that are insensitive to what are the limitations of New Mexico's water supply.

The Fish and Wild Life Bureau should think about making the clearing of the riparian along the Rio Grande and killing of the predatory ~~the~~ carp that feast on minnows their first agenda.

The Forest Guardians, to show their sincerity, might consider their help with the clearing.

The valley users of water that sprinkle drinkable groundwater instead of the irrigation water to which they should have access should be stopped. We will all pay the price for the overuse of our aquifer.

Our family has pursued farming orchard, vineyard, and animal husbandry since 1869. The conquistador families and those land grant Spanish families of Corrales have survived by agricultural use of their lands at least since 1712. Many have lost their holding in part because of the taxes levied since 1934 for the water structure improvements.

Some of our families have foolishly pursued gardens and orchards with the ideal of contributing to the food supply and environment. For our family, we foolishly have done this at great expense of our resources and health. Bear in mind our fields and trees are the lungs of the valleys and our irrigations the cleansing of ground water through percolation, which does recycle back into Corrales' clear drainage ditches.

Please remember that people gave up land for 466 acres of the Corrales bosque alone and 6 ditches (3 irrigation and 3 drainage) for the common good. We have deeds to show that if we were not assured of flood-control, drainage and irrigation structures, that those of us still bordering those waterways would be granted back land if said structures were abandoned. Again I repeat many of your Bureaus don't have an honorable or respectful sense of the history.

Just remember that our country is loosing 500 family farms a day. From the lack of understanding and support by most New Mexicans, expect the few remaining farmers, orchardists and animal husbandry families to be a thing of the regrettable past. We should all be wary of the hidden agendas of all.

For bona fide productive and efficient farms, thank you.

Sincerely,

Evely Salce Curtis Losack

C: Surface Water Quality Bureau
Middle Rio Grande Council of Governments
Middle Rio Grande Conservancy
Fish and Wild Life
Forrest Guardian
Cuidad Soil and Water Conservation District

Dear Mr. Hogge,
Thanks for the e @ the end of your name, opps! Forest Guardians is John Horning. As you can tell this water situation is that, a situation we're all going to have to face, but please don't make agriculture the bad group. We're assailed by far to much distruction forces already. It isn't a matter to dismiss with an Oh Well! We deserve commendation not condemnation. Thanks, E.L

897-3672

NMED/SWQB Response

The Bureau appreciates the time and effort that you have put into local water issues and would encourage you to continue to voice your concerns.

Southern Sandoval County
Arroyo Flood Control Authority

David Stoliker
Executive Director

October 11, 2000

David Hogge, TMDL Coordinator
TMDL Development Section
Surface Water Quality Bureau
New Mexico Environment Department
P.O. Box 26110
Santa Fe, New Mexico 87502

Re: Middle Rio Grande TMDL Comments

Dear Mr. Hogge:

I am receipt of your Middle Rio Grande TMDL Proposed rule. As requested, I have briefly reviewed the document and I have several comments for your review and incorporation during this process.

1. Treatment of storm water run-off is an extremely expensive option. On page 1, your report quoted from a 1979 report that, "...impounding and disinfecting run-off waters to reduce bacteria densities to levels compatible with the existing stream standards is not a reasonable alternative". Yet, on page 20 of your report, it states, "Structural BMP's should be used when it is determined that they will be 'cost effective'. Further discussion in the report identifies BMP's to include impounding and disinfecting and beyond, up to advanced treatment options. It appears that the earlier studies may have been ignored in developing this TMDL rule. Can you please comment on this.

NMED/SWQB Response

On page 27 of this document, the Bureau has incorporated the following language to clarify the intent of the Bureau. Phase II of the federal Storm Water Management Program would be the venue in which BMPs are planned for and implemented:

Implementation Approaches

Storm Water BMP Approaches and Cost Estimates

This section is meant to highlight approaches and estimated costs associated with the implementation of certain BMPs. The entire section was taken from a newsletter titled, ***Stormwater Runoff Water Quality Science/Engineering Newsletter, Urban Stormwater Runoff Water Quality Management Issues***, Volume 3, Number 2, May 19, 2000. The New Mexico Environment Department, Surface Water Quality Bureau does not endorse nor does it take any position in favor of one BMP over another for storm water management.

2. The cost for treating the flow from just one of the arroyos in the SSCAFCA area, the Montoyas Arroyo, is enormous, both in capital investment and operating expense. The Montoyas Arroyo receives storm water runoff from approximately 56 square miles of watershed. Recent modeling has indicated that a single 100-year rainfall event (the standard for storm water facilities design for flood protection) will generate a maximum flow of 5,860 cubic feet per second (CFS) with a total runoff volume of over 545,000,000 gallons. Using a capital cost of $1.00 per gallon treated (an accepted budgeting cost for basic treatment plant construction) results in a total capital cost of over $500 million to treat the storm water to achieve the desired Fecal Coliform levels. Further, this $500 million investment would sit idle the vast majority of the time, as storm events are very infrequent in the southwest. Using an annual O & M cost of $0.20/1000 gallons (again, an accepted budgeting cost for basic O & M) would require over $100,000 per year.

NMED/SWQB Response

See response to comment 1.

3. Your assumptions identified fecal coliforms as a "conservative pollutant" on page 9. However, degradation of fecal coliforms has been documented. Therefore, I do not understand your use of this definition.

NMED/SWQB Response

Fecal coliform is being treated as a conservative pollutant in this document due to the fact that exceedences of standards (both State and Tribal) occur mainly during storm events which result in high concentrations of fecal coliform. The Bureau recognizes that fecal coliform bacteria die off after storm events but the applicable standards do not allow for a storm event variance.

4. The BMP treatment options identified do not take into account the type of storm event we experience in the southwest. The storm events are of higher intensity and shorter duration than back east, and the soils do not readily adsorb the moisture. Therefore the run-off generated is greater and the cost estimates presented in the draft TMDL appear unreasonably low.

NMED/SWQB Response

See response to comment 1.

5. It does not appear that your BMP cost estimates include right-of-way acquisition. Right-of way for either media filtration or retention would be considerable, in an area where land cost are high. Therefore, I believe that right-of-way acquisition cost estimates must be included to present the full picture of economic impacts.

NMED/SWQB Response

See response to comment 1.

Southern Sandoval County Arroyo Flood Control Authority
4200 Meadowlark S.E., Suite 6 Rio Rancho, New Mexico 87124

(505) 892-5266 FAX (505) 892-7241

6. Extended detention of storm water run-off appears contrary to the State Engineers requirement that the storm water shall not be detained for more than 96 hours without a variance from the SEO. I believe this issue must be addressed both technically, as to how much detention is needed to reduce the Fecal Coliform to acceptable counts, and in terms of regulations, as to what the State Engineer's position would be.

NMED/SWQB Response

See response to comment 1.

7. The Implementation Plan section, page 20, states, "Structural BMPs should be used when it is determined that they will be cost effective". Who will identify and assess the cost effectiveness of a BMP? Who will quantify the "benefit" of reducing Fecal Coliform to allow for a cost effectiveness determination?

NMED/SWQB Response

See response to comment 1.

8. The draft TMDL has identifies major sources of pollution. These sources could and should be addressed as point sources, whenever possible. Addressing the pollution at the point source is the least costly solution and correctly assigns the cost to the producer of the pollution, thus saving the general public from bearing the cost for those polluters.

NMED/SWQB Response

The following is a definition of a point source:

Pollutant loads discharged at a specific location from pipes, outfalls and conveyance channels from either municipal wastewater treatment plants or industrial waste treatment facilities.

The following is a definition of what is considered to be a non point source:

Pollution that is not released through pipes but rather originates from multiple sources over a relatively large area. Non point sources can be divided into source activities related to either land or water use including failing septic tanks, improper animal-keeping practices and urban and rural runoff.

9. Storm water is only a transport mechanism for pollutants. Again, shouldn't the pollution be addressed at the source? It is my understanding that current laws and regulations exist to control animal waste (i.e., it is a zoning enforcement issue to address animal waste disposal).

NMED/SWQB Response

You are correct and additional clarifying language has been added on pages 8 and 9 of this document.

10. An additional source of pollution not clearly identified in the TMDL might be the septic tanks/leaching fields, particularly those located in the middle Rio Grande valley. Experience suggests that some septic systems may be illegally discharging directly to the Riverside Drain. Have you assessed the potential impacts from this source? Would it not be more cost effective to address this issue prior to implementing storm water treatment? Has the true source of the Fecal Coliforms been identified?

NMED/SWQB Response

Additional "sources" language has been added on pages 7-9 of this document. With respect to agricultural return flows, the following federal and state exemptions apply:

The CWA states at 33 U.S.C. § 1342(l) that the United States Environmental Protection Agency (EPA) "shall not require a permit under this section for discharges composed entirely of return flows from irrigated agriculture, nor shall [EPA] direct or indirectly, require any State to require such a permit." Likewise, the Water Quality Act states the Water Quality Control Commission "shall not require a permit respecting the use of water in irrigated agriculture, except in the case of the employment of a specific practice in connection with such irrigation that documentation or actual case history has shown to be hazardous to public health or the environment . . . ." § 74-6-4(K) NMSA 1978 (2000 Repl.).

Both State and Tribal standards do not require the delineation of fecal coliform bacteria sources. In other words, all fecal coliforms are treated equally. The Bureau would support a bacteria source tracking (BST) study to delineate the fecal coliform sources in the MRG for the purposes of targeting implementation dollars.

11. Storm water run-off and its associated infrastructure (e.g., arroyos) serves many functions. Who will assess the negative effects of each treatment option on the function of the arroyos and the impacts on the river system such as sediment transport, ground water recharge and degradation and/or aggradation of the Rio Grande?

NMED/SWQB Response

See response to comment 1.

12. Why is this TMDL rule only for a limited portion of the middle Rio Grande? Hydrologically, this watershed has been clearly identified by many others, including the US Corp of Engineers and USGS, to extend from the Cochiti outfall to Elephant Butte, including the Pueblos. I would ask for inclusion of this entire area prior to adoption of this rule. To do otherwise may end up pitting one group against another or possibly missing the true source of a particular pollutant. Additionally, this may appear as discriminatory against the non-indian population.

NMED/SWQB Response

This reach of river was required to have a TMDL written for it under the schedule set forth in the federal court monitored consent decree (<u>Forest Guardians and Southwest Environmental Center v. Carol Browner, Administrator, U.S. Environmental Protection Agency</u>, Civil Action No. 96-0826 LH/LFG). In addition, the EPA requires the State to limit those waterbodies on its 303(d) list to only those where it has jurisdiction and not to include those waters wholly under Tribal jurisdiction. The Rio Grande from Cochiti Dam to the Angostura Diversion Works will be studied as part of the upper Rio Grande survey in 2001. The Rio Grande from the southern border of Isleta Pueblo to Elephant Butte will be studied as part of the lower Rio Grande survey tentatively scheduled for 2002. As with any other reach of river, if the surveys show exceedences of applicable water quality standards, a

13. You state on page viii of the Executive Summary that this part of the Rio Grande is designated for use as a "warm water fishery, irrigation, *livestock watering, wildlife habitat* and secondary contact". On page 5 of the TMDL significant sources of Fecal Coliform, bacteria are identified as livestock/domestic animals and wildlife. If point sources are currently regulated and livestock and wildlife habitat are allowable uses, are you not limiting the use of this resource below that for which it was legally intended. What is the possibility of raising the stream standard to provide for allowable uses? I would note that the stream standard changes at the Alameda bridge from 400 Fecal Coliforms to 2000 Fecal Coliforms, for a single sample only. Is this good science and does it truly reflect what is happening in the environment?

NMED/SWQB Response

Any private or public entity can petition the WQCC at any time to have surface water quality standards changed. Sandia Pueblo petitioned the State to have the reach north of Alameda Bridge changed to make the standard more stringent and the WQCC adopted the standard. The TMDL document is required to be written to protect the most current and protective surface water quality standards on the affected waterbody.

14. I would like to offer one additional BMP and that is education. If we are contemplating treating millions of gallons of storm water, at a considerable cost to local taxpayers, an education program directed towards the sources of Fecal Coliform may be effective in reducing these counts prior to investing in treatment. I believe this avenue should be incorporated in you approach.

NMED/SWQB Response

The Bureau agrees that education will be key in the success of any attempts to abate fecal coliform loads to the MRG. The Bureau suggests the EPA incorporate this approach into the Phase II Storm Water Management Program due March 10, 2003.

15. The implementation plan is also of concern. What if education is the key and it accomplishes the necessary reductions? Will BMP's be required? I would suggest that a program be established prior to the implementation of this rule to allow for the following:

1. Inclusion of all sources of the Fecal Coliforms.
2. Identification/quantification of the true source(s) of the Fecal Coliforms.
3. Investigation into what regulatory mechanisms currently exist to control identified sources of the Fecal Coliforms and what reductions are possible.
4. Inclusion of all potential sources into the TMDL rule, including uncontrollable sources.
5. Quantification/allocation of identified uncontrollable sources of the Fecal Coliforms.
6. Reassessment of the current standards to allow for uncontrollable sources, regulated sources and unregulated sources of Fecal Coliforms.

NMED/SWQB Response

See response to comment 1.

16. Quantification or assessment of the benefits to be derived by SSCAFCA constituents from funding the effort to reduce the Fecal Coliform levels in the Rio Grande is also necessary.

NMED/SWQB Response

See response to comment 1.

17. It appears that, in preparing the TMDL, many potential sources of contamination were not identified such as the MRGCD ditches and drains, and runoff from systems outside of AMAFCA. For this reach of the Rio Grande the most significant livestock operations appear to be the Pueblos. Why were these not included? Is the credibility of the TMDL diminished by overlooking these additional sources?

NMED/SWQB Response

See response to comment 10.

18. I appreciate that the TMDL report suggests a program of voluntary compliance, but the document does not appear to provide an assessment and review period for each implemented item. I believe that this should be done. Further, many regulations have begun as "voluntary" only to be incorporated into regulations in subsequent years. I believe that your intentions in this regard should be clearly stated.

NMED/SWQB Response

See response to comment 1.

19. Because of the potential impact of these rules, I am requesting a 90-day extension for further review by the SSCAFCA Board and its technical staff. Further comments may be brought forth at that time.

NMED/SWQB Response

A 30-day extension was agreed upon by the State and affected stakeholders and granted by the WQCC.

SSCAFCA strongly supports protection of water quality where benefits can be demonstrated and a process of addressing improvements in a cost-effective manner is implemented. This TMDL program appears to do neither.

David Stoliker, PE
Executive Director

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November 9, 2000

Honorable Peter Maggiore
Secretary, New Mexico Environment Department
Chairman, New Mexico Water Quality Control Commission
Harold S. Runnels Building
1190 St. Francis Dr.
Santa Fe NM 87502-0110

Re: *Comments on Draft Middle Rio Grande TMDL for Fecal Coliform*

Dear Secretary Maggiore:

This letter provides comments on the draft "Middle Rio Grande Total Maximum Daily Load (TMDL) for Fecal Coliform in Storm Water." This letter was developed by, and represents the concerns and positions of, the City of Albuquerque (City), the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA), Bernalillo County, and the New Mexico State Highway Transportation Department (the "Stakeholders"). We are applicants for various Municipal Separate Storm Sewer System (MS4) permits to be issued by the federal Environmental Protection Agency (EPA) under the National Pollutant Discharge Elimination System (NPDES) program of the federal Clean Water Act (CWA). The City and AMAFCA applied to EPA for a MS4 permit in 1992. Additional information in the form of a final biological assessment was provided to EPA in June of 1999 and a final biological assessment in July of 2000. To date, no MS4 permit has been issued to the City or AMAFCA. As applicants for these MS4 NPDES permits, we have a critical interest in the outcome and implementation of the proposed TMDL regulation. Our primary technical, policy, and legal concerns are addressed in the letter.

Development and application of TMDLs for the middle Rio Grande is an extremely complex and complicated undertaking. It is critical that the Stakeholders be afforded full opportunity to participate in the entire process and that the process of TMDL development and implementation account for the effects of the regulations on Stakeholder operations, mandates, and obligations.

The Stakeholders look forward to cooperatively working with the New Mexico Environment Department (NMED) to revise the proposed TMDL rule consistent with our request to postpone submittal of the middle Rio Grande Fecal Coliform TMDL to EPA in order to revise the rule during 2001.

EXECUTIVE SUMMARY

The Stakeholders recognize and support the need to develop TMDLs for impaired water bodies such as the middle Rio Grande. The Stakeholders share much concern and uncertainty, however, that as proposed, the middle Rio Grande TMDL for fecal coliform will result in impracticable regulatory requirements that are outside the permissible scope of state and federal law. While the commenters understand the legal requirement for the NMED to promulgate the TMDL, we also recognize that final agency action on the TMDL by the NMED and the New Mexico Water Quality Control Commission (WQCC), and subsequent administrative action by the federal Environmental Protection Agency, will substantively impact our legal rights and duties.

As a general matter, these comments establish on the administrative record the Stakeholders' concerns that the TMDL must reflect sound science and methodologies, and that the TMDL must be implemented in a manner that complies with state and federal law.

Our comments on the draft TMDL are presented in four sections. Section 1 is a brief overview of the North Diversion Channel and its relationship to the Rio Grande. Section 2 is a review and evaluation of TMDL process as it has been applied to the middle Rio Grande for fecal coliforms. This section sets forth the concerns of the Stakeholders with regard to the legal and scientific basis under which the TMDL was developed. Section 3 provides implementation and process steps to achieve the stated objectives of the TMDL report, and Section 4 summarizes a set of alternative approaches and useful background information to address human health concerns and protection in the middle Rio Grande. An appendix providing detailed information on alternative approaches is attached.

The remainder of this Executive Summary sets forth specific points addressed in Section 2 of our comments.

Section 2 – Point 1 – The Proposal Must Not Establish a Basis for Numerical WQBELs

Although the EPA has previously opted NOT to require or enforce numeric standards in relation to municipal stormwater sources, the effect of the proposed TMDL for fecal coliforms will be the imposition of a numeric standard.

It is critical that the TMDL be reformatted to ensure that the load allocations will not be imposed as numerical Water Quality Based Effluent Limitations (WQBELs) in federal MS4 NPDES permits. This issue is especially important given the fact that the Pueblo stream use designations and resultant water quality standards, which in part form the basis of the TMDL, are *physically unattainable* when expressed as numeric WQBELs. These comments discuss briefly the mediation process that the Stakeholders hope will resolve the Pueblo water quality issues that impact this rulemaking.

Irrespective of the Pueblo water quality standards, for the purposes of the present comments, the Stakeholders strongly believe that the proposed regulation must make it clear that for MS4 NPDES facilities, the TMDL will be implemented through Best Management Practices (BMPs), not numeric WQBELs. With respect to specific BMPs, the Stakeholders believe that NMED should conduct a more robust analysis of the actual cost and effectiveness of the available BMPs. Evaluation of additional BMPs would also be productive and innovate solutions may be identified. This cost-benefit analysis should be incorporated into regulatory decisions regarding what BMPs are appropriate.

NMED/SWQB Response:

On page 27 of this document, the Bureau has incorporated the following language to clarify the intent of the Bureau. Phase II of the federal Storm Water Management Program would be the venue in which BMPs are planned for and implemented:

Implementation Approaches

Storm Water BMP Approaches and Cost Estimates

This section is meant to highlight approaches and estimated costs associated with the implementation of certain BMPs. The entire section was taken from a newsletter titled, *ASCE, **Storm Water Runoff Water Quality Science/Engineering Newsletter, Urban Storm Water Runoff Water Quality Management Issues***, Volume 3, Number 2, May 19, 2000. The New Mexico Environment Department, Surface Water Quality Bureau does not endorse nor does it take any position in favor of one BMP over another for storm water management.

In addition, on pages 8 and 9 of this document the following section was inserted:

Storm Water Discharges

Point source storm water discharges from municipal separate storm sewer systems (MS4s) are regulated under the national Pollutant Discharge Elimination System (NPDES). MS4s serving a population of 100,000, or more, currently require NPDES storm water permits. Smaller MS4s, in urbanized areas will require NPDES permits starting in March 2003. Therefore, storm water discharges in this TMDL will be assigned a waste load allocation.

Numerical targets for storm water conveyances are established by this TMDL. However, EPA has recognized that numeric limitations for storm water permits can be very difficult to develop at this time because of the existing state of knowledge about the intermittent and variable nature of these types of discharges and their effects on receiving waters during storm events (EPA 1998).

EPA has found that although NPDES permits must contain conditions to ensure that water quality standards are met, this does not necessarily require the use of numeric water quality-based effluent limitations and therefore the permitting authority has some flexibility in establishing permit conditions.

Storm water discharges are highly variable both in terms of flow and pollutant concentrations, and the relationship between discharges and water quality can be complex (EPA 1998). EPA's interim permitting approach for NPDES storm water permits establishes the use of best management practices to provide for the attainment of water quality standards through a combination of source reductions and structural controls. In addition, storm water permits include coordinated monitoring efforts to gather necessary information to determine the extent to which the permit provides for attainment of applicable water quality standards and to determine the appropriate requirements of subsequent permits. This monitoring may include ambient receiving stream water assessments in addition to discharge monitoring to gather this information.

Section 2 – Point 2 – Fecal Coliform Sources Should be Better Quantified

Complicated issues associated with the mixing of stormwater and agricultural waters are not addressed in the draft TMDL. Because of the nature of water management in the middle Rio Grande, this issue must be addressed before TMDLs are imposed on these river segments. This is particularly true in the southwest quadrant of the metro area.

Contributions to fecal coliform loads in the middle Rio Grande include sources from Department of Defense, Department of Energy, and Department of Agriculture (Forest Service) lands. These sources are not adequately quantified in the Draft TMDL report.

A significant portion of the Albuquerque metro area is not discussed in the draft TMDL. The entire northwest quadrant of the City is left out of the discussion. This area, and a significant portion of the City of Rio Rancho and the unincorporated area of Sandoval County, discharges to a series of outfalls to the Rio Grande between the Alameda Street Bridge and the Central Avenue Bridge. This total drainage area, most of which is undeveloped, exceeds 150 square miles. Background fecal coliform counts for undeveloped watersheds through the middle Rio Grande exceed the proposed TMDL limitations.

Loading capacity for the river is based on “critical low flow” and stormwater runoff waste load allocation is based on “mean annual maximum flow.” Using the mean annual maximum flow results in an annual flow volume approximately 25 times greater than the actual average flow volume. The loading capacity of the river is underestimated by a similar order of magnitude. The result of these assumptions is a flawed rule.

NMED/SWQB Response:

Additional “sources” language has been added on pages 7-9 of this document.

The following language can be found on page 14 of this document.

River Hydrology

The United States Geological Survey (USGS) Gage, **Rio Grande at Albuquerque (08330000)**, was used in this document to calculate the critical low flow condition or 4Q3 of the peak flow, from 1992-~~1997~~ 1999 and for the months of May through September. The critical low flow of a stream at a particular site shall be the minimum average four consecutive day flow which occurs with a frequency of once in three years (4Q3). Critical low flow values may be determined on an annual, a seasonal or monthly basis, as appropriate, after due consideration of site-specific conditions. The Hydrotec© computer program was used to calculate the 4Q3 of the peak seasonal flow (May through September) value of ~~363~~ 376 cubic feet per second (cfs). The reason this value was used was to be protective of the lowest flow during the peak flow season. The USGS gage at Albuquerque is above the discharge of the Albuquerque WWTF therefore, an additional 117 cfs will added to the river below the WWTF discharge to bring the 4Q3 value to ~~480~~ 493 cfs from the WWTF discharge down to the Isleta Diversion Dam.

Section 2 – Point 3 and Point 4 – Fate and Transport Should be Accurately Reflected and Critical Flow Periods Must be Adequately Defined

The Stakeholders believe that the proposed TMDL must be revised to account for seasonal flow variations with respect to fecal coliform loadings. Additionally, the TMDL should be re-evaluated to more accurately identify and quantify sources of fecal coliform loadings in the middle Rio Grande. The rule should also more accurately characterize the fate and transport of the pollutant, and the actual impact on designated stream uses, particularly human health.

NMED/SWQB Response

See response to point 2.

Section 2 – Point 5 – Margin of Safety Issues Must be Adequately Defined

NMED should use margin of safety calculations (MOS) which most accurately reflect the best science available or reasonably attainable. The MOS issue should be revisited to ensure that it reflects existing conditions.

NMED/SWQB Response

On page 27 of this document, the following language describes the Bureau's logic in its use of an implicit MOS. The use of an implicit MOS was predicated on the known seasonal inputs into the river, the abundance of data and the use of the most conservative flow numbers available for the calculations (4Q3 of the peak storm

water flows). The Bureau does not believe that any additional allocation needs to be made to MOS at this time.

Margin of Safety (MOS)

Significant conservative assumptions have been used in developing these loading limits. These include:

- use of the 4Q3 minimum peak flow for river loading assumptions,
- treating fecal coliform as a conservative pollutant, that is a pollutant that does not readily degrade in the environment,
- use of the design flow for calculation of WWTF contributions,
- use of the mean annual maximum flows and extremes for the period of record for storm water inputs

No additional explicit margin of safety will be applied in calculation of this TMDL.

Section 2 – Point 6 – State and Pueblo Standards Disparity Must Be Resolved

The New Mexico Water Quality Standard for Fecal Coliform and the Sandia Pueblo Water Quality Standard for Fecal Coliform differ substantially. The fact that the Pueblo standards are not practicably attainable poses a serious problem for the TMDL implementation. The Stakeholders believe the best way to resolve this difficult problem is through a mediated solution. We appreciate the ongoing efforts of the State and Pueblo to address the issue.

NMED/SWQB Response:

As of the writing of this response, the Pueblos on this reach of the Rio Grande have indicated publicly that the designated use of primary contact ceremonial and the associated standard for fecal coliform of 100 cfu/100ml will not be changed at this time. Accordingly, the appropriate Pueblo standard was used in writing the TMDL.

Section 2 – Point 7 – Structural BMPs May Not Be Appropriate

Voluntary incentive based approaches at the state or local level should be used to implement management practices for controlling municipal stormwater discharges. Therefore, “structural BMPs” may not be appropriate in the context of the proposed TMDL.

NMED/SWQB Response:

On page 27 of this document, the Bureau has incorporated the following language to clarify the intent of the Bureau. Phase II of the federal Storm Water

Management Program would be the venue in which BMPs are planned for and implemented:

Implementation Approaches

Storm Water BMP Approaches and Cost Estimates

This section is meant to highlight approaches and estimated costs associated with the implementation of certain BMPs. The entire section was taken from a newsletter titled, ***ASCE, Stormwater Runoff Water Quality Science/Engineering Newsletter, Urban Stormwater Runoff Water Quality Management Issues***, Volume 3, Number 2, May 19, 2000. The New Mexico Environment Department, Surface Water Quality Bureau does not endorse nor does it take any position in favor of one BMP over another for storm water management.

Section 2 – Point 8 – Cost Benefit Analysis Must be Factor

Cost estimates for implementation of the actions required to meet the requirements of the proposed TMDL are significant. Additional analysis is required.

NMED/SWQB Response

See response to point 7.

Section 2 – Point 9 – Use Attainability Must be Addressed in the TMDL Process

The Stakeholders believe that a reevaluation of the use attainability analysis must be completed to accurately reflect existing conditions in the middle Rio Grande.

NMED/SWQB Response:

The TMDL is written for fecal coliform which is consistent with EPA and NMED policy for addressing the constituents that are causing impairment of the designated uses of the water body. This document was developed to be protective of current water quality standards and designated uses on this reach.

Section 1 – Background information on the north diversion channel and flood conveyances

Stormwater management and conveyance in the Albuquerque metropolitan area is comprised of several large basins. Two of the largest features of this system are the North Diversion Channel and the South Diversion Channel. These channels intercept runoff from the mountains, municipal Albuquerque, areas east of the City, and the East Mesa and convey it to the Rio Grande. The North Diversion Channel is the largest of the urban basins in the stormwater conveyance system, encompassing approximately 92 square miles. Of the 92 square miles, approximately 10 percent are either U.S. Forest Service land or Pueblo land. The remaining 83 square miles constitutes less than half of the urbanized area in Bernalillo County. These numbers reflect not only the extent of the contributing sources of pollutant load to the middle Rio Grande but the extreme complexity of the relationship between the Rio Grande and stormwater runoff and management [Final Biological Evaluation. National Pollutant Discharge Elimination System (NPDES) Permit for the Albuquerque Municipal Separate Storm Sewer System (MS4). City of Albuquerque, AMAFCA, University of New Mexico, and New Mexico State Highway Transportation Department. June 2000]

Throughout the metropolitan area, the remainder of the stormwater conveyance system is comprised of the South Diversion Channel which has a drainage area of approximately 11 square miles, and is predominantly commercial and residential; the San Jose Drain which has a drainage area of approximately 2 square miles; the City of Albuquerque lift stations on the east side of Albuquerque which drain an area of approximately 3.8 square miles; the Mariposa Diversion; and several other smaller drainages (Mirehaven, Ladera and Rinconada Arroyos) the southwest area , the North Valley Area, the South Tramway Area, the Northwest Area, the Northeast Floodway Area, the San Jose Area and the South Diversion Area. Based on the diversity of sources and uses, it is apparent that additional study and documentation is required to adequately and accurately assess not only fecal coliform sources (drainages) but also fecal coliform species loads. We believe this information is essential to completing a TMDL process that will afford the desired level of protection for the designated uses of the middle Rio Grande.

Section 2 tmdl process and evaluation

Point 1 The Proposal Should Not Use A Numerical Basis for WQBELs in MS4 Permits
The Stakeholders are concerned that NMED's proposal will be interpreted to provide the basis for imposing numerical WQBELs into their MS4 permits and require strict compliance with State and Pueblo water standards. Such a result would violate the federal Clean Water Act and contravene existing administrative practice. Therefore, the Stakeholders are concerned that without clarification with respect to MS4 sources, the TMDL's present approach is arbitrary, capricious, and otherwise not in accordance with law.

The difficulty in the present proposal lies in both the expression of the TMDL wasteload allocation and in the narrative of the implementation plan. First, with respect to the expression of the TMDL wasteload allocation, the proposal seems to contemplate a numeric limitation. Specifically, for each of the proposed MS4 stormwater TMDL allocations, the proposal states that "[u]nder the conditions of the TMDL the permittee will be required to meet segment fecal coliform standards after final treatment." (*Proposed TMDL at p. 13*) The Stakeholders are very concerned that NMED interprets the TMDL as something more than an element of its Water Quality Management Plan, which is limited under applicable law. Rather, NMED appears to interpret the TMDL as the basis for numeric effluent limitations that will become enforceable MS4 permit terms.

The proposal's implementation plan discussion does little to dispel our concerns. While the proposed implementation plan speaks of implementing the TMDL through BMPs, there is no specific statement that the TMDL will not generate numeric WQBELs in MS4 permits that will require strict compliance with State and Pueblo water quality standards. To the contrary, NMED states that "[a]s a part of the reissued NPDES permit the permittee will be required to conduct regular compliance monitoring and report this information to the SWQB and EPA through Quarterly Discharge Monitoring Reports." *Proposed TMDL at 31.*

The Stakeholders believe that such a numeric WQBEL approach for implementing the TMDL in MS4 permits would represent an arbitrary departure from the requirements of the federal Clean Water Act and long-standing administrative practice. Municipal stormwater discharges originate as non-point, or "diffuse" runoff. Such sources of water pollution are appropriately controlled by BMPs, not WQBELs that are applied to industrial discharges.

This distinction between discharges from diffuse runoff and discharges from point sources recognizes the limits of practicability of controlling diffuse sources. The distinction is one that finds support in the federal Clean Water Act, which distinguishes between WQBEL requirements for "point sources" of pollution under § 301 and TMDL limitations under § 303 and MS4 discharges under § 402(p)(3). The legal distinction between these two types of effluent limitations was confirmed as a jurisdictional matter in *Longview Fibre Company v. Rasmussen, 980 F.2d 1307 (9th Cir. 1992)*.

Importantly, the legal distinction as a *practical* matter was recently resolved in *Defenders of Wildlife v. Browner, 191 F.3d 1159 (9th Cir. 1999)*. That case addressed

MS4 NPDES permits for the Arizona municipalities of Tempe, Tucson, Mesa, and Phoenix, and Pima County. Those entities obtained MS4 permits that did not contain numeric WQBELs to ensure strict compliance with the state water quality standards. The plaintiffs, challenging the terms of the permit, argued that strict compliance through numerical limits was required under §1311(b)(1)(c) of the statute. The Court unequivocally held that "Congress did not require municipal storm-sewer discharges to comply strictly with 33 U.S.C. § 1311(b)(1(C)." *Id. at 1165*. Instead, the statute prescribes a different standard, requiring MS4 discharges to reduce pollutants to the "maximum extent practicable." *Id. at 1164*.

Although the *Defenders of Wildlife* Court indicated that it is possible a permitting agency may have administrative authority to determine that ensuring strict compliance with state water-quality standards is necessary to control pollutants, *Id.*, *such a determination has not been made by NMED or EPA*. In fact, EPA has made the opposite determination, affirmatively electing to use BMPs in stormwater permits to provide for the attainment of water quality standards. *Id.* EPA's commitment to this long-standing practice of utilizing BMPs in MS4 permits has not changed.

Indeed, the Stakeholders believe EPA's approach <u>cannot</u> change under the limitations of the Clean Water Act. The Association of Metropolitan Sewerage Agencies (AMSD) has noted the difference between municipal point source discharges such as Combined Sewer Overflows (CSO's) and MS4 discharges:

> ''CSOs are treated like any other point source discharge and are therefore subject to the same water quality based controls found in the Clean Water Act (See CWA §301(b)(1)(C)). However, MS4s are not. When Congress enacted the Water Quality Amendments of 1987, it required MS4s to reduce the discharge of pollutants ''to the maximum extent practicable''. CWA §402(p)(3)(B)(iii). A question then arose as to whether MS4s need only comply with the ''maximum extent practicable'' standard found in 402(p) or must, in addition, comply with water quality standards as required by CWA §301(b)(1)(C).
>
> The question was answered in *Defenders of Wildlife v. Browner, 191 F. 3d 1159 (9th Cir. 1999).* The Court ruled that Congress did not require MS4s to comply with water quality standards in accordance with CWA § 301(b)(1)(C). Therefore, can it be argued that MS4s are completely and absolutely exempt from WLAs pursuant to a TMDL process? Since TMDLs implement water quality standards, and since MS4s need not comply with water quality standards, MS4s should not be part of the TMDL equation.
>
> Examining *Defenders of Wildlife* in its totality, AMSA believes that the ruling offers even further support that the policies in place for MS4s –

> essentially Best Management Practices as set forth in Phase I and II permits – embody the intended contribution of MS4s to any load reductions required within a TMDL context." *AMSA Evaluating TMDLs … Protecting the Rights of POTWs May 2000 Update (p. 23)*

The Stakeholders agree with AMSA's assessment. We encourage NMED, and most particularly EPA, to closely consider the legal limits of the TMDL program on MS4 permits.

NMED's TMDL must make clear that the regulation will not be the basis of numeric WQBELS in MS4 permits. The Stakeholders urge NMED to remove the language referring to mandatory standards and permit requirements, and to insert language affirmatively stating that the TMDL is not intended to create numeric WQBELs in MS4 permits.

Point 2 The Proposal Should Better Quantify Sources and Species Contributions

Applicable federal regulations require that TMDLs comprise "[t]he sum of the individual [wasteload allocations] for point sources and [load allocations] for nonpoint sources and natural background" 40 C.F.R. § 130.2(i). Although many of the sources are identified in the draft TMDL, they have not been quantified. For example, the nonpoint sources such as urban stormwater runoff are identified as one of the most important pollutant sources responsible for the high fecal coliform levels in the river. Current conditions of pollutant sources (e.g., subdrainages in the North Diversion Channel) and species (i.e., avian species, domestic animals, wild animals) contributions are important and necessary information for load allocation. Combining the average annual maximum flow in the North Diversion Channel with critical low flow in the river is demonstrably an infrequent event. Based on a preliminary analysis of the years 1989-1999, the following factors are relevant:

> Utilizing a daily flow rate in the NDC of 20 cfs or greater to define a stormwater runoff event, there were 411 such runoff events in the last eleven years, approximately one day in ten,

> During the eleven years flow in the NDC equaled or exceeded the mean annual maximum flow of 263 cfs only 35 times. That is less than one day in 100,

During the same eleven years, flow in the Rio Grande, as measured at the Alameda Bridge, was equal to or less than the critical flow of 363 cfs only seven times. The TMDL fails to adequately evaluate existing conditions in the subject river segments. Without load allocation and species-specific contribution information, it is impossible to complete best management practices (BMPs) to reduce the current fecal coliform load in the middle Rio Grande. Therefore, more effort is required to quantify potential pollutant sources, and facilitate scientifically defensible allocation of loads to protect human health. Development of a database, in concert with computer modeling activities, are essential to establish both the credibility and the accuracy of the TMDL objectives.

Point 3 The Proposal Should Accurately Reflect Fate and Transport

On page 9 of the TMDL rule, it is stated that fecal coliforms are treated as a conservative pollutant, that is, a pollutant that does not readily degrade in the environment. This assumption is inaccurate from a biological and hydrological perspective. Based on the commonly accepted first-flush concept, the concentration of fecal coliforms over time typically follows the first-order exponential decay model, and certainly is not a constant over a 4-day period through a significantly changing flood hydrograph. The decay coefficient for fecal coliforms is very high among general water quality parameters. Therefore, the assumption in the draft TMDL gives an extremely conservative estimate of the pollutant load, which makes it more difficult to proceed toward compliance with the applicable water quality standard. Because fate and transport of pollutants are usually very important in the linkage between water quality targets and sources, application of an appropriate decay coefficient to quantify this degradation process should result in a more appropriate estimate of fecal coliform load in the TMDL development process. This position is supported further by information provided by the Association of Metropolitan Sewerage Agencies (AMSA).

> *[from "Evaluating TMDLs … Protecting the Rights of POTWs May 2000 Update (p 22)]*
>
> "…the national criteria, as well as the state criteria if different, were developed assuming steady state exposures to toxicants. For example, the criteria for chronic aquatic toxicity (the Criterion Continuous Concentration (CCC) is set at the highest ambient concentration of a toxicant to which aquatic organisms can be continuously exposed over a 4-day period without causing an unacceptable effect…'
>
> "… Yet, your wet weather discharge does not last for four days (Even if it did, the level of pollutants being discharged at any given time would differ tremendously.). Thus [sic Water Quality Criteria] WQC are not representative of the potential impacts to aquatic life associated with transient wet weather events."

With respect to fecal coliforms in the middle Rio Grande, the 4-day period is not relevant and protection of human health is not adequately reflected in a standard that assumes constant flow of a pollutant load such as fecal coliforms. Monsoon storms in the middle Rio Grande are intense, but of limited duration. Additionally, the heaviest monsoon storms do not occur during the traditional low flow periods of the annual hydrograph.

Further, wet weather TMDLs are not, as yet, well defined anywhere in the United States. AMSA notes

> *[from "Evaluating TMDLs … Protecting the Rights of POTWs May 2000 Update (p 23)]*
>
> ''WET WEATHER TMDLs
>
> While, as mentioned above, wet weather criteria are needed they presently do not exist. Yet, TMDLs are now being developed nationwide in waters that have wet weather impacts from municipal separate storm sewer systems (MS4s) and combined

sewer overflows (CSOs). The question then becomes how will these wet weather sources be incorporated into the TMDL process if the traditional water quality criteria and wasteload allocation calculations do not work within the context of CSOs and MS4s? The answer to this question lies mostly in common sense and to some extent in the law.

First, the common sense. Wet weather discharges, such as CSOs and MS4s, are unique. As mentioned above, wet weather Points have always provided an imperfect fit into the water quality standards program where criteria and discharge assumptions are predicated on predictable flows and loadings. Congress, EPA, dischargers and environmental groups alike recognized that the special problem of wet weather discharges called for special solutions.

Thus, over the past decade, wet weather regulations, policy and guidance have emerged. National approaches to wet weather discharges, where they have been developed, are the product of years of discussion and debate, where consensus has come about through lengthy (and often painstaking) negotiation by all parties.

These regulations, policies and guidance must be incorporated into the TMDL process. The TMDL process should not attempt to reinvent wet weather controls but rather should formally incorporate them into the TMDL process. Thus, for example, a POTW that is implementing its approved Long Term Control Plan for CSOs should be deemed to be fully complying with any TMDL based water quality limitation. . . .’’

Finally, a quick note on fecal coliforms and wet weather TMDLs. Probably the most critical pollutant discharged from wet weather sources is fecal coliform. Regulated agencies should consider whether changing WQC from fecal coliform to e-coli, as EPA is encouraging, would be advantageous, considering that e-coli more precisely addresses human pathogens. **Also, be sure that the TMDL accounts for the animal-loading portion of a fecal coliform loading [emphasis added].**

C. Human Health Criteria

WQC are not only set to protect aquatic organisms but are also set to prevent adverse human health impacts.

EPA is modifying its approach to calculating human health WQC. For noncarcinogens, EPA's new methodology authorizes using a range around the Reference Dose (the estimate of the daily acceptable level of exposure without appreciable risk of deleterious health effects over a lifetime) and site-specific fish consumption data in order to derive the appropriate human health WQC. This could result in less stringent human health WQC for nonbioaccumulatives.

It may thus develop that a variation of the presently proposed standard or TMDL approach, is viable and will afford sufficient protection to human health concerns.

Point 4 The Proposal Must Recognize that Typical Fecal Coliform Loadings Occur During High Flow Events, Not "4Q3" Minimum Flows.

One of the essential components of developing a TMDL is to establish a link or relationship between loads and the numeric indicators. Once this link has been established, it is possible to determine the total capacity of the water body to assimilate loading while still supporting its designated use, and allowable loads can be allocated among the various pollutant sources. The proposed TMDL rule uses 4Q3 minimum peak flow loading assumptions. This approach is flawed.

The quotations on page 1 of the draft TMDL (New Mexico Health and Environment Department, 1979; New Mexico Environmental Improvement Division, 1988) acknowledge that the high fecal coliform levels in the middle Rio Grande are a wet weather (monsoon season – June - September) flow or high-flow problem. Using critical flow (4Q3) as a condition is normally applied to Waste Load Allocation (WLA) when a point source dominates. However, under the condition of wet weather flow where a nonpoint source plays a more important role, using low flow methodology like 4Q3 is an inappropriate approach for TMDL development. During the wet weather condition, the hydrology in the river changes significantly, directly influencing any stream water quality response. Because these relationships between storm runoff and water quality impacts on receiving waters are very complex, an approach which allows incorporation of storm flow into the receiving water must accurately assess the receiving water's response. It is essential that this assessment be supported by hydrologic and water quality modeling. Further, continuous simulations using an appropriate model can generate multiple data points that provide a 30-day period for application of the geometric mean criteria (discussed below). "What-if" analysis can then be performed to generate various feasible scenarios for the load allocation. Sensitivity analysis is also possible to provide more insights on the allocation scenarios. Financial outlay costs (capital as well as operation and maintenance) for Stakeholders are an important factor in justifying a realistic modeling approach for the TMDL to achieve its stated objectives. NMED should consider a TMDL expressed as an annual load, calculated to incorporate seasonal variations. This

approach was used to address phosphorus loadings for waterbodies in New York, and was recently validated in *NRDC v. Fox, 93 F.Supp. 2nd 531 (S.D.N.Y. 2000)*. The New York phosphorus TMDL was expressed in terms of annual rather than daily loads, and was calculated to account for seasonal variations based on growing season data. In upholding EPA's approval of the TMDL, the Court noted that the TMDL regulation provides that "a TMDL may be "expressed in terms of either mass per time, toxicity, or other appropriate measure." 40 C.F.R. § 130.2(i). *Id. at 554* The Stakeholders suggest that NMED derive an annual TMDL, calculated to account for seasonal variation based on monsoonal events.

Point 5 Margin of Safety (MOS):

There are generally two approaches to developing margins of safety recommended by EPA, namely, implicit and explicit methods. For the middle Rio Grande fecal coliform TMDL, the draft TMDL made an effort to develop a Margin of Safety (MOS) using the conservative assumptions of (1) critical low flow, (2) minimal dieoff of bacteria, and (3) stormwater and river flow annual extremes for an "implicit MOS". The MOS should be re-evaluated. A certain percentage of pollutant load (i.e. 5%) should be used as an explicit MOS to fulfill the TMDL requirement. This eventuality may occur if a major contributor of fecal coliforms is added or removed from the watershed. As written, the TMDL does not appropriately address the MOS issue.

Point 6 Resolving The Discrepancy Between State and Pueblo Fecal Coliform Water Quality Standards Will Require Mediation

The New Mexico Water Quality Standard for Fecal Coliform and the Sandia Pueblo Water Quality Standard for Fecal Coliform both apply in a common body of water in the middle Rio Grande, but they differ substantially. Although both standards are problematic, the New Mexico standard is potentially ***seasonally*** attainable and the Sandia Pueblo standard is not attainable. Based on field monitoring data and engineering knowledge, it is impracticable for the Stakeholders to meet the Sandia Pueblo in-stream fecal coliform geometric mean standard of 100 cfu/100mL. The discrepancy between the state and tribal standards will result in unreasonable consequences when BMPs are prescribed under MS4 and other NPDES permits because the discrepancy will lead to inconsistent and prohibitively expensive BMP determinations.

The Stakeholders believe the best way to resolve this difficult problem is though a mediated solution. The federal regulations that address water quality standards and TMDLs provide for such a process. *40 C.F.R. § 131.7.* Presently, the Stakeholders permittees understand that the NMED and Sandia Pueblo are discussing potential solutions to the problem. Similar concerns exist with respect to the Pueblo of Isleta standards further downstream.

We wish to express our appreciation of this effort to resolve the state/tribal stream standard issue. If a reasonable effort to resolve the dispute without EPA involvement is not productive, the Stakeholders believe it is appropriate for the State to initiate formal dispute resolution pursuant to 40 C.F.R. § 131.7.

Point 7 The Implementation Plan Should Provide More Substantive Emphasis On Voluntary, Incentive Based Approaches

The Stakeholders agree with NMED that voluntary, incentive-based approaches at the State or local level should be used to implement management practices for controlling municipal stormwater discharges. Therefore, we question why NMED proposes "Structural BMPs" since they are normally not cost-effective at watershed scales. Therefore, the TMDL should be incorporated into the State's Section 208 Water Management Plan as a planning tool. Source control and public education through outreach are good starting points.

Point 8 The Proposal Requires A Thorough Cost-Benefit Analysis For BMPs

Cost-Benefit issues were not addressed in the TMDL report. Based on figures derived from an interpretation of the best management practices information presented in the "Implementation" section of the draft report, our first level analysis indicates a capital cost in the range of $ 750,000,000to $ 1,600,000,000 for the drainage area of the North Diversion Channel. This expenditure would not result in a total capability to eliminate fecal coliforms in either river segment. These two factors, extreme expense, and failure to achieve the desired result, call the efficacy of the infrastructure enhancement into question.

The City of Albuquerque and AMAFCA have spent in excess of $3,000,000 on stormwater quality improvements in the last several years. The City and AMAFCA have also spent considerable funds on water quality. AMAFCA has spent $500,000 in the last two years and has a recently passed bond issue for $1,000,000 to address additional water quality management issues. The City has spent in excess of $5,000,000 in the last several years and spends $120,000 per year for water quality monitoring, a program that has continued for the last eight years. Implementation of BMPs for the control of fecal coliforms in the Rio Grande will compete with other high priority projects for funding.

Point 9 NMED Should Conduct A Use Attainability Analysis For The TMDL

While the Stakeholders fully understand the function of the Pueblo and State stream standards to protect designated uses, it is not apparent that the present proposed approach will result in that protection. We are concerned that despite investing millions of dollars in BMP infrastructure, the proposed TMDL approach will not effectively help attain water quality standards for designated uses. The Stakeholders recommend that NMED and the Stakeholders conduct a use attainability analysis before requiring a commitment of resources that would be better expended on other beneficial activities.

SECTION 3– PROPOSED PROCESS SCHEDULE FOR IMPLEMENTATION

The elements of our proposed process and schedule for implementation of the requirements noted in the TMDL report are presented below. Conceptually, the approach includes five elements and is represented graphically on the following page.

<u>Mediation</u>

Conflicting standards on the same reach of waterbody make it difficult if not impossible to equitably achieve water quality standards. Because of the complex issues facing the middle Rio Grande, it is essential that mediation efforts between the State, Pueblo, and concerned Stakeholders begin immediately and proceed to resolution.

Sources and Locations of Waste Loads

Presently, sources of fecal coliforms (species) and locations of contributors (drainages) are not well understood. It is essential that a comprehensive effort be initiated to document with scientific credibility not only the species that contribute to high fecal coliform loads in stream segments of the middle Rio Grande, but to understand those geographic areas where sources are located. Only with this information will credible, accurate, and defensible TMDL limitations be viable.

Analysis and Modeling

Following collection of adequate field data, analysis must be completed to facilitate use of the data in predictive models. Modeling will assist in the assignment of BMPs to target drainages and locations where significant problems have been identified.

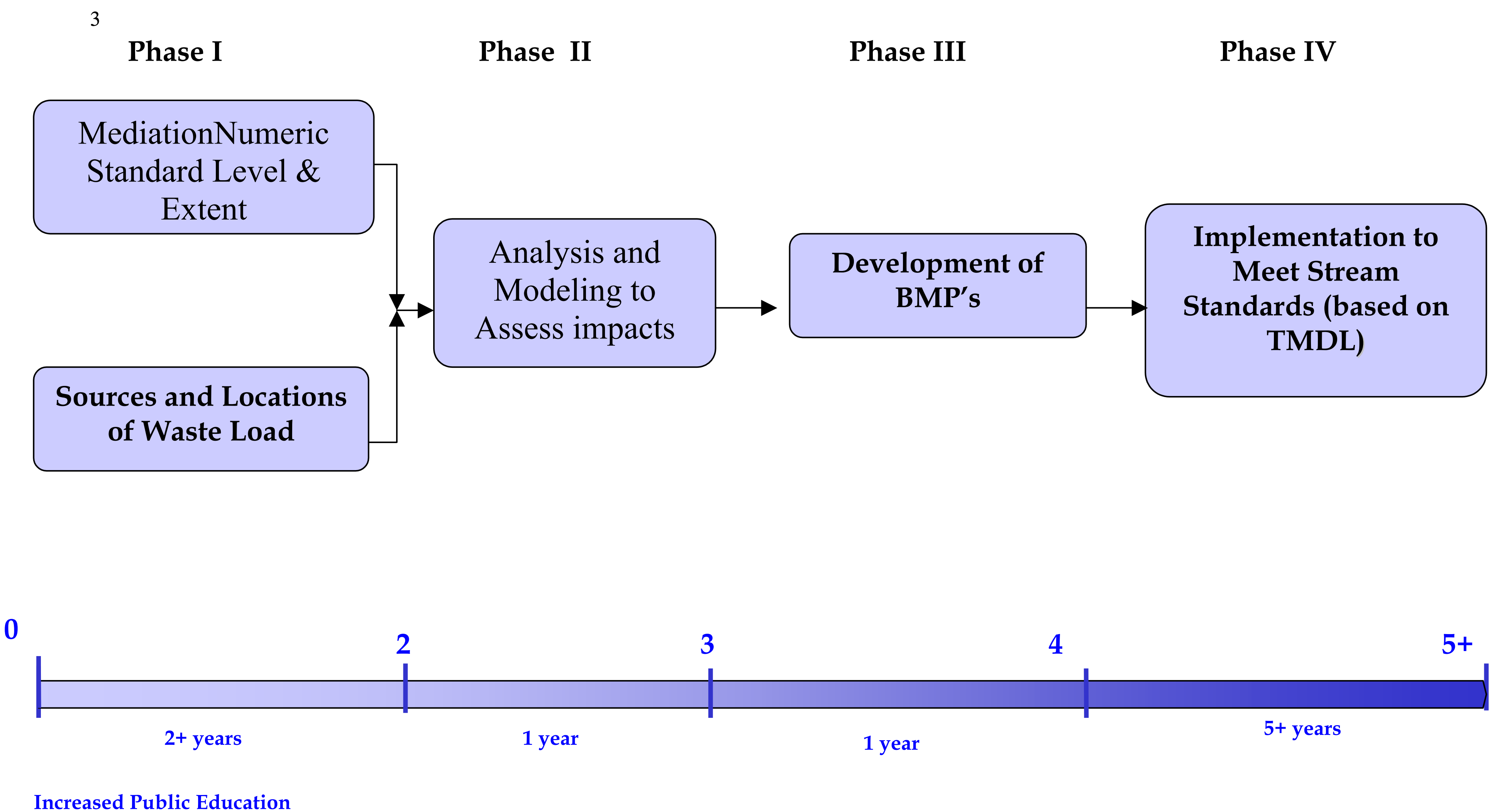
Development of Specific Best Management Practices

Best management practices based on the data and information collected in the previous phases will allow for the most beneficial expenditure of limited funds. Priority basins can be identified and a specific mix of BMPs applied to address both the level and the specific species contributing the fecal load.

Implementation to Meet Stream Standards to the Extent Practical

Implementation of the BMPs to meet existing or future stream standards, to the extent practicable, will necessitate close coordination with all Stakeholders in the middle Rio Grande.

Proposed Implementation Schedule for Middle Rio Grande Fecal Coliform TMDL



SECTION 4 ALTERNATIVE APPROACHES

Many alternative approaches to achieving water quality standards are available. A suite of these alternative approaches is presented in the attached Appendix I and briefly summarized here.

Modeling

There are generally two approaches in water quality modeling for wet weather conditions: (1) Continuous modeling; (2); Event-based modeling. The pros and cons of these two approaches and the descriptions of the two methodologies are given as follows.

Continuous Simulation Approach

Continuous modeling uses input values at a particular time interval to predict receiving water conditions. The model generates output for the same time step as the input variables. For example, if a daily time step is chosen, the model will predict receiving stream water quality for each day of the year. In contrast, event-based modeling simulates the water quality impact of a specific storm on the receiving water body.

Flow-Based Load Calculation (Event-based Modeling)

Limits of discharge from point sources are determined in large part by the amount of dilution that is available under low-flow conditions. Depending on the nature of the constituent, low-flows can be defined both for acute (one-day) or chronic (30-day) intervals. The determination of a low-flow is accomplished by a rationale developed by EPA. A computer program is applied to the hydrologic record for a given location, and produces an estimate of a threshold discharge corresponding to the low-flow rationale. The draft Middle Rio Grande TMDL includes low-flows based on an annual 4Q3 approach.

Other Approaches

Allocation Methodologies, Equal Concentration, Maximum Assimilative Capacity, Equitable Concentrations, Effluent Trading, Human Health Based Methods for Allocation.

New Tools

A number of tools have been developed or improved in recent years to assist in the analysis and mitigation of human risks to pathogens and compliance with stream standards. A few of these, as applicable to TMDL allocations and/or stream standards and as referenced in other sections of this report, are discussed below.

Fecal Coliform Source Tracking

Typical water quality monitoring for fecal coliform bacteria indicates only the presence and magnitude of fecal coliforms.

To address this issue, many techniques have been developed for characterizing and categorizing the source of fecal coliforms. To date, most methods have fallen short, as each has proven to be unreliable, laborious, costly, or too complicated for routine use. Examples of past techniques include fecal coliform-to-streptococci ratios, fatty acid profiling, DNA fingerprinting, and tracer studies. A more recent technique has emerged, termed Multiple Antibiotic Resistance Analysis (MARA) that has been shown to reliably identify the sources of fecal coliforms using relatively simple and accepted technologies.

Risk Assessment Methodology

The risk of waterborne infectious diseases is usually assessed by quantifying the concentrations of indicator microorganisms that signify the presence of fecal material in the water. Bacteria of the fecal coliform group are primary indicators of fecal contamination since they are usually associated in high numbers with the gastrointestinal tract and feces of warm-blooded animals and humans (EPA 1986).

Potential Exposure Pathways

Exposure to pathogens in surface water in the Rio Grande River is theoretically possible through the following pathways:

- Incidental ingestion of surface water
- Dermal contact with surface water
- Inhalation of aerosols during use of surface water for irrigation

Proposed Changes to the Risk Assessment Methodology used in the TMDL

Current water quality criteria for bacteria in the middle Rio Grande are overly conservative for the following reasons:

Criteria based on fecal coliform do not discriminate between human and animal sources of contamination

Current water quality criteria may not reflect actual uses of surface water in the middle Rio Grande

Adjust Criteria Based on the Presence of Human Pathogens

Discriminating between human and animal sources of contamination is important, because not all animal pathogens cause human disease. There is evidence that farm-animals may contribute significantly to fecal coliform sources in the Rio Grande. Avian species may also be significant contributors to the fecal coliform load.

Adjust Criteria Based on Actual Surface Water Uses

Current water quality criteria for bacteria were developed using epidemiological studies, in which numbers of indicator bacteria in surface water were linked to incidences of disease (mostly gastrointestinal) following exposure. "Acceptable" levels of bacteria in surface water were then developed using an acceptable level of disease incidence (e.g. X cases in 1,000 swimmers).

Changes to Stream Standards or Use Classifications

Alternate approaches to allocating loads under the TMDL process were presented above. These approaches assumed that the stream standards and use classifications remain unchanged from their current status. A longer-term approach that may make sense--both in terms of human health protection and achievable results--is modifications to the stream standards or designated use classifications that address the seasonal nature of elevated bacteria concentrations.

Seasonal or Flow-Based Standards or Use Classifications

Several states have enacted seasonal stream standards for bacteria (e.g., fecal coliform, *E. coli*) that relate to the largely seasonal nature of water recreation. While these generally result in stricter bacteria standards, precedents exist for recognizing the seasonal changes in use and classification of a waterbody. Such an approach could be applied to the middle Rio Grande.

Human Health Based Standards using Fecal Coliform Source Tracking

The fecal coliform source tracking methodologies explained in Section 2.2 could be useful in determining health effects and protecting human health, addressing the potential inaccuracies of fecal coliforms as a human health risk indicator. Precedent for such an approach exists, but to implement this approach would require changes to the New Mexico Water Quality Control Commission Regulations.

Subcategorization of Existing and Attainable Uses of Middle Rio Grande
Look at subcategories of designated uses, using risk assessment methodologies.
Incorporate *timing* of the designated uses, relative to seasons, storm events, and/or flows.
Do not attempt to change the uses or use designations, but provide a framework to identify the timing of those uses and develop conditional subcategories of existing standards or uses.

City of Albuquerque

Alternative TMDL Approaches for Human Health Protection in the Middle Rio Grande

November 6, 2000

Contents

Figures

Tables

Section 1
Overview of Draft Middle Rio Grande Total Maximum Daily Load

1.1 Introduction

The Total Maximum Daily Load (TMDL) process integrates point, nonpoint, and natural background impacts spatially and temporally in water quality management planning and permitting. It is a geographically-based approach to preparing load and wasteload allocations for sources and stresses that impair waterbody integrity. The TMDL establishes the allowable loadings or other water quality parameters for a waterbody. In doing so, it establishes the basis for water quality-based controls and the alternatives analysis. The TMDL process provides a mechanism for integrating the management of both the point and nonpoint pollution sources that contribute to impairment of use in a waterbody. When implemented, these controls should provide the pollution reduction necessary to meet appropriate water quality standards, which may be developed, based on site-specific criteria or uses.

Based on U.S. Environmental Protection Agency (EPA) guidance and policy, the following provides minimum requirements and a standard for review of TMDLs:

Application of TMDLs result in maintaining and attaining water quality standards (including the numeric, narrative, use classification, and antidegradation components of the standards; a "phased" TMDL can be used where a level of uncertainty exists; in addition, TMDLs can rely on either regulatory or voluntary approaches to attain standards).

TMDLs have a quantified target or endpoint (a numeric water quality standard often serves as the target, but any indicator or set of indicators which represent the desired condition would suffice).

TMDLs include a quantified pollutant reduction target, but this target can be expressed in any appropriate manner (TMDLs need not be expressed in pounds per day or concentration when alternative means of expression are better suited to the waterbody problem; TMDLs can be expressed as mass per unit of time, toxicity, percent reduction in sediment or nutrients, or other measure).

TMDLs must consider all significant sources of the stressor of concern (all sources or causes of the stressor must be identified or accounted for in some manner; this accounting can lump several sources of unknown origin together; the TMDL need only address the control of a subset of these sources as long as the water quality standards are expected to be met).

TMDLs are supported by an appropriate level of technical analysis (allocations for nonpoint sources are often best professional estimates whereas waste load allocations for point sources are often based on a more detailed analysis).

TMDLs must contain a margin of safety and consider seasonality (a margin of safety can be either explicit or implicit in the analysis or assessment).

TMDLs apportion responsibility for taking actions (allocations may be expressed in a variety of ways such as by individual discharger, by tributary watershed, by source or land use category, by land parcel, or other appropriate scale or dividing responsibility).

TMDLs involve some level of public involvement or review (public participation should fit the needs of the particular TMDL).

Modeling can play an important role in determining the TMDL and estimating the effectiveness of various management and alternatives in meeting water quality objectives.

In accordance with federal water quality regulations and under the terms of a consent order, the New Mexico Environment Department (NMED) has prepared a "Draft Middle Rio Grande TMDL for Fecal Coliform in Storm Water" (NMED September 2000). NMED has determined that the designated uses of the Middle Rio Grande are impaired due to exceedances of fecal coliform bacteria standards. Because of the complexity of the issues, stakeholders in the TMDL process requested and were granted an extension of the public comment period until November 10, 2000.

A number of concerns have been raised about the TMDL, most of which fall into one of two major categories:

Specific comments on the TMDL, within the existing NMED framework for TMDL development

Concerns about conflicts between the existing TMDL framework and its ability to protect human health during reasonable and existing uses of the subject reach of the Rio Grande

In this document, key concerns regarding the draft TMDL are highlighted in Section 1. Section 2 provides insight into alternative approaches that may be of use in resolving these concerns while meeting the underlying goal of protection of human health from exposure to bacteria in the Middle Rio Grande.

1.2 Concerns Regarding the Draft TMDL

The draft Middle Rio Grande TMDL offers a baseline for evaluating and allocating fecal coliform loads to the river. However, the methodology employed results in an overly conservative estimate of loads and load allocation, especially in light of the correlation between storm events and exceedances of the stream standards for fecal coliform.

The draft TMDL cites previous reports by the New Mexico Health and Environment Department (1979), the New Mexico Environmental Improvement Division (1988), and the City of Albuquerque (2000) that each document the relationship between storm events and elevated levels of fecal coliform in the Rio Grande. The draft TMDL acknowledges that high fecal coliform levels are a high-flow problem, but proceeds to calculate the TMDL on an annual 4Q3 critical low flow basis without explaining the apparent contradiction. This approach neglects two observations:

Low flow conditions are not the "critical" flow for fecal coliform concentrations in the Middle Rio Grande.

NMED/SWQB Response:

The following language can be found on page 14 of this document.

River Hydrology

The United States Geological Survey (USGS) Gage, **Rio Grande at Albuquerque (08330000)**, was used in this document to calculate the critical low flow condition or 4Q3 of the peak flow, from 1992-~~1997~~ 1999 and for the months of May through September. The critical low flow of a stream at a particular site shall be the minimum average four consecutive day flow which occurs with a frequency of once in three years (4Q3). Critical low flow values may be determined on an annual, a seasonal or monthly basis, as appropriate, after due consideration of site-specific conditions. The Hydrotec© computer program was used to calculate the 4Q3 of the peak seasonal flow (May through September) value of ~~363~~ 376 cubic feet per second (cfs). The reason this value was used was to be protective of the lowest flow during the peak flow season. The USGS gage at Albuquerque is above the discharge of the Albuquerque WWTF therefore, an additional 117 cfs will added to the river below the WWTF discharge to bring the 4Q3 value to ~~480~~ 493 cfs from the WWTF discharge down to the Isleta Diversion Dam.

Even if low flow conditions were appropriate, the 4Q3 flows for the season in which fecal coliforms are an issue (summer/monsoon season) would be significantly higher if calculated on a seasonal or monthly basis for the relevant portion of the year.

NMED/SWQB Response:

See response above.

Approaches that take the flow-related nature of bacterial contamination of surface waters have been used elsewhere and can be applied in this TMDL. A discussion of alternative approaches is included in Section 2.

The assumption that fecal coliforms are a "conservative" parameter also leads to a high degree of conservatism in the TMDL. The ability of coliform organisms to survive outside the body of a host animal, and as exposed to ultraviolet radiation in the stream, has been demonstrated to decrease with time in the receiving water. Application of a decay coefficient to the calculation to account for the expected degradation of fecal coliforms may result in a more appropriate estimate of the loads received and conveyed in the Middle Rio Grande.
Fecal coliform organisms decay via physical mechanisms, such as settling, adsorption, and coagulation, as well as temperature and sunlight (ultraviolet) decay. This phenomenon has been modeled and confirmed in river environments (e.g., Kittrell 1963; Thackston 1999).

NMED/SWQB Response:

Fecal coliform is being treated as a conservative pollutant in this document due to the fact that exceedences of standards (both State and Tribal) occur mainly during storm events which result in high concentrations of fecal coliform. The Bureau recognizes that fecal coliform bacteria die off after storm events but the applicable standards do not allow for a storm event variance.

With respect to implementation, a conflict in the text of the draft TMDL is apparent. The document outlines potential structural best management practices (BMPs) to apply in the watershed, but points out that none of the BMPs listed is highly effective in removing bacteria. The most effective BMP listed in the TMDL is cited as providing a 55 percent removal of bacteria. Additional information is required to support the draft TMDL's statement that "the time required to attain standards in this case is estimated to be five years."

NMED/SWQB Response:

On page 27 of this document, the Bureau has incorporated the following language to clarify the intent of the Bureau. Phase II of the federal Storm Water Management Program would be the venue in which BMPs are planned for and implemented:

Implementation Approaches

Storm Water BMP Approaches and Cost Estimates

This section is meant to highlight approaches and estimated costs associated with the implementation of certain BMPs. The entire section was taken from a newsletter titled, ***Stormwater Runoff Water Quality Science/Engineering Newsletter, Urban Stormwater Runoff Water Quality Management Issues***, Volume 3, Number 2, May 19, 2000. The New Mexico Environment Department, Surface Water Quality Bureau does not endorse nor does it take any position in favor of one BMP over another for storm water management.

In addition, on pages 8 and 9 of this document the following section was inserted:

Storm Water Discharges

Point source storm water discharges from municipal separate storm sewer systems (MS4s) are regulated under the national Pollutant Discharge Elimination System (NPDES). MS4s serving a population of 100,000, or more, currently require NPDES storm water permits. Smaller MS4s, in urbanized areas will require NPDES permits starting in March 2003. Therefore, storm water discharges in this TMDL will be assigned a waste load allocation.
Numerical targets for storm water conveyances are established by this TMDL. However, EPA has recognized that numeric limitations for storm water permits can be very difficult to develop at this time because of the existing state of knowledge about the intermittent and variable nature of these types of discharges and their effects on receiving waters during storm events (EPA 1998).

EPA has found that although NPDES permits must contain conditions to ensure that water quality standards are met, this does not necessarily require the use of numeric water quality-based effluent limitations and therefore the permitting authority has some flexibility in establishing permit conditions.

Storm water discharges are highly variable both in terms of flow and pollutant concentrations, and the relationship between discharges and water quality can be complex (EPA 1998). EPA's interim permitting approach for NPDES storm water permits establishes the use of best management practices to provide for the attainment of water quality standards through a combination of source reductions and structural controls. In addition, storm water permits include coordinated monitoring efforts to gather necessary information to determine the extent to which the permit provides for attainment of applicable water quality standards and to determine the appropriate requirements of subsequent permits. This monitoring may include ambient receiving stream water assessments in addition to discharge monitoring to gather this information.

One final area of note is that the TMDL is written on the basis of fecal coliforms, which is consistent with EPA and NMED policy for addressing the constituents that are causing impairment of the designated uses of the water body. However, EPA has determined that E. coli provides a more accurate indicator of pathogenic risk than fecal coliforms. EPA may require all state standards to be written to replace fecal coliform as a surrogate indicator organism with E. coli or enterococci by 2002. It has been well-documented in the literature that fecal coliforms cannot be directly correlated to E. coli levels. Thus, even if the TMDL is fully successful in bringing about compliance with today's fecal coliform stream standards, compliance with the anticipated future E. coli or enterococci standards is not assured.

NMED/SWQB Response:

As the comment states in the first sentence, "the TMDL is written on the basis of fecal coliforms, which is consistent with EPA and NMED policy for addressing the constituents that are causing impairment of the designated uses of the water body." The State of New Mexico currently has fecal coliform standards but no standards for E. coli. This document was developed to be protective of current water quality standards and designated uses on this reach.

Section 2
Alternate Approaches to Address Human Health Protection

Because of the unique nature of bacterial contamination, human exposure routes and health implications, and flow-based concentration variability, alternate approaches to address some of the concerns discussed in Section 1 are worthy of consideration. Many of the approaches discussed in this section have been implemented successfully elsewhere; others have been proposed but not yet adopted.

This section is organized to frame the types of approaches that could be considered for the Middle Rio Grande TMDL and associated stream standards. Included are a discussion (Section 2.1) of changes in TMDL methodology — changing the allocation approach and accounting for flow variability. Modeling techniques that can be used to support TMDL allocation, changes to stream standards or designated uses, or BMP selection support are discussed in Section 2.2. Other tools that could be used in the support of TMDL development or implementation are discussed in Section 2.3. Finally, Section 2.4 provides a discussion of possible changes to the relevant stream standards and use classifications, including an innovative approach of subcategorizing existing designated uses.

2.1 Changes in TMDL Methodology

2.1.1 Flow-Based Load Calculation

Limits of discharge from point sources are determined in large part by the amount of dilution that is available under low-flow conditions. Depending on the nature of the constituent, low-flows can be defined both for acute (1-day) or chronic (30-day) intervals. The determination of a low-flow is accomplished by a rationale developed by EPA. A computer program is applied to the hydrologic record for a given location, and produces an estimate of a threshold discharge corresponding to the low-flow rationale. The draft Middle Rio Grande TMDL was calculated at a "critical condition" of low-flow based on an annual 4Q3 approach.

The derivation of a TMDL using design low-flow situation is less than ideal and often misrepresents the hydrologic conditions in a receiving stream during a wet weather event. Thus, it is necessary to derive an approach for a wet weather condition that reflects the hydrology and is not overly restrictive due to the selection of this design low-flow condition.

Precedent has been set for calculation of TMDLs that account for wet weather and higher-flow conditions. An approach to this was developed as part of the South Platte Urban TMDL in Denver, Colorado. As another example, the State of Kansas calculates all TMDLs for a range of flow conditions.

2.1.1.1 South Platte River TMDL

The South Platte TMDL was executed for copper and nitrate. Modeling included not only characteristic flows and low-flows, but also storm flows. The quality and amount of runoff corresponding to any given type of storm is obtained from a watershed model, which computes the amount and quality of runoff based on land use and hydrology.

In order to simulate storm events, the TMDL modeling dealt with two different types of storms. The model is sufficiently flexible to deal with a broad range of additional storms that might be specified in the future. The rationale for these particular storms has to do with the statistical record for storms in the TMDL region, as explained below.

For storm flow modeling, storm flows were superimposed on characteristic flows for the South Platte in a particular month. Treatment plants were assumed to be operating under characteristic conditions. Other assumptions are possible either for river flow or for treatment plant operations, but this set of assumptions gives a broad overview of the consequences of storm flow.

In all cases, the results of storm flow modeling are cast in terms of acute regulatory limits rather than chronic limits. Because the duration of storms under consideration here generally does not exceed 24 hours, it would not be reasonable to evaluate water quality from the viewpoint of chronic limits for storm flows.

Storm flow modeling for the thunderstorm event was applied to one of the months when thunderstorms are likely (July). A thunderstorm centered within the Denver urban zone over a period of 4 hours did not cause the South Platte River to approach either the acute copper or the nitrate standards for both 2000 and 2020 land use. The flow of the South Platte is sufficiently large that storms of this magnitude, while producing strong storm runoff on a localized basis, are thoroughly diluted by the South Platte main stem.

Another storm event simulating a frontal storm event lasting 24 hours was used. The results in this case are very different. There is no strong effect on nitrate, because nitrate is not mobilized by stormwater. In contrast, the copper concentrations exceed the numeric standards in the South Platte. This is the case for both 2000 and 2020 land use projections.

In both cases, the "design wet weather flow" of the South Platte was set at an average monthly flow condition.

A technical problem with this approach has to do with the relationship between storms of long duration and the quality of runoff water. The quality of runoff from storms is set in the model exclusively from studies of brief storms. Storms of this type are likely to produce higher concentrations of pollutants than more extended storms, which benefit from the cleansing of hard surfaces over the duration of the storm. Thus some beneficial changes in water quality might occur over a storm of long duration, but these cannot be modeled in the absence of any data on this subject.

The modeling shows that nitrate does not raise regulatory issues for storm runoff. In contrast, copper does raise such issues because copper is mobilized by storms. At the same time, ambiguities in the regulation of total versus dissolved copper, plus weak information on the characteristics of extended storms, made any final interpretation premature at this time. Before an allocation of loads was determined for these constituents, more monitoring was required.

2.1.1.2 Kansas TMDL Curve Methodology

One example of integrating variability in flows into the TMDL process can be found in the Kansas Department of Health and Environment (KDHE) self-named "TMDL Curve Methodology." For all TMDLs — regardless of constituent of concern — KDHE evaluates TMDLs across the broad spectrum of historical flows for a given stream segment.

The process is initiated by developing a flow frequency-duration curve for the gauge site of interest, with flow rate plotted against the percent of days for which that flow is exceeded at the gauge. The flow curve is subsequently translated to a load duration (TMDL) curve by multiplying the flow values by the water quality standard. The resulting plot of constituent load (e.g., pounds per day [lb/day]) versus the percent of days that load is exceeded forms the basis for determining compliance with the stream standards. A water quality sample is converted to a load by multiplying the sampled concentration by the average daily flow (on the day of sampling).

The sample load is plotted on the TMDL plot. Values lying above the TMDL curve represent deviations from the water quality standard, whereas those below the curve represent compliance. KDHE interprets loads from these analyses as follows:

Loads plotting above the curve in the load-exceedance regime defined as being exceeded 85 to 99 percent of the time are generally attributed to point sources.

Loads plotting above the curve in the 10 to 85 percent regime are typically attributed to nonpoint sources.

Loads plotting above the curve at exceedances less than ten percent of the time or more than 99 percent of the time are considered reflections of extreme hydrologic conditions of flood or drought, and are deemed to "exceed feasible management."

The KDHE TMDL Curve Methodology inherently recognizes that loads are a function of flow, and that calculation of a TMDL at only a single (low) flow condition is not representative of actual conditions in the watershed. This is of particular relevance for bacterial parameters, which have been demonstrated across the nation (including in the Middle Rio Grande) to be highly influenced by storm events and stormwater runoff.

The State of Arizona, while not recognizing the flow-sensitive nature of load calculations like Kansas does, is sensitive to seasonal variations and "critical conditions." The federal TMDL regulations require that seasonal variations be considered in development of a TMDL. Arizona's approach also highlights the determination of so-called critical conditions, which are not clearly defined. However, in the case of bacterial contamination, in light of the broad evidence to support it, a case could be made that "critical conditions" are in fact not the low-flow conditions (e.g., 4B3, 7Q10) used in traditional development of TMDLs and point source discharge permits.

2.1.2 Allocation Methodologies

After the TMDLs have been identified for all parts of the watershed, the issuance of a permit anywhere in the watershed can be based in part upon the TMDL. The TMDL by itself is insufficient for calculation of permit numbers, however, if multiple discharges are contributing to the TMDL. This is often the case in urban areas such as the Middle Rio Grande.

Where multiple sources of waste contribute to a TMDL, the issuance of permits must be based upon sharing of the load, or waste load allocation (WLA). Thus, when modeling shows that TMDLs will be exceeded for a given point or section of a drainage network, the solution will be achieved through WLA. WLA is not necessary if exceedance of TMDL is not anticipated.

The creation of a WLA system is not a purely technical matter because it involves judgments about fairness and equitability. Various means of achieving WLA have been presented in the technical literature (Chadderton, et al. 1981; Chadderton and Kropp 1985) and in EPA guidance documents (EPA 1985; Driscoll, et al. 1983). A useful and readable overview is given by McLoud (1990). The essence of each of these documents is to show that there are a number of possible technical solutions to the problem of WLA. The allocation itself, then, must be determined either by state policy or by some process of negotiation in each specific situation.

For present purposes, we have shortened the list of possible approaches to WLA to three, as described below. There are numerous other alternatives, but none of the alternatives are in wide use because they are generally viewed as inequitable or difficult to implement. For example, it would be possible to do a WLA on the basis of the equal total loads for different dischargers, but this is obviously unfair in failing to take into account the greatly differing size of discharges.

2.1.2.1 Equal Concentration

The equal concentration method involves the use of a computer model to find the critical concentration for two or more effluents as necessary to bring the stream up to, but not above, the TMDL. This is probably the most broadly acceptable method. It is equitable in the sense that it demands the same final performance for all dischargers. Like any other method, however, it can be criticized from various viewpoints. For example, feasibility or cost for treatment to reach a specific concentration may not be the same for two different dischargers, and in this sense the principle of equal concentration can be questioned on grounds of equity in certain situations. In addition, the concentration method may be considered wasteful of assimilative capacity in the sense that the uppermost discharger may have assimilative capacity that goes unused in order to maintain the principle of equal concentrations.

2.1.2.2 Maximum Assimilative Capacity

The maximum assimilative capacity method allows each discharger to use a fixed percentage (typically 90 percent) of the capacity below the point of discharge. This is a highly efficient way of using the capacity of a stream to assimilate waste because each discharger is using essentially the full available capacity. In principle, the method also seems equitable because it allows each discharger equal access to assimilation capacity. The outcome, however, will be different concentration limits for different dischargers, simply because the assimilation capacity will be different for an upstream discharger than for a downstream discharger. The main criticism of this method is that it may not be fair to downstream dischargers.

2.1.2.3 Equitable Concentrations

A third alternative, which in fact is quite flexible in the way it can be used, would be based on equal concentration but with adjustments to achieve equity. Thus the initial principle would be equal concentrations, but one discharger would be allowed a deviation from the equal concentration rule on the basis of some factor such as cost or feasibility. For example, a WLA might be calculated initially for equal concentrations, and the concentrations might then be modified by a formula reflecting the cost per gallon of discharge or the cost per customer for treatment. Thus the final product would be unequal concentrations based on some ratio that was agreed initially to represent an equity adjustment. For a wet weather condition, equitable concentrations may be the most flexible approach.

2.1.3 Effluent Trading

In order to achieve water quality standards and associated designated uses within surface waters, it is evident that pollution management must be addressed through a watershed approach. The watershed approach is a holistic approach that considers the impacts from all sources of pollution and use impairment in a receiving water. Recent efforts to encourage watershed approaches to manage process wastewater discharges, other point source discharges such as stormwater discharges, and nonpoint sources of pollution have required a new level of cooperation between local units of government that share common hydrologic boundaries, as well as between regulatory agencies and local governments.

The historic implementation of water quality management programs at the federal and state levels has worked well to control pollution from point sources, but it has left a patchwork of regulated and unregulated discharges to surface waters. This patchwork is especially evident in urbanized areas where multiple local jurisdictions are located in the same watershed. This past incremental approach has fragmented water quality enhancement strategies, and has overlooked significant pollution sources while focusing on increasing restrictions on the relatively small number of National Pollutant Discharge Elimination System (NPDES) permitted sources. This historic regulatory approach has offered little flexibility or incentive for the development of innovative solutions to achieve water quality objectives that may: (1) be more cost-effective, (2) be implemented in a more timely fashion, and (3) be better able meet local needs. Watershed-based trading is one such innovative approach that offers the potential to reduce the cost of achieving local water quality objectives.

As described in the EPA *Draft Framework for Watershed-Based Trading* (EPA 1996), there is considerable support from EPA and others for the use of the watershed approach and watershed-based trading as a potential method of achieving the goals of the Clean Water Act (CWA). In addition, the Urban Wet Weather Flows Federal Advisory Committee (UWWFAC), an advisory committee to EPA on wet weather pollution management, is currently drafting a recommendation for a potential EPA policy on the watershed alternative for the management of wet weather flows. The watershed approach to pollution management and watershed-based trading as a means to achieve management goals are exciting concepts that have been discussed by many, but for which there is limited practical experience. This is particularly true in urban situations where there are multiple sources of impairment to a water body and stiff competition for limited local resources to address the pollution sources.

The watershed approach uses TMDLs or NPDES permits as the basis for establishing required pollutant load allocations within the geographic area (i.e., the watershed) under consideration. NPDES effluent limits from point source dischargers can be designed to meet water quality goals and reflect various trading options.

Trading Approach

The CWA does not explicitly authorize the use of pollutant trading. The Act does contain provisions that suggest that trading is allowed through the establishment of the TMDL process. Under this process, the states can allocate pollutant waste loads between point and nonpoint sources.

In the EPA *Draft Framework for Watershed-Based Trading*, EPA has identified the following as principles that exist to promote trading.

Trading participants meet applicable CWA technology-based requirements — All municipal and industrial point source discharges in the Middle Rio Grande meet technology-based CWA requirements.

Trades are consistent with water quality standards throughout a watershed as well as antibacksliding, other requirements of the CWA, other federal laws, state laws, and local ordinances — The Middle Rio Grande has considered compliance with stream standards as a TMDL endpoint.

Trades are developed within a TMDL or other equivalent management framework — The interjurisdictional watershed approach already developed for the Middle Rio Grande under the NPDES system is consistent with the watershed management framework required to effect a watershed-based trading program.

Trades occur in the context of current regulatory enforcement mechanisms — Within the context of the NPDES regulatory program, the Middle Rio Grande is seeking to identify innovative and efficient approaches that will increase accountability and responsibility at the local level while including regulators (both state and federal) as stakeholders in the watershed management approach.

Trading boundaries generally coincide with the watershed or waterbody segment boundaries, and trading areas are of a manageable size — Although the Rio Grande is a large drainage area, several subwatersheds should be hydrologically delineated to facilitate development of management alternatives.

Trading will generally add to existing ambient monitoring — The Middle Rio Grande includes a very detailed baseline ambient instream water quality monitoring program. In addition, a detailed stormwater monitoring program is underway.

Careful consideration is given to types of pollutants traded — Fecal coliform was selected for the initial TMDL modeling work.

Stakeholder involvement and public participation is important — The Middle Rio Grande should develop extensive institutional mechanisms to enable stakeholders to become actively involved in the development of the overall watershed management approach.

As indicated, the Middle Rio Grande has extensive information characterizing the existing water quality and ecosystem health of the Rio Grande and its tributaries, and pollutants of interest have been identified by stream segment. Potential benefits to achieving water quality standards will be identified and categorized based on the biological receptors and aspects of the human environment likely to benefit from control actions. Existing characterization data and refined computer models for the watershed have been used by NMED to determine fecal coliform loading. This analysis may be a foundation, but additional work is needed to quantify the impacts of identified sources on water quality, land use, biological resources, and human ecology in the watershed, and to identify economic benefit. These completed analyses lay the foundation for the required technical and institutional discussions.

2.1.4 Human Health Based Methodologies for Allocation

The stream standards, and thus the draft TMDL, use fecal coliforms as the measure of pathogenic risk to human health. It is widely recognized that fecal coliforms are not an ideal indicator organism, as virtually any warm-blooded animal can be a source of fecal coliforms, but human health risk is tied primarily to fecal coliforms of human origin. The literature contains numerous examples showing a lack of correlation between fecal coliform levels (of unidentified sources) to human health effects. An example is a 1996 study of Santa Monica Bay in California (Santa Monica Bay Restoration Project, 1996), in which levels of fecal coliform could be correlated only to dermal irritation and not to gastrointestinal disorders of swimmers. A 1991 EPA study (Calderon 1991) documented that swimmer illness could not be correlated to the presence of indicator organisms of non-human origin or to high-volume rainy days.

To address this issue, the allocation of fecal coliforms could be modified to be based only on those fecal coliforms that are of human origin, rather than all fecal coliforms. This would provide a more accurate and appropriate methodology of allocation of fecal coliforms, while maintaining the basic goal of protecting humans from health risks associated with exposure to pathogens in the stream.

Methods to identify and categorize the sources of fecal coliforms have been in place for years. However, most of these have proven either unreliable or complex and expensive, such that they have not been widely used. A new "tool" in the identification of fecal coliform sources is available, as discussed later in this document. Use of this approach would require additional data collection throughout the subject reach of the Rio Grande to identify and quantify the degree of fecal coliforms that are of human origin.

2.2 Modeling Approaches

One methodology available to address the flow-related characteristics of fecal coliform concentrations is the use of water quality models. A model of the system would allow the following:

Increased understanding of the river system, contributors of bacteria, and the response of the Rio Grande to these inputs under varying conditions

Ability to perform "what-if" scenarios for different storm intensities and durations, as well as an evaluation of the potential benefits of implementing BMPs

An assessment of the practicability of meeting the stream standards under varying conditions

Several watershed and receiving water computer models are available for TMDL development. Most models have similar overall capabilities but operate at different time and spatial scales and were developed for varying conditions. The available models range between empirical and physically based. However, all existing watershed and receiving water computer models simplify processes and often include obviously empirical components. An empirical model omits the general physical laws and is in reality a representation of data. Even detailed models only include the most significant physical process for the simulation of runoff, river hydraulics, and constituent reaction kinetics using a combination of empirical- and physically-based algorithms.

Each model has its own set of limitations on its use, applicability, and predictive capabilities. For example, watershed models may be designed to project loads on annual, seasonal, monthly, or storm event time scales with spatial scales ranging from large watersheds to small subbasins to individual parcels, such as construction sites. Receiving stream models can be steady state, quasi-dynamic, or fully dynamic. As the level of temporal and spatial detail increases the data requirements and level of modeling effort increase. Very few models have integrated rainfall-runoff and receiving water capabilities. The models that do have these capabilities tend to be very complex and labor intensive with large data requirements.

Model selection is a significant step in the TMDL development approach because it sets boundaries on the scope and potential of the process. The selected model establishes the necessary framework for exploring TMDL options, but many facets of the modeling exercise are readily transferable to other models (e.g., segmentation strategy, input conditions, basis for predictions, etc.). The case for recommending a particular model must rest on a careful assessment of the needs of the Middle Rio Grande Watershed TMDL process, tempered with a pragmatic look at data availability and future data collection.

Model capabilities will be examined in terms of both general and specific considerations. General considerations include those characteristics important in any comparison of models and assess the level of complexity appropriate for this project. Specific considerations address technical requirements for modeling in the Rio Grande basin. The requirements of receiving water quality models and watershed models are treated separately. Then the relative merits of the most appropriate models will be explored and a recommendation made.

The preferred model selection addresses the TMDL development objectives, matches potential model precision with the available data, and maintains the simplest approach possible. The preferred model selections also required compatible model formats so that the watershed and receiving water model can be easily linked to facilitate an integrated approach. Ease of use is a key ingredient where so many stakeholders are involved. Each stakeholder may have a different view of the "best" TMDL strategy. If the model is easy to use and can produce informative graphical output in a short time, it will afford users the opportunity to explore options by manipulating model input.

The integrated TMDL model is a tool for enhancing our understanding of the stream and for aiding the TMDL decisionmaking process with regard to WLA in the Middle Rio Grande. For the tool to be effective, it must have sufficient complexity for adequate physical representation of the Middle Rio Grande system from Bernalillo to the Isleta property. Land use ranges from urban to agricultural.

The Draft Middle Rio Grande TMDL for fecal coliform relies on a simple mass balance approach under very limited low flow conditions. The current approach appears to be overly conservative.

2.2.1 Watershed Model

The purpose of a watershed simulation model is to simulate runoff from precipitation and transport of pollutants to the Rio Grande through the receiving water model. The watershed modeling objectives include:

Characterize urban and agricultural runoff temporarily and spatially

Provide loading values to the receiving water quality model

Determine effects, magnitudes, and locations for control options

Perform frequency analysis of quality parameters

Provide input to cost-benefit analyses

A wide variety of models are available that can meet these objectives. An important element of the watershed modeling process is to determine appropriate loading rates for the water quality parameters to be simulated. Techniques that have been used include: event mean concentrations; buildup/washoff algorithms; regression equations; and statistical modeling.

Models of moderate complexity rely on event mean concentrations as the basis for predicting loads. Event-mean concentrations (EMCs) are developed for each parameter by collecting flow-weighted composite samples at given locations. The EMC is defined as the average of individual measurements of storm pollutant mass loadings divided by the storm runoff. Nonpoint loading factors (pounds per acre per year [lb/acre/year]) for different land use categories are based upon annual runoff volumes and EMCs for individual pollutant parameters. EMC data can be collected for the Rio Grande Urban watershed under the Albuquerque NPDES Stormwater permitting project and the National Urban Runoff (NURP) program and will be used in the watershed model.

The manner in which input data are processed varies from the simple to the complex models as mentioned above. When using the EMCs as the basis for pollutant load estimates, one of the keys to effective transfer of EMC values is to make adjustments for actual runoff volumes in the Rio Grande watershed. In order to calculate annual runoff volumes for each subbasin, the pervious and impervious fractions of each land use category are used as the basis for determining rainfall/runoff relationships. Runoff volumes are calculated for each storm event by multiplying the rainfall volume by a runoff coefficient. Runoff coefficients developed by Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) for land use types will be used.

Output conditions can be computed on a storm event or annual basis and will serve as input to the receiving water model. Concentrations of pollutant parameters will be input at major stormwater outfalls to the Rio Grande.

2.2.1.1 Available Models

Watershed models can be broken into a range of levels or categories based upon complexity, data requirements, and the level of expertise required to accurately use the models. EPA has grouped existing watershed-scale models for TMDL development into three categories based on the number of processes they incorporate and the level of detail they provide:

Simple models

Midrange models

Detailed models

Simple models primarily implement empirical relationships between physiographic characteristics of the watershed and pollutant runoff. A list of simple category models with an indication of the capabilities of each model is show in Table 2.2-1. Simple models may be used to support an assessment of the relative significance of different nonpoint sources, guide decisions for management plans, and focus continuing monitoring efforts. Generally, simple models aggregate watershed physiographic data spatially at a large-scale and provide pollutant loading estimates on large time-scale scales. Although they can easily be adopted to estimate storm event loading, their accuracy decreases since they cannot capture the large fluctuations of pollutant concentrations observed over smaller time-scales.

Table 2.2-1 Range of Application of Watershed Models - Simple Models

Simple Methods	Watershed Analysis			Control Analysis		Receiving Water Quality
	Screening	Intermediate	Detailed	Planning	Design	
EPA Screening	●	–	–	–	–	○
The Simple Method	●	–	–	○	–	–
Regression	●	–	–	–	–	–
SLOSS/PHOSPH		–	–	–	–	–
Water Screen	●	–	–	–	–	–
Watershed	●	–	–	○	–	–
FWHA	●	–	–	○	–	○
WMM	●		–	■	–	■

● High ○ Low

■ Medium – Not available

Midrange models attempt a compromise between the empiricism of the simple models and complexity of detailed mechanistic models. Midrange models are designed to estimate the importance of pollutant contributions from multiple land uses and many individual source areas in a watershed. Therefore, they require less aggregation of the watershed physiographic characteristics then the simple models. Midrange models may be used to define large areas for pollution mitigation programs on a watershed basis and make qualitative evaluations of BMP alternatives. a list of models within the midrange category and their capabilities is shown in Table 2.2-2.

Table 2.2-2 Range of Application of Watershed Models - Midrange Models

Simple Methods	Watershed Analysis			Control Analysis		Receiving Water Quality
	Screening	Intermediate	Detailed	Planning	Design	
NPSMAP	●	○	○	■	–	○
GWLF	●	■	○	–	–	–
P8-UCM	●	■	■	○	●	–
SIMPTM	○	■	■	■	○	–
Auto-QI	●	●	○	■	○	○
AGNPS	●	●	○	●	○	○
SLMM	●	■	○	●	○	○

● High ○ Low

■ Medium – Not available

Detailed models track not only pollutant washoff but also pollutant accumulation rates on the watershed land surface. These models explicitly simulate the physical processes of infiltration, runoff, and pollutant accumulation with detailed changes in watershed physical characteristics and processes over space and time. A list of models within the detailed category is shown in Table 2.2-3. These models are large and are not designed with emphasis on their potential used by the typical state or local planner. Many of these models were developed for research into the fundamental land surface processes influencing runoff and pollutant generation rather than to communicate information to decisionmakers faced with planning watershed management. Input data file preparation and calibration require extensive resources.

2.2.1.2 Criteria for Selection

The model selection criteria were developed to provide a best match between the TMDL objectives and available data. The criteria included:

Ease of use

Compatible with existing data

Easily integrated with previous modeling efforts

Not resource intensive

Provide adequate level of detail for decisionmaking

Table 2.2-3 Range of Application of Watershed Models - Detailed Models

Simple Methods	Watershed Analysis			Control Analysis		Receiving Water Quality
	Screening	Intermediate	Detailed	Planning	Design	
STORM	●	●	○	●	○	○
ANSWERS	●	●		●	○	○
SWRRBQ	■	●	●	●	■	■
DR3M-Q	■	●	●	●	■	■
SWMM	■	●	●	●	■	–
HSPF	■	●	●	●	■	●

● High ○ Low

■ Medium – Not available

These criteria would be best fit by a model in the upper simple to lower midrange model choices.

2.2.1.3 Capabilities and Recommendation

The Watershed Management Model (WMM) is recommended as the watershed model to project loads for the stormwater source of the TMDL. WMM is a spreadsheet-based model used to estimate annual, seasonal, or storm event nonpoint source loads from direct runoff based upon event mean concentrations (EMCs) and runoff volumes. The conceptual design of WMM is shown in Figure 2.2-1. Data required to use the WMM include EMCs for each pollutant type, land use, average precipitation, annual baseflow, and average baseflow pollutant concentrations. The most intensive data for WMM is land use coverages. The City of Albuquerque has made large investments in land use GIS, which will reduce the cost of developing WMM significantly. The features of the WMM are summarized below:

Estimates runoff pollution loads and concentrations for constituents (fecal coliform, total phosphorus, dissolved phosphorus, total nitrogen, ammonia plus organic nitrogen), heavy metals (lead, copper, zinc, cadmium), and oxygen demand and sediment (BOD_5, COD, total suspended solids, total dissolved solids) based upon EMCs, land use, percent impervious, and annual rainfall.

Estimates runoff pollution load reduction due to partial- or full-scale implementation of up to five types of onsite or regional BMPs.

Uses delivery ratio to account for reduction in runoff pollution load due to uptake or removal in stream courses.

Estimates pollution loads from stream baseflow.

Estimates point source loads for comparison with relative magnitude of nonpoint pollution loads.

Estimates pollution loads from failing septic tanks.

Stormwater pollution control strategies that may be identified and evaluated using WMM include:

Nonstructural controls (e.g., land use controls, buffer zones, etc.)

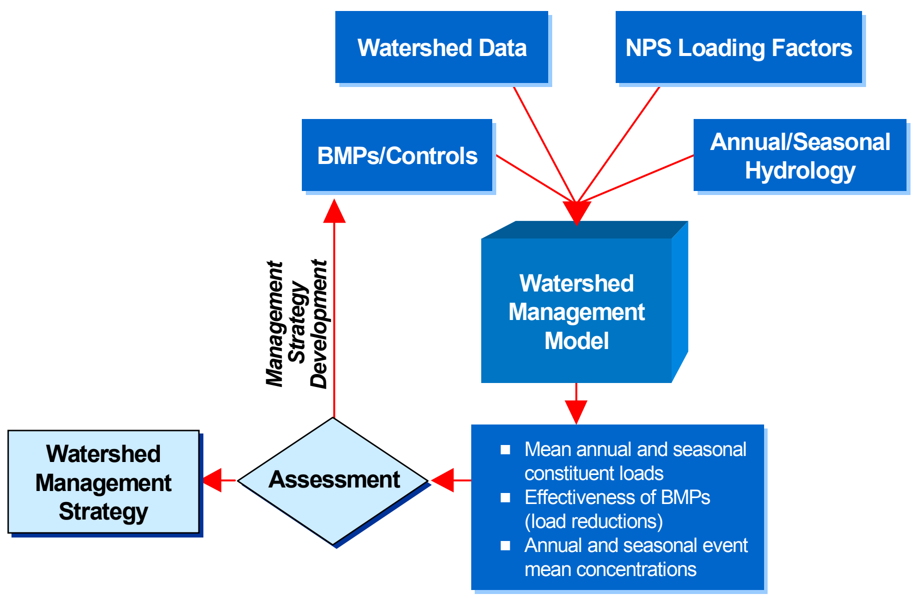


Figure 2.2-1
Watershed Management Model Overview

Structural controls (e.g., filtration devices, onsite and regional detention basins, wet detention ponds, dry detention ponds, etc.)

Within a given watershed, multiple subbasins can be evaluated. Subbasins are typically delineated by drainage areas to various tributaries, outfalls, or other receiving water bodies within a watershed. However, subbasins can be delineated based on nonhydrologic boundaries such as jurisdictional limits. This provides decisionmakers with information regarding the relative contribution of nonpoint pollution loadings from various areas within the watershed which can be used for targeting control measures to those areas that are responsible for generating the majority of the pollutant load.

The model is a planning level tool that provides a basis for evaluation of stormwater pollution loads and the relative benefits of stormwater pollution management strategies to reduce these loads. Stormwater pollution control strategies may be identified and evaluated for nonstructural controls, including land use controls and buffer zones, and for structural BMPs such as onsite and regional detention basins. Combinations of nonstructural and structural controls can be evaluated to develop TMDL implementation strategies, a proposed municipal NPDES stormwater management plan, a water supply watershed management plan, or other stormwater management plan. Alternative management strategies can be evaluated using the WMM, which projects stormwater pollution loadings from the watershed. WMM has been used extensively in support of TMDLs and NPDES stormwater permit development, watershed management planning, waste load allocations, and master planning with several applications in New Mexico.

2.2.2 Receiving Water Quality Models

Receiving water quality models differ in many ways, but some important dimensions of discrimination include: conceptual basis, input conditions, process characteristics, and output. Table 2.2-4 presents extremes of simple and complex for each condition as a point of reference. Most receiving water quality models have some mix of simple and complex characteristics that reflect tradeoffs made in optimizing performance for a particular task.

Table 2.2-4 General Receiving Water Quality Model Characteristics

Model Characteristics	Simple Models	Complex Models
Conceptual Basis	Empirical	Mechanistic
Input Conditions	Steady State	Dynamic
Process	Conservative	Nonconservative
Output Conditions	Deterministic	Stochastic

The concept behind a receiving water quality model may reflect an effort to represent major processes individually and realistically in a formal mathematical manner (mechanistic), or it may simply be a "black-box" system (empirical) wherein the output is determined by a single equation, perhaps incorporating several input variables, but without attempting to portray constituent processes mechanistically. A mechanistic approach is desirable for the TMDL project because it provides a more flexible and reliable basis for extrapolating to future conditions.

In any natural system, important inputs such as flow in the river change over time. Most receiving water quality models assume that the change occurs sufficiently slowly that the parameter (for example, flow) can be treated as a constant (steady state). A dynamic receiving water quality model, which can handle unsteady flow conditions, provides a more realistic representation of hydraulics, especially those conditions associated with short duration storm flows, than a steady state model. However, the price of greater realism is an increase in model complexity that may not be either justified or supportable. The tradeoffs associated with increasing model complexity are discussed in more detail later in this document.

The manner in which input data are processed varies greatly according to the purpose of the receiving water quality model. The simplest conditions involve conservative substances where the model need only calculate a new flow-weighted concentration when a new flow is added (conservation of mass). Such an approach is unsatisfactory for constituents such as fecal coliform, dissolved oxygen, or labile nutrients like nitrogen that will change in concentration due to biological processes occurring in the stream. The Middle Rio Grande TMDL model must have the capacity to handle nonconservative substances even if they are not chosen for the first round of studies.

Most receiving water quality models produce a single value for the concentration of a given constituent at a specific point in the river. The outcome is deterministic in the sense that one set of input conditions will produce one output every time. a deterministic approach, which is used by most water quality models, masks the uncertainty that exists for each parameter and input value in the model. Uncertainty in the model output creates the risk that must be faced by decisionmakers who use the model. Some receiving water quality models allow for the inclusion of random variation (stochastic processes) and thus give predictions for which uncertainty estimates are available. However, if data are not available for meaningful assessment of variation in each parameter, then inclusion of stochastic processes may be misleading.

The TMDL model must contain enough chemical and biological realism for describing longitudinal trends of major nonconservative constituents such as fecal coliform, dissolved oxygen, and nitrogen fractions. Biological processes may occur in the water column or on the substrate. New Mexico streams are often shallow and have significant populations of benthic algae and rooted macrophytes that must be modeled by kinetics that differ from those typically applied to suspended algae. In addition, mass balance calculations must allow for the influence of seepage and other nonpoint source additions.

2.2.2.1 Available Models

Several prospects exist of which the most promising are QUAL2E and STREAMDO-IV. Both are steady state, mechanistic models with the ability to handle the nonconservative constituents of interest. STREAMDO has been used by the City of Albuquerque to simulate loadings of ammonia and dissolved oxygen to the Rio Grande. The two models incorporate most of the same processes but differ significantly in construction and operation. QUAL2E takes a linear programming approach in which each new data set requires a separate run. STREAMDO has all inputs, processes, and outputs on a spreadsheet where conditions are simple to manipulate.

QUAL2E is a widely-used water quality model that relies on *FORTRAN* code. Input must be carefully structured for each run. Graphics are cumbersome, but can be improved with a separate interface. There are some dimensional limitations in the "off-the-shelf" program that would be exceeded by the number of computational elements and tributaries in the Middle Rio Grande. These limitations can be overcome, but the format is not very flexible for making changes in the physical representation of the receiving water body.

STREAMDO is a more recent development that places standard mass balance equations in a spreadsheet. The format is very convenient for modifying model structure and inserting additional processes. The biggest advantage for STREAMDO is the ease with which results are displayed and the fact that the City of Albuquerque invested in developing the model in 1993. The facility with which users can adjust the model to investigate different scenarios is an important advantage when so many stakeholders are involved. The TMDL process will be aided by a high level of involvement rather than restricting access to a few expert modelers. The single disadvantage of STREAMDO is that it is a model developed and supported by EPA Region VIII unlike QUAL2E, which is maintained by EPA on a national basis. However, recent TMDL efforts by EPA indicate the agency is accepting a broad range of modeling approaches.

2.2.2.2 Criteria for Selection

Attention should be focused on models of moderate complexity that will meet the objectives of the TMDL project.

The receiving water quality model should be mechanistic, steady state, and deterministic with the capacity to handle nonconservative substances by mass balance principles. The option to include uncertainty analysis is desirable.

2.2.2.3 Recommendation

The recommendation for the fecal coliform TMDL on the Rio Grande is a mass-balance spreadsheet model of moderate complexity, such as STREAMDO, as the model is specifically designed to serve TMDL purposes. Specifically, the spreadsheet model based on STREAMDO is more transparent to regulatory authorities, dischargers, and other interested parties than other models; it is highly flexible in anticipation of the use of improved data bases; and it is capable of representing a wide range of processes that affect water quality. The model has also been developed for the Middle Rio Grande by the City of Albuquerque.

2.2.3 Model Linkages

Spreadsheet models offer the greatest flexibility for integrating the three components of the TMDL model and for modifications to the basic structure and function of the model.

Spreadsheet models are very well suited for rapid, graphical display of model output and for easy manipulation of model input and operating conditions.

The watershed model should be based on EMCs and land use coverages as the basis for pollutant loading.

2.2.4 BMP Effectiveness

As discussed above, the potential effectiveness of BMPs on improving stream quality can be assessed using modeling techniques. This provides a cost-effective manner of assessing and selecting the types and locations of structural BMPs, if any, to implement before they are constructed. Numerous communities have implemented costly BMPs to control a variety of constituents (including fecal coliforms), only to find out via after-the-fact monitoring that they did not have the intended effect on the receiving water.

The draft Middle Rio Grande TMDL points out that many structural BMPs are ineffective in reducing bacterial constituents (or indicator organisms). The draft TMDL cites the following bacteria removal efficiencies:

Drain inlet insert: 5 percent

Extended detention basin: 40 percent

Vegetated swales: 0 percent

Filter strips: 0 percent

Media filters: 55 percent

If accurate, it is apparent that the above-mentioned BMPs cannot provide the orders-of-magnitude reduction in fecal coliform levels needed to achieve compliance with the stream standards during and following storm events. However, modeling could be used to simulate and predict the effects that these BMPs could achieve on a basinwide basis, and in response to storm events.

Additional BMPs not listed in the draft TMDL should be considered and evaluated for their potential to reduce stream bacteria levels as part of the modeling activities. For example, infiltration trenches, infiltration basins, and porous pavement have shown to provide at least some bacteria removal in other studies (MWCOG 1987).

2.3 New Tools

A number of tools have been developed or improved in recent years to assist in the analysis and mitigation of human risks to pathogens and compliance with stream standards. A few of these, as applicable to TMDL allocations and/or stream standards and as referenced in other sections of this report, are discussed below.

2.3.1 Fecal Coliform Source Tracking

Typical water quality monitoring for fecal coliform bacteria indicates only the presence and magnitude of fecal coliforms. As noted earlier, fecal coliforms can be an inaccurate indicator of human pathogens, since fecal coliforms can originate in a wide range of warm-blooded animals, but the greatest risk to humans is from fecal coliforms of human origin. Identification of the sources of fecal coliforms could thus help identify the degree of risk to human health for a given sample, which in turn could be used either in allocation of bacteria under a TMDL, or in the setting of stream water quality standards.

To address this issue, many techniques have been developed for characterizing and categorizing the source of fecal coliforms. To date, most methods have fallen short, as each has proven to be unreliable, laborious, costly, or too complicated for routine use. Examples of past techniques include fecal coliform-to-streptococci ratios, fatty acid profiling, deoxyribonucleic acid (DNA) fingerprinting, and tracer studies. A more recent technique has emerged, termed Multiple Antibiotic Resistance Analysis (MARA) that has been shown to reliably identify the sources of fecal coliforms using relatively simple and accepted technologies.

The MARA technique is based on the principle of resistance to a set of antibiotics at a range of doses or concentrations. Because different groups of animals are exposed to different sets of antibiotics (or no antibiotics), the fecal coliform organisms originating in those groups of animals respond differently to antibiotics. Resistance to antibiotics is evidenced by growth of fecal coliforms in a standard fecal coliform colony-forming unit test in the laboratory. MARA was recently used to support an analysis of fecal coliform sources in the Big Creek Watershed in Fulton County, Georgia.

The technique requires that a database be initially set up to characterize the resistance of fecal coliforms from known sources to a suite of antibiotics at a range of concentrations. Unknown (e.g., river) samples are then exposed to the same suite and concentration range of antibiotics; the resistance results from which are processed through the database using discriminant analysis techniques. Using these statistical methods, the unknown sample is then characterized as matching the resistance pattern of one of the "known" groups of samples and the source of the unknown sample is identified. The MARA methodology has been shown to have accuracies exceeding 95 percent. Careful selection of the types and concentrations of antibiotics to use in the evaluation is key to distinguishing sources of fecal coliforms, and should take into account the types of antibiotics that are normally used for treatment of the subject animal groups.

2.3.2 Risk Assessment Methodology

The risk of waterborne infectious diseases is usually assessed by quantifying the concentrations of indicator microorganisms that signify the presence of fecal material in the water. Bacteria of the fecal coliform group are primary indicators of fecal contamination since they are usually associated in high numbers with the gastrointestinal tract and feces of warm-blooded animals and humans. When the concentration of fecal coliform bacteria exceed state or federal criteria for indicator organisms, pathogen levels may be sufficient for waterborne illnesses to develop in humans exposed to the contaminated water. Water quality criteria recommended by EPA were developed using a series of research studies, which examined the relationship between swimming-associated illness, and the microbiological quality of waters used by recreational bathers.

Indicator organisms often do not cause illness directly, but have demonstrated characteristics that make them good predictors of harmful pathogens in water bodies. Pathogens are disease-causing microorganisms that include viruses, protozoa, and bacteria. Typically used indicator organisms include total coliform bacteria, *E. coli* and enterococci. Fecal coliform bacteria show less correlation to swimming-associated gastroenteritis than the other indicator organisms. The stronger correlation for the other two indicator organisms may be a result of the survivability of the indicator organisms in the environment being similar to the survivability of the pathogens of concern. EPA's 1986 ambient water quality criteria for bacteria recommended the use of *E. Coli* and enterococci rather than fecal coliforms.

2.3.2.1 Potential Exposure Pathways

Exposure to pathogens in surface water in the Rio Grande is theoretically possible through the following pathways:

Incidental or intentional ingestion of surface water

Dermal contact with surface water

Inhalation of aerosols during use of surface water for irrigation

Incidental ingestion and dermal contact with a large body surface are may occur during primary contact uses but are unlikely or very limited during secondary uses. The New Mexico Water Quality Control Commission defines primary uses where there is prolonged and intimate water contact such as swimming and water skiing. Primary uses also include Native American traditional cultural, religious and ceremonial purposes. Secondary uses include activities such as fishing, boating and wading. Secondary uses also include limited seasonal contact. Water quality criteria established by EPA and most states are less stringent for secondary than primary uses, reflecting the decreased probability for contact with contaminated water.

Many states have also developed water quality criteria for indicator bacteria based on inhalation of aerosols. Aerosols are liquid droplets suspended in air usually less than 50 microns (µm) in diameter. Many bacteria are no more than 1 to a few microns along any dimension and can therefore be carried in aerosol droplets. Airborne pathogens can then be inhaled into the lungs or may be trapped on mucous lining and be subsequently swallowed. The major factors influencing risks from inhalation of aerosols are the concentration of pathogenic organisms in the aerosol, and the distance of the exposed person from the source.

2.3.2.2 Potential Changes to the Risk Assessment Methodology used in the TMDL

Current water quality criteria for bacteria in the Middle Rio Grande are overly conservative for the following reasons:

Criteria based on fecal coliform do not discriminate between human and animal sources of contamination.

Current water quality criteria may not reflect actual uses of surface water in the Middle Rio Grande.

The first factor overestimates the number of pathogens that may be present in surface water, whereas the second factor overestimates the degree to which people may be exposed to pathogens in surface water. It is possible to modify the existing water quality criteria by addressing these issues while still protecting the beneficial uses of the Middle Rio Grande.

Adjust Criteria Based on the Presence of Human Pathogens

Discriminating between human and animal sources of contamination is important, because not all animal pathogens cause human disease. There is evidence that farm-animals may contribute significantly to fecal coliform sources in the Rio Grande. The *Public Health Study and Assessment of Middle Rio Grande and Albuquerque's Reclaimed Water* (CDM 2000) indicates that commercial and residential uses of farm animals are common along the Middle Rio Grande and lists numerous types of farm animals (e.g. cows, horses, chickens, ostriches) that have recently been observed. This suggests that a large percentage of the observed fecal coliform levels in the Rio Grande are from animal rather than human sources.

A screening level method that can be used to identify sources of coliform bacteria involves developing fecal coliform:fecal streptococcus (FC:FS) ratios. Fecal coliform levels are generally high compared to fecal streptococci in human domestic waste, but fecal streptococci are more prevalent in stormwater. Generally FC:FS ratios that are 4.0 or higher, typically indicate domestic waste, while FC/FS ratios of 0.6 or lower are associated with discharge from farm animal or stormwater runoff. This method cannot be used to numerically adjust the existing water quality criteria but can be used to justify such an approach. Potential methods for quantifying the percentages of human versus animal based indicator organisms are presented in Section 2.4.1.

Adjust Criteria Based on Actual Surface Water Uses

Current water quality criteria for bacteria were developed using epidemiological studies, in which numbers of indicator bacteria in surface water were linked to incidences of disease (mostly gastrointestinal) following exposure. "Acceptable" levels of bacteria in surface water were then developed using an acceptable level of disease incidence (e.g., X cases in 1,000 swimmers).

Tribal surface water uses may be less intensive than those upon which the water quality criteria are based. If the tribal uses can be characterized, and they are found to involve relatively short-term activities or activities during which less water may be ingested than during swimming, this information could be used to adjust the water quality criteria. EPA has published studies that discuss amount of water typically ingested for a given swimming duration. These data could be used to develop water quality criteria that better reflect actual uses of the surface water in the Middle Rio Grande.

The elevated levels of fecal coliform in the Middle Rio Grande are not an uncommon problem. In many cases around the country, bacterial contamination levels frequently exceed the standards for the designated use of a body of water. Often, this is in response to a storm event (due to stormwater runoff, combined sewer overflows [CSO], or other problems). This phenomenon has been demonstrated in the Middle Rio Grande, associated largely with stormwater runoff.

In some cases, it may not be possible to achieve the stream standards, whether on an interim basis (e.g., while BMPs are being implemented) or on a long-term basis where the designated use is determined to be nonattainable. In either case, public awareness and education can form a critical component of a plan to protect public health.

An example of an effective public awareness and education campaign is one developed as part of the Rouge River National Wet Weather Demonstration Project in Michigan. For recreational uses of the river, which was identified as having levels of *E. Coli* that exceeded stream standards, specific subsegments of the river were categorized based on the following:

Condition Quality: based on depth of water (suitability for recreation) and *E. Coli* concentrations, categorized as "green" (good), "yellow" (fair), or "red" (poor)

Use Quality: categorized based on suitability for full use, limited use, or restricted recreational use of the stream segment

By conveying this information to the public, and obtaining public buy-in via a public participation program, the Rouge River successfully managed the conflicts between stream standards and actual use conditions such that public health could be protected.

2.4 Changes to Stream Standards or Use Classifications

Alternate approaches to allocating loads under the TMDL process were presented in Section 2.1. These approaches assumed that the stream standards and use classifications remain unchanged from their current status. A longer-term approach that may make sense — both in terms of human health protection and achievable results — is modifications to the stream standards or designated use classifications that address the variable, yet temporary nature of elevated bacteria concentrations. A closer examination of the types and timing of uses of the Middle Rio Grande could provide key information in reaching a common goal of protecting human health from bacterial contamination.

To a large degree, the data needed to fully understand the sources, variability, and duration of higher bacterial concentrations in the Middle Rio Grande are not presently available. While several studies have shown that higher concentrations are tied to precipitation events and higher flows, a thorough characterization is lacking. To support a water quality standards review, and to better understand the nature of the impairment the TMDL seeks to resolve, the following types of information would be highly valuable:

Timing of storm events and their impacts on primary or secondary contact recreational uses

Average time between storm events and elevated bacteria concentrations

Severity, number, frequency, and duration of stream standard exceedances

Details on the actual impairment of the recreational uses, including the severity and geographic extent of impairment

Specific locations in which the recreational uses may be impaired (i.e., where recreation occurs and stream standards are not met)

Locations and relative contributions of sources of bacteria contributing to nonattainment of the fecal coliform standard in the Middle Rio Grande

2.4.1 Time- or Flow-Based Standards or Use Classifications

The time- and flow-based variability in fecal coliform levels in the Rio Grande is reflective of the impact storm events have on water quality in the area. A better understanding of these dynamics, coupled with enhanced information regarding the types, location, and frequency of bacteria-sensitive uses that actually occur in the subject portion of the Rio Grande, could be used to set standards or use classifications that protect human health while reflecting realistic conditions in the river. Moreover, the ability to control bacterial contributions – especially during storm events – must be considered in evaluating the stream quality and standards. For any such review, it is important that the actual in-stream existing uses of water be protected – not changed – by modifying the standards or designated uses to reflect the uses and provide public health protection. Among the types of revisions that could be implemented are:

Modifying the stream standards for a particular designated use

Changing the designated use for one or more segments of the Middle Rio Grande (or tributaries/channels), or creating new subsegments, to preserve the designated use in areas where it actually occurs

Creating new subclasses of the existing designated use categories to reflect more specific stream and use conditions and recognize intermittent exceedances of bacteriological standards

Modifying stream standards for a given designated use would only be appropriate in terms of providing conditional changes to the standards (e.g., standards change based on flow conditions or specified seasons). This would affect streams throughout New Mexico. Modifying the designated use classifications would be specific to stream segments addressed in the request. The most flexible approach would be to subcategorize the existing designated uses to reflect specific stream or use conditions.

The federal regulations regarding water quality standards (40CFR131.10(f)) specify that

"States may adopt seasonal uses as an alternative to reclassifying a water body or segment thereof to uses requiring less stringent water quality criteria. If seasonal uses are adopted, water quality criteria should be adjusted to reflect the seasonal uses; however, such criteria shall not preclude the attainment and maintenance of a more protective use in another season."

Several states have enacted seasonal stream standards for bacteria (e.g., fecal coliform, e. coli) that relate to the largely seasonal nature of water recreation. These generally provide stricter bacteria standards during summer months (e.g., May through September), when temperatures are conducive to a higher level of recreation (and thus, exposure to bacterial contaminants in the water).

Examples of states that have implemented seasonal recreation standards are Kansas, Nebraska, South Dakota, and Wyoming. In general, states try to protect and maintain the recreational uses of their waters to be consistent with the "swimmable" goal of the Clean Water Act. Some states consider site-specific factors such as the actual use, existing water quality, potential for water quality improvement, access, recreational facilities, safety considerations, and the physical attributes of the water body in determining whether recreation is an appropriate use designation. Montana's most restrictive recreational use applies only when water temperatures exceed 60 °F.

The State of Nevada's TMDL approach includes listing a water body as being impaired only if water quality standards for the designated use are exceeded more than 25 percent of the time. If such an approach were used in New Mexico, the Middle Rio Grande may not be subject to this TMDL for fecal coliform. In addition, Nevada code provides that its water quality standards are "not considered violated when the natural conditions of the receiving water are outside the established limits including periods of extreme high or low flow…"

Thus, statutory authority and precedent exists for recognizing the seasonal and flow-based changes in use and classification of a water body. Any of these approaches might be applied to the Middle Rio Grande to help resolve the conflicts between the existing designated uses and stream standards and the increase in bacterial levels during storm events.

Subcategorization of existing uses is also allowed by federal statute. 40CFR131.10(g) provides that:

"States may … establish sub-categories of a use if the State can demonstrate that attaining the designated use is not feasible because:

(1) Naturally occurring pollutant concentrations present the attainment of the use; or

(2) Natural, ephemeral, intermittent, or low flow conditions or water levels prevent the attainment of the use…"

By federal law, a use attainability analysis (UAA) must be conducted before use subcategories can be implemented. EPA has prepared a list of relevant questions and information that would be required in preparing a UAA for bacterial-related stream standards (EPA 2000) that may be of use in evaluating the Middle Rio Grande's designated use categories or subcategories.

Some states have adopted subcategories of recreational uses to reflect combined sewer overflow (CSO) events. Similar methodologies could be adopted for storm events in the southwest, including the Albuquerque area. Under this approach, swimming (or similar contact) less than every day during the recreation season is recognized and allowed. Because each watershed has unique characteristics, the duration and "trigger conditions" for using such subcategories must be defined on a site-specific basis, recognizing that the water quality effects from a storm event can linger beyond subsidence of increased flows. EPA policy requires that the public be notified of the use restrictions and prevented, wherever possible, from recreating in the water during these times.

The States of Massachusetts and Maine subdivide their designated use categories for CSO events, temporarily suspending the recreational use designation during CSO events. Stream standards must meet recreational goals 95 percent of the time. Stream standard variances can be employed while a determination of the attainability of the original designated use is being conducted (e.g., via comprehensive monitoring).

A different concept before EPA is one of a high-flow cutoff for water quality standards that temporarily suspend bacteria criteria and recreational uses during specifically defined weather/flow conditions in the watershed. The cutoff might best be implemented as a subcategory of recreational use. Considerations in evaluating such a cutoff include:

Protection of other designated uses during the cutoff (versus limiting the cutoff to recreation uses only)

Channel velocities during the subject flow conditions and the types of recreational uses that would be physically precluded by that flow

Duration of the cutoff, and the possibility of relating it to precipitation or flow measurements

Applicability of the cutoff to specific stream segments versus an across-the-board change in use classifications in the state

Again borrowing from CSO policy and guidance elsewhere in the U.S., use subcategories could be delineated under a "frequency of exceedance" approach. In developing CSO control plans, communities are encouraged to examine the costs and benefits associated with the following frequency of overflows (and presumably, water quality impacts): zero; one to three events per year; four to seven events per year; and eight to 12 events per year. Communities are also expected to prioritize CSO controls such that the most sensitive areas (e.g., those with the heaviest recreational use) are protected.

The State of Oregon allows CSO discharges that occur during a storm event greater than the one-in-five-year 24-hour duration storm in winter and greater than the one-in-ten year 24-hour duration storm in summer. To utilize this provision, a community must have identified the specific conditions that trigger this exemption; have and use a public notification plan; investigate the sources of bacteria under these conditions; and implement a "bacteria control program" in the subject watershed.

In many cases, expensive controls on CSO point sources have proven ineffective in reaching compliance with stream standards due to natural nonpoint contributions during wet weather events, reiterating the sensibility of a frequency of exceedance provision in the standards. Time-based standards may also make sense for the Middle Rio Grande, recognizing that elevated bacteria counts after a storm event are a natural occurrence. A proposal before EPA by municipalities that experience CSOs would provide a waiver of bacteria standards for 72 hours after a storm event - regardless of whether a CSO occurred. A similar methodology for stormwater could be explored for the Middle Rio Grande.

2.4.2 Human Health Based Standards using Pathogen Indicator Source Tracking

The fecal coliform source tracking methodologies explained earlier in this section could be useful in determining health effects and protecting human health, addressing the potential inaccuracies of fecal coliforms as a human health risk indicator. Precedent for such an approach exists, but to implement this approach would require changes to the New Mexico Water Quality Control Commission Regulations.

In Georgia, the state allows a relaxation of bacteria standards if non-human sources of fecal coliform can be shown to occasionally exceed the base standards. In Alabama, Recreation and Incidental Contact standards apply only from June through September. If the fecal coliform standards are exceeded, the water quality can be deemed acceptable if a sanitary survey and evaluation discloses no significant public health risk in the use of these waters. Oklahoma uses narrative standards for Secondary Body Contact Recreation, stating that waters are to be free from human pathogens in numbers that may produce adverse health effects in humans.

A more clear understanding of the sources of bacteria in the Middle Rio Grande – especially as a function of flows and wet weather events – would serve the following functions:

Provide a more accurate evaluation of the true potential for human health effects

Allow development of a targeted program to reduce, where feasible, the levels of bacterial contamination by attacking them at their source

Both components fit directly into development of a comprehensive, sensible TMDL for the Middle Rio Grande and in implementing effective measures to address the problem.

Appendix A
References

Appendix A
References

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