Middle Rio Grande Microbial Source Tracking Assessment Report

Prepared for

New Mexico Environment Department
Albuquerque Metropolitan Arroyo Flood Control Authority
Bernalillo County

Prepared by

Parsons Water & Infrastructure Inc.
8000 Centre Park Drive, Suite 200
Austin, TX 78754

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This study was funded by the New Mexico Environment Department's Surface Water Quality Bureau, Bernalillo County, and the Albuquerque Metropolitan Arroyo Flood Control Authority.

EXECUTIVE SUMMARY

This Middle Rio Grande (MRG) Microbial Source Tracking Project was funded by the New Mexico Environmental Department, Albuquerque Metropolitan Arroyo Flood Control Authority, and Bernalillo County. The objective of this project was to identify specific sources of fecal coliform causing high levels of bacteria in the MRG. The three agencies recognized that this type of data was essential to provide water quality program managers and stakeholders the information necessary to target solutions for reducing fecal coliform concentrations/loadings within the surface waters of the study area. The study area lies within the MRG between Angostura Diversion Dam in southeastern Sandoval County to the Isleta Diversion Dam, at the northern border of Isleta Pueblo, a distance of approximately 42 river miles (Figure 2.1).

To identify specific sources of fecal coliform by subwatershed, this project involved several steps:

- Execution of a sanitary survey or reconnaissance tour of the watershed and a compilation of available data and literature to identify potential contributing sources of fecal bacteria to be considered.
- Development of watershed-specific libraries of ribotypes and antibiotic resistance profiles of *E. coli* isolated from fecal matter collected from known sources throughout the study area.
- Collection and culturing of a representative set of *E. coli* isolates from the waterbodies of concern under dry and wet-weather conditions.
- Determination of the ribotypes and antibiotic resistance profiles of these waterborne *E. coli* isolates, followed by matching to those from the known source library to identify the sources of each *E. coli* isolate.
- Quantification of the accuracy and precision of the ribotyping and ARA source determinations.
- Estimation of the relative source contributions of *E. coli* in the MRG watersheds, and the confidence of these estimates, based on the above measurements.

The sanitary survey proved valuable as it provided greater understanding of the diversity of animal species, location, and condition of wastewater infrastructure, and hydrology (pollutant loading pathways) throughout the MRG watershed. Examples of existing data and literature reviews used to identify potential sources of fecal coliform included land use data for each subwatershed from the National Land Cover Database; the number of people and their means of sewage disposal, such as a sewer connection or on-site disposal (septic systems); and estimates of cat and dog populations within each subwatershed using published per household data. Data were not available to determine the quantity of livestock or wildlife within each watershed. Countywide livestock populations were utilized.

Field collection of both ambient water samples and fecal coliform samples from known sources (local library samples) throughout the MRG study area were collected. Eight water sampling sites on the MRG were investigated. These sites are at the same locations where historical water quality sampling was performed. Another 22 sites within contributing subwatersheds were also selected for collection of ambient water samples. All ambient water and local library samples were collected in accordance with an U.S. Environmental Protection Agency (USEPA) approved quality assurance project plan (QAPP). Two-hundred and six water samples were collected from the 30 sampling stations. Due to the lack of rain, only 10 sampling stations were sampled during both dry-weather and storm water runoff conditions. Concentrations of fecal coliform generally increased from the most upstream station to the most downstream station. By far, the highest fecal coliform concentrations were in surface waters under the influence of storm water runoff. Concentrations ranged from a low of 27 colony-forming units per 100 milliliters (cfu/100 mL) at Angostura Diversion Dam to over 1 million cfu/100 mL at the North Diversion Channel at Roy.

To identify the specific sources of fecal coliform from the water samples collected, this project utilized microbial source tracking (MST) technology. MST is based upon two principles. The first principle is that the bacterial population genetic structure is clonal. Therefore MST makes use of the clonal population structure of bacteria to classify organisms based on their genetic fingerprints into groups of clonal descent. The second principle behind the MST methodology is the assumption that within a given species of bacteria, various members have adapted to living/environmental conditions in specific hosts/environments. As a result, there is a high degree of host specificity among bacterial strains that are seen in the environment.

Knowing that in any watershed, there are multiple, contributing sources of animal microbial pollution, each of which has its own unique clones of bacteria that constitute their normal flora MST was recognized as an effective tool to achieve the goals and objectives of this study. When a strain of bacteria with an identical genetic fingerprint is isolated from both a water sample and a suspected animal source, the animal is implicated as a contributor of that specific strain of the bacteria to the polluted site.

At the outset of the project it was decided that two different MST methods would be used: ribotyping and Antibiotic Resistance Analysis (ARA) to quantify and compare the precision, accuracy, and specificity of ARA and ribotyping. In addition to the usefulness of the direct head-to-head comparison, application of two methods would provide benefits to NMED and stakeholders in other ways. First, application of two independent methods can validate the results, increasing stakeholder confidence in the outcome. Second, because any one method may not perform completely successfully in all samples of a given study, a second method provides back-up to ensure the study will generate useful results. For instance, if an *E. coli* ribotype from a water sample does not match a ribotype from a known source species, ARA may be able to at least indicate whether the source was wildlife, livestock, or human. A third benefit of using two methods is that the results may be more directly compared to other studies, including the 2002 ARA project conducted by the City of Albuquerque.

Although the New Mexico and Pueblo surface water quality standards specify fecal coliform concentration limits, *Escherichia coli* (*E. coli*) was selected for MST analysis because they are exclusively endemic to the mammalian intestinal tract and comprise a substantial fraction of the fecal coliform microbial group. Studies show that the *E. coli* strain that inhabits the intestines of one species is genetically different from the strain that inhabits another. *E. coli* strains collected from water samples are compared to a library of known *E. coli* strains to determine the contributing species. Development of an *E. coli* strain library for local species was part of this MST project.

E. coli strains were also analyzed using the Antibiotic Resistance Analysis (ARA) method, which subjects the *E. coli* strain to various antibiotics. The resulting profiles are compared to a library of known *E. coli* ARA profiles. A given antibiotic resistance profile is seldom unique to a given animal or source. The ARA method uses statistics to determine the most probable mammal category, such as human, livestock, and wildlife.

The results using ribotyping indicate that a variety of sources appear to contribute to the fecal coliform levels in the MRG, as illustrated in Table E.1 below.

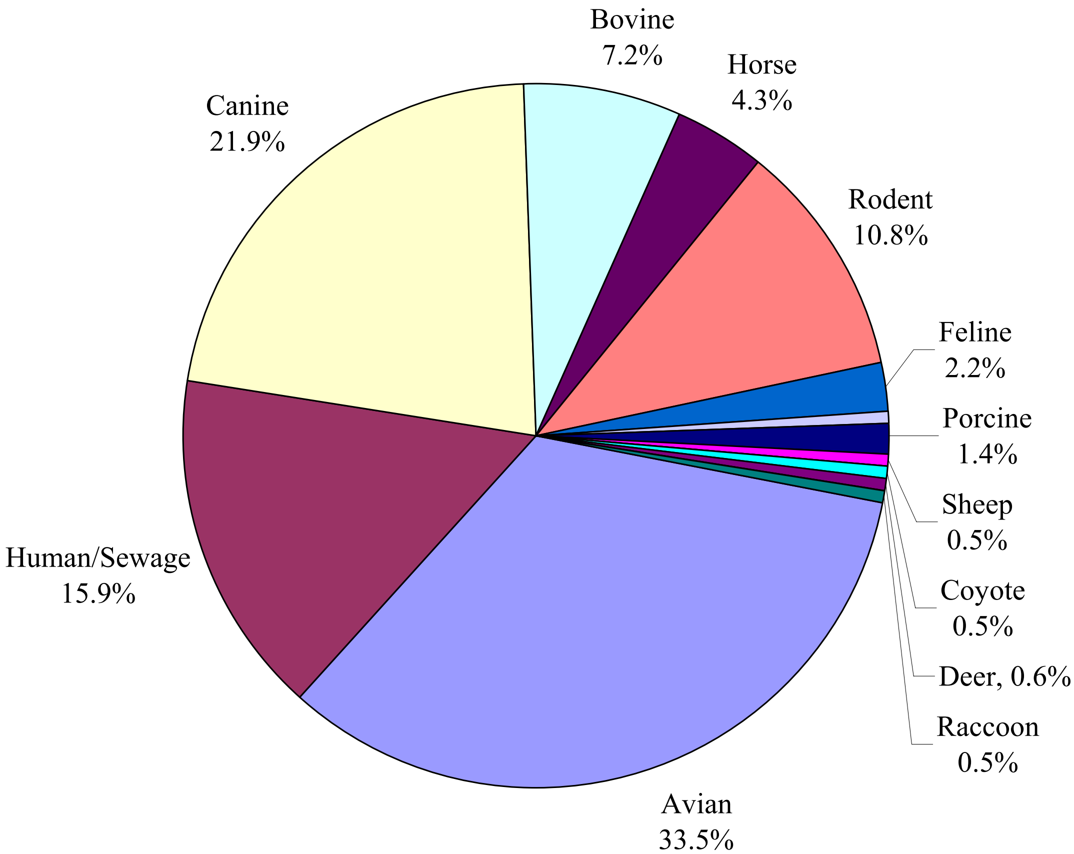
Table E.1 Fecal Source Estimate using Ribotyping for the Entire MRG Project Area

Category	Number of Isolates	% Source Contribution	95% Confidence Interval
Human/ Sewage Subtotal	235	15.9 %	14.0 – 17.8 %
Bovine	106	7.2%	5.9 – 8.5 %
Equine	63	4.3%	3.3 – 5.3 %
Porcine	21	1.4%	0.8 – 2.0 %
Sheep	8	0.5%	0.1 – 0.9%
Goats	5	0.3%	0 – 0.6 %
Livestock Subtotal	203	13.7%	11.9 – 15.5 %
Avian Subtotal	496	33.5%	31.1 – 35.9 %
Canine	324	21.9%	19.8 – 24.0 %
Feline	33	2.2%	1.4 – 3.0 %
Canine & Feline Subtotal	357	24.1%	21.9 – 26.3 %
Rodent	164	10.8%	9.2 – 12.4 %
Deer & elk	9	0.6%	0.2 – 1.0 %
Coyote	7	0.5%	0.2 – 0.8 %
Raccoon	8	0.5%	0.1 – 0.9 %
Bear	1	0.1%	0 – 0.2%
Opossum	1	0.1%	0 – 0.2%
Non-Avian Wildlife Subtotal	190	12.8%	11.1 – 14.5 %
Unknown	139	8.6 %	7.2 – 9.9 %
Grand Total	1620		

Overall, ribotyping results show, the largest fraction of *E. coli* matched those found in avian sources, followed by canine, human/sewage, rodents, bovine, and equine. The source of approximately 9 percent of the *E. coli* could not be identified. With the exception of rodents, only a few species of wild mammals were identified as sources of fecal coliform found in water: deer or elk, raccoon, coyote, bear, and opossum. It should be noted that an unknown fraction of the canine isolates may be from coyotes and foxes, as many *E. coli* strains are resident both in domestic dogs and wild canines. Figure E.1

provides a graphical representation of the percentage contribution of the identified sources of fecal coliform based on ribotyping.

Figure E.1 Sources of *E. coli* in the Entire MRG Study Area using Ribotyping



The percentage contribution of each species will vary with time and conditions. The percentages shown in the table and figure measure the quantity of *E. coli* strains in the water at that particular station and time. The larger the number of *E. coli* strains identified, the more confidence there is that the measured percent contribution is close to the actual percent contribution.

Forty-seven (2.9%) of the 1,635 *E. coli* isolated and purified from ambient water samples were hemolytic strains of *E. coli*. Hemolytic *E. coli* such as strain O157:H7 can cause serious illness in humans. These hemolytic *E. coli* were found in 29 water samples under runoff and non-runoff conditions from 15 sites, and thus generally were in low abundance compared to non-hemolytic strains in all samples. The ribotypes of these hemolytic bacteria indicated that 21 were resident in canine hosts, eight were from cats, seven were from human or sewage sources, five were avian-resident species, one each were from equine and rodent sources, and four were from unknown sources. As a percentage of *E. coli* by source, hemolytic *E. coli* were most abundant in canines (45%), cats (17%), humans (15%), and avian (11%). Only one hemolytic *E. coli* was observed in livestock-resident strains, and few were also observed in wildlife-resident strains.

Table E.2 compares *E. coli* data collected under runoff (storm event) or non-runoff weather conditions. Although not shown in this table, the number of *E. coli* strains increased during runoff conditions for within each of the species categories. The proportion of *E. coli* relative to the total number increased or decreased for each species. The most striking difference was the proportional increase in canine *E. coli*. Dog scat left in yards, parks, and along sidewalks or trails appears to be responsible for approximately one-quarter of the *E. coli* in storm induced surface waters. It should be noted that wastewater treatment facilities treating human sewage are typically permitted to discharge up to the most stringent applicable water quality standard. Typical permit limits are 100 colony-forming units per 100 milliliter (cfu/100 mL) of water discharge. Dilution by the receiving stream can significantly reduce the discharged concentration.

The scope of this study did not permit field investigations upstream of each sampling station to identify where various sources of *E. coli* were entering the drainage ways or river. Nevertheless, some sources of excessive human E. coli were identified and include inadequately treated wastewater discharges and improperly disposed dirty diapers. Other sources of human *E. coli* that are typical across the U.S. include broken underground sewer pipes that leak into the storm water collection system and sewer system overflows (SSO). Although local authorities have had success in significantly reducing SSOs, it is a constant battle and no large city has completely eliminated them. SSOs are typically caused by a blockage in the pipeline or a pump station failure. Collapsed pipes or tree-roots and grease are common problems. Routine sewer system cleaning of the sewer system has been shown to reduce SSOs and identify potential problem areas. Aggressive enforcement of grease trap ordinances has also been shown to reduce SSOs.

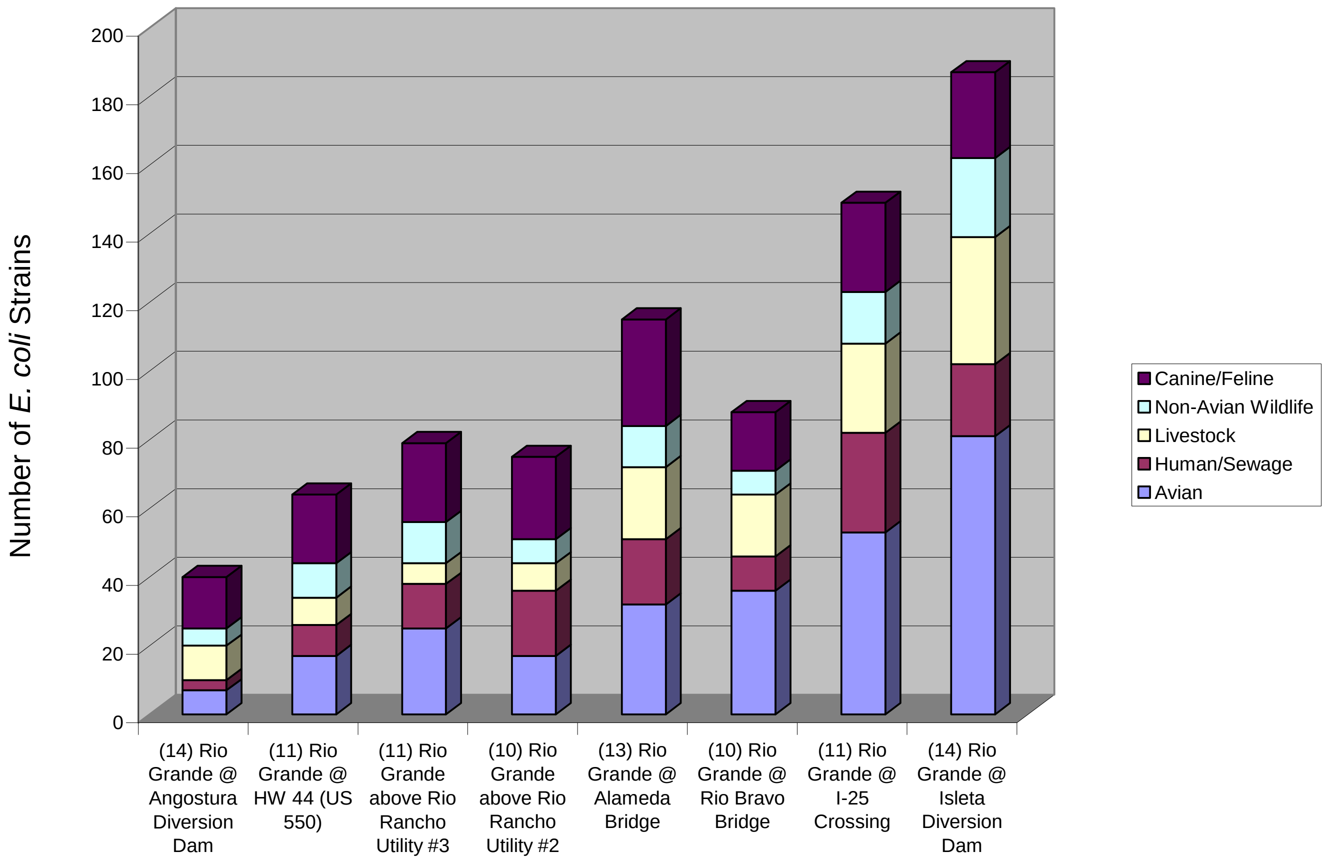
Table E.2 Comparison of Sources under Runoff vs. Non-Runoff Conditions

Category	Runoff		Non-Runoff	
	% Contribution	95% Confidence Interval	% Contribution	95% Confidence Interval
Human/Sewage Subtotal	15.5 %	13.5 – 17.4 %	18.5 %	13.6 – 23.5 %
Bovine	7.2 %	5.8 – 8.5 %	6.9 %	3.7 – 10.1 %
Equine	4.4 %	3.3 – 5.5 %	3.4 %	1.1 – 5.8 %
Porcine	1.2 %	0.6 – 1.7 %	3.0 %	0.9 – 5.2 %
Sheep	0.6 %	0.2 – 1.0 %	0.4 %	0 – 1.3 %
Goats	0.4 %	0.1 – 0.8 %	0.0 %	0 – <1.3 %
Livestock Subtotal	13.7 %	11.9 – 15.6 %	13.8 %	9.4 – 18.2 %
Avian Subtotal	31.9 %	29.4 – 34.4 %	38.8 %	32.6 – 45.0 %
Canine	**23.8 %**	**21.5 – 26.1 %**	**13.4 %**	**9.1 – 17.7 %**
Feline	2.1 %	1.3 – 2.8 %	3.4 %	1.1 – 5.8 %
Canine & Feline Subtotal	**25.9 %**	**23.5 – 28.2 %**	**16.8 %**	**12.1 – 21.5 %**
Rodent	11.1 %	9.5 – 12.8 %	10.8 %	6.9 – 14.7 %
Deer & Elk	0.5 %	0.1 – 0.9 %	1.3 %	0 – 2.7 %
Coyote	0.6 %	0.2 – 1.0 %	0.0 %	0 – <1.3 %
Raccoon	0.7 %	0.2 – 1.1 %	0.0 %	0 – <1.3 %
Bear	0.1 %	0 – 0.2 %	0.0 %	0 – <1.3 %
Opossum	0.1 %	0 – 0.2 %	0.0 %	0 – <1.3 %
Non-Avian Wildlife Subtotal	13.1 %	11.2 – 14.9 %	12.1 %	7.9 – 16.2 %
Unknown	**9.1 %**	**7.6 - 10.7 %**	**3.3 %**	**1.1 – 5.6 %**

The report provides a table like Table E.1 and a pie-chart like Figure E.1 for most of the 30 sampling stations. A table similar to Table E.2 is provided for certain sampling stations with storm water runoff data.

Figure E.2 below graphically shows the proportional contribution of the species categories for the eight main stations and an increasing upstream-downstream trend in the number of *E. coli* collected (Y-axis) at each station.

Figure E.2 Comparison of Fecal Coliform Sources for 8 Monitoring Sites on the Rio Grande



Conclusion

The overall top *E. coli* contributors are wildlife (primarily avian) at 46 percent and pets at 24 percent. These two groups account for 70 percent of the *E. coli* detected in all the water samples. Humans and livestock contributed 16 and 14 percent, respectively.

The estimated percentages of *E. coli* sources are inversely proportional to man's ability to control these sources. *E. coli* contributions from wildlife are the highest, but the most difficult to control, particularly given the large population of waterfowl that frequent the MRG watershed. Pet waste throughout the MRG watershed may be more controllable. Both the City of Albuquerque and Bernalillo County have ordinances limiting the number of dogs at a residence. Nevertheless, it will take a significant behavior change by pet owners to regularly pick up after their dogs on both public and private property.

E. coli contributions from humans are more easily reduced through reduction of sewer system overflows (SSO) and leaks, compliance with wastewater treatment permit limits, and identifying and repairing failing septic systems. SSOs are caused by pipeline blockage and/or lack of adequate pipeline capacity. A wastewater conveyance system capacity management and operations and maintenance program was implemented by the City of Albuquerque in the 1990s which significantly reduced SSOs. Improvements or plans for improvements to the Rio Rancho area wastewater treatment facilities are unknown at this time. Bernalillo County passed an ordinance requiring all residences or businesses using a septic system within 200 feet of a sanitary sewer to connect to the sewer. Three-thousand new sewer connections have been made since 1990.

Permitted concentrated animal feeding operations (CAFO), such as dairies, are required to capture manure and water in contact with the manure. Three medium size dairies are located in the Isleta Drain watershed. The bovine *E. coli* contribution detected at the Isleta Drain sampling station was much less than the average bovine contribution at all the sampling stations. Therefore, CAFOs may not be the major source of bovine *E. coli*. Some residential areas do have significant livestock populations – predominantly horses and cattle. While there are limitations on the number of head per acre by local ordinance, manure management at these facilities is not specifically regulated.

This study has accomplished the state intent. As a result of this study, sources of fecal coliform in the MRG and in the contributing subwatersheds have been documented. The results of this study will enable water resource managers and stakeholders in the region to undertake appropriate, geographically specific control actions and management measures to improve storm water and surface water quality.

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ACRONYMS AND ABBREVIATIONS

µL	Microliter
4Q3	Minimum 4-day, 3-year discharge
AMAFCA	Albuquerque Metropolitan Arroyo Flood Control Authority
ARA	Antibiotic Resistance Analysis
ARP	Antibiotic Resistance Profile
BISON-M	NM Biota Information System
BMP	Best Management Practice
CAFO	Confined Animal Feeding Operation
CFU	Colony-Forming Unit
CFR	Code of Federal Regulations
CMOM	Capacity Management, Operations, and Maintenance
CWA	Clean Water Act
DNA	Deoxyribonucleic Acid
DQO	Data Quality Objective
dH_2O	Distilled water
LA	Load Allocation
MAL	Minimum analytical level
MEI	Molecular Epidemiology, Inc.
mFC	A nutrient agar (growth medium) used in the isolation and enumeration of fecal coliform bacteria
MOS	Margin of Safety
MRG	Middle Rio Grande
MS4	Municipal Separate Storm System
MST	Microbial Source Tracking
NM	New Mexico
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NPDES	National Pollutant Discharge Elimination System
PCS	Permit Compliance System
QA/QC	Quality Assurance/Quality Control
QAO	QA Officer
QAPP	Quality Assurance Project Plan
RFLP	Restriction Fragment Length Polymorphism
rRNA	ribosomal Ribonucleic Acid
SDS	Sodium dodecyl sulfate
SSO	Sanitary Sewer Overflow
SWMP	Storm Water Management Program
SWQB	Surface Water Quality Bureau
TMDL	Total Maximum Daily Load
USEPA	U.S. Environmental Protection Agency
USGS	United States Geological Survey
WLA	Wasteload Allocation
WQA	Water Quality Act

WQCC	Water Quality Control Commission
WQS	Water Quality Standards
WWTF	Wastewater Treatment Facility

SECTION 1
INTRODUCTION

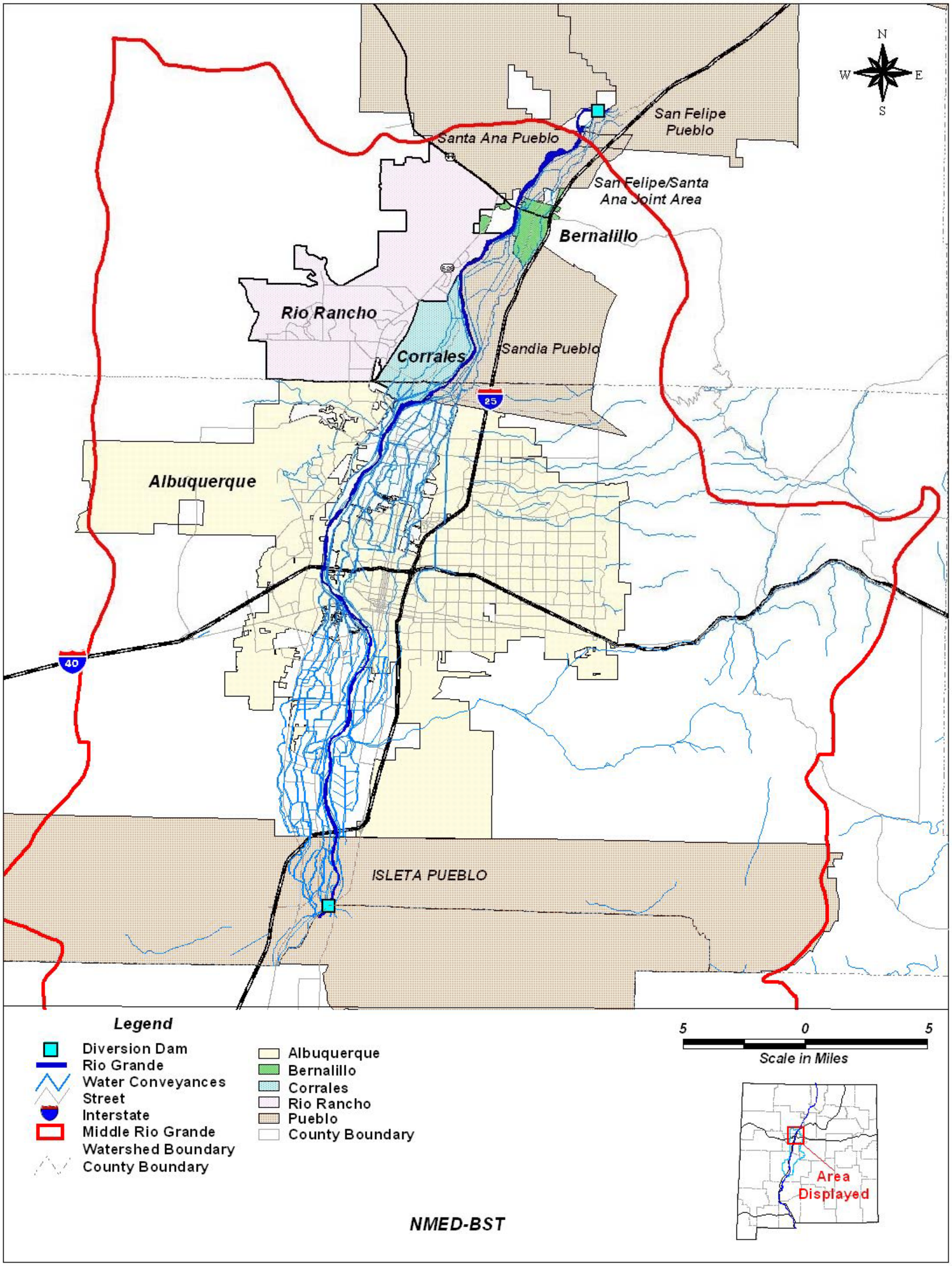
1.1 Purpose and Scope

The Middle Rio Grande (MRG) Microbial Source Tracking Project was driven by a wide array of water quality management programs, but the reason for conducting this project was singular in purpose: to identify specific sources of fecal coliform causing high levels of bacteria in the MRG. Initiated in February 2002, this project was undertaken to advance implementation of the fecal coliform total maximum daily loads (TMDL) approved by the U.S. Environmental Protection Agency (USEPA) Region 6 in May 2002. This project was jointly funded by the New Mexico Environment Department (NMED), Bernalillo County, and Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA).

This project is one of many that reflect the direction of the NMED water quality management program and NMED's commitment to restore and maintain the designated uses in impaired watersheds. Following completion of the TMDL, NMED determined that the most appropriate next step for addressing the fecal coliform loading problem in the MRG watershed was to acquire additional data to assist in developing a more detailed implementation plan. To achieve this objective, NMED chose to utilize the relatively new scientific method known as Microbial Source Tracking (MST) to provide additional data and certainty necessary to identify specific sources or types of fecal contamination throughout the MRG watershed. Given the vast number of sources of fecal coliform bacteria in the environment, it was believed that differentiating those sources by species type or category would provide invaluable data essential for adequately and economically designing and targeting specific point and nonpoint source management measures. In addition, a more clear understanding of the sources of bacteria, especially as a function of flows and wet weather events, would provide a more accurate evaluation of the true potential for human health effects.

The MRG, for the purposes of this study, 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 MRG watershed. The project study area is depicted in Figure 1.1. While the contributing watershed upstream of the MRG (HUC 13020201) covers thousands of square miles, in order to focus on the same geographic area covered by the approved TMDLs, it was agreed at the outset of the project that the study would only address the contributing subwatersheds associated with the Albuquerque metropolitan area (HUC 13020203) north of Isleta Pueblo.

Figure 1.1 MRG Project Study Area



1.2 Regulatory Background

In 1978 the New Mexico Legislature revised the New Mexico (NM) Water Quality Act (WQA), which became the basic authority for water quality management in New Mexico. This law expanded the duties and powers of the NM Water Quality Control Commission (WQCC) to more effectively implement requirements of the federal Clean Water Act (CWA). These duties include adoption of water quality standards (WQS) and regulations "…to prevent or abate water pollution in the state or in any specific geographic area or watershed of the state...or for any class of waters." Under the NM WQA, water is defined as "…all water including water situated wholly or partly within or bordering upon the state, whether surface or subsurface, public or private, except private waters that do not combine with other surface or subsurface water." The NM WQCC is the State water pollution control agency for all purposes of the CWA, and may take all necessary actions to secure the benefits of the CWA.

Under the authority of the NM WQA, the NM WQCC adopted the basic framework for water quality management in New Mexico. Major components of this framework include:

- the State water quality management plan;
- the nonpoint source management program;
- the State continuing planning process;
- surface WQSs;
- TMDLs;
- regulations for discharge to surface waters;
- regulations for disposal of refuse in watercourses;
- regulations for spill-cleanup; and
- utility operators regulations.

Since the NM WQCC has no technical staff of its own, responsibilities for water quality management activities are delegated to constituent agencies, generally the NMED or the Oil Conservation Division of the NM Energy, Minerals and Natural Resources Department. Responsibilities for water quality management activities involving surface waters are delegated to the NM Surface Water Quality Bureau (SWQB). The Pueblo of Sandia also has jurisdiction over a portion of the MRG watershed.

1.3 Designated Uses and Water Quality Standards

Water quality standards, consisting of designated beneficial uses, water quality criteria to protect the uses, and antidegradation policies, serve dual purposes of establishing water quality goals for the nation's water bodies and providing the regulatory basis for establishing certain treatment controls and strategies. Both State of New Mexico and Pueblo of Sandia WQSs apply to the MRG. State WQSs, as described in *State of New Mexico Standards for Interstate and Intrastate Surface Waters* (20.6.4 NM Administrative Code [NMAC]), are summarized in Table 1.1, which was derived from the MRG Fecal Coliform TMDL Report (NMED 2002).

The MRG is divided into two segments (20.6.4.105 and 20.6.4.106) and is classified by NM WQSs as having designated uses as a limited warm water fishery and secondary contact recreation and irrigation. Segment 20.6.4.105 is defined 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 the Jemez River which enters the main stem of the Rio Grande. 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.

Water quality criteria list specific constituent levels to be maintained to ensure that designated uses are met. To protect contact recreation use, water quality criteria are based on the concentrations of fecal coliform bacteria in water. Fecal coliform bacteria are a group of moderately heat-tolerant coliform bacteria abundant in the intestines of warm-blooded animals, but are not believed to survive long in the environment. Because they are relatively easy to measure in water, they are used as an indicator of the possible presence of fecal pathogenic microorganisms in water, including other bacteria, viruses, and harmful protozoans. Most fecal coliform bacteria are not pathogenic. *E. coli* is often the most abundant species of the fecal coliform group of bacteria, and a few strains of *E. coli*, notably strain O157:H7, are pathogenic. State WQSs for fecal coliform for Segments 20.6.4.105 and 20.6.4.106 are listed in Table 1.1.

Table 1.1 State of New Mexico Designated Uses and Fecal Coliform Criteria Applicable to the Middle Rio Grande

Designated Uses	Fecal Coliform Criteria
MRG Segment 20.6.4.105	
• Irrigation • Limited warm water fishery • Livestock watering • Wildlife habitat • Secondary contact	The monthly geometric mean of fecal coliform bacteria shall not exceed 1,000 cfu/100 mL; no single sample shall exceed 2,000 cfu/100 mL.
MRG Segment 20.6.4.106	
• Irrigation • Limited warm water fishery • Livestock watering • Wildlife habitat • Secondary contact	The monthly geometric mean of fecal coliform bacteria shall not exceed 200 cfu /100 mL; no single sample shall exceed 400 cfu/100ml.

Pueblo of Sandia WQSs related to fecal coliform bacteria are summarized in Table 1.2. The Pueblo of Isleta has jurisdiction downstream of the studied portion of the MRG. The uses and criteria in the Pueblo of Isleta standards are identical to the standards of the Pueblo of Sandia.

Table 1.2 Pueblo of Sandia Designated Uses and Fecal Coliform Criteria Applicable to the Middle Rio Grande[1]

Designated Uses	Fecal Coliform Criteria
Primary contact ceremonial	a. geometric mean maximum of 100 colonies/100 mL (geometric mean calculation based on a minimum of five samples taken over a maximum of 30 days.) b. single sample maximum of 200 colonies/100 mL.
Primary contact recreation	a. April 1 to September 30 1) geometric mean maximum of 100 colonies/100 mL (geometric mean calculation based on a minimum of five samples taken over a maximum of 30 days.) 2) Single sample maximum of 200 colonies/100 mL. 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/100 mL (geometric mean calculation based on a minimum of five samples taken over a maximum of 30 days.) b. single sample maximum of 400 colonies/100 mL.
Warm water fishery	a. geometric mean maximum of 100 colonies/100 mL (geometric mean calculation based on a minimum of five samples taken over a maximum of 30 days.) b. single sample maximum of 200 colonies/100 mL.
Agricultural water supply	a. geometric mean maximum of 1000 colonies/100 mL (geometric mean calculation based on a minimum of five samples taken over a maximum of 30 days.) b. single sample maximum of 2000 colonies/100 mL.

1.4 Water Quality Assessment and Total Maximum Daily Loads

Section 303(d) of the federal CWA requires states to assess all water bodies to determine if they are supporting all applicable WQSs. The 2000-2002 State of New Mexico §303(d) List included the MRG as water quality limited because fecal coliform levels sometimes exceed water quality criteria.

Section 303(d) also requires states to develop TMDL plans for water bodies determined to be water quality limited. A TMDL describes the maximum amount of a pollutant a water body can assimilate (load capacity) without violating a state's or Tribe's WQSs. A TMDL also allocates load capacity to known point sources and nonpoint

1 *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)*

sources. TMDLs are defined in 40 CFR Part 130 as the sum of the individual wasteload allocations (WLA) for point sources and load allocations (LA) for nonpoint sources, including a margin of safety (MOS) and natural background conditions. In November 2001, the NMED completed a TMDL for fecal coliform in the MRG (NMED 2002). TMDL numeric targets were calculated to provide protection of contact recreation designated use. Load capacities were estimated as a function of these water quality targets and the assimilative capacity of the MRG. Load allocations presented in the MRG fecal coliform TMDL (Table 1.3) are based on the load allowances developed using these targets.

Table 1.3 Approved Fecal Coliform TMDLs for the MRG – NMED 2002

Station	Load Allocation	Waste Load Allocation	Margin of Safety	TMDL
Discharges to Sandia Pueblo Tribal Waters				
Bernalillo WWTF	0	3.030×10^{9} cfu	0	3.030×10^{9} cfu/day
North Diversion Channel	0	6.438×10^{11} cfu	0	6.438×10^{11} cfu/day
Discharges to State of New Mexico Waters				
Rio Rancho #3 WWTF	0	3.219×10^{9} cfu	0	3.219×10^{9} cfu/day
Rio Rancho #2 WWTF	0	2.083×10^{10} cfu	0	2.083×10^{10} cfu/day
City of Albuquerque WWTF	0	2.878×10^{11} cfu	0	2.878×10^{11} cfu/day
San Jose Drain	0	1.068×10^{10} cfu	0	1.068×10^{10} cfu/day
South Diversion Channel	0	1.444×10^{11} cfu	0	1.444×10^{11} cfu/day
Tijeras Arroyo	0	1.199×10^{11} cfu	0	1.199×10^{11} cfu/day
La Cueva Arroyo	6.435×10^{11}cfu/day		0	
Pino Arroyo	6.166×10^{11} cfu/day		0	
Grant Line Arroyo	6.156×10^{11} cfu/day		0	
North Fork Hahn Arroyo	6.146×10^{11} cfu/day		0	
South Fork Hahn Arroyo	5.729×10^{11} cfu/day		0	
Hahn Arroyo	3.453×10^{11} cfu/day		0	
Embudo Arroyo	3.450×10^{11} cfu/day		0	
Academy Acres Drain	3.421×10^{11} cfu/day		0	
Tramway Floodway	3.127×10^{11} cfu/day		0	

The TMDL process integrates point, nonpoint, and natural background sources spatially and temporally in water quality management planning and permitting. It is a geographically based approach to preparing LAs and WLAs for pollutants that impair water quality integrity (NMED 2002). 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 WQSs which may be developed based on site-specific criteria or uses.

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SECTION 2
MRG WATERSHED AND HISTORICAL DATA OVERVIEW

2.1 Middle Rio Grande and Hydrology of its Watershed

This study addresses portions of the MRG between Angostura Diversion Dam in southeastern Sandoval County to the Isleta Diversion Dam, at the northern border of Isleta Pueblo, a distance of approximately 42 river miles. The MRG watershed located in southern Colorado and north-central New Mexico (Figure 2.1) encompasses approximately 17,900 square miles. The size of the study area watershed (watershed) downstream of Cochiti Dam and Jemez Dam is approximately 2,000 square miles. The portion of the MRG watershed addressed in this study includes all or parts of Cochiti, Santo Domingo, San Felipe, Santa Ana, Isleta, and Sandia Pueblos, and the Cities of Bernalillo, Rio Rancho, Corrales, and Albuquerque.

The flow of surface water through the watershed is highly regulated through an extensive and complex system of canals, drains, diversions, pump stations, and stormwater detention basins, along with natural and channelized arroyos. The watershed's topography is varied, and its elevations range from 10,678 feet above sea level at Sandia Crest down to 4,882 feet at the Isleta Diversion Dam. With the wide variation in topography, there is a corresponding variation in climate; however, rainfall is scarce throughout the watershed. Annual total precipitation at lower elevations in the watershed is typically between 8 and 10 inches. Annual total precipitation in the mountains can reach 20 inches; however, much of that precipitation falls as snow rather than rain. Annual average precipitation in the foothills and plateaus is intermediate between the valley and mountains. On average, approximately one-half of the total annual rainfall occurs during the monsoon months of July, August, and September, when rain often falls in brief but intense thunderstorms.

Runoff from the frequent thunderstorms of the summer monsoon is thought to transport large quantities of fecal bacteria to the MRG through its network of arroyos and storm drains. It is believed this runoff leads to exceedance of water quality criteria designed to protect the contact recreation and ceremonial use of the MRG. The MRG TMDL document (NMED 2002) identified nonpoint source runoff transported through storm water conveyances as the main source of fecal coliform bacteria to the MRG. These sources include sewage spills, livestock, wildlife, and pets. The TMDL document also identified discharges from certain wastewater treatment facilities (WWTF) as contributors of excessive fecal coliform.

2.2 Summary of Historical Fecal Coliform Monitoring Data

Water quality monitoring of the MRG indicates that fecal coliform water quality criteria are frequently exceeded. The most recent NMED/SWQB data were collected during the summer of 1999 by the Surveillance and Standards Section. These data were collected over a 6-week period and included both dry and rainfall-influenced sampling days. Table 2.1 lists the fecal coliform data for eight water quality monitoring stations from the 1999 NMED sampling effort and summarizes this information with respect to the water quality criteria. It is apparent from these results that levels of fecal coliform were higher following significant rainfall events.

Also, there is a consistent increase in fecal coliform levels with the degree of urbanization of the watershed.

Figure 2.1 Middle Rio Grande Watershed

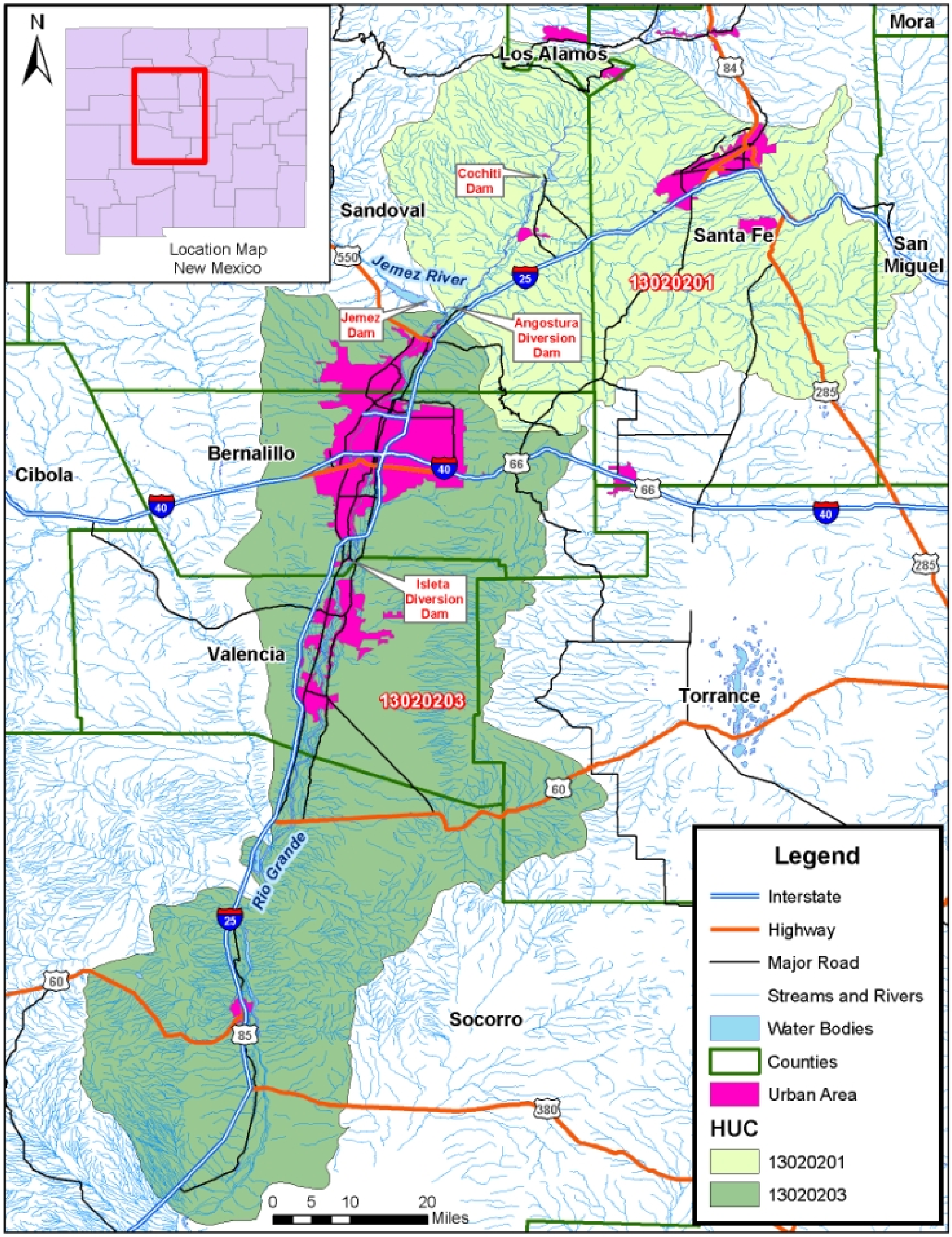

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Table 2.1 Results of 1999 SWQB Fecal Coliform Sampling of the Middle Rio Grande

Site	Date YYMMDD	Time	Fecal Coliform Col/100 mL
Rio Grande Below Angostura Diversion Dam	990628	1010	20
	990706	**0800**	**300**
Geometric Mean = 110 CFU/100 mL 0% of samples exceed 400 CFU/100 mL	990712	0855	110B
	990719	**0830**	**300**
	990726	0850	80B
Rio Grande Above Highway US 550 Bridge	990628	1025	34
	990706	**0820**	**900**
Geometric Mean = 232 CFU/100 mL 20% of samples exceed 400 CFU/100 mL	990712	0920	160B
	990719	**0850**	**340**
	990726	0910	400
Rio Grande Above Rio Rancho WWTF #3	990628	1055	37
	990706	**0855**	**1600L**
Geometric Mean = 291 CFU/100 mL 40% of samples exceed 400 CFU/100 mL	990712	0955	200
	990719	**0925**	**1600**
	990726	0945	110B
Rio Grande Above Rio Rancho WWTF #2	990628	1125	49
	990706	**0925**	**500**
Geometric Mean = 302 CFU/100 mL 43% of samples exceed 400 CFU/100 mL	990712	1030	330
	990719	**1000**	**2400**
	990726	1010	90B
	990729	1000	82B
	990802	**0840**	**1600L**
Rio Grande Above Alameda Bridge	990628	1200	2400
	990706	**0955**	**1000**
Geometric Mean = 620 CFU/100 mL 57% of samples exceed 400 CFU/100 mL	990712	1055	250
	990719	**1030**	**1300**
	990726	1040	350
	990729	1035	81B
	990802	**0910**	**1600L**
Rio Grande Above Rio Bravo Bridge	990628	1230	180B
	990706	**1030**	**2400B**
Geometric Mean = 574 colonies/100 mL	990712	1200	170B

Site	Date YYMMDD	Time	Fecal Coliform Col/100 mL
57% of samples exceed 400 colonies/100 mL	**990719**	**1105**	**5000**
	990726	1120	500
	990729	1115	70B
	990802	**0945**	**1600L**
Rio Grande Above I-25 Bridge	990628	1300	540
	990706	**1100**	**2100B**
Geometric Mean = 868 colonies/100 mL 71% of samples exceed 400 colonies/100 mL	990712	1235	170B
	990719	**1130**	**16000**
	990726	1150	500
	990729	1200	150B
	990802	**1010**	**1600L**
Rio Grande Above Isleta Diversion Dam	990628	1315	400B
	990706	**1115**	**1800B**
Geometric Mean = 663 colonies/100 mL 43% of samples exceed 400 colonies/100 mL	990712	1245	290
	990719	**1145**	**5000**
	990726	1200	240
	990729	1215	140B
	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
Dates with more than ¼ inch of rain during previous 48 hours are in bold.

The TMDL document identified several potential sources of fecal bacteria to the MRG. The potential sources discussed include:

1. National Permit Discharge Elimination System (NPDES) permitted discharges from WWTF;
2. periodic spills of incompletely treated sewage and end-of-pipe permit violations at permitted facilities;
3. nonpoint source runoff of storm water contaminated by livestock, wildlife, pets, and other domestic animals, and discharged to the river through arroyos and storm drains;
4. seasonally abundant migratory waterfowl in the river;
5. failing or ill-sited septic systems;
6. leaks, breaks, and overflows from sanitary sewer collection systems; and
7. illicit connections between sanitary sewers and storm drains that allow sewage to enter storm drains.

Of these sources, the TMDL document indicates that septic systems and failures in sanitary sewer systems (5, 6, and 7 above) do not appear to be a large contributor to the elevated fecal coliform levels in the MRG. Nonpoint source runoff is identified as the likely major contributor to fecal coliform contamination.

The maximum fecal coliform assimilative capacity was calculated to be 9.205 x 10^{12} colony-forming units per day (cfu/day) for Segment 20.6.4.105, and 9.205 x 10^{11} cfu/day for Segment 20.6.4.106, at the minimum 4-day, 3-year discharge (4Q3) low flow. The river's capacity to assimilate fecal coliform without exceeding water quality criteria increases in proportion with flow.

2.3 Study Design and Identification of Potential Fecal Sources

In light of the expected importance of contaminated runoff from land as a source of fecal contamination, it was important to evaluate land uses and potential fecal sources by individual subwatersheds contributing runoff to the MRG. The geography, complex hydrology, historical sampling stations, and an understanding of potential fecal sources as outlined in the NMED 2002 Fecal Coliform TMDL influenced the sampling design of this MST study. NMED, AMAFCA, and Bernalillo County collaborated to recommend monitoring stations throughout the MRG watershed. After evaluating and prioritizing these recommendations, 30 sampling sites were identified and incorporated into a quality assurance project plan (QAPP) which was approved by USEPA and dictated data quality objectives (DQO) and all field sampling and laboratory analysis procedures and protocols. These sites included points on the MRG, as well as a number of contributing subwatersheds with varying land uses and potential sources.

2.3.1 Sampling Sites and Subwatersheds

This study included thirty different sampling sites which are displayed in Figure 2.16 at the end of this subsection. Eight sampling sites on the MRG were investigated. These sites were at the same locations where historical water quality sampling was performed. The north-most site at Angostura Diversion Dam drained a primarily rural watershed without wastewater inputs. For the eight sites investigated, the wastewater volume and degree of urbanization of the watershed increased on the MRG with its distance downstream. Another 22 sites within contributing subwatersheds with varying land uses and potential sources were also selected for investigation.

The subwatershed of each monitoring site was also evaluated to obtain a more thorough understanding of the potential for human and nonhuman sources of fecal contamination from rainfall runoff. First, the contributing watershed to each site was delineated using both automated computer programs based on the U.S. Geological Survey (USGS) National Elevation Dataset (Gesch, *et al*. 2002) and manual tracing of contributing storm drain and arroyo linear features. In some cases there was considerable uncertainty regarding the watershed boundary and/or discharge point to the Rio Grande. Figures 2.2, 2.3, and 2.4 display subwatershed boundaries for some of the sampling stations located on tributaries and arroyos. Next, the land uses in each subwatershed were identified from the National Land Cover Dataset (USGS 1999) which is displayed in Figure 2.5 and summarized by category in Table 2.2 presented later in this section.

Figure 2.2 Subwatersheds for Select Northwest Sampling Stations

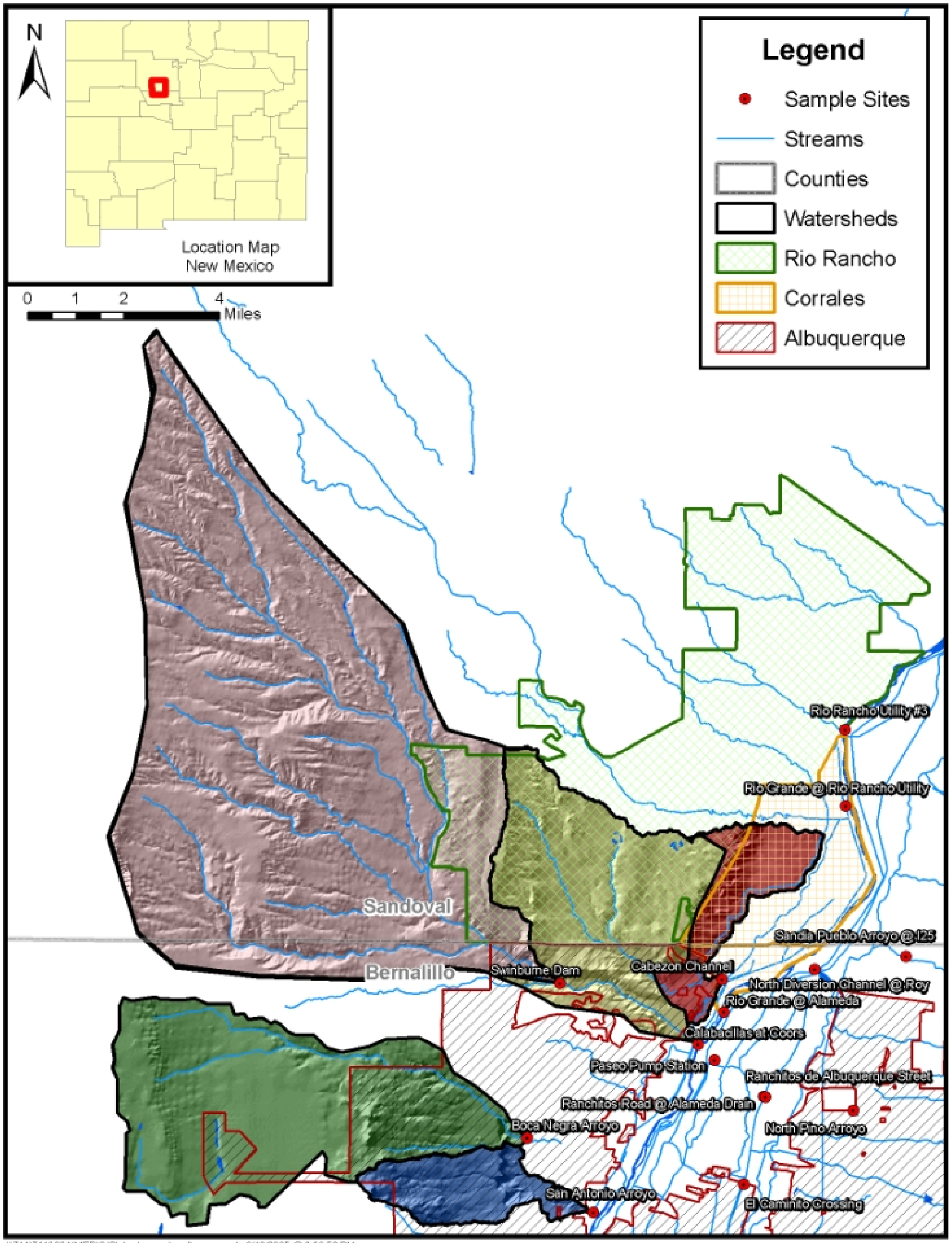

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Figure 2.3 Subwatersheds for Select Northeast Sampling Stations

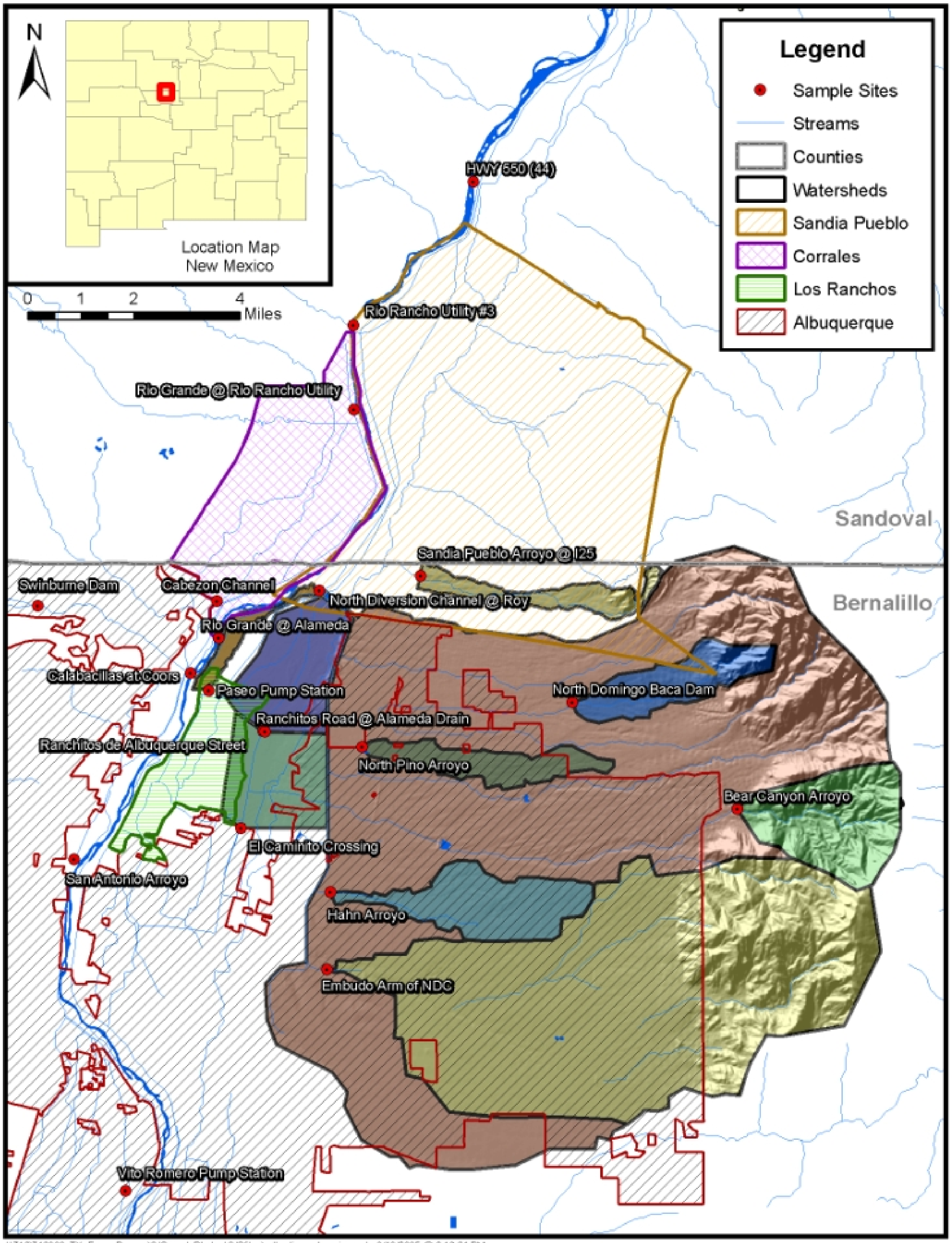

Figure 2.4 Subwatersheds for Select South Sampling Stations

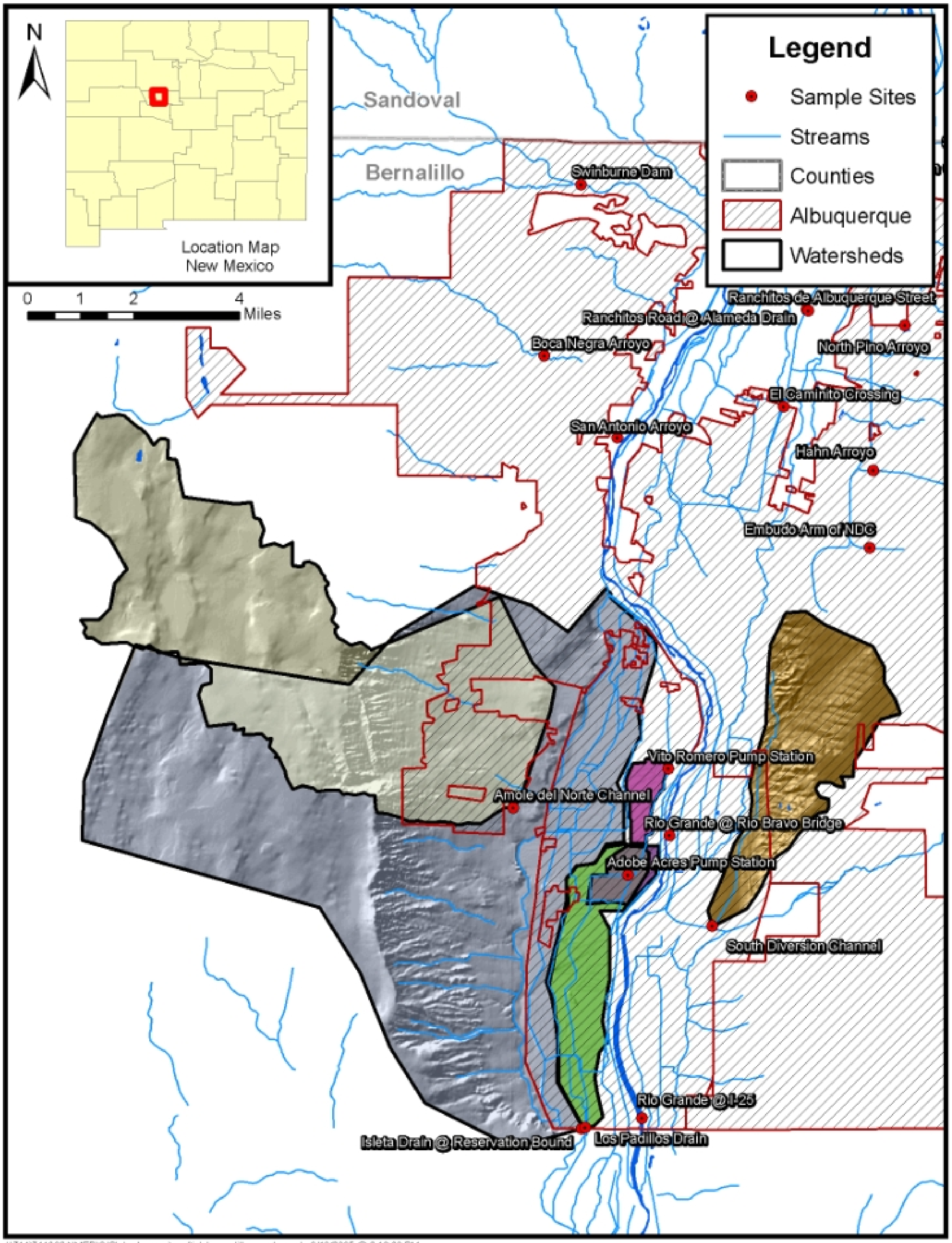

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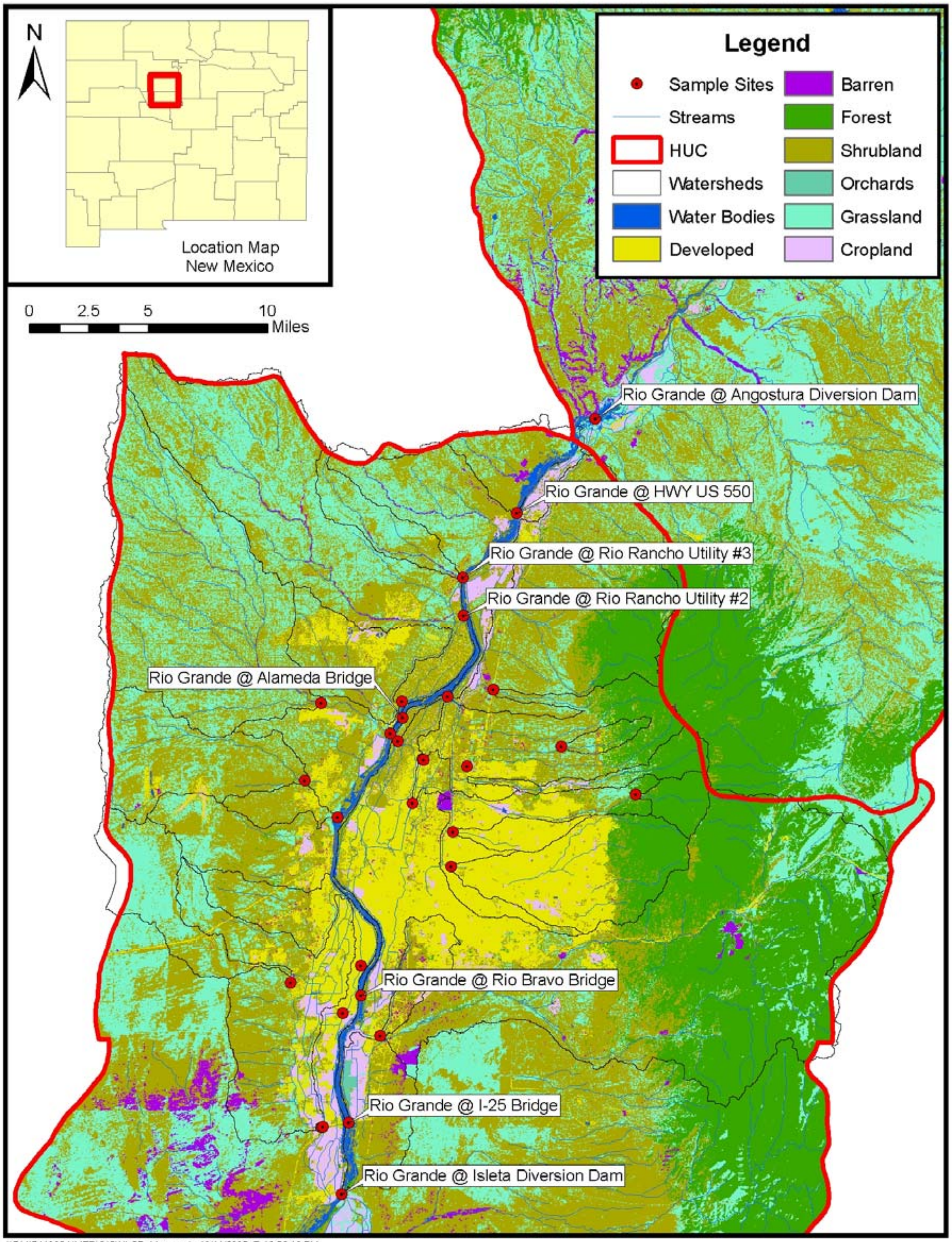
Figure 2.5 Land Use/Land Cover in the Middle Rio Grande Watershed



The human population residing in each subwatershed was estimated from the 2000 federal census at block resolution. The method of household sewage disposal (public sanitary sewer, septic tank, or other), and the number of households with farm income in each subwatershed were estimated from 1990 federal census data at block group resolution (Table 2.3). Populations of dogs and cats were estimated from the 2000 census data based on national average statistics on pet ownership per household, as reported by the American Veterinary Medical Association (AVMA 2002). The populations of livestock could not be estimated for each subwatershed, but county total populations of major livestock species were retrieved from the National Agricultural Statistics Service of the U.S. Department of Agriculture. A more spatially resolved estimate of livestock distributions within counties was obtained as the fraction of households with farm income for each subwatershed, as reported in the 1990 federal census at the block group level. While it was not possible to quantify wildlife populations, abundant wildlife species were identified through a review of available reports on hunting and bird surveys, as well as through a physical tour of the watershed. Each of the 30 total sites is described below, the first eight being those sites located on the Rio Grande. Tables 2.2 and 2.3, presented after the descriptions below, provide additional statistics on each subwatershed.

1. Rio Grande at Angostura Diversion Dam - The most upstream site, depicted in Figure 2.6, is downstream of Cochiti Reservoir but upstream of the Jemez River confluence. Excluding portions above the Cochiti Reservoir, the watershed contributing to the MRG at this point covers 1,230 square miles. No NPDES-permitted facilities discharge wastewater to this reach of the MRG. The primary land cover is grassland, and less than 1 percent of the land is developed (Table 2.2). The overall human population density of the watershed in 2000 was approximately 20 persons per square mile (Table 2.3).

Figure 2.6 Rio Grande at Angostura Diversion Dam

2. Rio Grande at Highway US 550 – The second most upstream site (Figure 2.7) on the MRG is approximately 6 miles downstream of the Angostura Diversion Dam. The Jemez River enters the Rio Grande between these two sites. While the Jemez River has a substantial watershed of over 1,000 square miles, it is impounded by the Jemez Dam just a few miles above its confluence with the Rio Grande. The unimpounded portion of the

Jemez watershed that directly contributes to the Rio Grande is small and thus, the watershed is primarily the same as that at Angostura Diversion Dam.

Figure 2.7 Rio Grande at Highway US 550

3. Rio Grande above Rio Rancho Utility #3 - Approximately 4 miles downstream of Highway US 550, this site (Figure 2.8) is immediately upstream of the wastewater discharge outfall of Rio Rancho Utility #3. Watershed properties are similar to those of the upstream sites; however, it also receives treated domestic wastewater discharged by the City of Bernalillo, and is immediately upstream of the wastewater discharge from Rio Rancho Utility #3.

Figure 2.8 Rio Grande above Rio Rancho Utility #3

4. Rio Grande above Rio Rancho Utility #2 - Less than 2 miles downstream of the Rio Rancho Utility #3 site and with no major tributaries in between them, this site has essentially the same watershed as Rio Rancho Utility #3. However, the site is influenced by treated wastewater discharged by Rio Rancho Utility #3, and is immediately upstream of the wastewater discharge outfall of Rio Rancho Utility #2 (Figure 2.9).

Figure 2.9 Rio Grande above Rio Rancho Utility #2

5. Rio Grande at Alameda Bridge – This site, depicted in Figure 2.10, is approximately 6 miles downstream of Rio Rancho Utility #2. The North Diversion Channel and the Upper Corrales Riverside Drain enter the MRG above Alameda Bridge, vastly increasing the urban influence in the Rio Grande's watershed at this site. The North Diversion Channel drains much of the City of Albuquerque east of the river. The percentage of the watershed with "developed" land uses, which include residential, commercial, industrial, and transportation, increases to 3.8 percent from 0.6 percent at the nearest upriver site, and the human population density of the watershed increases almost tenfold to 223 per square mile. While the portion of households served by public sanitary sewers increase from 33 percent to 95 percent, the density of septic tanks also increases from two to four per square mile. Along with the increasing urban nature of the watershed, the portion of households in the watershed with farm income declines to less than 1 in 100; however, the overall density of households with farm income increases substantially.

Figure 2.10 Rio Grande at Alameda Bridge

6. Rio Grande at Rio Bravo Bridge – This site is approximately 14 miles downstream of the Alameda Bridge (Figure 2.11). In addition to the watershed contributing to the upstream site, the MRG's watershed at this point includes Corrales,

Rio Rancho, and most of Albuquerque on both banks, including portions draining to the Alameda Drain, the Lower Corrales Riverside Drain, and several arroyos. The human population density of the contributing watershed is 275 per square mile, and 4.7 percent of the watershed is developed land. The number of households in the watershed served by public sanitary sewer declines from 95 percent to 92 percent between these two sites.

Figure 2.11 Rio Grande at Rio Bravo Bridge

7. Rio Grande at Interstate 25 - This site is approximately 6 miles downstream of the Rio Bravo Bridge (Figure 2.12). However, the contributing watershed is almost the same as that at Rio Bravo, as no significant tributaries discharge into the river in this reach. The possible exception is the Tijeras Arroyo which discharges to the Rio Grande above Interstate 25. The South Diversion Channel discharges to the Tijeras Arroyo. The City of Albuquerque WWTF discharges to this reach of the Rio Grande. A permitted concentrated animal feeding operation (CAFO) is located within this watershed on the east side of the river. The CAFO is a dairy located west of Highway 47 and south of Mountainview.

Figure 2.12 Rio Grande at Interstate 25

8. Rio Grande at Isleta Diversion Dam - This site is approximately 3 miles downstream of the Interstate 25 Bridge and is within the Isleta Pueblo (Figure 2.13). In

addition to the watersheds of upstream sites, the contributing watershed includes the southeast parts of Albuquerque drained by Tijeras Arroyo, the South Diversion Channel, Albuquerque Riverside Drain, Isleta Riverside Drain, and Atrisco Riverside Drain. The watershed includes essentially all the urbanized area with the exception of southwestern portions drained by the Isleta and Los Padillas Drains, which discharge to the Rio Grande downstream of the Isleta Diversion Dam. Thus, this site is considered an “integrator” site because it integrates the cumulative impact of the entire watershed of concern. The contributing watershed area, excluding portions above Cochiti and Jemez Reservoirs, is approximately 2,000 square miles. Almost 600,000 people and an estimated 137,000 dogs and 156,000 cats lived in this watershed in 2000. Approximately 6 percent of the watershed is developed land. Other major land use categories include grassland (41%), shrubland (31%), and forest (18%). Approximately 3 percent of the watershed is used to grow crops, and slightly less than one in 100 households reported farm income in 1990. Public sanitary sewers conveyed sewage to WWTFs from 91 percent of the households, with the balance utilizing septic tanks or other private sewage systems. Three permitted CAFOs (dairies) are located within this watershed on the west side of the river. Two CAFOs are located approximately 1 mile northwest of Highway 45 and Los Padillas Road Southwest. The third dairy is located approximately 1 mile northwest of Coors Boulevard Southwest and Powers Way Road.

Figure 2.13 Rio Grande at Isleta Diversion Dam

9. North Diversion Channel at Roy – This site is just upstream of the North Diversion Channel discharge to the Rio Grande (Figure 2.14). The North Diversion Channel drains much of the eastern half of Albuquerque to the Sandia Mountains. Tributaries include the Embudo (I-40) Channel and Embudo Arroyo, Pino Arroyo, North Pino Arroyo, Hahn Arroyo, Bear Canyon Arroyo, Domingo Baca Arroyo, La Cueva Arroyo, and Grant Line Channel. Approximately 45 percent of the watershed area is developed land, and 98 percent of households are served by public sanitary sewers.

Figure 2.14 North Diversion Channel at Roy

10. North Domingo Baca Arroyo Dam at Primary Spillway – This small (3 square mile) watershed is just northeast of the City of Albuquerque in the foothills of the Sandia Mountains. Approximately 40 percent of the watershed is forested, and 7 percent is developed land. Only 34 percent of the households in the watershed were served by a public sewer system in 1990, and septic tank density is relatively high for this area (111 per square mile).

11. North Pino Arroyo above North Diversion Channel – This small watershed in Albuquerque is densely populated, with over 4,000 persons per square mile. Over half of the land area is developed.

12. Hahn Arroyo above North Diversion Channel at Carlisle – This small watershed in Albuquerque is almost completely developed land. The population density is 5,282 persons per square mile; the highest of the watersheds investigated. Essentially all households in the watershed are served by public sewers.

13. Embudo Channel above Confluence with North Diversion Channel – This watershed covers 30 square miles of Albuquerque and Sandia Mountain foothills. Approximately 60 percent of the land is developed. Essentially all households in the watershed are served by public sanitary sewer.

14. Bear Canyon Arroyo – This small watershed drains the west side of the Sandia Mountains and appears to be entirely unpopulated and undeveloped. The land cover is primarily forest.

15. South Diversion Channel just above Tijeras Arroyo – The South Diversion Channel watershed is primarily developed land in southern Albuquerque just east of the Rio Grande (Figure 2.15).

Figure 2.15 South Diversion Channel just above Tijeras Arroyo

16. Sandia Pueblo Natural Arroyo at I-25 Crossing – This watershed lies just south of the Bernalillo-Sandoval County line east of the river. It is unpopulated and essentially undeveloped.

17. Paseo del Norte Pump Station – This station drains a small watershed between the Rio Grande and 4th Street at Paseo del Norte. The septic tank density in 1990 was 334 per square mile, approximately one for every 2 acres, which is relatively high for this area.

18. Alameda Drain at Ranchitos Road – The Alameda Drain watershed at this point covers a small area between the Rio Grande and the North Diversion Channel just north of the city limits of Albuquerque. The septic tank density in 1990 was the highest of the studied sites, at 390 per square mile.

19. Alameda Drain at El Caminito Road – The drainage area of the Alameda Drain includes that at Ranchitos Road, and an additional area of approximately equal size. The watershed properties are similar to those at Ranchitos Road, though the area closer to El Caminito is more developed, more households are served by public sewers, and septic tank density is somewhat less.

20. Ranchitos de Albuquerque Storm Drain – This storm drain is located near the intersection of Ranchitos Road and 2nd Street at the Alameda Drain. The contributing watershed area could not be determined, but it is expected to be similar to that of the Alameda Drain at Ranchitos Road.

21. Cabezon Channel – The Cabezon Channel appears to drain a 20-square mile area west of the Rio Grande, including much of Corrales, the southern half of Rio Rancho, and a small portion of northwest Albuquerque. One quarter of the watershed is developed land, and 57 percent is shrubland.

22. Calabacillas Arroyo at Swinburne Dam – Calabacillas Arroyo drains a 76-square mile area north and west of Albuquerque. The watershed is primarily undeveloped shrubland and grassland. The population density in 2000 was low – 69 persons per square mile. Septic tank density was only one per square mile in 1990.

23. Calabacillas Arroyo at Coors Road – This site, downstream of Swinburne Dam and just upstream of the Rio Grande, includes an additional 10 square miles that are more populated. At the time of the 2000 census, the population of the Calabacillas watershed at Coors Road was 38,843, compared to 5,257 at Swinburne Dam. The septic tank density was also much higher at Coors Road – 19 per square mile.

24. Boca Negra Arroyo at Tesuque Road – This arroyo drains part of western Albuquerque. Approximately 3 percent of the watershed is developed land; most of the balance is shrubland. The population density is very low – only 20 persons per square mile.

25. San Antonio Arroyo at Rio Grande (Montana) oxbow – This arroyo also drains a portion of western Albuquerque, but this watershed is more densely populated than the watershed associated with Boca Negra Arroyo at Tesuque Road.

26. Amole del Norte Channel above Amole Dam – The watershed of this southwestern drainage way is primarily grassland, and the population density was only 70 persons per square mile in 2000.

27. Adobe Acres Pump Station – Most of the small area draining to this pump station near the Rio Grande south of Albuquerque is developed land, but 13 percent is cropland and 2 percent of the households reported farm income in 1990. The density of septic tanks in 1990 was moderately high (118 per square mile) compared to other watersheds.

28. Vito Romero Pump Station – Draining a small watershed near the MRG north of Adobe Acres, its watershed is 98 percent developed land. The population density, at over 4,000 persons per square mile, is high in comparison to most other areas in the MRG basin.

29. Los Padillas Drain just upstream of the confluence with the Isleta Drain – Draining a 5 square mile watershed south of Albuquerque and just west of the Rio Grande, this watershed comprises a mixture of residential and cropland uses. Cropland composes a larger portion of the watershed (35%) than any other watershed investigated in this study. Almost 4 percent of the households reported farm income in 1990. Only 37 percent of the households were served by public sanitary sewers in 1990, and the density of septic tanks was 239 per square mile.

30. Isleta Drain just upstream of the confluence with the Los Padillas Drain – Draining an approximately 60 square mile watershed mostly southwest of Albuquerque and adjacent to Los Padillas Drain, this watershed is much less developed than that of Los Padillas. Cropland and developed land are less abundant in the Isleta Drain watershed, and shrubland and grassland are the major land covers. Eighty percent of the households in the watershed reported in 1990 that they were attached to public sewer systems.

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Figure 2.16 Middle Rio Grande Microbial Source Tracking Study Sampling Stations

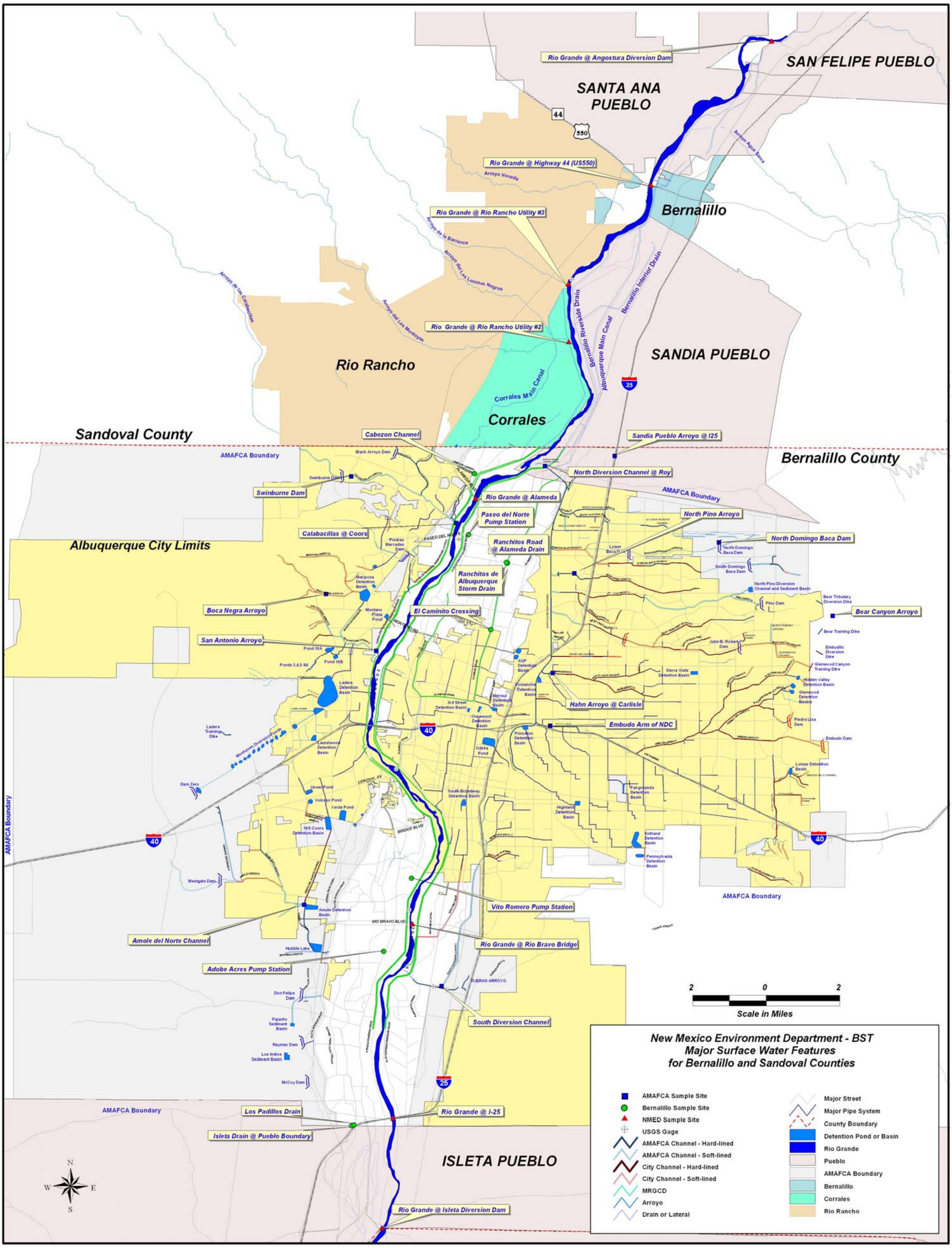

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Table 2.2 Land Use in Middle Rio Grande Watersheds and Subwatersheds[1]

Sampling Site	Watershed Size (mi^2)	Land Use / Land Cover						
		Developed	Barren	Forest	Shrubland	Grassland	Cropland	Water & Wetlands
1. Rio Grande at Angostura Diversion Dam	16,090 (1,230†)	0.64%	1.10%	16.98%	25.12%	55.52%	0.53%	0.11%
2. Rio Grande at Highway US 550	17,189 (1,289†)	0.63%	1.29%	17.61%	25.60%	54.13%	0.53%	0.21%
3. Rio Grande above Rio Rancho Utility #3	17,221 (1,321†)	0.63%	1.30%	17.33%	25.95%	53.99%	0.54%	0.26%
4. Rio Grande above Rio Rancho Utility #2	17,221 (1,321†)	0.63%	1.30%	17.32%	25.95%	53.98%	0.54%	0.27%
5. Rio Grande at Alameda Bridge	17,393 (1,493†)	3.81%	1.22%	17.24%	26.62%	50.28%	0.49%	0.34%
6. Rio Grande at Rio Bravo Bridge	17,658 (1,758†)	4.73%	1.12%	15.52%	30.41%	47.07%	0.77%	0.38%
7. Rio Grande at I-25 Crossing	17,658 (1,758†)	5.05%	1.11%	15.46%	30.32%	46.89%	0.77%	0.40%
8. Rio Grande at Isleta Diversion Dam	17,900 (2,000†)	5.78%	1.12%	17.56%	30.81%	41.24%	2.95%	0.53%
9. North Diversion Channel at Roy	100	45.42%	0.40%	28.44%	20.38%	5.37%	0.00%	0.00%
10. North Domingo Baca Arroyo Dam at Primary Spillway	3	6.52%	0.74%	39.73%	35.94%	17.07%	0.00%	0.00%
11. North Pino Arroyo above North Diversion Channel	2	53.85%	0.52%	3.08%	36.72%	5.83%	0.00%	0.00%
12. Hahn Arroyo above N. Diversion Channel at Carlisle	5	97.92%	0.14%	0.13%	1.79%	0.02%	0.00%	0.00%
13. Embudo Channel above confluence with North Diversion Channel	30	60.62%	0.13%	30.96%	8.12%	0.17%	0.00%	0.00%
14. Bear Canyon Arroyo	5	0.00%	0.00%	97.46%	2.20%	0.34%	0.00%	0.00%
15. South Diversion Channel just above Tijeras Arroyo	9	62.57%	3.39%	1.46%	31.91%	0.33%	0.33%	0.00%

Sampling Site	Watershed Size (mi^2)	Land Use / Land Cover						
		Developed	Barren	Forest	Shrubland	Grassland	Cropland	Water & Wetlands
16. Sandia Pueblo Natural Arroyo at I-25 Crossing	2	0.88%	0.00%	7.92%	59.32%	31.88%	0.00%	0.00%
17. Paseo del Norte Pump Station	0.7	13.91%	0.10%	0.00%	73.10%	3.10%	0.00%	9.80%
18. Alameda Drain at Ranchitos Rd.	4	34.09%	0.23%	0.16%	63.81%	1.66%	0.03%	0.02%
19. Alameda Drain at El Caminito Crossing	7	44.82%	3.68%	0.22%	48.99%	2.21%	0.07%	0.01%
20. Ranchitos de Albuquerque Storm Drain	watershed could not be determined							
21. Cabezon Channel	20	25.32%	0.85%	0.17%	57.47%	16.12%	0.02%	6.00%
22. Calabacillas Arroyo at Swinburne Dam	76	0.22%	0.29%	0.11%	49.23%	50.15%	0.00%	0.00%
23. Calabacillas Arroyo at Coors Rd.	86	5.28%	0.46%	0.11%	50.64%	43.49%	0.00%	0.01%
24. Boca Negro Arroyo at Tesuque Rd.	28	3.16%	0.22%	0.12%	61.91%	34.59%	0.00%	0.00%
25. San Antonio Arroyo at Rio Grande (Montano) Oxbow	5	11.45%	0.33%	0.67%	78.22%	9.34%	0.00%	0.00%
26. Amole del Norte Channel above Amole Dam	18	1.54%	0.13%	0.11%	34.54%	63.68%	0.00%	0.00%
27. Adobe Acres Pump Station	1	78.92%	0.44%	0.59%	3.84%	3.18%	13.03%	0.00%
28. Vito Romero Pump Station	0.9	97.82%	0.04%	0.04%	0.29%	1.80%	0.00%	0.00%
29. Los Padillas Drain just upstream of the confluence with the Isleta Drain	5*	47.80%	0.20%	0.23%	13.40%	2.96%	35.42%	0.00%
30. Isleta Drain just upstream of the confluence with Los Padillas Drain	62*	16.18%	1.15%	0.14%	49.04%	30.98%	2.51%	0.00%

1 USGS (U.S. Geological Survey). 1999. National Land Cover Dataset. Reston, VA. Available via http://landcover.usgs.gov/natllandcover.asp.

† below Cochiti Reservoir and Jemez Dam

**Note that Isleta Drain and Los Padillas Drain flow into the Rio Grande downstream of the Isleta Diversion Dam*

Table 2.3 Selected Features and Properties of Middle Rio Grande Watersheds and Subwatersheds

Sampling Site	Human Population†	Persons† per mi^2	Households†	Households with Public Sewer‡	Septic Tanks ‡ per mi^2	Farm Households‡	Dogs†	Cats†
1. Rio Grande at Angostura Diversion Dam	25,132	20	8,905	33%	<1	1.50%	5,165	5,877
2. Rio Grande at Highway US 550	27,115	21	9,745	30%	<1	1.92%	5,652	6,432
3. Rio Grande above Rio Rancho Utility #3	33,140	25	11,768	33%	<1	1.91%	6,825	7,767
4. Rio Grande above Rio Rancho Utility #2	33,140	25	11,768	33%	<1	1.92%	6,825	7,767
5. Rio Grande at Alameda Bridge	333,500	223	138,614	95%	<1	0.79%	80,396	91,485
6. Rio Grande at Rio Bravo Bridge	484,319	275	195,288	92%	<1	0.85%	113,267	128,890
7. Rio Grande at I-25 Crossing	505,018	286	202,188	92%	<1	0.87%	117,269	133,444
8. Rio Grande at Isleta Diversion Dam	590,473	294	235,788	91%	1	0.87%	136,757	155,620
9. North Diversion Channel at Roy	273,625	2,736	116,994	98%	23	0.70%	67,857	77,216
10. North Domingo Baca Arroyo Dam at Primary Spillway	2,740	982	1,128	70%	111	2.12%	654	744
11. North Pino Arroyo above North Diversion Channel	9,455	4,221	3,696	99%	17	0.66%	2,144	2,439
12. Hahn Arroyo above N. Diversion Channel at Carlisle	25,196	5,282	10,672	100%	3	0.70%	6,190	7,044
13. Embudo Channel above confluence with North Diversion Channel	96,383	3,234	41,045	100%	6	0.61%	23,806	27,090
14. Bear Canyon Arroyo	0	0	0	NA	0	NA	0	0
15. South Diversion Channel at Tijeras Arroyo	20,136	2,288	9,026	99%	8	0.35%	5,235	5,957

Sampling Site	Human Population†	Persons† per mi^2	Households†	Households with Public Sewer‡	Septic Tanks ‡ per mi^2	Farm Households‡	Dogs†	Cats†
16. Sandia Pueblo Natural Arroyo at I-25 Crossing	0	0	0	NA	0	NA	0	0
17. Paseo del Norte Pump Station	463	634	175	13%	218	2.13%	102	116
18. Alameda Drain at Ranchitos Rd.	5,796	1,529	2,182	27%	390	1.72%	1,266	1,440
19. Alameda Drain at El Caminito Crossing	7,438	1,019	2,775	41%	238	1.02%	1,610	1,832
20. Ranchitos de Albuquerque Storm Drain	watershed could not be determined							
21. Cabezon Channel	34,941	1,792	13,498	75%	115	0.68%	7,829	8,909
22. Calabacillas Arroyo at Swinburne Dam	5,257	69	1,799	97%	1	0.30%	1,043	1,187
23. Calabacillas Arroyo at Coors Rd.	38,843	452	14,525	83%	19	0.57%	8,425	9,587
24. Boca Negro Arroyo at Tesuque Rd.	550	20	43	99%	0	0.45%	25	28
25. San Antonio Arroyo at Rio Grande (Montano) Oxbow	5,719	1,126	2,028	97%	7	1.81%	1,176	1,338
26. Amole del Norte Channel above Amole Dam	1,247	70	359	80%	3	0.79%	208	237
27. Adobe Acres Pump Station	2,260	2,253	729	84%	118	2.1%	423	481
28. Vito Romero Pump Station	3,670	4,078	1,162	95%	53	0.93%	674	767
29. Los Padillas Drain just upstream of the confluence with the Isleta Drain	6,530	1,335	2,160	37%	239	3.8%	1,253	1,426
30. Isleta Drain just upstream of the confluence with Los Padillas Drain	58,699	945	18,485	80%	44	0.79%	10,721	12,200

2.3.2 Livestock in the Middle Rio Grande Watershed

As noted previously, agricultural census data are reported only at the state and county levels; therefore, it is not possible to estimate livestock populations for individual subwatersheds within the study area. However, livestock populations for the counties comprising a significant portion of the studied watersheds – Bernalillo, Sandoval, and Santa Fe – are summarized in Table 2.4 to provide insight into the potential livestock sources of fecal coliform to the MRG. These estimates are compiled from the 2002 census of agriculture, as reported by the National Agricultural Statistics Service. It must be noted that these estimates may be low – the census addresses only those animals on farms, defined as a place where $1,000 or more of agricultural products are produced and sold. Thus, animals kept as pets or livestock maintained for household use would not be counted.

Table 2.4 Livestock Populations of the Middle Rio Grande Watershed in 2002

Type	Bernalillo County Population	Sandoval County Population	Santa Fe County Population
All Cattle	10,235	11,287	10,961
Beef Cows	3,487	nr†	7,729
Dairy Cows	2,920	nr†	9
Other Cattle	3,828	3,871	3,223
Horses and Ponies	2,496	1,648	1,745
Sheep and Lambs	1,780	525	440
Goats	505	307	564
Hogs and Pigs	117	nr†	57
Rabbits	nr†	183	186
Llamas	267	14	390
Chickens	>100,000†	1,119	2,205
Turkeys	110	36	54
Ducks and Geese	156	92	243
Other Poultry‡	195	nr†	120

‡ *includes pigeon, squab, pheasant, emu, ostrich, and other*

† *not reported in census, to avoid disclosing herd size of one or two farms*

2.3.3 Wildlife of the Middle Rio Grande Watershed

While no estimates of wildlife populations were found for the specific watersheds, an attempt was made to elucidate the most abundant species based on a variety of sources.

2.3.3.1 Wild Birds

Wild birds have been found to be a significant source of *E. coli* in many watersheds around the United States. Riparian-associated birds feed or reside in or adjacent to water and may serve as direct *E. coli* sources to natural waters. Upland birds tend to serve as indirect sources of *E. coli*, through rainfall into natural waters. Populations of most birds vary seasonally in the MRG watershed; however, the Albuquerque area has a significant population of avian species since the MRG falls within a major migratory bird flyway.

Direct population estimates were not available for wild birds in the MRG watershed. However, bird lists are based on extensive observations of birds, and provide an indication of the relative seasonal abundance of birds in specific geographic areas. Bird lists were retrieved for several areas in north and central New Mexico, comprising various types of habitat. Kirtland Air Force Base in Albuquerque includes primarily upland habitat: grasslands, foothills, and canyons. Salinas Pueblo Missions National Monument and Sevilleta National Wildlife Refuge also include primarily upland habitat, with small riparian areas. Bosque del Apache National Wildlife Refuge includes primarily riparian areas with adjacent uplands. Petroglyph National Monument, just west of the Rio Grande in Albuquerque, is primarily shrubland habitat. Rio Grande Nature Center State Park, along the eastern bank of the Rio Grande in Albuquerque, has abundant riparian habitat.

Bird abundance is typically grouped into the following categories based on the frequency with which they are seen: abundant, common, uncommon, occasional, rare, and accidental. Birds that represent the greatest potential sources of *E. coli* in the MRG watershed are the abundant riparian species, and the upland species that are abundant in the summer and/or fall when rainfall levels are higher. Table 2.5 provides a list of some bird species that are potentially significant sources of fecal coliform in portions of the MRG watershed.

Table 2.5 Some Common Birds of the Middle Rio Grande Watershed

Pied-billed grebe	Mourning dove	White-crowned sparrow
Great blue heron	Rock dove (pigeon)	Brewer’s sparrow
Snowy egret	Northern flicker	Chipping sparrow
Canada goose	American crow	Lincoln’s sparrow
Snow goose	Pinyon jay	Vesper sparrow
Green-winged teal	Scrub jay	Black-throated sparrow
Mallard	Northern mockingbird	Green-tailed towhee
Northern pintail	Great-tailed grackle	Spotted towhee
Northern shoveler	Western meadowlark	Rufus-sided towhee
Gadwall	Barn swallow	Song sparrow
Wood duck	House sparrow	Wilson’s warbler
American coot	Tree swallow	MacGillivray’s warbler
Sandhill crane	Blue grosbeak	Orange-crowned warbler
Killdeer	American robin	Yellow warbler
Lesser nighthawk	Western kingbird	Hermit thrush
Red-winged blackbird	Ruby-crowned kinglet	Horned lark
Red-tailed hawk	Lesser goldfinch	Bewick’s wren
Turkey vulture	House finch	Curved-bill thrasher
Ladder-back woodpecker	Hummingbirds	Fly-catchers
Oriels		

2.3.3.2 Wild Mammals

It is difficult to find data sources on the populations of wildlife in the MRG Basin. The USGS Gap Analysis Program has created habitat-based maps of likely areas where various species could occur, but there is no indication of their abundance. The NM Biota Information System (BISON-M) (http://fwie.fw.vt.edu/states/nm.htm) of the NM Department of Game and Fish provides a list of New Mexico mammal species and the counties where those species occur. For most species, BISON-M also provides an indication of how common they are by way of descriptions such as "demonstrably secure in NM," "apparently secure in NM," "rare or uncommon in NM," or "imperiled in NM." The mammal species with secure reproducing populations reported in portions of Bernalillo and/or Sandoval Counties are listed below in Table 2.6. More than half of the species identified are rodents.

Table 2.6 Some Common Mammals of the Middle Rio Grande Watershed

Big brown bat	Rock pocket mouse	White-throated wood rat
California myotis bat	Brush mouse	Long-tailed vole
Southwestern myotis bat	Cactus mouse	Common muskrat
Pallid bat	Deer mouse	Common porcupine
Western pipistrelle bat	Northern grasshopper mouse	Coyote
Silver-haired bat	Crawford's desert shrew	Common gray fox
Jack rabbit	Dusky shrew	Kit fox
Colorado chipmunk	Western harvest mouse	Black bear
Cliff chipmunk	Plains harvest mouse	Ringtail
Spotted ground squirrel	Pinyon mouse	Common raccoon
Abert's squirrel	Merriam's kangaroo rat	Long-tailed weasel
Red squirrel	Ord's kangaroo rat	American badger
White-tailed antelope squirrel	Northern rock mouse	Western spotted skunk
Botta's pocket gopher	Norway rat	Striped skunk
Hispid pocket mouse	White-footed mouse	Bobcat
Plains pocket mouse	Mexican wood rat	Mule deer
Silky pocket mouse	Southern plains wood rat	

2.3.4 Sanitary Survey

A reconnaissance tour, or sanitary survey, of the MRG watershed was performed by Parsons in May and June 2002 to identify sources of fecal coliform that could potentially be missed by a review of available data and literature. The sanitary survey proved valuable as it provided greater understanding of the diversity of animal species, location, and condition of wastewater infrastructure, and hydrology (pollutant loading pathways) throughout the MRG watershed. This step was important and influenced the sampling approach taken for collecting fecal samples for development of a local library of known isolates. A particular focus was placed on sources near the river and drainages, especially in the vicinity of the investigated sites, as those sources might exert large impacts on the observed fecal coliform source distribution.

No malfunctioning septic systems or sewer lines were observed during the sanitary survey. The only significant human sources observed, excluding NPDES-permitted WWTF outfalls, were dirty diapers among trash discarded along rural roads. Cattle and especially horses were observed in abundance throughout the watershed. Other livestock observed included sheep, llamas, donkeys, goats, pigs, chickens, guinea fowl, and bison (on the Sandia Pueblo). It was noted during the sanitary survey that there were a significant number of households throughout the watershed with one to 10 head of livestock (*e.g.,* horses, cows, goats) which are not accounted for in the county livestock census data discussed in Section 2.3.2.

Wild mammals observed included prairie dogs, rabbits, wood rats, squirrels, and signs of raccoon, beaver, ground squirrel, and other small rodents. Wild birds observed included pigeon (rock dove), house finch, American crow, European starling, northern mockingbird, barn swallow, tree swallow, cliff swallow, turkey vulture, western kingbird, mallard, snowy egret, downy woodpecker, northern flicker, killdeer, mourning dove, burrowing owl, blue grosbeak, lazuli bunting, Canada geese, blue-winged teal, wood duck, northern shoveler, black-chinned hummingbird, American coot, black-crowned night heron, and roadrunner.

The City of Albuquerque's Rio Grande Zoo was identified as a potential source of fecal material in runoff due to the concentration of animals and its location on the banks of the Rio Grande.

SECTION 3
MICROBIAL SOURCE TRACKING OBJECTIVES AND METHODS

3.1 Introduction/Background

This section provides a basic background to the science of microbial source tracking.

3.1.1 Underlying Assumptions

The MST method is based on two principles: first, that the genetic structure of the bacterial population is clonal. This is a well-established element of microbial genetics. Bacteria reproduce by binary fission, or dividing in half. The two daughter cells generated as a result of this cell division are virtually identical in all aspects. All descendents of a common ancestral cell are genetically related to each other. Over time, members of a given clone may accumulate genetic changes which will cause them to diverge from the main lineage and form one or several new clonal groups. MST makes use of the clonal population structure of bacteria to classify organisms based on their genetic fingerprints into groups of clonal descent.

The second principle behind MST methods is the assumption that within a given species of bacteria, various members have adapted to living/environmental conditions in specific hosts/environments. As a result, there is a high degree of host specificity among bacterial strains seen in the environment. A bacterial strain that has adapted to a particular environment or host (*e.g.*, animal intestinal tract) is capable of colonizing that environment and competing favorably with members of the host's indigenous flora. Such a bacterial strain is called a resident strain. Resident strains are usually shed from their host over a long period of time, thus providing a reliable, characteristic signature of their source. A transient strain is a bacterial strain that is introduced into a new environment or host but which cannot colonize and persist in that environment. If a host is sampled over time for a given species of bacteria, a few resident strains are consistently being shed while a large number of transient strains are shed for brief lengths of time. A study conducted by Hartl and Dykhuizen (1984) illustrates this point. Over a period of 11 months, 22 fecal samples were taken from a single individual. A total of 550 *E. coli* isolates were characterized, of which two were considered to be resident strains, appearing 252 times. Dr. Mansour Samadpour of Molecular Epidemiology, Inc. (MEI) accumulated considerable evidence to support this assertion for *E. coli*. Using this subtyping method (ribosomal ribonucleic acid [rRNA] typing using two restriction enzyme reactions), data show that more than 96 percent of *E. coli* strains are seen in only one host species, or a group of related species (Mazengia 1998). Thus, it appears that only about 4 percent of the *E. coli* strains are transient and not attributable to one specific source.

3.1.2 Ribotyping

The key methodological problem in tracing sources of microbial contamination in the environment used to be the lack of a universal single-reagent typing scheme for bacteria. This was overcome by the work of several investigators in the fields of population genetics, molecular systematics, and molecular epidemiology. In 1986, Grimont and Grimont showed that deoxyribonucleic acid (DNA) probes corresponding to specific regions of the rRNA operon could be used to speciate bacteria. Stull *et al.*

(1988) and Lipuma, *et al.* (1988) used the rRNA operon to study the molecular epidemiology of several species of bacteria. To trace the indicator bacterium, *E. coli*, from water to its specific source, the bacterial strain must first be uniquely identified. Populations of *E. coli*, like other bacteria, are composed essentially of a mixture of strains of clonal descent. Due to the relatively low rates of recombination, these clones remain more or less independent (Selander *et al*. 1987). These clones, or strains of bacteria, are uniquely adapted to their own specific environments. As a result, the *E. coli* strain that inhabits the intestines of one species is genetically different from the strain that inhabits another.

Ribosomal ribonucleic acids, which are integral to the machinery of all living cells and tend to be very highly conserved, make an ideal choice of target in interstrain differentiation. Since the *E. coli* chromosome contains seven copies of the rRNA operon, an rRNA probe can be used as a definitive taxonomic tool (Grimont and Grimont 1986). That is, when digested with restriction enzymes, resolved by agarose gel electrophoresis, transferred to a membrane, and hybridized with an rRNA probe, an *E. coli* chromosome will produce several bands to create a specific restriction fragment length polymorphism (RFLP) pattern that can be used to uniquely identify the bacterial strain.

The pattern of DNA fragments corresponding to the rRNA operon is referred to as the ribotype. Ribotyping has been useful in many studies to differentiate between bacterial strains that would have otherwise been difficult or impossible to distinguish. Fisher *et al*. (1993) followed the transmission of *Pseudomonas cepia* from environmental sources to and between cystic fibrosis patients and discovered that the majority of patients contracted cystic fibrosis from one of two treatment centers. Moyer *et al*. (1992) used rRNA typing to identify the *Aeromonad* strains responsible for several waterborne gastroenteritis episodes in a community and was able to trace the contamination to specific locations in water treatment and distribution systems. Baloga and Harlander (1991) compared several typing methods for distinguishing between strains of *Listeria moncytogenes* implicated in a food-borne illness and found that ribotyping was the preferred method due to its precision and reproducibility. Atlas *et al.* (1992) described the technology of ribotyping as applicable to the tracking of genetically engineered microorganisms in the environment.

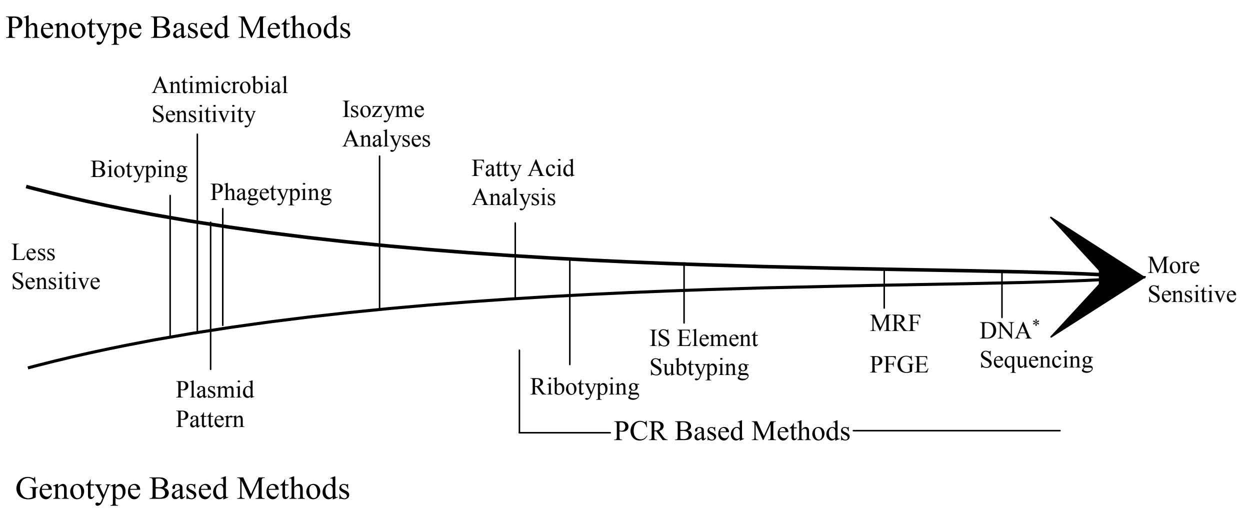
Dr. Samadpour’s MST method was developed on the basis of the principles of microbiology, epidemiology, molecular epidemiology, microbial population genetics, sanitary engineering, and hydrology. In any watershed, there are multiple contributing animal sources of microbial pollution, each of which has its own unique clones of bacteria that constitute their normal flora. Ribotyping is applied as part of an MST study in the following steps. First, collections of isolates from appropriate bacterial species can be compiled from the polluted sites and the suspected animal sources of pollution, which are identified through a sanitary survey of the region surrounding the polluted site. Second, using an appropriate molecular subtyping method, all bacteria in the collection can be subtyped. Finally, the genetic fingerprints of the bacterial isolates from the polluted site can be compared to those of the bacteria from the suspected animal sources. When a strain of bacteria with an identical genetic fingerprint is isolated from both a water sample and a suspected animal source, the animal is implicated as a contributor of that specific strain of the bacteria to the polluted site. The relative contributions of various sources are quantified based on the fraction of isolates from a representative set of ambient water samples that match ribotypes of resident strains from that source (human or nonhuman).

3.1.3 Antibiotic Resistance Analysis

Antibiotic Resistance Analysis (ARA) is another method commonly used in MST studies. The basic underlying assumption for ARA is that the use of therapeutic antibiotics in humans and both therapeutic and feed additive uses in animals would result in imposing selective pressure on the intestinal microflora of humans and animals. Due to differences in the types of antibiotics used in humans and animals, it should be possible to categorize the environmental isolates of bacteria, and on the basis of their antibiotic resistance profile (ARP), determine their host origin (Krumperman 1983; Kaspar *et al*. 1990; Wiggins 1996; Parveen *et al*. 1997; and Hagedorn *et al*. 1999).

Antibiotic resistance profiles are generated by measuring the ability of *E. coli* to grow in the presence of each of several antibiotics. In a manner similar to ribotyping, the antibiotic resistance profiles of *E. coli* isolates are compared to those from a library of known fecal sources. A given antibiotic resistance profile is seldom unique to a given animal or source. Instead, statistical methods are used to determine the most likely source. Also, the specificity of ARA is less than that of ribotyping; often, source classification is limited to human, livestock, and wildlife categories. However, ARA is less expensive than ribotyping.

Figure 3.1 MST Methods



Source: Dr. Mansour Samadpour 2001.

Figure 3.1 above displays a conceptual sensitivity continuum of some of the widely used subtyping methods. Phenotypic based methods (methods based on the expression of phenotypes) are at the less sensitive domain of the continuum while genotypic based methods constitute the more sensitive end of the spectrum. The level of sensitivity depends upon the choice of gene(s) and the size of fragment(s) sequenced.

3.1.4 Study Design and Data Quality Objectives

A key factor influencing the study design and DQOs was the need to identify contributing sources of fecal coliform bacteria in the MRG watershed under wet-weather conditions, and correlating these findings to the periods when elevated fecal coliform levels had been observed historically. The geographic scope of the project included a 40-mile stretch of the Rio Grande, from Angostura Diversion Dam near the southern border of the Santa Ana Pueblo downstream to the Isleta Diversion Dam near the northern border of Isleta Pueblo and contributing tributaries and watersheds.

During the first 2 years of the study, progress was hindered by a lack of rainfall. During the study, drought conditions intensified from "severe" to "extreme" or "exceptional." According to the National Weather Service, 2003 was the driest year since 1956. Rainfall sufficient to produce runoff was extremely rare and widely scattered. From June 2002 to December 2003, only 64 percent of the planned runoff-influenced ambient water samples were collected. Long-term forecasts indicated that the drought would likely continue. Given the limited amount of rainfall, the forecast of continuing drought, and other practical considerations to complete the necessary MST analyses, the DQOs were modified to also include identification of the contributing sources of fecal coliform bacteria under dry-weather conditions.

This project involved several steps:

- A sanitary survey of the watershed and a review of available data and literature to identify potential contributing sources of fecal bacteria to be considered.
- Development of watershed-specific libraries of ribotypes and antibiotic resistance profiles of *E. coli* isolated from fecal matter collected from known sources.
- Collection and culturing of a representative set of *E. coli* isolates from the waterbodies of concern under dry and wet-weather conditions.
- Determination of the ribotypes and antibiotic resistance profiles of these waterborne *E. coli* isolates, followed by matching to those from the known source library to identify the sources of each *E. coli* isolate.
- Quantification of the accuracy and precision of the ribotyping and ARA source determinations.
- Estimation of the relative source contributions of *E. coli* in the MRG watersheds, and the confidence of these estimates, based on the above measurements.

It is important to note that fecal coliform was cultured and enumerated from water samples, but *E. coli* was subjected to MST procedures. Fecal coliform are a method-defined group of coliform bacteria that can grow at the elevated temperatures inside the mammalian intestinal tract, whereas *E. coli* is a particularly abundant species of the fecal coliform group of bacteria. However, the fecal coliform group also includes many other species of bacteria, some of which are not exclusively fecal in origin. Fecal coliform, rather than *E. coli*, was enumerated in water samples because current New Mexico WQSs are based on fecal coliform concentrations. However, the ribotyping method must be applied to a single species of bacteria because inter-specific DNA differences likely outweigh the small differences between intra-specific strains of bacteria on which the MST method is based. *E. coli* were selected for MST in this project because they are exclusively endemic to the mammalian intestinal tract in temperate zones and they comprise a substantial fraction of the fecal coliform group. The fraction of fecal coliform verified to be *E. coli* in water samples were noted.

3.2 Library Development

On the basis of the watershed sanitary survey, review of existing data and information, and communications with stakeholders, the Parsons team identified the major potential sources of fecal pollution to the MRG and devised a plan to develop libraries of *E. coli* isolated from fecal samples from these potential sources. The goal was to develop a local library of 1,000 *E. coli* isolates from approximately 500 samples with, on average, two *E. coli* collected from each known source sample. The sources sampled included sewage, wildlife, avian, pet, livestock, and exotic species from the Albuquerque Zoo (Table 3.1). These locally collected isolates supplemented an extensive library of over 65,000 isolates ribotyped by Dr. Samadpour at MEI from hundreds of different species and sources, including many of the domestic and wild species found in the MRG watershed. Because the abundance of particular *E. coli* strains in animals is expected to vary with space and time, reliance on the MEI library alone would likely result in an unacceptably large percentage of *E. coli* with ribotypes for which sources could not be identified. In numerous studies, Dr. Samadpour found that sources can be identified for approximately 60-70 percent of *E. coli* isolates based on his nationwide library alone, but that with a local library, the identified percentage can be increased by 15 to 25 percent.

Known source samples were collected directly from the source when possible. An exception was human samples, which were collected from septage haulers, sanitary sewers, and WWTFs. Because sewage can also contain fecal matter from other sources, it will not be referred to as human in origin. However, it was expected that the bulk of fecal matter in most septage and sewage was human in origin. In addition to sewage and septage, the MEI library also contains samples directly from human feces. In many cases, wildlife and pet samples were collected indirectly, from "found" fecal samples. However, only samples for which the field biologists were confident of the source were collected. After a few reported cases of hanta virus in the area, it was decided for safety reasons not to collect additional fecal samples from mice and rats for the library, but to rely on the existing rodent *E. coli* library at MEI.

Fecal samples were collected aseptically into sterile test tubes, capped, and sealed. All sample containers were labeled with the following information: sample type, host species, sample date and time, sample location, and sampler's initials. The sample information was recorded in a field log. Samples were then shipped on ice via overnight courier to MEI. Only a single sample was collected from each individual animal.

At the MEI laboratory in Seattle, Washington, fecal samples were plated on MacConkey agar and incubated at 35°C overnight. The next day three to five lactose fermenting, non-mucoid colonies that exhibited *E. coli* morphology were picked and re-plated on MacConkey agar for purification. Well-isolated non-mucoid colonies were picked from these plates and plated on tryptic soy agar. After overnight incubation at 35°C, each colony was tested by a Spot indol test using appropriate positive and negative controls. Indol positive cultures were further tested for the ability to utilize citrate using Simon citrate media. Indol positive, citrate negative colonies were identified as *E. coli* and were given isolate numbers and incorporated into the library. A portion of each E. coli isolated from the samples was stored at –80°C, in nutrient broth plus 15 percent glycerol.

In total, 579 fecal and sewage samples from known sources were collected from the Albuquerque vicinity for the library. These samples are summarized in Table 3.1. From these samples, a total of 1,733 colonies were picked and, ultimately 861 individual *E. coli* isolates were added to the known source library.

Table 3.1 Summary of Fecal Source Sampling for Library Development

Major Category	Category 2	Category 3	Total Samples Collected	Sample Target	Sample % of Target
Sewage	Septage haulers		26		
	Sanitary sewers		22		
	Wastewater treatment plant influent		28		
Sewage Total			**76**	**80**	**95%**
Livestock	Bovine	Beef cattle	36		
		Dairy cattle	14		
		Bison	5		
		Subtotal	55	55	100%
	Equine	Horse	50		
		Pony	2		
		Donkey	2		
		Mule	2		
		Subtotal	56	50	112%
	Poultry	Chicken	11		
		Turkey	5		
		Duck	4		
		Emu	5		
		Geese	2		
		Subtotal	27	15	180%
	Goats		14	4	350%
	Sheep		14	6	233%
	Hogs & pigs		4	5	80%
	Rabbits, domestic		4	5	80%
	Alpacas, llamas, & guanicos		3		
Livestock Total			**177**	**140**	**126%**
Pets	Cat		43	40	108%
	Dog		51	50	102%
	Other mammals		13	10	
	Reptile		3		
Pets Total			**110**	**100**	**110%**
Wildlife	Large herbivores	Deer	10		
		Elk	1		
		Pronghorn	1		
		Subtotal	12	15	80%
	Large carnivores	Bobcat	2		
		Cougar	3		

Major Category	Category 2	Category 3	Total Samples Collected	Sample Target	Sample % of Target
		Coyote	1		
		Wolf	4		
		Subtotal	10		
	Rodents	Prairie dog	12	3	
		Rabbit	18	10	
		Squirrel	1		
		Subtotal	31	53 (13)*	58% (238%)*
	Other mammals	Bats	2		
		Javelina	1		
		Raccoon	3		
		Subtotal	6	10	60%
	Water birds	Ducks/Geese	43		
		Cranes	13		
		Herons	2		
		Subtotal	58	50	116%
	Upland birds	Pigeons	16	10	
		Crows / ravens	7	5	
		Grackles	7	5	
		Hawks/Falcons	6		
		Owls	7		
		Roadrunner	3		
		Other	7		
		Subtotal	53	20	265%
	Reptiles		2		
Wildlife Total			**172**	**170 (130)***	**101% (132%)***
Zoo	Exotic species	mammals	36		
		birds	2		
	Native species	mammals	3		
	Mixed species		3		
Zoo Total			**44**	**20**	**220%**
Grand Total			579	520 (480)*	111% (121%)

* *Number in parenthesis is the revised target after decision to exclude small rodent trapping due to concern over hantavirus.*

3.3 Ambient Water Sampling Plan

The stakeholders and sponsors of this project identified 30 water quality monitoring sites in the MRG watershed to be sampled in this project, based on their needs for information to assist in the design of water quality management measures. Eight stations were selected to represent the ambient conditions along the MRG, from Angostura Diversion Dam at the northernmost extent of the watershed, to Isleta Diversion Dam at the southernmost extent. Other stations were selected on major arroyos or drains flowing to the MRG, or at pump stations that drain watersheds where elevated fecal coliform levels have been observed. The stations and the properties of their subwatersheds were described previously under Section 2.3. The subwatersheds of the tributaries represent a wide variety of land use types and potential fecal sources, and drain a large percentage of the MRG watershed within the study area.

To identify fecal coliform sources associated with rain events, water samples were initially collected only during, or within 24 hours after, a rainfall event. Because drought conditions prevented obtaining the required number of samples, the monitoring plan was revised to include sample collection during February and March 2004 to quantify fecal coliform sources under dry weather conditions. The samples were collected under base flow conditions before water releases for irrigation use began, at stations where water is often present under base flow conditions**.** These stations included the eight Rio Grande stations, as well as the North Diversion Channel and South Diversion Channel.

The sampling design called for each location to be sampled on five dates (events). In addition, two "integrator" sites were to be sampled on 10 dates to provide more precise source contribution estimates. These integrator sites were located on the Rio Grande, at the upper and lower ends of the study area. The upper integrator site, at the Angostura Diversion Dam on the Rio Grande, provided an estimate of background fecal source contributions in the Rio Grande watershed upstream of the study area. The lower integrator site, at the Isleta Diversion Dam on the Rio Grande, quantified fecal source contributions from the entire study area.

Because fecal coliform populations have been found to vary on fine spatial and temporal scales, Parsons increased sampling representativeness by collecting composite water samples from six sub-samples collected several minutes and/or several meters apart. Parsons' field staff followed the field sampling procedures for field and conventional chemical parameters documented in the 2002 QAPP for Water Quality Management Programs of the NMED SWQB and the Scientific Laboratory Division of the New Mexico Health Department. Sampling personnel wore clean, disposable, powder-free gloves while collecting samples. At many sites, water samples were collected directly from the stream (approximately 1 foot below the surface) into sterile wide-mouthed polypropylene bottles supplied by the culturing laboratory. Containers were rinsed in sample water before the grab samples were collected. In cases where, for safety reasons, it was inadvisable to enter the stream bed, staff used a clean bucket and rope from a bridge to collect the samples from the stream, and poured the water into the sample bottles. Care was taken to avoid contaminating the sample and ensure that the bucket and rope did not come into contact with the bridge. The bucket was thoroughly rinsed between stations, and sanitized with a bleach- or isopropyl alcohol-soaked wipe. The first bucketful of water collected from a bridge was used to rinse the bucket and the sampler's gloved hands. Samples were collected from subsequent buckets of water.

Following collection, samples were delivered within 24 hours to the Assaigai Analytical Laboratory in Albuquerque for fecal coliform culturing and enumeration via the membrane filter-based Standard Method 9222D (APHA 1995). Following their incubation and enumeration, Assaigai shipped the fecal coliform culture plates on ice overnight to MEI for ribotyping and ARA.

Water samples were received by MEI in the form of mFC agar plates, with (usually) at least 12 colonies per plate. Twelve or more randomly-selected blue colonies were picked from mFC plates corresponding to each sample, and each was plated onto MacConkey agar (Difco Laboratories, Detroit, Michigan, USA) for purification as individual *E. coli* colonies. At this stage, each of the colonies picked from a given sample bore the Sample ID number and an accession number. A single well-isolated non-mucoid colony that exhibited *E. coli* morphology was picked from each MacConkey plate and plated on Triptic soy agar. After overnight incubation at 35°C, each culture was tested by the Spot indol test using appropriate positive and negative controls. Indol positive cultures were further tested for the ability to utilize citrate using the Simon citrate media. Indol positive, citrate negative colonies were identified as *E. coli* and given isolate numbers.

As noted, for each water sample, MEI performed ribotyping and ARA on approximately 12 *E. coli* isolated from the culture plates. Given five sampling events per site, this provided 60 isolates for each site. For the two integrator sites, 120 isolates per site were typed. The number of isolates typed impacts the confidence level around the estimate of the fecal source contributions at each site. Table 3.2 shows the predicted confidence levels around the source contribution estimate for 30, 60, and 120 isolates per site for major sources comprising 20 to 50 percent of the total fecal loading. Typing 60 isolates permitted Parsons to quantify the relative contribution of a source comprising 20 percent of the total *E. coli* loading with a precision of plus or minus 10 percent at the 95 percent confidence level.

Table 3.2 Confidence Intervals of Source Contribution Estimates

True Source % Contribution to Fecal Loading	Number of Isolates Ribotyped	Predicted 95% Confidence Interval of Estimated Source Contribution
20%	30	5.7 - 34.3%
	60	9.9 – 30.1%
	120	12.8 - 27.2%
30%	30	13.6 - 46.4 %
	60	18.4 - 41.6%
	120	21.8 - 38.2%
40%	30	22.5 - 57.5%
	60	27.6 - 52.3%
	120	31.2 - 48.8%
50%	30	32.1 - 67.9%
	60	37.3 - 62.7%
	120	41.1 - 58.9%

3.4 MST Methods

As mentioned previously, MEI characterized the isolated *E. coli* strains using both ribotyping and ARA methods. Results from both methods will be described individually. In addition to the usefulness of the direct head-to-head comparison between ribotyping and ARA, application of two independent methods can validate the results, increasing stakeholder confidence in the outcome. Second, because any one method may not perform completely successfully in all samples of a given study, a second method provides back-up to ensure the study will generate useful results. For instance, if an *E. coli* ribotype from a water sample does not match a ribotype from a known source species, ARA may be able to at least indicate whether the source was wildlife, livestock, or human. A third benefit of using two methods is that the results may be more directly compared to other studies.

3.4.1 MST Ribotyping Procedure

MST was performed at the Seattle, Washington laboratories of MEI, Inc.

Genomic DNA Isolation and Restriction Endonuclease Digestion

Confluent growth was scraped with a sterile flat-head toothpick and suspended in 200 microliters (µL) 50mM Tris, 50mM EDTA (pH 8.0). Six hundred µL more of 50mM Tris, 50mM EDTA was then added and the suspension was thoroughly mixed by pipetting up and down. Then 45 µL 20% sodium dodecyl sulfate (SDS) and then 10 µL proteinase K (20 µg/mL; Pharmacia, Piscataway, N.J.) were added. This solution was then incubated at 40°C for 1 hour. After an equal volume of phenol was added to each tube, samples were vortexed, and centrifuged for 5 minutes. The top layer was extracted, and an equal volume of chloroform was added. The preparation was vortexed again, centrifuged, and extracted. Two and a half volumes of absolute ethanol were added and the DNA was precipitated out and spooled onto a glass capillary pipette. The DNA was washed with a few drops of absolute ethanol, dried, and re-suspended in 50µL distilled water (dH_2O).

Separate restriction endonuclease digestion reactions were set up using *Eco*R1 and *Pvu*II, 10 units/µL (Boehringer Mannheim, GmbH, Germany) as instructed by the manufacturer using 2 µL DNA. They were incubated at 37°C overnight. The samples were then centrifuged and 0.5 µl of enzyme was added. The samples were re-incubated at 37°C for a minimum of 3 hours. They were centrifuged again and 3 µL stop dye was added. Every batch of restriction enzyme reaction contained two reactions with a positive control strain that was included on two lanes on each gel.

Gel Electrophoresis and Southern Blot Hybridization

Samples were run on a 0.8% agarose gel in 1X Tris-borate-EDTA at 22 volts and 17 milliamps, for 17 hours. λ HindIII was used as a size standard along with a known *E. coli* isolate designated as 3915. Each agarose gel was assigned a number, and when more than one gel was run, the position of the first standard reference strain was changed in each gel (1st lane on the first gel, to the Nth lane on the Nth gel). Electrophoresis gels were stained in ethidium bromide. If two gels were stained in a single container, one corner of the gel with the higher number was clipped. The label for each gel was also transferred to the staining container. Each gel was then photographed and a hard copy of the print was labeled with the gel sheet (containing the isolate numbers loaded on each lane, and the enzyme used to cut the DNA, plus date, gel number, voltage, current, gel strength, buffer strength, and electrophoresis time information). After photography each gel was returned to the same staining container.

The DNA fragments were then transferred to a Nitran filter (Schleicher & Schuell, Keene, N.H.), baked at 80°C for 1 hour, and probed with ^{32}P-labeled copies of *E. coli* rRNA, which were made by extension of random hexanucleotide primers using Avian Myeloblastosis Virus reverse transcriptase (Stratagene, La Jolla, California) under conditions specified by the supplier. Each membrane filter was labeled with the gel number, restriction enzyme designation, date, and technician's initials. Hybridization was done in 5X SSC (1X SSC is 0.15 M NaCl plus 0.015 M sodium citrate), 0.1% SDS, 1mM EDTA, and 50% formamide at room temperature overnight. Salmon sperm DNA and blocking reagent (Boehringer Mannheim GmbH, Germany) were used to block non-specific binding. Three washes were done with a solution of 2X SSC and 0.1% SDS, once at 25°C for 20 minutes and twice at 65°C for 20 minutes to wash off low-homology, non-specific binding. Blots were then exposed with an intensifying screen to x-ray film (Kodak, Rochester, New York) for 24 hours at -70°C. Two to three exposures were done to ensure all possible bands would show up.

All reagents and buffers were made according to formulas in the MEI standard operating procedures. Reagents and buffers were tested for sterility.

Restriction Fragment Length Polymorphism Analysis

Each ribotype was then analyzed by assigning an alphanumeric pattern based on the distance between the bands. Bands more than 3 mm apart were counted as singles while bands that were within 3 mm of each other were counted as doubles or triples. For example, two bands that were closer than 3 mm were designated "2" and a group of three bands with 3 mm or less between each band were designated "3." A "1" designated a single band more than 3 mm distant from another band. Each unique banding pattern was called a ribotype and assigned an alphanumeric pattern.

Two isolates that had the same numeric value but different banding patterns were assigned letters to differentiate the two ribotypes. For example, two isolates with an identical numerical pattern of 2122111, but with the bands shifted so the two isolates did not have identical banding patterns, were labeled 2122111A and 2122111B.

The ribotypes were then entered into a Microsoft® Access™ database and compared to the other ribotypes of known source in the library database. Ribotype patterns that numerically appeared to be similar were compared side-by-side visually to judge matching.

Isolates with the same *Pvu*II and *Eco*R1 ribotypes are deemed to be members of the same ribogroup. Using this approach, only isolates with two identical ribotypes were grouped together.

3.4.2 ARA Procedure

Antibiotic resistance and susceptibilities were determined by disk diffusion assay, following the standard protocol of the National Committee for Clinical Laboratory Standards (NCCLS 1999), included in Appendix A. The specific antibiotics and concentrations used, in antibiotic disks obtained from Remel, Inc. (Lenexa, KS), were amikacin (30 µg), ampicillin (10 µg), ampicillin/sublactarn (10/10 µg), ceftriaxone (30 µg), chloramphenicol (30 µg), ciprofloxacin (5 µg), gentamicin (10 µg), kanamycin (30 µg), nalidixic acid (5 µg), streptomycin (10 µg), tetracycline (30 µg), and trimethoprin (5 µg). These antibiotics are commonly used for human and veterinary purposes, and/or in animal feed. The control organism ATCC 25923 was used with each susceptibility assay. Using this method, each *E. coli* is tested for growth or inhibition in the presence of each of the 12 antibiotics. Growth of *E. coli* indicates it has developed some resistance to the antibiotic, while inhibition of growth indicates susceptibility. A

12-character ARP code is assigned to each *E. coli* indicating its resistance or susceptibility to the 12 antibiotics, in the order listed above. A "0" indicates inhibition, while a "2" indicates growth (resistance). For example, the antibiotic resistance profile 200000000020 would indicate an *E. coli* with resistance to amikacin and tetracycline, but susceptible to all other antibiotics tested. Unlike the ARA protocols utilized by some other investigators, this method does not utilize quantification of the intermediate degree of growth and inhibition based on the diameter of the zone of inhibition around an antibiotic disk, but simply classifies growth or inhibition.

3.5 Quality Assurance/Quality Control Measures

Along with an estimate of the relative contributions from various fecal sources in the watershed, it is important to understand the uncertainty of those estimates. Precision, accuracy, sensitivity, completeness, and representativeness are critical data quality issues affecting uncertainty. Representativeness was controlled by developing an environmental monitoring program characteristic of actual environmental conditions. Accuracy, precision, sensitivity, and completeness were similarly controlled through careful planning, but also were quantified via quality control (QC) measures. These QC measures included analysis of blank samples, replicate samples, and known standards (in MST, samples of known origin). A detailed QAPP was developed to ensure the quality of data produced by the project.

3.5.1 Quantification of Accuracy and Precision in Ribotyping and ARA Source Determinations

MST does not lend itself easily to the same QC methods as chemical quantification. Blank samples may be irrelevant, and replicate water samples may often yield different *E. coli* strains. Parsons quantified method accuracy and precision through a special QC study with "blind" safeguards, as practiced in epidemiological QC. MEI prepared triplicate cultures of 100 *E. coli* isolates randomly selected from various sources in the MEI library, including human (10), bovine (31), seagull (17), dog (18), sanitary sewage (13), and ambient water (12) sources. The cultures were placed in identical slant tubes, each with a removable label indicating its source and the isolate number (1-100). These tubes were mailed to the Parsons quality assurance (QA) manager. The Parsons QA manager replaced each tube label with a new label, numbered from 1 to 300 in random fashion, and recorded both the old and new label numbers for each tube in a key. After verifying there was no way to distinguish the tubes, the Parsons QA manager then sent the 300 slant tubes back to MEI as unknowns. The *E. coli* in each tube was then processed through the ribotyping and ARP procedures by MEI in a blind fashion; that is, MEI did not know the source. MEI then identified the original isolate number of each culture through ribotyping and ARA and sent the results to the Parsons QA manager, who then evaluated and reported the accuracy and precision of the two methods. Precision was evaluated as correct assignment of the three identical triplicates of each of the 100 unknown cultures to the same original isolate number. Accuracy was evaluated as correct assignment of unknown cultures to their original isolate number. The results are shown in Section 4.1.

3.5.2 Bottle and Equipment Blanks

An equipment blank is a sample of reagent water poured into a sample bottle, or poured over or pumped through a sampling or analysis device. It is collected in the same type of container as the environmental sample, preserved in the same manner, and analyzed for the same parameter. In addition to regularly collected bottle and equipment blanks, laboratory equipment blanks are prepared at the laboratory where collection materials are cleaned between uses. These blanks document that the materials provided by the laboratory are free of contamination. The QC check is performed with each new batch of equipment or bottles, as documented in the laboratory quality assurance manual. The analysis of equipment blanks should yield values less than the minimum analytical level (MAL). When target analyte concentrations are very high, blank values must be less then 20 percent of the lowest value of the batch.

3.5.3 Field Duplicates

Field duplicates utilized in this study were split replicates, collected by splitting a composite sample, immediately after compositing in the field, into two bottles. Field duplicate samples were sealed, handled, stored, shipped, and analyzed in the same manner as the primary sample. Because only a small subset of the bacterial colonies cultured from a water sample are typed, and there are often many different bacterial sources impacting a body of water, it is expected that two samples will yield different results, depending on which colonies are selected for typing. Thus, duplicate results from a single sampling event are not a meaningful measure of quality; they are expected to disagree. However, the overall source identification, based on multiple sampling events and many isolates, should be consistent from duplicate samples. If this difference is large, it may indicate problems with sampling, analysis, experimental design, or typing. In this study, field duplicate samples were collected at a single sampling station: Rio Grande at Isleta Diversion Dam. One DQO of this study was to elicit a 75 percent agreement between the sources identified, as illustrated in the example below:

Isolate #	Duplicate 1 Source	Duplicate 2 Source	Same?
1	Cattle	Cattle	Yes
2	Cattle	Cattle	Yes
3	Cattle	Cattle	Yes
4	Cattle	Human	No
5	Cattle	Dog	No
6	Dog	Dog	Yes
7	Dog	Dog	Yes
8	Dog	Dog	Yes
9	Horse	Human	No
10	Human	Human	Yes
11	Human	Human	Yes
12	Human	Human	Yes
			9/12 = 75% agreement

Actual precision and accuracy results were in 100 percent agreement and are described in Section 4.1.

3.5.4 Field Blanks

Field blanks consisted of sterile buffer water taken to the field and transferred to the appropriate container in precisely the same manner as a sample during the course of a sampling event. They were used to assess contamination from field sources such as airborne materials, carryover from prior sampling sites, and containers. The analysis of field blanks should yield values less than the MAL. When target analyte concentrations are high, blank values should be less then 20 percent of the lowest value of the batch. Field blanks were to be collected at a frequency of 5 percent or greater through fecal coliform culturing and quantification steps, but not processed by ribotyping or ARA.

3.5.5 Completeness

Data completeness is simply a measure of the fraction of data that meets project DQOs. In water sampling and fecal coliform culturing and enumeration, completeness is affected by the number of water samples collected and analyzed that meet the project's DQOs relative to the original data collection planned. Data completeness can be affected by lack of suitable conditions for sampling (*e.g*, lack of runoff-influenced water at sampling sites), and by sampling or laboratory QC failures. A goal of the project was collection and analysis of 90 percent or more of the planned samples.

In ribotyping and ARA, data completeness is most affected by the number of ribotypes observed as unknowns in water samples that match ribotypes and ARPs in the known source library. This completeness can be reduced by 1) an abundance of transient clones among the *E. coli* isolated from water, or 2) a known source library of insufficient size that does not contain ribotypes or ARPs from known sources matching the *E. coli* isolated from water. Thus, a large library is important. Another DQO of the project was that a fecal source be identified for at least 70 percent of the planned number of *E. coli* isolates.

SECTION 4
RESULTS AND DISCUSSION

Ambient water sampling for this project lasted approximately 2 years - beginning on July 8, 2002 and ending July 27, 2004. Due to a lack of rain, the planned data collection was not achieved at many sites. At some sites, such as Bear Canyon Arroyo, Paseo del Norte Pump Station, Boca Negro Arroyo at Tesuque Road, and Adobe Acres Pump Station (Figures 4.1, 4.2, 4.3, and 4.4, respectively) runoff water was seldom or never observed. This was considered likely to be due to the small watershed size draining to these sites, high soil perviousness of the watershed reducing runoff, and the short duration of rainfall and runoff in these areas. Another factor may have been the relatively long driving distance from Parsons' office or the homes of sampling personnel to these sites. Upon observation of rainfall, often by the time the site was reached the runoff had passed. Finally, efforts to use automatic samplers to collect water samples at these sites were unsuccessful.

Figure 4.1 Bear Canyon Arroyo above High Desert Subdivision Looking East

Figure 4.2 Paseo del Norte Pump Station

Figure 4.3 Boca Negra Arroyo at Tesuque Road Looking East

Figure 4.4 Adobe Acres Pump Station Looking West

To make up for the samples not obtained at some sites, additional samples were collected at other sites where runoff was more frequently observed. Table 4.1 summarizes the actual number of ambient water samples collected under runoff and non-runoff conditions as compared to the target number of ambient samples proposed at the start of the project. Additionally, some samples were collected in February and March 2004 under dry, base flow conditions at the eight Rio Grande sites, the North Diversion Channel, and the South Diversion Channel. Finally, upon discovery that MEI never received a number of fecal coliform plates from Assaigai Analytical Laboratory, additional runoff water samples were collected in July 2004 to make up for these misplaced samples.

Table 4.1 Summary of Ambient Water Sampling

Sampling Site	Planned Ambient Samples	Collected Ambient Samples	
		Runoff	Non-runoff
1. Rio Grande at Angostura Diversion Dam	10	10	4
2. Rio Grande at Highway US 550	5	7	4
3. Rio Grande above Rio Rancho Utility #3	5	7	4
4. Rio Grande above Rio Rancho Utility #2	5	6	4
5. Rio Grande at Alameda Bridge	5	9	4
6. Rio Grande at Rio Bravo Bridge	5	7	3
7. Rio Grande at I-25	5	8	3
8. Rio Grande at Isleta Diversion Dam	10	11(2)	3
9. North Diversion Channel at Roy	5	9	3
10. North Domingo Baca Arroyo Dam at Primary Spillway	5	5 (1)	0
11. North Pino Arroyo above North Diversion Channel	5	11	0
12. Hahn Arroyo above North Diversion Channel at Carlisle	5	9	0
13. Embudo Channel above North Diversion Channel	5	9	0
14. Bear Canyon Arroyo above High Desert Subdivision	5	0	0
15. South Diversion Channel above Tijeras Arroyo	5	7	2
16. Sandia Pueblo Natural Arroyo at I-25	5	3	0
17. Paseo del Norte Pump Station	5	1	0
18. Alameda Drain at Ranchitos Road	5	7	0
19. Alameda Drain at El Caminito	5	7	0
20. Ranchitos de Albuquerque Storm Drain	5	4	0
21. Cabezon Channel	5	5	0
22. Calabacillas Arroyo at Swinburne Dam	5	2	0
23. Calabacillas Arroyo at Coors Road	5	4	0
24. Boca Negro Arroyo at Tesuque Road	5	1	0
25. San Antonio Arroyo at Rio Grande (Montano) Oxbow	5	3	0
26. Amole del Norte Channel above Amole Dam	5	2	0
27. Adobe Acres Pump Station	5	0	0
28. Vito Romero Pump Station	5	1	0
29. Los Padillas Drain just upstream of the Isleta Drain	5	8 (1)	0
30. Isleta Drain just upstream of the Los Padillas Drain	5	9	0
Grand Total	**160**	**172**	**34**

Number in parentheses represents duplicate samples.

4.1 Quality Assurance/Quality Control Results

Blanks and Duplicates

Bottle and equipment blanks were run with each group of samples delivered to the laboratory at the same time. All bottle and equipment blanks were negative for fecal coliform, reflecting a lack of contamination.

Field blanks were run at an average rate of one for every 12 samples. These blanks are run by collecting sterile water in the same manner as an ambient water sample, at the sampling location, and between ambient water samples. Thus, they incorporate potential contamination from all sources. Fourteen (82%) of the 17 field blank samples showed no contamination from fecal coliform bacteria. Two field blanks in July 2002 showed a single fecal coliform bacteria, but because this was less than 2 percent of the fecal coliform concentration in corresponding ambient water samples, this level of contamination met QC requirements. One field blank sample in August 2002 showed substantial contamination, with a fecal coliform concentration almost 25 percent of the lowest fecal coliform level of the associated ambient water samples. These water samples were not submitted for ribotyping and ARA due to the potential for effects from cross-sample contamination, and field staff were re-educated on procedures to prevent contamination. After August 2002, no contamination was observed in any field blank sample.

The analysis of field duplicates at the Rio Grande at Isleta Diversion Dam sample site yielded unclear results. Field duplicate samples were collected on only four dates due to staff error. Overall, 34 duplicate isolates were ribotyped, including as many as 5 for which sources were not identified. The sources of 18 (62%) of these isolates matched those of the respective duplicate samples, which was below the project objective of 75 percent. This may indicate the wide variety of contributing sources of fecal coliform observed at this site, with no dominant source. It may also be due, in part, to the fact that the number of *E. coli* ribotyped from many of the duplicate filters for each pair of samples was far from equal. Finally, the disagreement is likely due partially to the smaller than planned number of duplicate samples and isolates.

Precision and Accuracy

Ribotyping was extremely precise and repeatable. As stated earlier, MEI analyzed 300 unknown *E. coli* cultures. These 300 cultures represented three copies each of 100 different *E. coli* isolates cultures provided by MEI to the Parsons QA Officer (QAO) from the MEI known source library of *E. coli* isolates. These isolates included cultures from dogs, humans, cattle, seagulls, and sewage. Labels on the slant tubes containing the isolates were removed and replaced by the Parsons QAO with a randomly assigned number label (after making a key linking the MEI label number to the new label) before being returned to MEI. Thus, MEI could not identify the cultures except through ribotyping.

For each of the 300 unknown *E. coli* tested, MEI assigned the same ribotype ID to each of the three copies of a given isolate. In other words, with repeated analysis, the method produced the same ribotype result each time; thus, precision of the method was judged to be 100 percent.

Accuracy was judged by the ability of the lab to assign the correct ribotype ID to the unknown cultures. MEI assigned the correct ID to 94 percent of the unknown cultures. It should be noted that in most cases where the ribotype ID was incorrectly identified, the source species identified was actually correct. These precision and accuracy rates met the accuracy and precision DQOs of the project, and indicate that the ribotyping method used is a highly precise and accurate method with sufficient power to resolved differences in source ribotypes.

Sampling Representativeness

It is difficult to quantitatively assess the representativeness of actual conditions by the sampling effort. The representativeness of sampling was affected by severe drought conditions, by an unexpected lack of runoff at some sites, by contamination and lab errors that caused a loss of data, and other factors.

The severe drought conditions caused the sampling effort to be extended over more than 2 years, including parts of three summer monsoon seasons, which probably increased the representativeness of the sampling effort compared to the shorter period planned.

The lack of runoff water reduced the sample collection at some sites, which increased the uncertainty in identifying the sources of fecal pollution at those sites. However, this was balanced by additional sample collection at other sites where water was more frequently available. Because the sites where sampling was increased tended to be those with larger drainage areas, representing large portions of the watershed, the representative of overall conditions in the MRG watershed may have been increased. Some data were lost due to contamination and errors. Contamination of field blanks caused invalidation of data for a few samples. Overall, the sampling effort adequately represented ambient conditions in the MRG watershed during the study period.

4.2 Fecal Coliform Levels in Water

An urban influence on levels of fecal coliform bacteria was observed in the Rio Grande under runoff conditions, with river reaches in Sandoval County often substantially lower than those in Bernalillo County (Table 4.2). The geometric mean fecal coliform levels in the Rio Grande increased from 341 at Angostura Diversion Dam to 4,610 at the Interstate 25 bridge south of Albuquerque, before declining at Isleta Diversion Dam. The North Diversion Channel, with a geometric mean of almost a 100,000 fecal coliform level under runoff conditions, may serve as the primary factor causing the increase in Rio Grande fecal coliform levels between the Angostura Diversion Dam and Isleta Diversion Dam.

Among the various arroyos and storm drains monitored, the highest levels of fecal coliform were typically found in the North Diversion Channel and several of the arroyos draining to it, including Hahn Arroyo, Embudo Arroyo, North Domingo Baca Arroyo, and to a lesser extent, the North Pino Arroyo. These arroyos drain some of the most populated portions of the watershed. Runoff from the North Diversion Channel drainage may explain the large increase in fecal coliform levels in the Rio Grande between Rio Rancho Utility #2 and the Alameda Bridge. Fecal coliform levels in the South Diversion Channel tended to be much lower than those in the North Diversion Channel under runoff conditions.

On the west bank of the Rio Grande, high fecal coliform levels in runoff were observed in San Antonio Arroyo and Amole del Norte Channel, although the number of samples was small. Isleta and Los Padillas Drains present an interesting contrast. Although they drain adjacent watersheds, the levels of fecal coliform in the Isleta Drain were on average an order of magnitude higher than those in Los Padillas Drain after rainfall. The factors responsible for this difference are difficult to discern. The Isleta Drain watershed has substantially less developed land and cropland as a fraction of total land area, and while the Isleta Drain watershed has a higher human population, its population density is actually less than that of Los Padillas Drain. The Isleta Drain also has a lower density of septic tanks and a higher percentage of households served by public sewer. One possible explanation for the higher fecal coliform levels in the Isleta Drain is that the return from a lateral irrigation ditch enters the Isleta Drain just above the sampling point.

Among the sites with four or more samples, a rank correlation test revealed that the geometric mean fecal coliform levels were strongly related to the human population density of the watershed (Spearman's rho=0.75, α=0.0001). Fecal coliform levels were inversely related to cropland density and household agricultural income, and not significantly related to septic tank density, indicating that agricultural sources and septic tank malfunctions may not be major sources of fecal coliform in runoff.

In dry weather, fecal coliform levels at all Rio Grande sites, as well as the North and South Diversion Channels, were typically low and met WQSs (Table 4.3). This is consistent with historical observations. Under base flow conditions, the Rio Grande sites exhibited a pattern of increasing fecal coliform levels with distance downstream, peaking at the Interstate 25 bridge, similar to that observed under runoff conditions. This may indicate that the sources of fecal coliform are similar in dry and wet weather, even though the magnitude is much different. Table 4.2 does not include fecal counts for site number 14, Bear Canyon Arroyo above High Desert Subdivision, and site 27, Adobe Acres Pump Station, because no ambient water quality data were collected at these sites as indicated in Table 4.1.

Table 4.2 Summary of Ambient Fecal Coliform Levels under Runoff Conditions

Site Number	Site Name	Number of Samples	Mininum[1]	Maximum[1]	Geometric Mean[1]
1	Rio Grande at Angostura Diversion Dam	10	27	36,000	341
2	Rio Grande at Highway US 550	7	45	29,000	354
3	Rio Grande above Rio Rancho Utility #3	7	54	34,000	657
4	Rio Grande above Rio Rancho Utility #2	6	63	1,820	362
5	Rio Grande at Alameda Bridge	9	45	38,000	1,630
6	Rio Grande at Rio Bravo Bridge	7	64	650,000	2,320
7	Rio Grande at I-25	8	490	360,000	4,610
8	Rio Grande at Isleta Diversion Dam	11	360	38,000	2,160
9	North Diversion Channel at Roy	9	2,800	1,040,000	95,900
10	North Domingo Baca Arroyo Dam at Primary Spillway	5	25,000	110,000	63,600
11	North Pino Arroyo above North Diversion Channel	11	631	>600,000	17,500
12	Hahn Arroyo above North Diversion Channel at Carlisle	9	1,080	530,000	97,500
13	Embudo Channel above confluence with	9	1,610	>600,000	76,300

Site Number	Site Name	Number of Samples	Mininum[1]	Maximum[1]	Geometric Mean[1]
	North Diversion Channel				
15	South Diversion Channel above Tijeras Arroyo	7	189	800,000	7,090
16	Sandia Pueblo Natural Arroyo at I-25	3	3,700	200,000	22,500
17	Paseo del Norte Pump Station	1	900	900	900
18	Alameda Drain at Ranchitos Road	7	851	51,000	5,470
19	Alameda Drain at El Caminito	7	712	36,000	8,180
20	Ranchitos de Albuquerque Storm Drain	4	1,710	80,000	18,000
21	Cabezon Channel	5	742	70,000	3,140
22	Calabacillas Arroyo at Swinburne Dam	2	270	60,000	4,020
23	Calabacillas Arroyo at Coors Road	4	200	800,000	18,400
24	Boca Negro Arroyo at Tesuque Road	1	7,270	7,270	7,270
25	San Antonio Arroyo at Rio Grande (Montano) Oxbow	3	3,000	200,000	39,100
26	Amole del Norte Channel above Amole Dam	2	20,000	80,000	40,000
28	Vita Romero Pump Station	1	2,600	2,600	2,600
29	Los Padillas Drain just upstream of the confluence with the Isleta Drain	8	36	2,600	253
30	Isleta Drain just upstream of the confluence with Los Padillas Drain	9	200	420,000	2,110
	Grand Total	172	27	1,040,000	4,970

[1] cfu/100 mL

Table 4.3 Summary of Ambient Fecal Coliform Levels under Non-Runoff Conditions

Station Number	Station Name	Number of Samples	Mininum[1]	Maximum[1]	Geometric Mean[1]
1	Rio Grande at Angostura Diversion Dam	4	<10	18	6
2	Rio Grande at Highway US 550	4	<10	63	7
3	Rio Grande above Rio Rancho Utility #3	4	<10	54	13
4	Rio Grande above Rio Rancho Utility #2	4	<10	27	12
5	Rio Grande at Alameda Bridge	4	9	36	20
6	Rio Grande at Rio Bravo Bridge	3	9	135	22
7	Rio Grande at I-25	3	189	684	412
8	Rio Grande at Isleta Diversion Dam	3	36	350	119
9	North Diversion Channel at Roy	3	63	712	296
15	South Diversion Channel above Tijeras Arroyo	2	18	90	40
	Grand Total	34	<10	712	28

[1] cfu/100 mL

4.2.1 *E. coli* Counts Relative to Fecal Coliform

Of the fecal coliform colonies collected during the study, on average 70 percent were positively identified as *E. coli*. For samples collected in runoff conditions, 65 percent of fecal coliform were identified as *E. coli*, while approximately 90 percent of the fecal coliform collected in dry weather were identified as *E. coli*.

4.2.2 Occurrence of Pathogenic Bacteria Strains

Forty-seven (2.9%) of the 1,635 *E. coli* isolated and purified from ambient water samples were hemolytic strains of *E. coli*. Hemolytic *E. coli* such as strain O157:H7, can cause serious illness in humans. These hemolytic *E. coli* were found in 29 water samples under runoff and non-runoff conditions from 15 sites, and thus generally were in low abundance compared to non-hemolytic strains in all samples. The ribotypes of these hemolytic bacteria indicated that 21 were resident in canine hosts, eight were from cats, seven were from human or sewage sources, five were avian-resident species, one each were from horse and rodent sources, and four were from unknown sources. As a percentage of *E. coli* by source, hemolytic *E. coli* were most abundant in canines (45%), cats (17%), humans (15%), and avian (11%). Only one hemolytic *E. coli* was observed in livestock-resident strains, and a few were also observed in wildlife-resident strains.

Nineteen *E. coli* bacteria from septage or sewage samples were also hemolytic, providing evidence of the hazard of human waste.

4.3 Identified Bacterial Sources Based on MST Technology

To interpret results of MST and summarize the fraction of fecal coliform in ambient water from specific sources, it is important to note that the relative weighting of individual water samples in the source summary are not equal. There are many reasons for this unequal weighting related to the sampling and analytical process. The primary reasons include:

- the number of water samples collected from each site was variable;
- the number of discrete fecal coliform colonies that could be harvested by MEI from a filter varied from 0 to more than 100;
- the fraction of fecal coliform colonies harvested from a filter that, upon purification and testing, were found not to be *E. coli* varied from 0 to 100 percent; and
- discretion of the laboratory staff. In some cases, fecal coliform plates were re-sampled to harvest additional colonies.

It is notable that the number of satisfactory ribotypes obtained from a single water sample ranged from 0 to 44. Thus, when reporting and interpreting the data, the reader must understand that when computing summary statistics regarding source identification, one sample may have far more influence on the results than another. Science can attempt to normalize the results to reduce this disparate influence, but because many factors control the sample influence, there are as many different possible ways to normalize. For this reason, Parsons provided the raw data in Appendix B to allow users to interpret data according to their needs.

4.3.1 Source Categories

The subjective grouping of ribotypes into source categories merits discussion. The categorization is based to some extent on the basis of biological similarity, but is also influenced by co-occurrence of species. For example, cattle and emu are not biologically similar, but these categories can be grouped as livestock that tend to occur on farms.

E. coli strains that have been observed in more than one source type are considered transient strains. Because they cannot be used to identify a source, the source of *E. coli* is identified as "unknown." *E. coli* isolated from water samples that do not match any *E. coli* in the known source library are also assigned to "unknown" sources.

When *E. coli* are observed in multiple species, but the species are closely related, they are not identified as transient strains, but the source category description is expanded. For example, strains that have been seen only in dogs and coyotes will be assigned to the category "canine," and strains observed in bison and cattle will be assigned to the category "bovine." There is a biological basis for this grouping, as the conditions in the gut of closely related species are expected to be similar, and gut conditions are believed to be one of the primary factors influencing which *E. coli* strains are abundant.

Resolution of the avian source to the species level does not appear practical with ribotyping at this time. The *E. coli* strains of the avian gut have been commonly found in many different bird species. However, some strains of *E. coli* are only seen in waterfowl. Thus, avian strains may be categorized as the more specific "waterfowl" or the less specific "avian," but no identification to species level can be made with confidence. As the size of the known source library grows, it is possible that more species-specific strains will be identified.

The category "human" is assigned to *E. coli* strains that have only been observed in human feces. Sewage, septage, and sewage sludge are assumed to consist primarily of human waste, but may also include fecal matter from other domestic and livestock species. When source categories are grouped into "supercategories," Parsons grouped sewage, septage, and sludge with human sources.

Dogs, cats, and other non-native, non-livestock animals are grouped into the supercategory "pets." All native wild mammals, including rodents, coyotes, deer, *etc*., are grouped into the supercategory "non-avian wildlife." When categories include both wild and domestic species, they are included in the respective domestic supercategory totals because it is believed the abundance of the domestic species typically exceeds that of the wild species. For example, *E. coli* from the "canine" source category, which includes strains found in both dogs, coyotes, and wolves, are included in the supercategory "pets" rather than "non-avian wildlife."

The total number of *E. coli* ribotypes and ARPs from ambient water samples was somewhat below the planned total overall (1920 isolates), and at many specific sites (Table 4.4). The high number of *E. coli* at some sites was due in part from a lack of water samples at many sites, to low sample fecal coliform concentrations at other sites (*e.g.*, Rio Grande at Angostura), and an abundance of non-*E. coli* fecal coliforms at other sites. The number of isolates typed will affect the uncertainty in source estimates. The uncertainty of the source estimate will be reported as a 95 percent confidence interval.

Table 4.4 Summary of Ribotype and Antibiotic Resistance Profiles

Station	Planned Ambient Isolates	Valid Ambient Isolates Typed	
		Ribotype	ARA
1. Rio Grande at Angostura Diversion Dam	120	41	44
2. Rio Grande at Highway US 550	60	67	79
3. Rio Grande above Rio Rancho Utility #3	60	82	91
4. Rio Grande above Rio Rancho Utility #2	60	89	93
5. Rio Grande at Alameda Bridge	60	119	130
6. Rio Grande at Rio Bravo Bridge	60	90	92
7. Rio Grande at I-25	60	152	167
8. Rio Grande at Isleta Diversion Dam	120	202	213
9. North Diversion Channel at Roy	60	106	109
10. North Domingo Baca Arroyo Dam at Primary Spillway	60	25	28
11. North Pino Arroyo above North Diversion Channel	60	58	59
12. Hahn Arroyo above North Diversion Channel at Carlisle	60	73	77
13. Embudo Channel above North Diversion Channel	60	75	79
14. Bear Canyon Arroyo above High Desert Subdivision	60	0	0
15. South Diversion Channel above Tijeras Arroyo	60	91	94
16. Sandia Pueblo Natural Arroyo at I-25	60	4	4
17. Paseo del Norte Pump Station	60	2	2
18. Alameda Drain at Ranchitos Road	60	56	45
19. Alameda Drain at El Caminito	60	36	41
20. Ranchitos de Albuquerque Storm Drain	60	7	24
21. Cabezon Channel	60	34	39
22. Calabacillas Arroyo at Swinburne Dam	60	19	21
23. Calabacillas Arroyo at Coors Road	60	23	23
24. Boca Negro Arroyo at Tesuque Road	60	0	0
25. San Antonio Arroyo at Rio Grande (Montano) Oxbow	60	0	0
26. Amole del Norte Channel above Amole Dam	60	24	24
27. Adobe Acres Pump Station	60	0	0
28. Vita Romero Pump Station	60	20	20
29. Los Padillas Drain just upstream of the Isleta Drain	60	79	86
30. Isleta Drain just upstream of the Los Padillas Drain	60	46	52
Grand Total	1920	1620	1736

4.3.2 Fecal Coliform Source Contribution Estimates Based on Ribotyping

In this section, fecal coliform source contributions are estimated for the watershed as a whole and for individual sampling sites with more than 10 *E. coli* as typed. There were seven sampling sites out of 30 that could not be evaluated for fecal coliform source contributions because they did not meet this threshold of having at least 10 *E. coli* isolates. Source contributions are calculated as the sum of isolates matching a particular source category or supercategory, divided by the total number of *E. coli* for which sources are identified. *E. coli* from unknown sources will not be included in the calculation because they may belong to any of the categories.

4.3.2.1 Middle Rio Grande Watershed as a Whole

Ribotype results indicate a variety of sources appear to contribute to the fecal coliform levels in the MRG watershed, as illustrated in Table 4.5 and Figure 4.5. Overall, the largest fraction of *E. coli* matched those found in avian sources, followed by canine, human/sewage, rodents, bovines, and equines. The source of approximately 9 percent of the *E. coli* could not be identified.

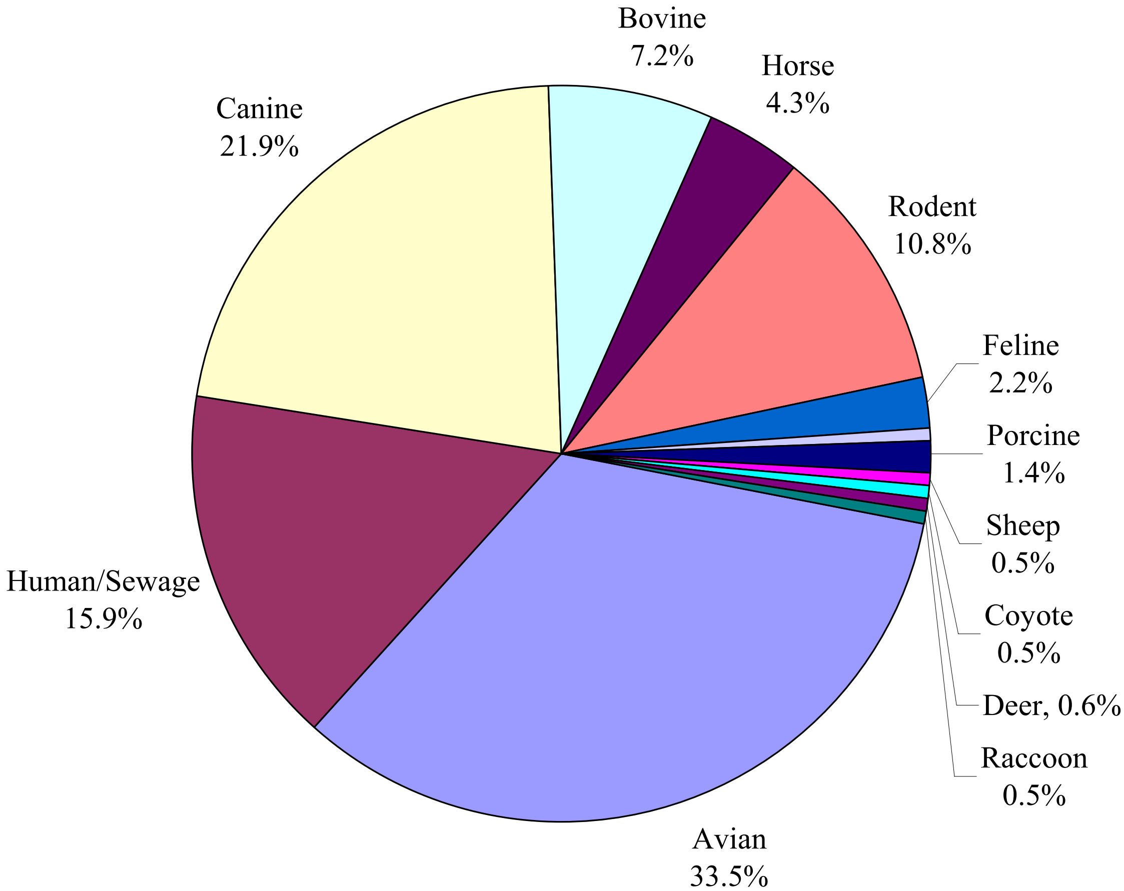
With the exception of rodents, only a few species of wild mammals were identified as sources of fecal coliform found in water: deer or elk, raccoon, coyote, bear, and opossum. It should be noted that an unknown fraction of the canine isolates may be from coyotes and foxes, as many *E. coli* strains are resident both in domestic dogs and wild canines.

Table 4.5 Fecal Source Estimate using Ribotyping for the Entire MRG Project Area

Category	Number of Isolates	% Source Contribution†	95% Confidence Interval
Human/ Sewage Subtotal	235	15.9 %	14.0 – 17.8 %
Bovine	106	7.2%	5.9 – 8.5 %
Equine	63	4.3%	3.3 – 5.3 %
Porcine	21	1.4%	0.8 – 2.0 %
Sheep	8	0.5%	0.1 – 0.9%
Goats	5	0.3%	0 – 0.6 %
Livestock Subtotal	203	13.7%	11.9 – 15.5 %
Avian Subtotal	496	33.5%	31.1 – 35.9 %
Canine	324	21.9%	19.8 – 24.0 %
Feline	33	2.2%	1.4 – 3.0 %
Canine & Feline Subtotal	357	24.1%	21.9 – 26.3 %
Rodent	164	10.8%	9.2 – 12.4 %
Deer & elk	9	0.6%	0.2 – 1.0 %
Coyote	7	0.5%	0.2 – 0.8 %
Raccoon	8	0.5%	0.1 – 0.9 %
Bear	1	0.1%	0 – 0.2%
Opossum	1	0.1%	0 – 0.2%
Non-Avian Wildlife Subtotal	190	12.8%	11.1 – 14.5 %
Unknown	139	8.6 %	7.2 – 9.9 %
Grand Total	1620		

† *Because the unknown isolates may have come from any of these categories, the 139 unknown isolates were ignored in calculating the % source contributions. In other words, the number of isolates of a source category were divided by the total isolates from all* identified *sources to calculate percentage source contributions*

Figure 4.5 Sources of *E. coli* in the Entire MRG Study Area Using Ribotyping



It should again be noted that the source apportionment in Table 4.5 is calculated from raw data, based on the number of *E. coli* isolates typed overall, including runoff and base flow samples. The unequal number of samples for each site and the number of isolates harvested from each sample may somewhat skew the results.

It is possible to normalize the results to attempt to remove the effect of the unequal isolate representation in the totals. One way to normalize the results involves weighting each isolate in the sum so each water sample has an equivalent weight in the source composition summaries. This is referred to as equal-sample weighting. One can additionally weight each isolate so that each site has an equivalent total weight of isolates contributing to the source composition summaries. This is referred to as equal-site weighting. The results of equal-sample and equal-site weighting are compared to the unweighted results in Table 4.6. It is apparent that equal-sample and equal-site weighting do not substantially change the source composition results. This is unexpected since the weights assigned to individual isolates differed by a factor of up to 50 for equal-sample weighting and up to 101 for equal-site weighting. The large number of samples collected and isolates characterized is one reason the weighting scheme does not greatly affect the results. Thus, even though some sites or samples are weighted very heavily relative to others, those samples still represent only a fraction of the total sample count. Another reason is that the sources were somewhat consistent among sites and dates. As a result of this comparison, the unweighted results will be discussed for the remainder of this report.

Table 4.6 Comparison of Unweighted and Weighted Source Composition Estimates

Category	Number of Isolates	Equal-Isolate (Unweighted) % Contribution	Equal-Sample Weighted % Contribution	Equal-Site Weighted % Contribution
Human/Sewage Subtotal	229	15.9 %	15.2 %	14.0 %
Bovine	102	7.2%	11.1 %	6.3 %
Equine	61	4.3%	4.7 %	3.2 %
Porcine	21	1.4%	1.2 %	0.9 %
Sheep	8	0.5%	0.7 %	0.4 %
Goats	5	0.3%	0.2 %	0.3 %
Livestock Subtotal	197	13.7%	17.9 %	11.1 %
Avian Subtotal	473	33.5%	31.1 %	30.5 %
Canine	317	21.9%	22.4 %	28.5 %
Feline	33	2.2%	2.1 %	2.6 %
Canine & Feline Subtotal	350	24.1%	24.5 %	31.1 %
Rodent	155	10.8%	9.3 %	11.7 %
Deer & Elk	9	0.6%	0.7 %	0.5 %
Coyote	7	0.5%	0.2 %	0.3 %
Raccoon	8	0.5%	1.1 %	0.7 %
Bear	1	0.1%	0.03 %	0.02 %
Opossum	1	0.1%	0.03 %	0.04 %
Non-Avian Wildlife Subtotal	185	12.8%	11.4 %	13.3 %

Parsons also examined fecal sources under runoff influences and non-runoff, base flow conditions. As demonstrated in Table 4.7, it is apparent that the major sources are found under both conditions. The only differences in source contributions that were significantly different at the 95 percent confidence level were for the categories "canine" and "unknown." Canines comprised a substantially smaller portion of the total sources under base flow conditions. *E. coli* from unknown sources were found to a greater extent under runoff conditions. Birds and human/sewage sources comprised a larger proportion of the total *E. coli* under base flow conditions, though the difference was not statistically significant. Further comparisons of sources under runoff and non-runoff conditions are provided for individual sites where 20 or more *E. coli* were typed from non-runoff water samples.

Table 4.7 Comparison of Sources under Runoff vs. Non-Runoff Conditions

Category	Runoff			Non-Runoff		
	Number of Isolates	% Contribution	95% Confidence Interval	Number of Isolates	% Contribution	95% Confidence Interval
Human/Sewage Subtotal	186	15.5 %	13.5–17.4 %	43	18.5 %	13.6–23.5 %
Bovine	86	7.2 %	5.8 – 8.5 %	16	6.9 %	3.7 – 10.1 %
Equine	53	4.4 %	3.3 – 5.5 %	8	3.4 %	1.1 – 5.8 %
Porcine	14	1.2 %	0.6 – 1.7 %	7	3.0 %	0.9 – 5.2 %
Sheep	7	0.6 %	0.2 – 1.0 %	1	0.4 %	0 – 1.3 %
Goats	5	0.4 %	0.1 – 0.8 %	0	0.0 %	0 – <1.3 %
Livestock Subtotal	165	13.7 %	11.9– 5.6 %	32	13.8 %	9.4 – 18.2 %
Avian Subtotal	383	31.9 %	29.4–34.4 %	90	38.8 %	32.6–45.0 %
Canine	286	23.8 %	21.5–26.1 %	31	13.4 %	9.1 – 17.7 %
Feline	25	2.1 %	1.3 – 2.8 %	8	3.4 %	1.1 – 5.8 %
Canine & Feline Subtotal	311	25.9 %	23.5–28.2 %	39	16.8 %	12.1–21.5 %
Rodent	130	10.8 %	9.0 – 12.6 %	25	10.8 %	6.9 – 14.7 %
Rabbit	4	0.3 %	0 – 0.6 %	0	0%	0 – <1.3 %
Deer & Elk	6	0.5 %	0.1 – 0.9 %	3	1.3 %	0 – 2.7 %
Coyote	7	0.6 %	0.2 – 1.0 %	0	0.0 %	0 – <1.3 %
Raccoon	8	0.7 %	0.2 – 1.1 %	0	0.0 %	0 – <1.3 %
Bear	1	0.1 %	0 – 0.2 %	0	0.0 %	0 – <1.3 %
Opossum	1	0.1 %	0 – 0.2 %	0	0.0 %	0 – <1.3 %
Non-Avian Wildlife Subtotal	157	13.1 %	11.2–14.9 %	28	12.1 %	7.9 – 16.2 %
Unknown	121	9.1 %	7.6 - 10.7 %	8	3.3 %	1.1 – 5.6 %
Total	1323			232		

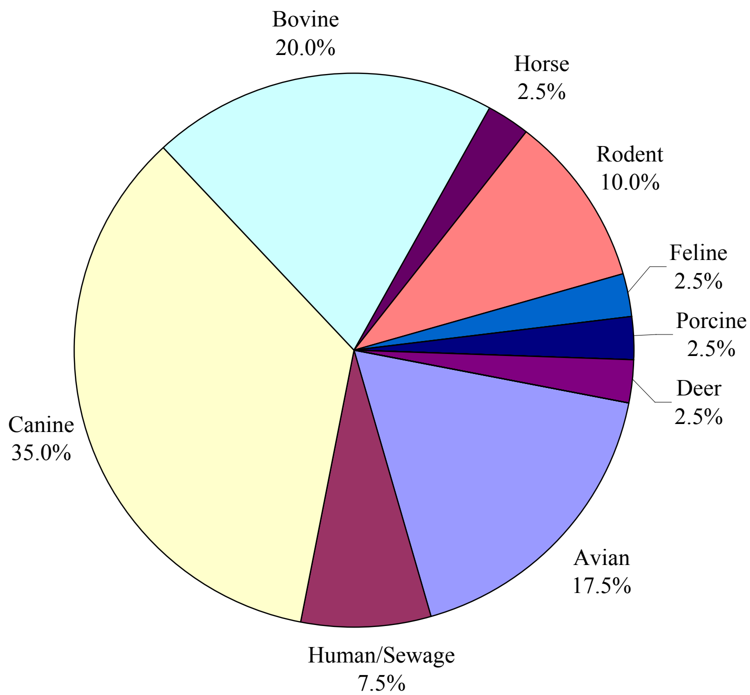
4.3.2.2 Rio Grande at Angostura Diversion Dam

The largest sources of fecal coliform at this site were canines - dogs, coyotes, and/or foxes. Cattle and birds were also major sources.

Table 4.8 Fecal Source Estimate for the Rio Grande at Angostura Diversion Dam

Category	Number of Isolates	% Source Contribution	95% Confidence Limits
Human/ Sewage Subtotal	3	7.5 %	0 – 15.7 %
Bovine	8	20.0 %	7.6 – 32.4 %
Equine	1	2.5 %	0 – 7.3 %
Porcine	1	2.5 %	0 – 7.3 %
Livestock Subtotal	10	25 %	11.6 – 38.4 %
Avian Subtotal	7	17.5 %	5.7 – 29.3 %
Canine	14	35%	20.2 – 49.8 %
Feline	1	2.5 %	0 – 7.3 %
Canine & Feline Subtotal	15	37.5 %	22.5 – 52.5 %
Rodent	4	10 %	0.7 – 19.3 %
Deer & elk	1	2.5 %	0 – 7.3 %
Non-Avian Wildlife Subtotal	5	12.5 %	2.3 – 22.7 %
Unknown	1	2.4 %	
Grand Total	41		

Figure 4.6 Sources of *E. coli* at Rio Grande at Angostura Diversion Dam



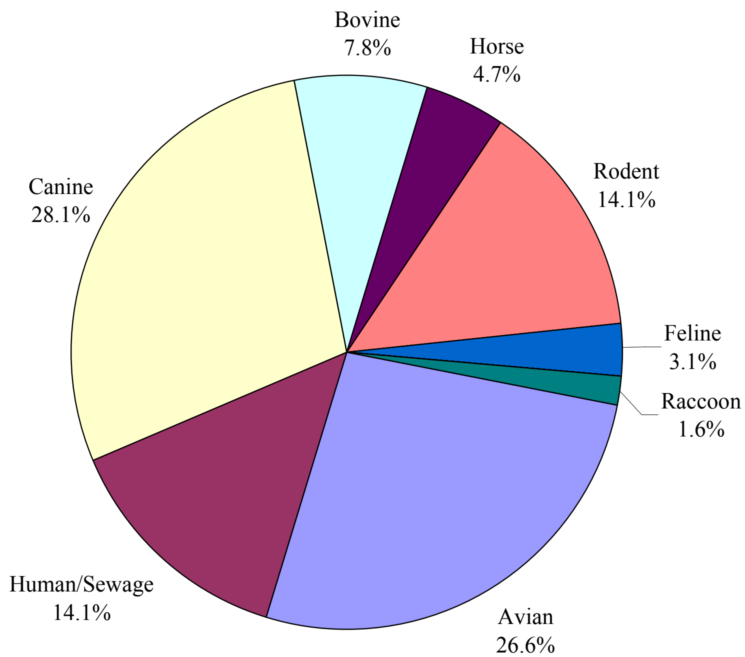
4.3.2.3 Rio Grande at Highway US 550

Canines and birds represented the largest source of fecal coliform at this site.

Table 4.9 Fecal Source Estimate for the Rio Grande at Highway US 550

Category	Number of Isolates	% Source Contribution	95% Confidence Limits
Human/ Sewage Subtotal	9	14.1 %	5.6 – 22.6 %
Bovine	5	7.8 %	1.2 – 14.4 %
Equine	3	4.7 %	0 – 9.9 %
Livestock Subtotal	8	12.5 %	4.4 – 20.6 %
Avian Subtotal	17	26.6 %	15.8 – 37.4 %
Canines	18	28.1 %	17.1 – 39.1 %
Feline	2	3.1 %	0 – 7.4 %
Canine & Feline Subtotal	20	31.3 %	19.9 – 42.7 %
Rodent	9	14.1 %	5.6 – 22.6 %
Raccoon	1	1.6 %	0 – 4.6 %
Non-Avian Wildlife Subtotal	10	15.6 %	6.7 – 24.5 %
Unknown	3		
Grand Total	67		

Figure 4.7 Sources of *E. coli* at Rio Grande at Highway US 550



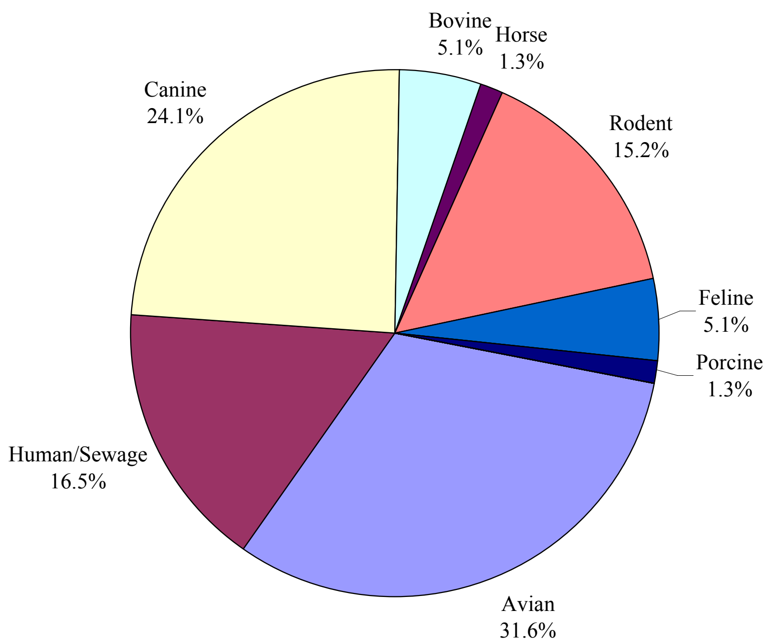
4.3.2.4 Rio Grande above Rio Rancho Utility #3

Birds and canines again represented the largest source of fecal coliform at this site.

Table 4.10 Fecal Source Estimate for the Rio Grande above Rio Rancho Utility #3

Category	Number of Isolates	% Source Contribution	95% Confidence Limits
Human/ Sewage Subtotal	13	16.5 %	8.3 – 24.7 %
Bovine	4	5.1 %	0.9 – 9.3 %
Equine	1	1.3 %	0 – 3.8 %
Porcine	1	1.3 %	0 – 3.8 %
Livestock Subtotal	6	7.6 %	1.8 – 13.4 %
Avian Subtotal	25	31.6 %	21.3 – 41.9 %
Canines	19	24.1 %	14.6 – 33.5 %
Feline	4	5.1 %	0.3 – 9.9 %
Canine & Feline Subtotal	23	29.2 %	19.2 – 39.2 %
Rodent	12	15.2 %	7.3 – 23.1 %
Non-Avian Wildlife Subtotal	12	15.2 %	7.3 – 23.1 %
Unknown	3		
Grand Total	82		

Figure 4.8 Sources of *E. coli* at Rio Grande above Rio Rancho Utility #3



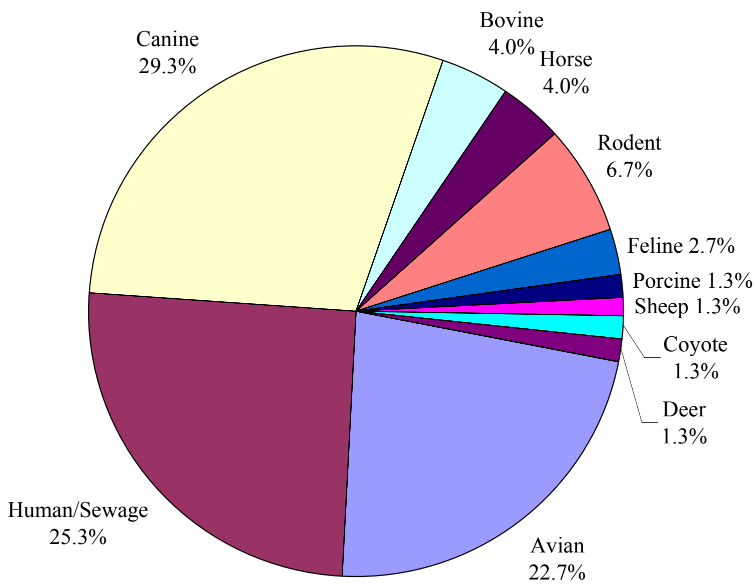
4.3.2.5 Rio Grande above Rio Rancho Utility #2

There was a significant increase in fecal coliform at this site from human/sewage sources; however, canine species again were the largest source of fecal coliform contribution.

Table 4.11 Fecal Source Estimate for the Rio Grande above Rio Rancho Utility #2

Category	Number of Isolates	% Source Contribution	95% Confidence Limits
Human/ Sewage Subtotal	19	25.3 %	15.5 – 35.1 %
Bovine	3	4.0 %	0- 8.4 %
Equine	3	4.0 %	0- 8.4 %
Porcine	1	1.3 %	0 – 3.8 %
Sheep	1	1.3 %	0 – 3.8 %
Livestock Subtotal	8	10.7 %	3.7 – 17.7 %
Avian Subtotal	17	22.7 %	13.2 – 32.2 %
Canines	22	29.3 %	19.0 – 39.6 %
Feline	2	2.7 %	0 – 6.3 %
Canine & Feline Subtotal	24	32.0 %	21.4 – 42.6 %
Rodent	5	5.3 %	0.2 – 10.5 %
Deer & elk	1	1.3 %	0 – 3.8 %
Coyote	1	1.3 %	0 – 3.8 %
Non-Avian Wildlife Subtotal	7	9.3 %	2.7 – 15.9 %
Unknown	14		
Grand Total	89		

Figure 4.9 Sources of *E. coli* at Rio Grande above Rio Rancho Utility #2



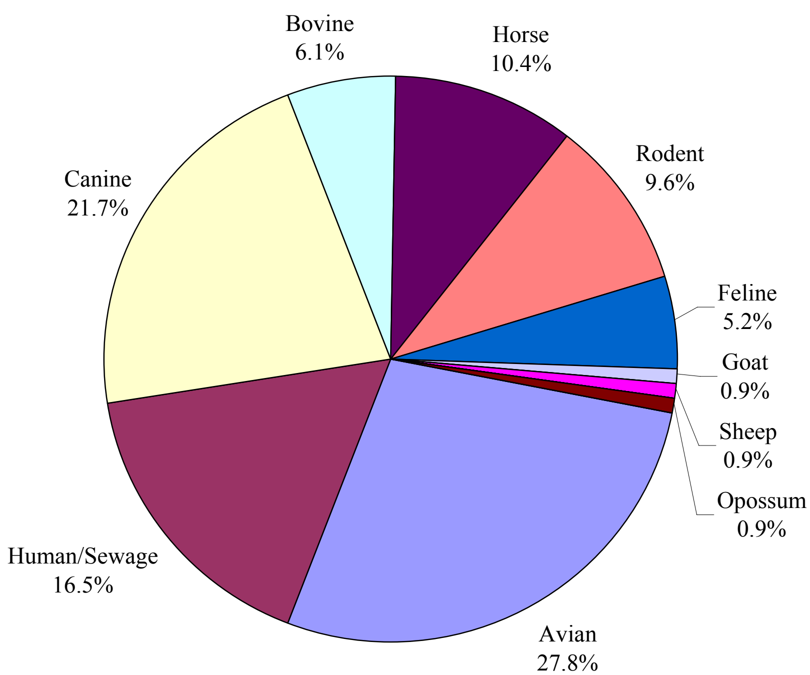
4.3.2.6 Rio Grande at Alameda Bridge

Birds and canines again represented the largest source of fecal coliform at this site.

Table 4.12 Fecal Source Estimate for the Rio Grande at Alameda Bridge

Category	Number of Isolates	% Source Contribution	95% Confidence Limits
Human/ Sewage Subtotal	19	16.5 %	9.7 – 25.3 %
Bovine	7	6.1 %	2.0 – 10.2 %
Equine	12	10.4 %	4.8 – 16.0 %
Sheep	1	0.9 %	0 – 2.6 %
Goats	1	0.9 %	0 – 2.6 %
Livestock Subtotal	21	18.3 %	11.2 – 25.4 %
Avian Subtotal	32	27.8 %	19.6 – 36.0 %
Canines	25	21.7 %	14.2 – 29.2 %
Feline	6	5.2 %	1.1 – 9.3 %
Canine & Feline Subtotal	31	27.0 %	18.9 – 36.1 %
Rodent	11	9.6 %	4.2 – 15.0 %
Opossum	1	0.9 %	0 – 2.6 %
Non-Avian Wildlife Subtotal	12	10.4 %	4.8 – 16.0 %
Unknown	4		
Grand Total	119		

Figure 4.10 Sources of *E. coli* at Rio Grande at Alameda Bridge



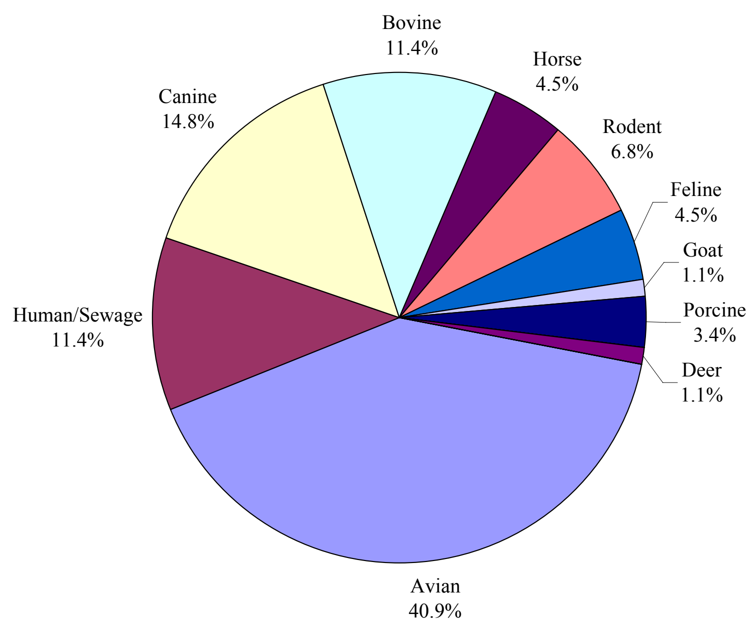
4.3.2.7 Rio Grande at Rio Bravo Bridge

Birds and livestock were the major sources identified at this site.

Table 4.13 Fecal Source Estimate for the Rio Grande at Rio Bravo Bridge

Category	Number of Isolates	% Source Contribution	95% Confidence Limits
Human/ Sewage Subtotal	10	11.4 %	4.8 - 18.0 %
Bovine	10	11.4 %	4.8 - 18.0 %
Equine	4	4.5 %	0.1 - 9.9 %
Porcine	3	3.4 %	0 - 7.2 %
Goats	1	1.1 %	0 - 3.3 %
Livestock Subtotal	18	20.5 %	12.1 - 28.9 %
Avian Subtotal	36	40.9 %	30.6 - 51.2 %
Canines	13	14.8 %	7.4 - 22.2 %
Feline	4	4.5 %	0.1 - 9.9 %
Canine & Feline Subtotal	17	19.3 %	11.1 - 27.5 %
Rodent	6	6.8 %	1.5 - 12.1 %
Deer & elk	1	1.1 %	0 - 3.3 %
Non-Avian Wildlife Subtotal	7	8.0 %	2.3 - 13.7 %
Unknown	2		
Grand Total	90		

Figure 4.11 Sources of *E. coli* at Rio Grande at Rio Bravo Bridge



4.3.2.8 Rio Grande at the Interstate 25 Bridge

Birds and human/sewage were the major sources of fecal coliform identified at this site. Birds were a more significant source under non-runoff conditions than under runoff conditions.

Table 4.14 Fecal Source Estimate for the Rio Grande at the Interstate 25 Bridge

Category	Number of Isolates	% Source Contribution	95% Confidence Limits
Human/ Sewage Subtotal	29	19.5 %	13.1 - 25.9 %
Bovine	14	9.4 %	4.7 - 14.1 %
Equine	7	4.7 %	1.3 - 8.1 %
Porcine	4	2.7 %	0.1 - 6.3 %
Sheep	1	0.7 %	0 - 2.0 %
Livestock Subtotal	26	17.4 %	11.3 - 23.5 %
Avian Subtotal	53	35.6 %	27.9 - 43.3 %
Canine	21	14.1 %	8.5 - 19.7 %
Feline	5	3.4 %	0.5 - 6.3 %
Canine & Feline Subtotal	26	17.4 %	11.3 - 23.5 %
Rodent	12	8.1 %	3.7 - 12.5 %
Deer & elk	2	1.3 %	0 - 3.1 %
Coyote	1	0.7 %	0 - 2.0 %
Non-Avian Wildlife Subtotal	15	10.1 %	5.3 - 14.9 %
Unknown	3		
Grand Total	152		

Figure 4.12 Sources of *E. coli* at Rio Grande at I-25

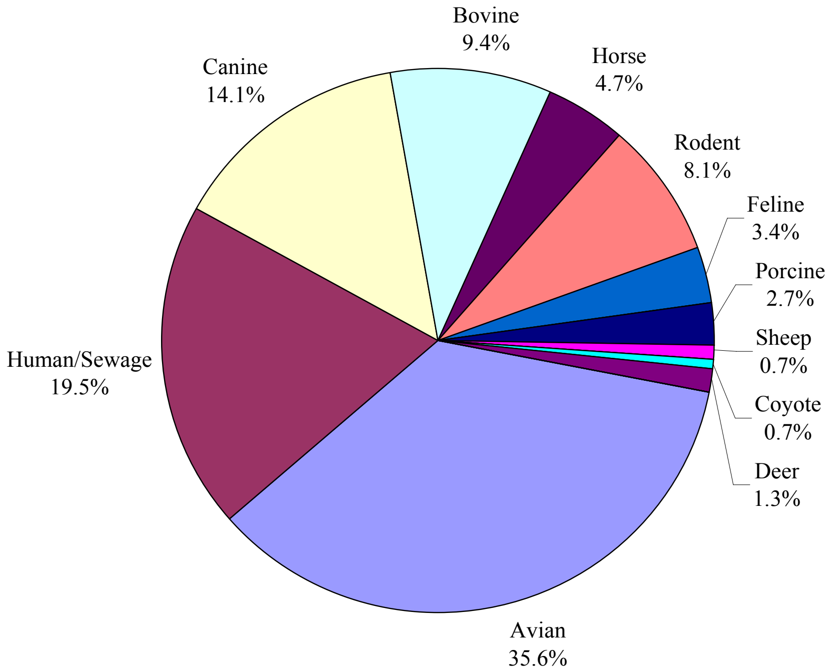


Table 4.15 Comparison of *E. coli* Sources in the Rio Grande at Interstate 25 under Runoff and Non-Runoff Conditions

Category	Runoff % Contribution	Runoff 95% Confidence Interval	Non-Runoff % Contribution	Non-Runoff 95% Confidence Interval
Human/Sewage Subtotal	22.7 %	13.3 – 32.0 %	16.2 %	7.9 – 24.6 %
Bovine	10.7 %	3.8 – 17.6 %	8.1 %	0 – 14.3 %
Equine	6.7 %	1.1 – 12.2 %	2.7 %	0 – 6.4 %
Porcine	4.0 %	0 – 8.4 %	1.4 %	0 – 4.0 %
Sheep	1.3 %	0 – 3.9 %	0 %	0 – <4.0 %
Livestock Subtotal	22.7 %	13.3 – 32.0 %	12.2 %	4.8 – 19.6 %
Avian Subtotal	25.3 %	15.6 – 35.0 %	45.9 %	34.7 – 57.2 %
Canine	17.3 %	8.9 – 25.8 %	**10.8 %**	3.8 – 17.8 %
Feline	2.7 %	0 – 6.3 %	4.1 %	0 – 8.5 %
Canine & Feline Subtotal	20.0 %	11.1 – 28.9 %	14.9 %	6.8 – 22.9 %
Rodent	6.7 %	1.1 – 12.2 %	9.5 %	2.8 – 16.1 %
Deer & Elk	1.3 %	0 – 3.9 %	1.4 %	0 – <4.0 %
Coyote	1.3 %	0 – 3.9 %	0 %	0 – <4.0 %
Non-Avian Wildlife Subtotal	9.3 %	2.8 – 15.8 %	10.8%	3.8 – 17.8 %
Unknown	2.6 %		1.3 %	

4.3.2.9 Rio Grande at Isleta Diversion Dam

Birds and livestock were the major fecal coliform sources identified in this watershed. *E. coli* from hogs and pigs were observed to a much greater extent in non-runoff, baseflow sampling, but overall they were a minor source.

Table 4.16 Fecal Source Estimate for the Rio Grande at Isleta Diversion Dam

Category	Number of Isolates	% Source Contribution	95% Confidence Limits
Human/ Sewage Subtotal	21	11.2 %	6.7 - 15.7 %
Bovine	17	9.1 %	5.0 - 13.2 %
Equine	13	7.0 %	3.4 - 10.6 %
Porcine	6	3.2 %	0.7 - 5.9 %
Sheep	1	0.5 %	0 - 1.5 %
Livestock Subtotal	37	19.8 %	14.1 - 25.5 %
Avian Subtotal	81	43.3 %	36.2 - 50.4 %
Canines	24	12.8 %	8.0 - 17.6 %
Feline	1	0.5 %	0 - 1.5 %
Canine & Feline Subtotal	25	13.4 %	8.5 - 18.3 %
Rodent	20	10.7 %	6.3 - 15.1 %
Deer & elk	1	0.5 %	0 - 1.5 %
Raccoon	1	0.5 %	0 - 1.5 %
Bear	1	0.5 %	0 - 1.5 %
Non-Avian Wildlife Subtotal	23	12.3 %	7.6 - 17.0 %
Unknown	15		
Grand Total	202		

Figure 4.13 Sources of *E. coli* in the Rio Grande at Isleta Diversion Dam

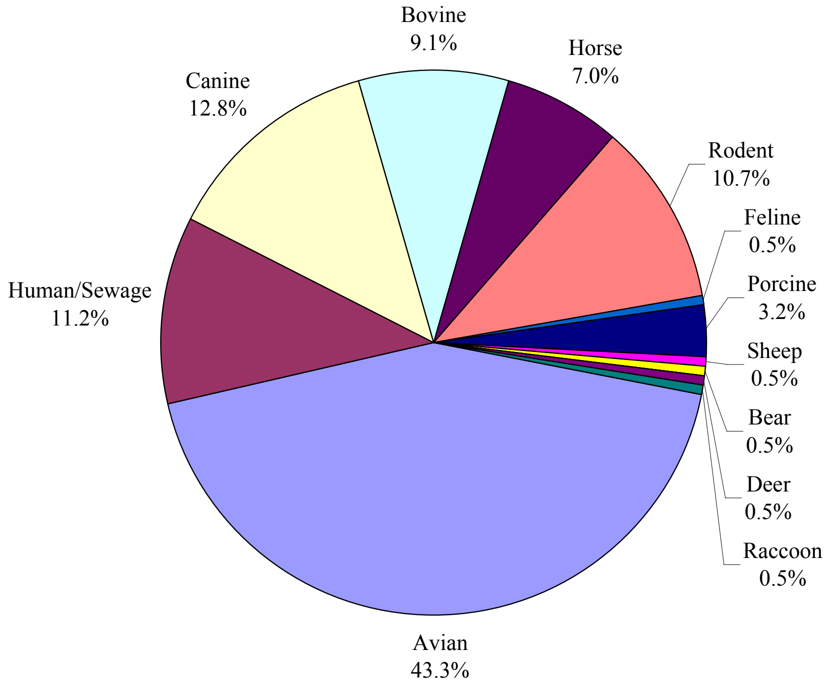


Table 4.17 Comparison of E. coli Sources in the Rio Grande at Isleta Diversion Dam under Runoff and Non-Runoff Conditions

Category	Runoff % Contribution	Runoff 95% Confidence Interval	Non-Runoff % Contribution	Non-Runoff 95% Confidence Interval
Human/Sewage Subtotal	12.4 %	6.6 – 18.1 %	14.6 %	3.8 – 25.5 %
Bovine	8.8 %	3.9 – 13.8 %	12.2 %	2.2 – 22.2 %
Equine	7.1 %	2.6 – 11.6 %	7.3 %	0 – 15.3 %
Porcine	0.9 %	0 – 2.5 %	12.2 %	2.2 – 22.2 %
Sheep	0.9 %	0 – 2.5 %	0 %	0 - <7.2 %
Livestock Subtotal	17.7 %	11.0 – 24.4 %	31.7 %	17.5 – 46.0 %
Avian Subtotal	41.6 %	33.0 – 50.2 %	41.5 %	26.4 – 56.5 %
Canine	13.3 %	7.3 – 19.2 %	7.3 %	0 – 15.3 %
Feline	0.9 %	0 – 2.5 %	0 %	0 - <7.2 %
Canine & Feline Subtotal	14.2 %	8.1 – 20.2 %	7.3 %	0 – 15.3 %
Rodent	11.5 %	5.9 – 17.1 %	4.9 %	0 – 11.5 %
Deer & Elk	0.9 %	0 – 2.5 %	0 %	0 - <7.2 %
Raccoon	0.9 %	0 – 2.5 %	0 %	0 - <7.2 %
Bear	0.9 %	0 – 2.5 %	0 %	0 - <7.2 %
Non-Avian Wildlife Subtotal	14.2 %	8.1 – 20.2 %	4.9 %	0 – 11.5 %
Unknown	10.3 %	5.0 – 15.6 %	0 %	0 - <7.2 %

4.3.2.10 North Diversion Channel at Roy

The major sources of fecal coliform at this site included birds, humans, canines, and rodents. Livestock sources comprised a greater portion of the *E. coli* tested under runoff conditions than base flow conditions, whereas birds were a more substantial source under base flow conditions, but the differences were not statistically significant at the 95 percent confidence level.

Table 4.18 Fecal Source Estimate for the North Diversion Channel at Roy

Category	Number of Isolates	% Source Contribution	95% Confidence Limits
Human/ Sewage Subtotal	23	23.7 %	15.2 - 32.2 %
Equine	5	5.2 %	0.8 - 9.6 %
Porcine	3	3.1 %	0 - 6.5 %
Livestock Subtotal	8	8.2 %	2.7 - 13.7 %
Avian Subtotal	25	25.8 %	17.1 - 34.5 %
Canines	22	22.7 %	14.4 - 31.0 %
Canine & Feline Subtotal	22	22.7 %	14.4 - 31.0 %
Rodent	17	17.6 %	10.0 - 25.2 %
Deer & Elk	1	1.0 %	0 - 3.0 %
Coyote	1	1.0 %	0 - 3.0 %
Non-Avian Wildlife Subtotal	19	19.6 %	11.7 - 27.5 %
Unknown	9		
Grand Total	106		

Figure 4.14 Sources of *E. coli* in the North Diversion Channel at Roy

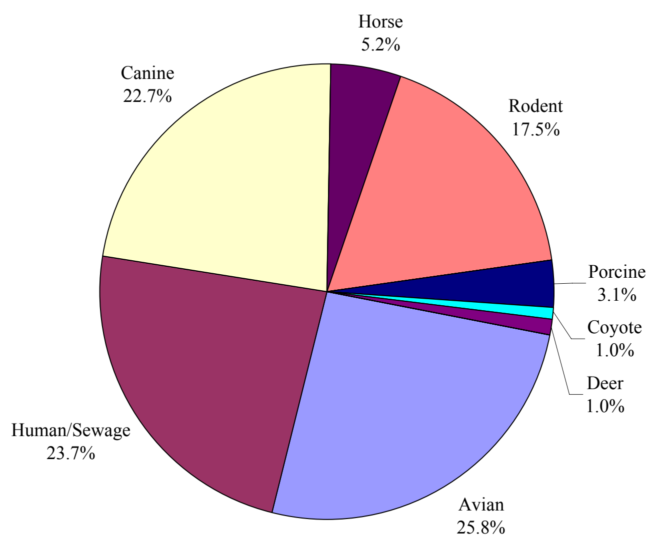


Table 4.19 Comparison of *E. coli* Sources at the North Diversion Channel under Runoff and Non-Runoff Conditions

Category	Runoff % Contribution	Runoff 95% Confidence Interval	Non-Runoff % Contribution	Non-Runoff 95% Confidence Interval
Human/Sewage Subtotal	20.8 %	9.9 – 31.8 %	26.5 %	14.6 – 38.4 %
Equine	8.3 %	0.9 – 15.8 %	2.0 %	0 – 5.8 %
Porcine	6.3 %	0 – 12.8 %	0	0 – <5.8 %
Livestock Subtotal	14.6 %	5.1 - 24.1 %	2.0 %	0 – 5.8 %
Avian Subtotal	18.8 %	8.2 – 29.3 %	32.7 %	20.0 – 45.3 %
Canine	20.8 %	9.9 – 31.8 %	24.5 %	12.9 – 36.1 %
Canine & Feline Subtotal	20.8 %	9.9 – 31.8 %	24.5 %	12.9 – 36.1 %
Rodent	20.8 %	9.9 – 31.8 %	14.3 %	4.9 – 23.7 %
Deer & Elk	1.9 %	0 – 5.9 %	0	0 – <5.8 %
Coyote	1.9 %	0 – 5.9 %	0	0 – <5.8 %
Non-Avian Wildlife Subtotal	25.0 %	13.3 - 36.7 %	14.3 %	4.9 – 23.7 %
Unknown	9.4 %		7.5 %	

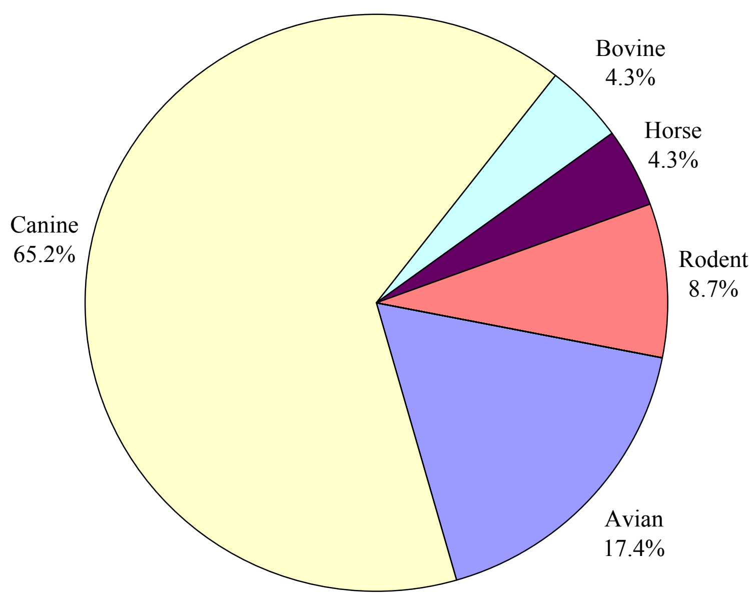
4.3.2.11 North Domingo Baca Arroyo Dam at Primary Spillway

Canines were the major source of fecal coliform isolated from this site.

Table 4.20 Fecal Source Estimate for North Domingo Baca Arroyo Dam at Primary Spillway

Category	Number of Isolates	% Source Contribution	95% Confidence Limits
Human/ Sewage Subtotal	0	0 %	
Bovine	1	4.3 %	0 - 12.6 %
Equine	1	4.3 %	0 - 12.6 %
Livestock Subtotal	2	8.7 %	0 - 20.2 %
Avian Subtotal	4	17.4 %	1.9 - 32.9 %
Canine	15	65.2 %	45.7 - 84.7 %
Canine & Feline Subtotal	15	65.2 %	45.7 - 84.7 %
Rodent	2	8.7 %	0 - 20.2 %
Non-Avian Wildlife Subtotal	2	8.7 %	0 - 20.2 %
Unknown	2		
Grand Total	25		

Figure 4.15 Sources of *E. coli* in North Domingo Baca Arroyo Dam at Primary Spillway



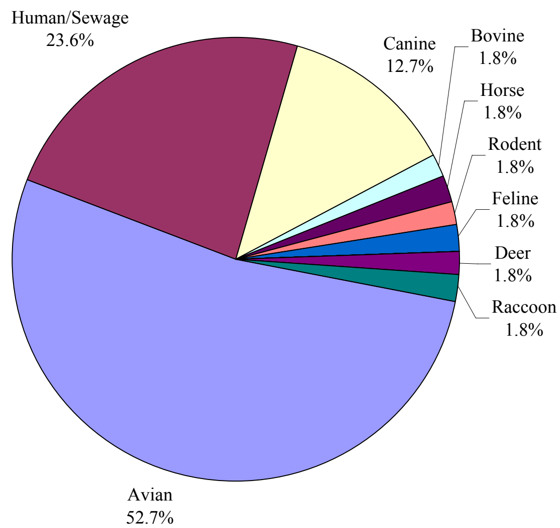
4.3.2.12 North Pino Arroyo above North Diversion Channel

Birds and humans/sewage were the major sources of fecal coliform at this site.

Table 4.21 Fecal Source Estimate for North Pino Arroyo above North Diversion Channel

Category	Number of Isolates	% Source Contribution	95% Confidence Limits
Human/ Sewage Subtotal	13	23.6 %	12.4 - 34.8 %
Bovine	1	1.8 %	0 - 5.3 %
Horses	1	1.8 %	0 - 5.3 %
Livestock Subtotal	2	3.6 %	0 - 8.1 %
Avian Subtotal	29	52.7 %	39.5 - 65.9 %
Canines	7	12.7 %	3.9 - 21.5 %
Feline	1	1.8 %	0 - 5.3 %
Canine & Feline Subtotal	8	14.5 %	5.2 - 23.8 %
Rodent	1	1.8 %	0 - 5.3 %
Deer & elk	1	1.8 %	0 - 5.3 %
Raccoon	1	1.8 %	0 - 5.3 %
Non-Avian Wildlife Subtotal	3	5.4 %	0 - 11.4 %
Unknown	3		
Grand Total	58		

Figure 4.16 Sources of E. coli to North Pino Arroyo above North Diversion Channel



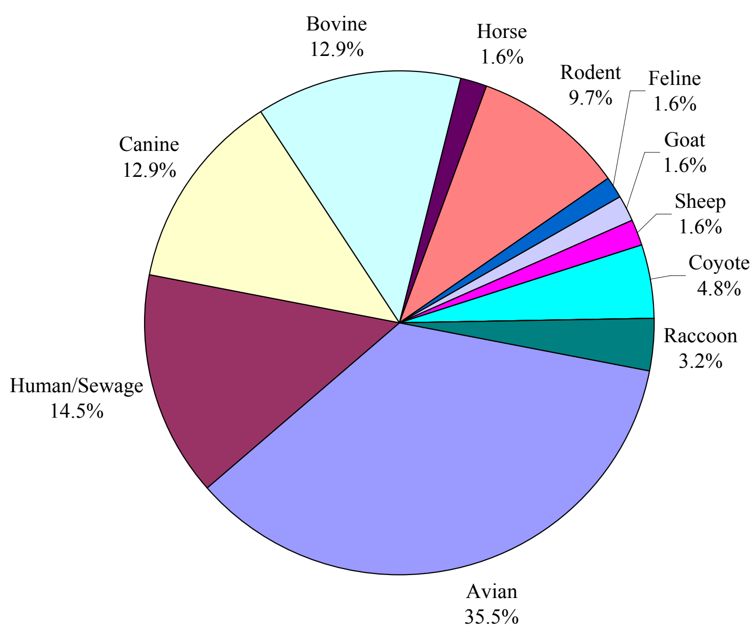
4.3.2.13 Hahn Arroyo above North Diversion Channel

Birds were the major source of fecal coliform at this site. The presence of bovine sources was somewhat surprising in this urban watershed. It may be due to manure spread in gardens. Four of the eight samples matched to bovine feces originated in a single water sample. The sources of 11 *E. coli* were unknown.

Table 4.22 Fecal Source Estimate for Hahn Arroyo above North Diversion Channel

Category	Number of Isolates	% Source Contribution	95% Confidence Limits
Human/ Sewage Subtotal	9	14.5 %	5.7 - 23.3 %
Equine	8	12.9 %	4.6 - 21.2 %
Horses	1	1.6 %	0 - 4.7 %
Sheep	1	1.6 %	0 - 4.7 %
Goats	1	1.6 %	0 - 4.7 %
Livestock Subtotal	11	17.7 %	8.2 - 26.2 %
Avian Subtotal	22	35.5 %	23.6 - 47.4 %
Canines	8	12.9 %	4.6 - 21.2 %
Feline	1	1.6 %	0 - 4.7 %
Canine & Feline Subtotal	9	14.5 %	5.7 - 23.3 %
Rodent	6	9.7 %	2.3 - 17.1 %
Coyote	3	4.8 %	0 - 10.1 %
Raccoon	2	3.2 %	0 - 7.6 %
Non-Avian Wildlife Subtotal	11	17.7 %	8.2 - 26.2 %
Unknown	11		
Grand Total	73		

Figure 4.17 Sources of *E. coli* to Hahn Arroyo above North Diversion Channel



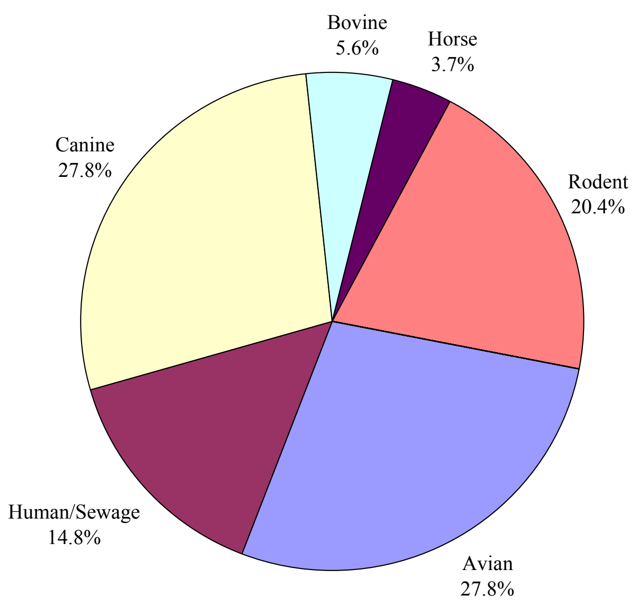
4.3.2.14 Embudo Channel above Confluence with North Diversion Channel

Birds, canines, and rodents were the major sources of fecal coliform at this site.

Table 4.23 Fecal Source Estimate for the Embudo Channel above the North Diversion Channel

Category	Number of Isolates	% Source Contribution	95% Confidence Limits
Human/ Sewage Subtotal	8	14.8 %	5.3 - 24.3 %
Bovine	3	5.6 %	0 - 11.7 %
Equine	2	3.7 %	0 - 8.7 %
Livestock Subtotal	5	9.3 %	1.6 - 17.0 %
Avian Subtotal	15	27.8 %	15.9 - 39.7 %
Canines	15	27.8 %	15.9 - 39.7 %
Canine & Feline Subtotal	15	27.8 %	15.9 - 39.7 %
Rodent	11	20.4 %	9.7 - 31.1 %
Non-Avian Wildlife Subtotal	11	20.4 %	9.7 - 31.1 %
Unknown	21		
Grand Total	75		

Figure 4.18 Sources of *E. coli* to the Embudo Channel above the North Diversion Channel



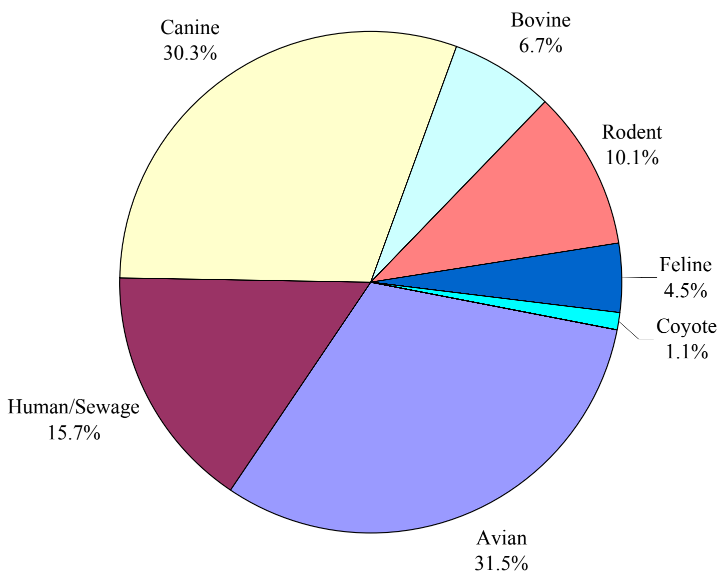
4.3.2.15 South Diversion Channel above Tijeras Arroyo

Birds and canines were the major sources at this site.

Table 4.24 Fecal Source Estimate for the South Diversion Channel above Tijeras Arroyo

Category	Number of Isolates	% Source Contribution	95% Confidence Limits
Human/ Sewage Subtotal	14	15.7 %	8.1 - 23.3 %
Bovine	6	6.7 %	1.5 - 11.9 %
Livestock Subtotal	6	6.7 %	1.5 - 11.9 %
Avian Subtotal	28	31.5 %	21.9 - 41.1 %
Canines	27	30.3 %	20.7 - 39.9 %
Feline	4	4.5 %	0.2 - 8.8 %
Canine & Feline Subtotal	31	34.8 %	24.9 - 44.7 %
Rodent	9	10.1 %	3.8 - 16.4 %
Coyote	1	1.1 %	0 - 3.3 %
Non-Avian Wildlife Subtotal	10	11.2 %	4.6 - 17.8 %
Unknown	2		
Grand Total	91		

Figure 4.19 Sources of *E. coli* to the South Diversion Channel above Tijeras Arroyo



4.3.2.16 Sandia Natural Arroyo at I-25

Only four *E. coli* collected at this site were ribotyped. Therefore, the source contributions cannot be estimated.

4.3.2.17 Paseo del Norte Pump Station

Only two isolates were ribotyped from this site; both matched canine sources. The source contributions cannot be estimated due to the small number of isolates typed.

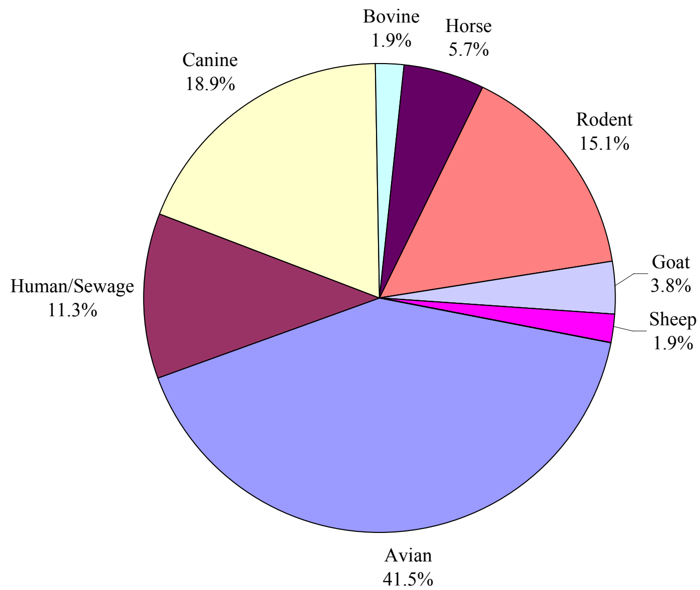
4.3.2.18 Alameda Drain at Ranchitos Road

Birds were the major source of fecal coliform at this site.

Table 4.25 Fecal Source Estimate for Alameda Drain at Ranchitos Road

Category	Number of Isolates	% Source Contribution	95% Confidence Limits
Human/ Sewage Subtotal	6	11.3 %	2.8 - 19.8 %
Bovine	1	1.9 %	0 - 5.6 %
Equine	3	5.7 %	0 - 11.9 %
Sheep	1	1.9 %	0 - 5.6 %
Goats	2	3.8 %	0 - 8.9 %
Livestock Subtotal	7	13.2 %	4.1 - 22.3 %
Avian Subtotal	22	41.5 %	28.2 - 54.8 %
Canines	10	18.9 %	8.4 - 29.4 %
Canine & Feline Subtotal	10	18.9 %	8.4 - 29.4 %
Rodent	8	15.1 %	5.5 - 24.7 %
Non-Avian Wildlife Subtotal	8	15.1 %	5.5 - 24.7 %
Unknown	3		
Grand Total	56		

Figure 4.20 Sources of *E. coli* to the Alameda Drain at Ranchitos Road



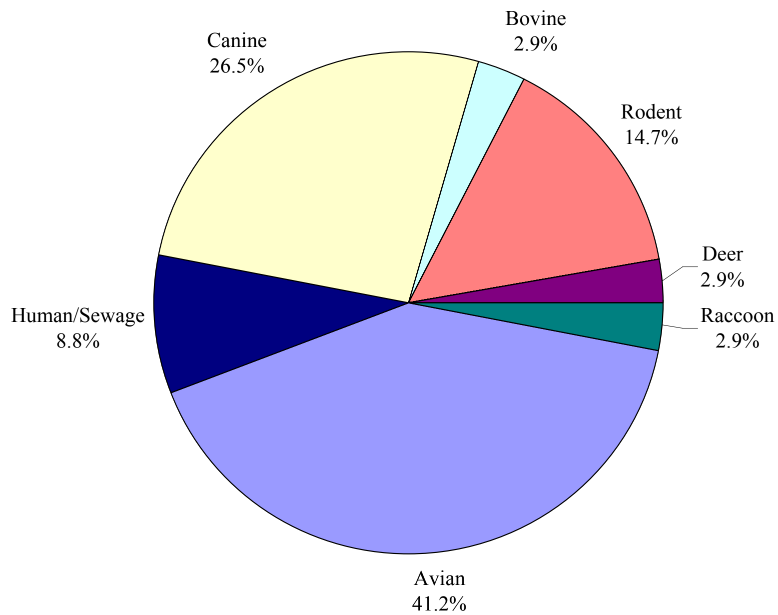
4.3.2.19 Alameda Drain at El Caminito Crossing

Birds, canines, and rodents were the major sources of fecal coliform identified in samples from this site. Although septic tanks were abundant in this watershed, sewage was not found to be a major source.

Table 4.26 Fecal Source Estimate for Alameda Drain at El Caminito Crossing

Category	Number of Isolates	% Source Contribution	95% Confidence Limits
Human/ Sewage Subtotal	3	8.8 %	0 - 18.3 %
Bovine	1	2.9 %	0 - 8.6 %
Livestock Subtotal	1	2.9 %	0 - 8.6 %
Avian Subtotal	14	41.2 %	24.7 - 57.7 %
Canines	9	26.5 %	11.7 - 41.3 %
Canine & Feline Subtotal	9	26.5 %	11.7 - 41.3 %
Rodent	5	14.7 %	2.8 - 26.6 %
Deer & elk	1	2.9 %	0 - 8.6 %
Raccoon	1	2.9 %	0 - 8.6 %
Non-Avian Wildlife Subtotal	7	20.6 %	7.0 - 34.2 %
Unknown	2		
Grand Total	36		

Figure 4.21 Sources of *E. coli* to the Alameda Drain at El Caminito Crossing



4.3.2.20 Ranchitos de Albuquerque Storm Drain

Because only seven isolates were typed from this site, a reliable estimation of fecal sources cannot be made. Three of the seven isolates matched *E. coli* from rodent hosts, two matched canines, and one each matched bovine and avian-resident strains of *E. coli*.

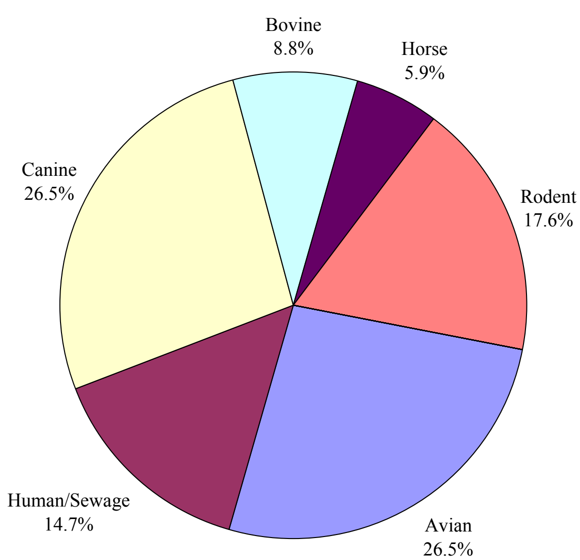
4.3.2.21 Cabezon Channel

Birds and canines were the major sources of fecal coliform identified at this site.

Table 4.27 Fecal Source Estimate for the Cabezon Channel

Category	Number of Isolates	% Source Contribution	95% Confidence Limits
Human/ Sewage Subtotal	5	14.7 %	2.8 - 26.6 %
Bovine	3	8.8 %	0 - 18.7 %
Equine	2	5.9 %	0 - 13.8 %
Livestock Subtotal	5	14.7 %	2.8 - 26.6 %
Avian Subtotal	9	26.5 %	11.7 - 41.3 %
Canines	9	26.5 %	11.7 - 41.3 %
Canine & Feline Subtotal	9	26.5 %	11.7 - 41.3 %
Rodent	6	17.6 %	4.8 - 30.4 %
Non-Avian Wildlife Subtotal	6	17.6 %	4.8 - 30.4 %
Unknown	0		
Grand Total	34		

Figure 4.22 Sources of *E. coli* to the Cabezon Channel



4.3.2.22 Calabacillas Arroyo at Swinburne Dam

While five of the 19 isolates from this site did not match any isolates from known sources, the other 14 isolates all matched canine-resident isolates. However, all of the isolates were from a single composite water sample, which may explain the lack of diversity. For this reason, a reliable source estimation cannot be made for this site.

4.3.2.23 Calabacillas Arroyo at Coors Road

The identified sources at this site were evenly distributed among human sewage, avian, rodent, and other sources. Eight of the 23 isolates from this site did not match any *E. coli* from known sources. With only 15 *E. coli* matching known sources, a reliable source estimation cannot be performed. Of the 15 *E. coli* matching those from known sources, there were four matching sewage-specific ribotypes, four matching avian-specific ribotypes, four matching rodent-specific ribotypes, and one each matching bovine-, canine-, and feline-specific ribotypes.

4.3.2.24 Amole del Norte Channel Above Amole Dam

Given the small human population of this watershed, the large number of human sewage resident *E. coli* strains is unexpected. However, the total number of isolates was low, and all 24 isolates were from the same composite water sample. For this reason, a reliable source estimation cannot be made for this site.

Table 4.28 Fecal Source Estimate for the Amole del Norte Channel above Amole Dam

Category	Number of Isolates	% Source Contribution	95% Confidence Limits
Human/ Sewage Subtotal	10	47.6 %	26.2 – 69.0 %
Bovine	1	4.8 %	0 – 13.9 %
Equine	2	9.5 %	0 – 22.1 %
Livestock Subtotal	3	14.3 %	0 – 29.3 %
Avian Subtotal	7	33.3 %	13.1 – 53.4 %
Canines	1	4.8 %	0 – 13.9 %
Canine & Feline Subtotal	1	4.8 %	0 – 13.9 %
Non-Avian Wildlife Subtotal	0	0 %	
Unknown	3		
Grand Total	24		

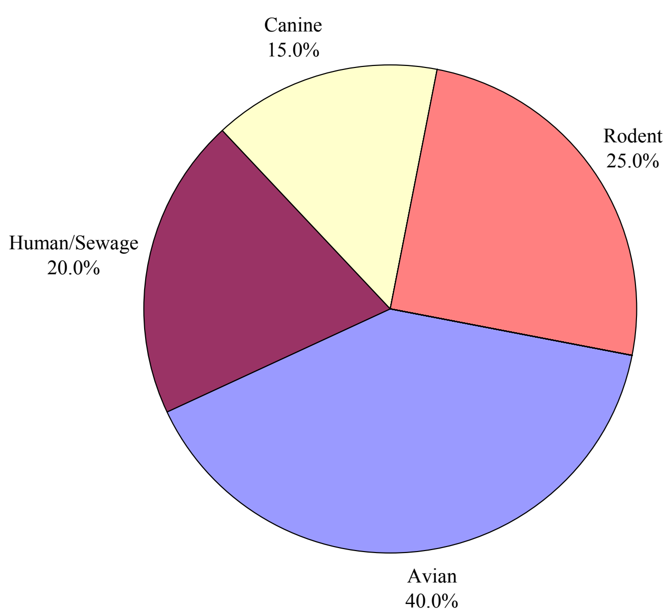
4.3.2.25 Vito Romero Pump Station

Birds and rodents were the major sources identified in this small, densely populated watershed. No livestock sources were noted. However, because the number of isolates typed was low, the uncertainty of the source estimates was high.

Table 4.29 Fecal Source Estimate for Vito Romero Pump Station

Category	Number of Isolates	% Source Contribution	95% Confidence Limits
Human/ Sewage Subtotal	4	20 %	2.5 – 37.5 %
Livestock Subtotal	0	0 %	
Avian Subtotal	8	40 %	18.5 – 61.5 %
Canine	3	15 %	0 – 30.6 %
Canine & Feline Subtotal	3	15 %	0 – 30.6 %
Rodent	5	25 %	6 – 44 %
Non-Avian Wildlife Subtotal	5	25 %	6 – 44 %
Unknown	0		
Grand Total	20		

Figure 4.23 Sources of *E. coli* to Vito Romero Pump Station



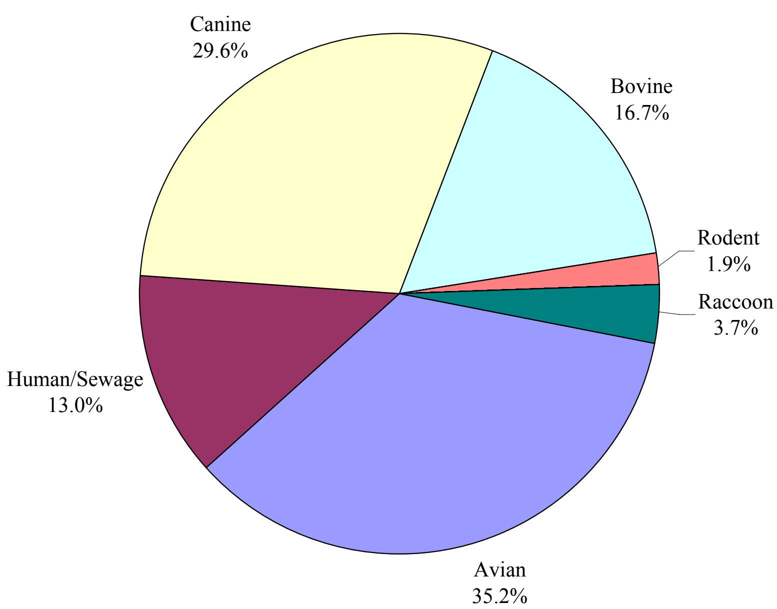
4.3.2.26 Los Padillas Drain Immediately Upstream of the Isleta Drain

Birds and canines were the major sources of fecal coliform identified at this site. A large number of isolates did not match strains from the known source library.

Table 4.30 Fecal Source Estimate for the Los Padillas Drain Immediately Upstream of the Isleta Drain

Category	Number of Isolates	% Source Contribution	95% Confidence Limits
Human/ Sewage Subtotal	7	13.0 %	4.0 – 22.0 %
Bovine	9	16.7 %	6.8 – 26.6 %
Livestock Subtotal	9	16.7 %	6.8 – 26.6 %
Avian Subtotal	19	35.2 %	22.5 – 47.9 %
Canine	16	29.6 %	17.4 – 41.8 %
Canine & Feline Subtotal	16	29.6 %	17.4 – 41.8 %
Rodent	1	1.9 %	0 – 5.5 %
Raccoon	2	3.7 %	0 – 8.7 %
Non-Avian Wildlife Subtotal	3	5.6 %	0 – 11.7 %
Unknown	25		
Grand Total	79		

Figure 4.24 Sources of *E. coli* to the Los Padillas Drain Immediately Upstream of the Isleta Drain



4.3.2.27 Isleta Drain Immediately Upstream of the Los Padillas Drain

Birds were the major source of fecal coliform in water at this site.

Table 4.31 Fecal Source Estimate for the Isleta Drain Immediately Upstream of the Los Padillas Drain

Category	Number of Isolates	% Source Contribution	95% Confidence Limits
Human/ Sewage Subtotal	6	13.0 %	3.3 – 22.7 %
Bovine	2	4.3 %	0 – 10.2 %
Equine	2	4.3 %	0 – 10.2 %
Porcine	2	4.3 %	0 – 10.2 %
Sheep	2	4.3 %	0 – 10.2 %
Livestock Subtotal	8	17.4 %	6.4 – 28.4 %
Avian Subtotal	19	41.3 %	27.1 – 55.5 %
Canine	6	13.0 %	3.3 – 22.7 %
Canine & Feline Subtotal	6	13.0 %	3.3 – 22.7 %
Rodent	7	15.2 %	4.8 – 25.6 %
Non-Avian Wildlife Subtotal	7	15.2 %	4.8 – 25.6 %
Unknown	0		
Grand Total	46		

Figure 4.25 Sources of *E. coli* to the Isleta Drain Immediately Upstream of the Los Padillas Drain

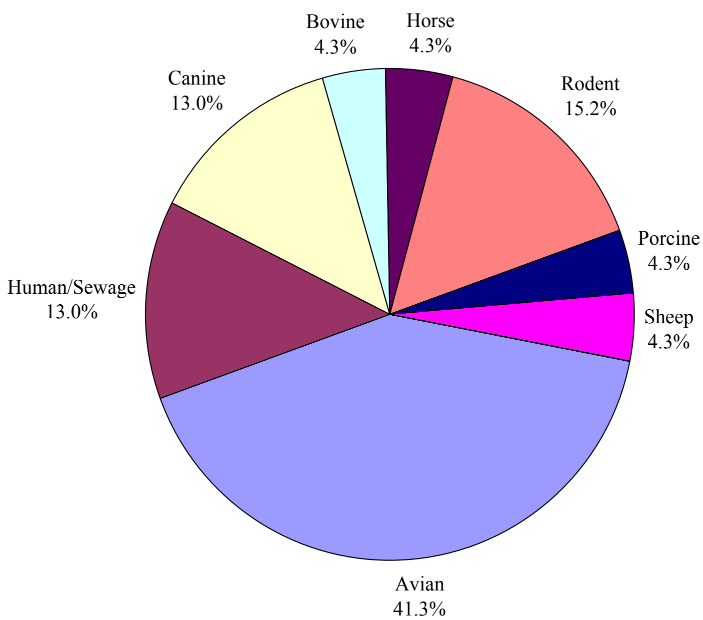


Table 4.32 Ribotype-Based Source Identification Summarized at the Supercategory Level by Site

Site Number	Station Description	Human/ Sewage	Avian	Livestock	Canine & Feline	Non-Avian Wildlife	Unknown	Total
1	Rio Grande at Angostura Diversion Dam	3	7	10	15	5	1	41
2	Rio Grande at Highway US 550	9	17	8	20	10	3	67
3	Rio Grande above Rio Rancho Utility #3	13	25	6	23	12	3	82
4	Rio Grande above Rio Rancho Utility #2	19	17	8	24	7	14	89
5	Rio Grande at Alameda Bridge	19	32	21	31	12	4	119
6	Rio Grande at Rio Bravo Bridge	10	36	18	17	7	2	90
7	Rio Grande at Interstate 25 Bridge	29	53	26	26	15	3	152
8	Rio Grande at Isleta Diversion Dam	21	81	37	25	23	15	202
9	North Diversion Channel at Roy	23	25	8	22	19	9	106
10	North Domingo Baca Arroyo Dam at Primary Spillway	0	4	2	15	2	2	25
11	North Pino Arroyo above North Diversion Channel	13	29	2	8	3	3	58
12	Hahn Arroyo above North Diversion Channel at Carlisle	9	22	11	9	11	11	73
13	Embudo Channel above confluence with North Diversion Channel	8	15	5	15	11	21	75
15	South Diversion Channel above Tijeras Arroyo	14	28	6	31	10	2	91
16	Sandia Pueblo Natural Arroyo at I-25	0	2	0	2	0	0	4
17	Paseo del Norte Pump Station	0	0	0	2	0	0	2
18	Alameda Drain at Ranchitos Road	6	22	7	10	8	3	56
19	Alameda Drain at El Caminito Crossing	3	14	1	9	7	2	36
20	Ranchitos de Albuquerque Storm Drain	0	1	1	2	3	0	7

Site Number	Station Description	Human/ Sewage	Avian	Livestock	Canine & Feline	Non-Avian Wildlife	Unknown	Total
21	Cabezon Channel	5	9	5	9	6	0	34
22	Calabacillas Arroyo at Swinburne Dam	0	0	0	14	0	5	19
23	Calabacillas Arroyo at Coors Road	4	4	1	2	4	8	23
26	Amole del Norte Channel above Amole Dam	10	7	3	1	0	3	24
28	Vita Romero Pump Station	4	8	0	3	5	0	20
29	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7	19	9	16	3	25	79
30	Isleta Drain just upstream of the confluence with Los Padillas Drain	6	19	8	6	7	0	46
	Grand Total	235	496	203	357	190	139	1620

4.4 Antibiotic Resistance Analysis Results

The 2,214 *E. coli* isolates subjected to ARA included 462 isolates from known sources and 1,752 from ambient water samples. Ninety nine different ARPs were observed among the *E. coli*. The most common ARP, with 1,711 isolates, was *E. coli* susceptible to all 12 of the antibiotics. There was no antibiotic to which all *E. coli* were susceptible. The number of *E. coli* resistant to each antibiotic is listed in Table 4.33, and complete data are provided in Appendix B.

The utility of ARA in identifying fecal sources was limited in this study. First, as noted above, 77 percent of the samples were susceptible to all 12 antibiotics. Second, there was a variety of sources associated with most of the antibiotic resistance profiles, and the number of known source isolates associated with each ARP was insufficient to reliably indicate a significant source association. There were a few exceptions: ARPs with resistance to ciprofloxacin or nalidixic acid were more commonly observed from known sewage or human samples, but these were seldom found in water samples. For these reasons, an attempt to identify fecal sources based on ARA was not made.

Table 4.33 *E. coli* Antibiotic Resistance

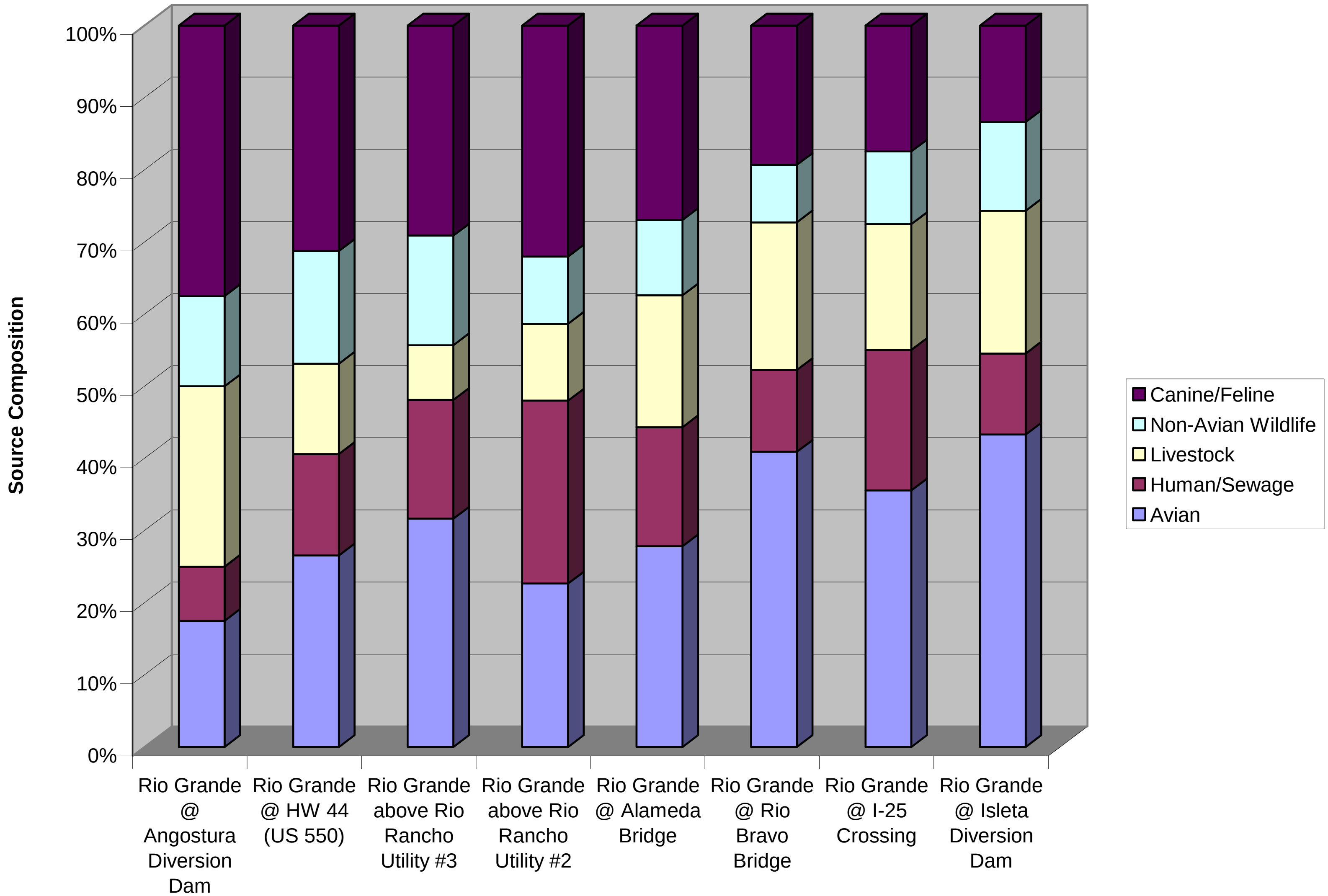
Antibiotic	Resistant *E. coli* Count (of 2214 total isolates)	Known Source Associations
Amikacin	15	
Ampicillin	228	sewage/human, feline, avian, bovine
Ampicillin/sulbactam	32	sheep
Ceftriaxone	3	
Chloramphenicol	2	
Ciprofloxacin	130	human/sewage, avian
Gentamicin	27	
Kanamycin	35	canine, porcine
Nalidixic acid	84	sewage
Streptomycin	228	sewage, avian, sheep, porcine, canine, feline
Tetracycline	163	sewage, poultry, sheep, avian
Trimethoprim	89	sewage, horse, avian

4.5 Geographic Relationships with Identified Sources

There appears to be an increase in the relative abundance of avian sources from upstream to downstream along the MRG, while the relative abundance of canine sources declines (Figure 4.26). The urbanization of the MRG watershed also increases from upstream to downstream. Urban areas provide an abundance of suitable habitat and food supply for many species of birds which concentrate in urban areas. The reduction in the relative importance of canine and feline sources of fecal coliform with the increasingly developed nature of the watershed runs counter to expectations. Parsons assumed that the sheer number of dogs in urban areas would cause an increase in fecal loading to water, in both absolute and relative terms, with increasing urbanization of the watershed. This was not observed. In addition, several of the relatively undeveloped small watersheds indicated a major canine source. It may be that a large population of canines in less developed portions of the watershed, and/or efficient dog waste cleanup in urban areas, may be responsible for the observations. In either case, canines represent a major source of fecal coliform in the watershed.

The relative importance of livestock as a source of fecal coliform in the MRG was highest at the uppermost site at Angostura, declines, and then increases again in the lower river reaches. The relative importance of human/sewage as a fecal source in the river appears to be highest at sites in the vicinity of the permitted WWTF outfalls of Rio Rancho Utilities #2 and #3 and the City of Albuquerque. This may indicate that the NPDES-treated sewage discharges outweigh leaking sewers and malfunctioning septic tanks as fecal sources.

Figure 4.26 Changes in Fecal Source Composition in the Rio Grande with Distance Downstream



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SECTION 5
IMPLEMENTATION OPTIONS

5.1 Targeting Controllable Sources

This section provides inferences to assist water quality managers in targeting management measures to address specific fecal source categories based on the ribotyping results at the eight sampling sites along the MRG. It is not the intention of this section to provide a detailed implementation plan for reducing fecal coliform loadings to the MRG. A wide array of management measures and best management practices (BMP) are discussed in the MRG Fecal Coliform TMDL report that in some combination could result in reductions of fecal coliform loading to the MRG and its tributaries and arroyos. As stated in the TMDL Report:

> *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).*

Table 4.2 of the previous section identified storm water runoff as the major source of fecal coliform in the MRG. Table 4.3 indicated that fecal coliform counts were also exceeding the numeric criteria at the North Diversion Channel and the Rio Grande at the I-25 bridge downstream. Discharge Monitoring Reports provided to NMED by the local WWTFs suggest that continuous wastewater discharges may be an intermittent source of the fecal coliform loading. These three factors, along with the knowledge of the main source categories of fecal coliform at the eight MRG sampling stations, provide sufficient data to more effectively target the implementation of management measures by subwatershed.

5.2 Fecal Coliform Isolates by Source Detected at Eight Sampling Stations

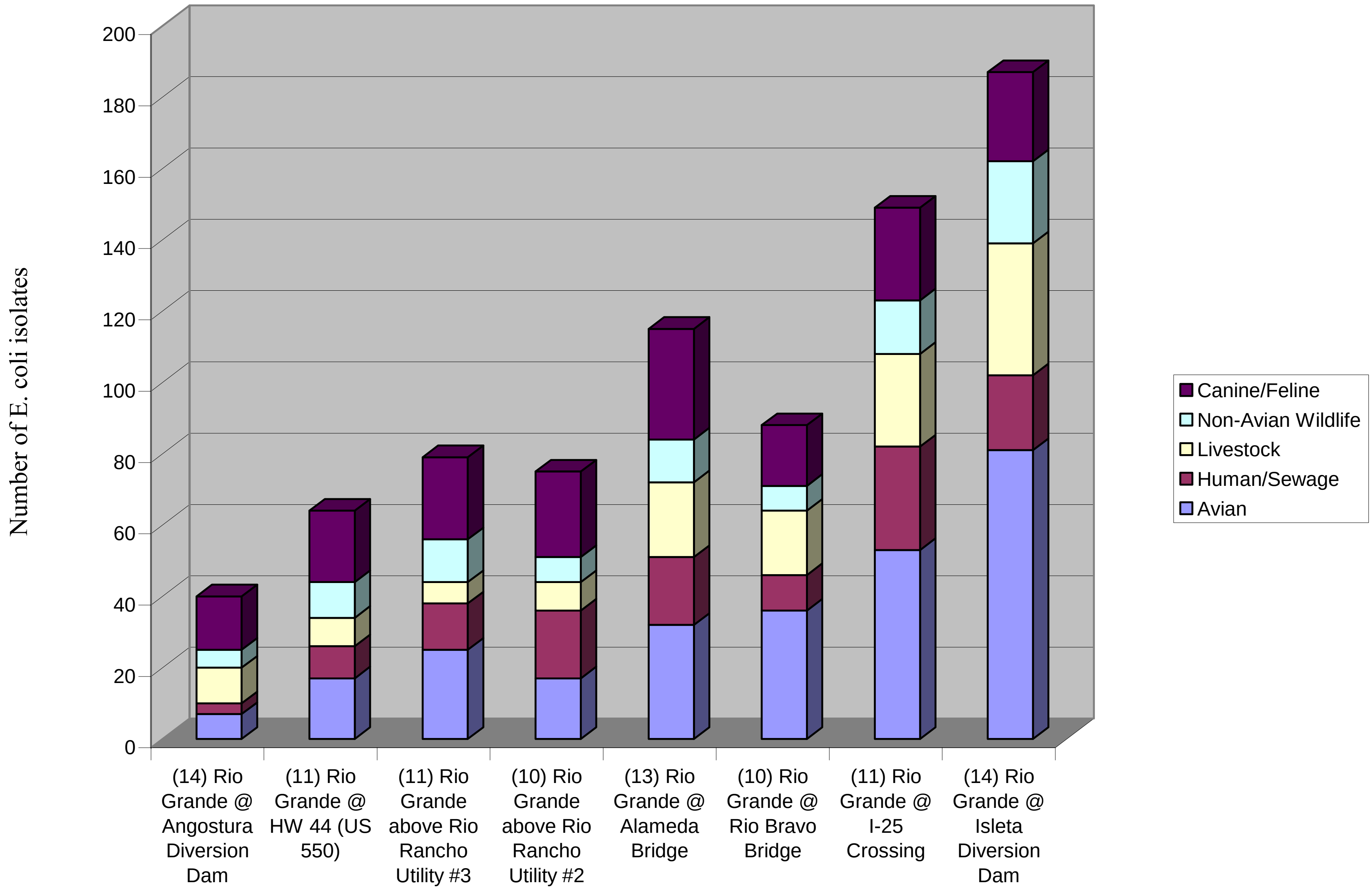
Figure 5.1 identifies the number of *E. coli* isolates matched for each source category group at each of the eight sampling sites on the Rio Grande. The number of samples taken at each station is shown in parenthesis.

As mentioned in Section 4, some isolates are associated with two or more species and are counted as unknown. The numbers of unknown isolates are not included in the totals shown in Figure 5.1, or in the text below.

5.2.1 Rio Grande at Angostura Diversion Dam

Forty-one *E. coli* isolates were identified from water samples at this sampling site and are shown on Figure 5.1. The individual number of isolates for each category was: seven Avian, three Human/Sewage, 10 Livestock, five Non-Avian Wildlife, and 15 Canine/Feline. Although not broken out individually in Figure 5.1, isolates from canine (35%), cattle (20%), and avian species (17%) make up the majority of *E. coli* detected at the Angostura Dam. The contributing watershed of this sampling site is approximately 1,230 square miles, all of which are considered outside of the study area.

Figure 5.1 Comparison of Fecal Coliform Sources for 8 Monitoring Sites on the Rio Grande



The primary purpose of conducting MST analysis at this station was to establish some benchmark for magnitude of fecal coliform concentrations (background level) and an understanding of the source categories coming from outside of the study area.

Although the fecal coliform contribution above the dam is relatively low compared to downstream stations, the data suggest the WQS of 200 cfu/100 mL is exceeded when the river contains local rainfall runoff. Given the land use characteristics of this subwatershed and the fact that exceedances of the water quality criteria occur only occasionally at this site, the value of targeting management measures upstream of the Angostura Diversion Dam needs to be carefully evaluated. Controlling cattle and dog waste by methods described in Subsection 5.3 may be an effective means of reducing these fecal coliform contributions.

5.2.2 Rio Grande at Highway US 550

The total number of *E. coli* isolates identified from water samples at this sampling site and shown on Figure 5.1 was 67. The individual number of isolates for each category was: 17 avian, nine human/sewage, eight livestock, 10 non-avian wildlife and 20 canine/feline. The major source categories identified in this subwatershed include canine (28%), avian (26.6%) and human/sewage (14%). The MRG watershed upstream of Highway US 550 is only slightly larger in size and very similar in land use/land cover to the river upstream of the Angostura Diversion Dam according to the fecal coliform concentrations shown in Table 4.2. Given the significant increase in percent contribution of fecal coliform from the human/sewage category, emphasis should aimed at identifying specific pathways of fecal loading from human sources particularly in the subwatershed area downstream of the Angostura Diversion Dam.

5.2.3 Rio Grande above Rio Rancho Utility #3

This sampling station is approximately 3 miles downstream of the Highway US 550 sampling site. The total number of *E. coli* isolates identified from water samples at this station and shown on Figure 5.1 was 82. The individual number of isolates for each category was: 25 avian, 13 human/sewage, six livestock, 12 non-avian wildlife, and 23 canine/feline. The major source categories identified in this subwatershed include avian (31.6%), canine (24%), human/sewage (16.5%), and rodent (15.2%). It should be noted that the three upstream most sampling sites on the Rio Grande (Angostura, Highway US 550, and Rio Rancho Utility #3) all have percent contributions from the rodent source category greater than 10 percent. The combined contributions of avian species and rodent species at these three sites indicate significant contributions from wildlife species in these largely rural watersheds.

Water samples collected at this station contain treated wastewater from the town of Bernalillo. The east side of this segment of the river is much more urbanized (Rio Rancho) than the two upstream segment subwatersheds. Given the significant increase in percent contribution of fecal coliform from the human/sewage category, emphasis should be aimed at identifying specific pathways of fecal loading from human sources, particularly in the subwatershed area downstream of the Highway US 550 station. A field survey that focuses on identifying sewer system overflows and popular locations for exercising pets such as parks, and penned livestock, is recommended. The field survey data can be used to direct efforts using the methods described in the next subsection.

5.2.4 Rio Grande above Rio Rancho Utility # 2

This sampling station is 1.7 miles downstream of the previous station. The total number of *E. coli* isolates identified from water samples at this station and shown on Figure 5.1 was 89. The individual number of isolates for each category was: 17 avian, 19 human/sewage, eight livestock, seven non-avian wildlife, and 24 canine/feline.

The major source categories identified in this subwatershed include canine (32.0%), human/sewage (25.3%), and avian (22.7%). This subwatershed is urbanized on the west side of the river with farms on the east side.

Fecal coliform concentrations collected at this station demonstrate the influence of treated wastewater upstream from Rio Rancho Utility #3. According to USEPA's Permit Compliance System (PCS) database, the Rio Rancho Utility #3 WWTF has on an intermittent basis, discharged fecal coliform in excess of the NPDES permit limits on 10 occasions from May 2001 through June 2003. The NPDES permit limits are a monthly average of 100 cfu/100 mL and a maximum limit of 200 cfu/100 mL on any one day. The range of fecal coliform concentrations above the permit limits are 184 cfu/100 mL to 10,000 cfu/100 mL. A summary of the PCS data is located in Appendix E. It is recommended that the method of effluent disinfection at the WWTF be analyzed by a qualified engineer. The most common cause of inadequate disinfection is undersized capacity of the disinfection unit during peak flow events or improper design. Given the significant increase in percent contribution of fecal coliform from the human/sewage category, emphasis should be aimed at identifying specific pathways of fecal loading from human sources, particularly in the subwatershed area downstream of the Rio Rancho Utility #3 sampling site.

5.2.5 Rio Grande at Alameda Bridge

This sampling station is approximately 6 miles downstream of the previous station. According to the calculated geometric mean fecal coliform concentration (Table 4.2), this subwatershed contributes four times the fecal coliform than the previous upstream station. The total number of *E. coli* isolates identified from water samples at this station (Figure 5.1) was 119. The individual number of isolates for each category was: 32 avian, 19 human/sewage, 21 livestock, 12 non-avian wildlife, and 31 canine/feline. The major source categories identified in this subwatershed include avian (27.8%), canine/feline (27.0%), and human/sewage (16.5%). There was also a significant increase in the percent contribution from horses (10.4%) compared to any of the stations upstream of the Rio Rancho Utility #2 site. A major factor that must be considered when evaluating this sampling site is the fecal source contributions from the North Diversion Channel, which joins the Rio Grande above the Alameda Bridge sampling site. The major source categories identified from the North Diversion Channel subwatershed include avian (25.8%), human/sewage (23.7%), canine (22.7%), rodent (17.5%) and equine (5.2%). No bovine isolates were detected in the North Diversion Channel.

The subwatershed drains a very large urban area interspersed with small farms. It should be noted that the *E. coli* count for livestock isolates increased from eight at the upstream station to 21 at this station. Controlling the fecal coliform contribution from livestock within such a large area may require educating the community and obtaining the backing of the majority before passing and enforcing local ordinances. This is discussed further in Subsection 5.2.1.

Water samples collected at this station contain treated wastewater from Rio Rancho Utility #2. According to USEPA's Permit Compliance System database, the Rio Rancho Utility #2 WWTF has on an intermittent basis discharged fecal coliform in excess of the NPDES permit limits on 11 occasions from July 1998 through September 2004. The NPDES permit limits are a monthly average of 100 cfu/100 mL and a maximum limit of 200 cfu/100 mL on any one day. The range of fecal coliform concentrations above the permit limits are 111.5 cfu/100 mL to 1,300 cfu/100 mL (September 2004). The two permit violations reported in 2004 are believed to be the result of an unusually high amount of rainfall that year. Again, it is recommended that a qualified engineer analyze the disinfection system to determine if the WWTF design capacity can handle the storm water charged sewers.

5.2.6 Rio Grande at Rio Bravo Bridge

This sampling station is approximately 14 miles downstream of the Alameda Bridge. According to Table 4.2, the maximum fecal coliform count from a sample collected at this bridge was 650,000 cfu/100 mL and the geometric mean (2,320 cfu/100 mL) was 42 percent higher than the Alameda Bridge station. The total number of *E. coli* isolates identified from 10 water samples at this station (Figure 5.1) was 90. The individual number of isolates for each category was: 36 avian, 10 human/sewage, 18 livestock, seven non-avian wildlife, and 17 canine/feline. The major source categories identified in this subwatershed include avian (41%), livestock (20%), canine/feline (19%).

Avian and non-avian wildlife species accounted for almost 50 percent of the typed isolates in the samples collected. This is congruent with the large number of water fowl that frequent stretches of the Rio Grande south of Rio Rancho Utility #2. There was also a considerable decrease in percent contribution from human/sewage sources and an increase in bovine contributions. A field survey to identify pathways of pet, livestock, and human waste in this subwatershed should be conducted. A public education campaign and passing and/or enforcing local ordinances to control this waste are recommended.

5.2.7 Rio Grande at Interstate 25

This sampling station is approximately 6 miles downstream of the Rio Bravo Bridge. According to Table 4.2, the maximum fecal coliform count from a sample collected at this bridge dropped to 360,000 cfu/100 mL, but the geometric mean was almost double that upstream at the Rio Bravo Bridge. The total number of *E. coli* isolates identified from water samples at this station (Figure 5.1) was 152. The individual number of isolates for each category was: 53 avian, 29 human/sewage, 26 livestock, 15 non-avian wildlife, and 26 canine/feline. The major source categories identified in this subwatershed include avian (35.6%), human/sewage (19.5%), and canine (14%). The increase in *E. coli* isolates identified as human or sewage again suggests the need for a focus on identifying specific pathways of fecal loading from human/sewage sources. The total isolates identified with controllable sources (human, canine, bovine, equine, feline, porcine, sheep) are 54 percent of the total. The source category contributions at this station indicate that fecal loadings from a large and diverse population of domestic animals in this urbanizing subwatershed need to be addressed. The same field survey, public education, and ordinance enforcement recommended previously also apply to this subwatershed. A major factor that must be considered at this station is the fecal source contributions from the South Diversion Channel which outfalls above the Rio Grande at Interstate 25 sampling site. The major source categories identified from the South Diversion Channel subwatershed include avian (31.5%), canine (30.3%), and human/sewage (15.7%).

It appears some sources of fecal coliform may be more consistent than intermittent, which is verified in Table 4.3 – fecal coliform under non-runoff conditions. One source worth further investigation is Albuquerque's Southside Water Reclamation Plant. According to USEPA's Permit Compliance System database, the Southside Water Reclamation Plant has, on an intermittent basis, discharged fecal coliform in excess of the NPDES permit limits on 21 occasions from July 1998 through September 2004 (See Appendix E). The NPDES permit limits are a monthly average of 100 cfu/100 mL and a maximum limit of 200 cfu/100 mL on any one day. The range of fecal coliform concentrations above the permit limits were 106 cfu/100 mL to 19,200 cfu/100 mL (both July 1999). Two of the maximum day permit exceedances occurred as recently as April and July 2004. Again, it is recommended that a qualified engineer analyze the disinfection system at the Southside Water Reclamation Plant to determine if the design capacity can handle the recorded-high peak flow rate.

5.2.8 Rio Grande at Isleta Diversion Dam

As the downstream most site, the results of this sampling station reflect the overall contributions of source categories from the entire study area. The total number of *E. coli* isolates identified from water samples at this station (Figure 5.1) was 202. The individual number of isolates for each category was: 81 avian, 21 human/sewage, 37 livestock, 23 non-avian wildlife, and 25 canine/feline. Avian and non-avian species account for approximately 56 percent of the total. Controllable source categories (human, canine, bovine, equine, feline, porcine [swine], sheep) account for approximately 44 percent of the total. The human/sewage and canine/feline categories accounted for approximately 25 percent of the total isolates identified.

The prioritization and targeting of management measures throughout the MRG study area will directly affect future fecal coliform loading reductions measured at the Isleta Diversion Dam. However, additional field reconnaissance should be undertaken to identify pathways of controllable sources in the large subwatershed southeast of Albuquerque that drains directly into the Rio Grande upstream of the Isleta Diversion Dam. The increased livestock contribution is attributed to the many irrigation drains entering the river upstream of this station. Manure management, discussed in the next subsection, may be an effective method to reduce the livestock fecal coliform contribution. The same field survey, public education, and ordinance enforcement implementation methods recommended previously also apply to this subwatershed.

5.3 Implementation Discussions

Rainfall runoff throughout the MRG watershed flushes fecal matter into the river. Ribotyping *E. coli* identified both controllable sources, such as livestock, pets, and untreated sewage, and natural sources such as wildlife. The following provides a general description of strategies to reduce the fecal coliform contributions from controllable sources. The degree of control of the fecal coliform contributions from canine/feline, livestock, and human/sewage categories is proportional to funding and community commitment. A discussion on natural sources follows.

5.3.1 Pets

Urban areas within the MRG contain an overpopulation of dogs and cats (CABQ 2005). Table 2.3 shows that in the overall 2,000 square mile watershed associated with Isleta Diversion Dam, there are an estimated 136,757 dogs and 155,620 cats. A 1978 estimate put the number of stray animals between 60,000 to 70,000 in Albuquerque alone (Funk 1996). In 2002 and 2003 the number of dogs and cats picked up by the City of Albuquerque animal control was 23,368 and 25,473, respectively (Sanchez 2004). Pet adoption rates were 20 percent and 23 percent for those years (Sanchez 2004). The City of Albuquerque and Bernalillo County impose a limit of four dogs and cats per household (Ordinance 9-2-3-1 and Section 6). Bernalillo County will allow six dogs and cats if they are spayed or neutered.

Dogs can be asymptomatic carriers of internal parasites like *Giardia* and *Cryptosporidium*. Infected animals pass up to 10 million *Giardia* cysts and/or 10 billion *Cryptosporidium* oocysts per gram of feces. Infection can occur with ingestion of one *Cryptosporidium* oocyst (City of Boulder 2004). Although no outside sources were found that addressed internal parasites in cats, this study determined that 17 percent of hemolytic *E. coli* found in the ambient water samples were from cats.

There are approximately 80,000 dogs registered with the City of Albuquerque producing 20 tons of feces per day (CABQ 2004). This figure does not include unregistered or stray dogs or dogs living outside of Albuquerque.

The most effective means of controlling dog waste in parks are the installation of signs, pick-up bag dispensers, receptacles, and fining ordinance violators. Albuquerque has three no-leash required dog parks with waste collection amenities.

The following are some suggested methods for reducing the fecal coliform contribution from pets to the MRG:

- Enforce adopted city and county pet ordinances.
- Continue public participation and education efforts. Provide public information about the problems, such as diseases, associated with animal feces entering the MRG. This could be accomplished through public service announcements on radio or television, investigative news articles in newspapers, brochures posted within public buildings, and information on websites.
- Place additional pick-up bag dispensers and receptacles in known problem areas such as hike and bike trails.

5.3.2 Livestock

Livestock in CAFOs, such as chickens, sheep, goats, donkeys, horses, and cattle, occupy land near and adjacent to the MRG (CDM 2000). In some cases, penned animals have direct access to the MRG for watering purposes (NMED 2002). Some owners gather manure from within the pen and store it in an uncovered pile (CDM 2000). A 1,000-pound beef cow produces approximately 11 tons of manure per year, and a 1,000-pound dairy cow produces approximately 15 tons (Ohio NRCS 1999). Assuming the average dairy or beef cow in the MRG watershed weighs 750 pounds, the manure production of 35,000 cows is approximately 800 tons per day. Commercial CAFOs are also located in the Isleta Drain (three) and Interstate 25 Bridge (one) watershed.(CDM 2000).

A single horse produces 350 pounds per week of manure (Card 2004). The manure production of 10,000 horses is approximately 250 tons per day.

It is possible that some of this manure is gathered and used on local gardens and farms as fertilizer. No ordinances were located regulating manure handling practices or prohibiting landowners from allowing livestock to enter the MRG.

For obvious reasons, the density of penned livestock is regulated differently in urban areas than in rural areas.

The following are some suggested methods for reducing fecal coliform released from penned livestock.

- Pass an ordinance regulating manure handling and disposal practices. Identify property owners with penned livestock or CAFOs that may be contributing to the fecal coliform standard exceedance. Determine if these properties meet current ordinances. Enforce ordinance.
- Modify existing websites and media addressing the handling of dog waste to include livestock.
- People are more cooperative when adequately informed about a health problem that they have some control over, such as cleaning livestock pens and avoiding exposure to storm water. Knowledge of the source of the problem may modify the behavior of people responsible for a known source of fecal coliform.

On December 7, 2004, USEPA Region 6 published notice of proposed general permit for discharges from CAFOs. As of September 2005, the proposed general permit had not been finalized.

5.3.3 Untreated or Inadequately Treated Sewage

The MRG water budget developed by the Middle Rio Grande Water Assembly (MRGWA 1999) indicates approximately 10 acre-feet of treated septic system wastewater enters the area's shallow aquifers each year. The report also states approximately 220 acre-feet of water from these shallow aquifers enter the MRG as seeps and springs. Nevertheless, based on the relatively low fecal coliform contribution from human waste, septic systems are not believed to be a major fecal coliform contributor to the MRG (NMED 2002).

Owners of WWTFs with an NPDES permit are required to report SSOs to NMED and USEPA Region 6. USEPA Region 6 is requiring permittees to eliminate SSOs or face large monetary fines. USEPA is encouraging permitted WWTF owners to implement an asset management approach to better manage their sewer systems.

Seventy percent of SSOs are caused by structural or electrical failures or pipe capacity restrictions (EPA http://www.epa.gov/npdes/sso/control/causes.htm). The most popular method of mitigating and managing SSOs is the Capacity Management, Operations, and Maintenance (CMOM) program. Permittees implementing the CMOM program are likely to be in a better position to negotiate SSO penalties with USEPA. See http://www.parsons.com/asset/capabilities/capabilities06.asp and http://cfpub.epa.gov/npdes/home.cfm?program_id=4 for more information. The City of Albuquerque has implemented a CMOM program and has been successful in addressing issues associated with SSOs.

5.3.4 Wildlife

The MRG watershed provides habitat for a diverse population of wildlife. The Rio Grande is a major bird flyway for migratory water fowl and other bird species. Approximately 90,000 lesser snow and Ross geese and Sandhill cranes visit the MRG each year and can contribute up to 19.8 quadrillion (19.8 x 10^{15}) fecal coliform bacteria each day (CDM 2000). This fecal coliform contribution occurs every migratory season and is considered a natural source. It is recommended that NMED, the Sandia Pueblo, and USEPA discuss and reach consensus on how natural background sources of fecal coliform from wildlife (avian and non-avian species) should be handled. A decision will need to be made regarding how progress toward meeting fecal coliform reduction goals established by the TMDL will be evaluated, and what the relationship between background concentrations of fecal coliform and interpretation of state and Tribal WQSs will be.

5.3.5 Milestones and Evaluation of Implementation Programs

A critical element of any watershed implementation plan is a well-designed water quality monitoring approach to evaluate the improvement in water quality conditions in response to implementation of control actions and management measures. It is recommended that fecal coliform sampling at stations addressed in this report be continued at as many of the stations as possible. This will allow verification of the effectiveness of the suite of management measures chosen to achieve fecal coliform reduction. It is also recommended that setting fecal coliform reduction goals should follow more intensive field surveys. The field surveys will identify the obvious problem areas (*e.g.*, sewer overflows, effluent disinfection, penned livestock, and CAFOs) and will allow assessments of the success of implementation programs. Goals may then be set prior to this initial program implementation. The effectiveness of reducing fecal coliform at these "easier" sites can be measured through routine fecal coliform sampling.

Milestones will be used for determining if control actions are being implemented and, ultimately, if WQSs are being attained. The milestones proposed in the MRG TMDL need to be refined and linked to the suite of management measures selected to address the controllable sources of fecal coliform outlined in Subsection 5.3. The milestones listed in the MRG TMDL include the following***:***

- Develop BMPs to reduce fecal coliform loading in storm water;
- Implement BMPs;
- Monitor effectiveness of BMPs after implementation;

- Re-assess BMP effectiveness; and
- Design new BMP approaches if original approach proves ineffective.

Monitoring BMP effectiveness and revised milestones need to be integrated, both spatially and temporally, to provide water resource managers and the public with information needed to modify implementation strategies.

SECTION 6
NEED FOR PUBLIC INVOLVEMENT

Public outreach and education is an important component of the overall effort to reduce fecal coliform loadings to the Rio Grande. MRG stakeholders need to play a central role in defining and targeting public education and participation efforts aimed at reducing fecal coliform loadings from known sources.

6.1 Public Education and Participation

The NPDES Municipal Separate Storm Sewer System (MS4) permit program (Phases I and II) require development of a Storm Water Management Program (SWMP). One of the MS4 permit conditions develops a public education and participation process. As a result of the 2002 fecal coliform TMDL, USEPA Region 6 and NMED are likely to require MS4 permit holders to develop and document rigorous public education and participation processes that address fecal coliform sources.

The USEPA has a website that specifically addresses pet waste management (see http://cfpub.epa.gov/npdes/stormwater/menuofbmps/edu_8.cfm). This website describes BMPs and provides links to other websites that address pet waste BMPs. Examples of public outreach material may be viewed at http://cfpub.epa.gov/npdes/stormwatermonth.cfm#materials. The USEPA also provides a BMP Fact Sheet that address public involvement and participation ideas at http://cfpub.epa.gov/npdes/stormwater/menuofbmps/pub_inv.cfm.

6.2 MRG Stakeholders

Stakeholders within the MRG can be categorized into at least two groups: those that have a financial stake and those with a special interest. USEPA passes the cost of TMDL implementation and enforcement to the stakeholders with NPDES permits. Some of these stakeholders are listed in the NPDES Phase I and Phase II MS4 regulations and are as follows.

- City of Albuquerque
- Albuquerque Metropolitan Arroyo Flood Control Authority
- New Mexico Department of Transportation
- University of New Mexico in Albuquerque
- Bernalillo County
- Village of Corrales
- Village of Los Ranchos de Albuquerque
- City of Rio Rancho
- Sandoval County
- Pueblo of Sandia
- Pueblo of Isleta
- Pueblo of Santa Ana

Not all financial stakeholders are listed in the MS4 regulations. Nevertheless, some stakeholders may be required to obtain an NPDES Phase I (co-permittee) or Phase II

MS4 permit because they have water-controlling jurisdiction over an urbanized area. These potential financial stakeholders are as follows:

- Town of Bernalillo
- Pueblo of San Felipe
- Pueblo of Santa Ana
- Kirkland Air Force Base
- Middle Rio Grande Conservancy District
- Southern Sandoval County Arroyo Flood Control Authority

Stakeholders with special interest include:

- USEPA Region 6
- New Mexico Environment Department
- Amigos Bravos
- Citizens for Clean Air and Water
- Corrales Residents for Clean Air and Water
- Other Interested Citizen Groups or Individuals.

6.3 Watershed Partnerships

Coordination among stakeholders is paramount to a significant reduction in reducing fecal coliform contribution to the MRG. Because MRG subwatersheds almost always extend through several jurisdictions of MS4 permit holders, partnerships between stakeholders is necessary. Stakeholder partnerships can be used as a mechanism to distribute the cost of fecal coliform TMDL implementation among multiple parties. Examples include shared cost of area-wide public service announcements or production of public education material.

6.4 Roles and Responsibilities

Both the financial and special interest stakeholders will have roles in implementing management measures and BMPs for fecal coliform. NMED, AMAFCA, Bernalillo County, and the Pueblos have well-defined water quality management roles and responsibilities. A key responsibility of these agencies will be to reach consensus on how data from this study will be utilized to guide decision making on selecting, funding, and implementing management measures and BMPs. Before USEPA Region 6 issues MS4 permits that specifically address the fecal coliform TMDL, stakeholders can organize to prioritize the phased implementation of management measures, identify funding sources, and establish milestones for evaluating reductions in fecal coliform loading. There are several advantages/benefits to organizing before USEPA issues MS4 permits addressing fecal coliform. These include having a larger influence on the requirements stipulated by the permits and the schedule of implementation. A potential benefit can be a lessening of the cost of fecal coliform reduction in the long term.

SECTION 7
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APPENDIX A
ARA METHOD

Performance Standards for Antimicrobial Disk and Dilution Susceptibility Tests for Bacteria Isolated from Animals; Approved Standard

1 Introduction

A variety of laboratory techniques can be used to measure the *in vitro* susceptibility of bacteria to antimicrobial agents. These include disk diffusion and broth and agar dilution techniques. This document includes a series of recommendations to help standardize the way these tests are actually performed. The performance, applications, and limitations of the currently recommended methods are described. Recommendations by the International Collaborative Study (ICS) and initial regulations proposed by the U.S. Food and Drug Administration have been reviewed, and the appropriate sections have been incorporated into this standard.[1-3]

The current methodology described in this document is applicable only to the therapeutic and control uses of antibiotics as described in Section 2. The subcommittee has determined that the development of new or modified *in vitro* testing procedures to breakpoints or zone interpretive criteria to accommodate field usage practices in livestock was not realistic for several reasons.

First, there is not an apparent variable which can be easily modified in the current procedure to reflect a key factor which will correlate to *in vivo* efficacy. For example, any alteration in the inoculum (which might be reflective of an initial low infectious dose early in an infectious process) would need to be validated with efficacy studies in animals.

Furthermore, redesigning the current methodology would require the development of new quality control guidelines; possibly disks with lowered antibiotic content, or extended dilutions on MIC dilution panels. Second, even if such a procedure were developed, how realistic is it to expect a laboratory to use it and explain the outcome to a veterinarian or other client?

The subcommittee will remain open to alternatives to new procedural development, such as revisions to interpretive criteria. With respect to growth promoters, since the beneficial effects of antibiotics can neither be entirely ascribed to effects on the microbial gut flora, nor correlated to physiological effects on the animal, new *in vitro* techniques for prediction of clinical outcome should be considered only when a better understanding of the mode of action of antibiotics in this situation become available.

1.1 Performance Standards for Disk Diffusion Antimicrobial Susceptibility Tests for Bacteria That Grow Aerobically

In most veterinary diagnostic laboratories, the agar disk diffusion method is used for testing the common rapidly growing bacterial pathogens. If results are to be reliable, the technical details of such procedures must be carefully standardized and controlled. Agar disk diffusion methods based solely on the presence or absence of a zone of inhibition, without regard to its magnitude as an indicator of the organism's susceptibility to the drug being tested, are not acceptable.

The standardized method currently recommended by the NCCLS Subcommittee on Veterinary Antimicrobial Susceptibility Testing for agar disk diffusion tests is based on that described by Bauer et al.[4] This is the most completely described method for which interpretive standards have been developed and supported by clinical and laboratory data.

Reliable results can be obtained with disk diffusion tests that use standardized methodology and zone diameter measurement correlated with minimum inhibitory concentration (MIC) and the behavior of strains among clinically susceptible and resistant species.

1.2 Performance Standards for Dilution Antimicrobial Susceptibility Tests for Bacteria That Grow Aerobically

Both broth and agar dilution techniques may be used to measure quantitatively the *in vitro* activity of an antimicrobial agent against a given bacterial culture. Basically, a series of tubes, wells, or plates is prepared with an agar or broth medium to which various concentrations of the antimicrobial agents are added. The tubes, wells, or plates are then inoculated with a suitably standardized suspension of the test organism. After overnight incubation at 35 °C, the tests are examined and the MIC is determined. The final result is influenced greatly by methodology, which must be carefully controlled if reproducible results (intralaboratory and interlaboratory) are to be achieved. Therefore, for the sake of standardization, there must be a reference method to which all other techniques can be compared.

This document describes such standard agar dilution and standard broth dilution (macrodilution and microdilution) techniques. These techniques are based largely on information gathered from the International Collaborative Study in Human Medicine.[1] Although these methods are primarily standard reference methods, some are sufficiently practical to warrant their use both in clinical laboratories and in the research laboratory. If one of these tests is to be adopted as the routine method in an institution where it has not been previously used, an educational program for the clinicians and the staff should be carried out before the sole use of MICs is initiated.

This document describes currently recommended techniques for antimicrobial agent disk and dilution susceptibility tests. When future improvements in methodology are developed, changes will be incorporated into the standard and distributed as informational supplements.

2 Selection of Antimicrobial Agents for Routine Testing and Reporting

Selection of the most appropriate antimicrobial agents to test and to report is a decision best made by each laboratory in accordance with the needs of its clientele. The lists in Table 1 comprise agents of proven clinical efficacy for treatment of systemic infections in that animal group, and which show acceptable *in vitro* test performance. Tests on selected agents can be useful for infection-control purposes. Agents listed are currently approved for treatment or control of disease. Agents used for other purposes such as prevention or growth promotion are not listed because the correlation of antimicrobial susceptibility tests for these uses cannot be established (see Section 2.1).

The subcommittee believes that it is both appropriate and necessary to provide the rationale used to limit the scope of this document to therapeutic and control uses of antibiotics in veterinary medicine. For the most part, these limitations reflect antibiotic uses in livestock used for food production, and do not necessarily apply to equine, or small animal medicine. Currently antibiotics are approved by the U.S. FDA Center for Veterinary Medicine for certain indications; treatment (i.e., therapy), control or prevention of disease, or growth promotion. The subcommittee has used the following definitions of antibiotic uses, which are consistent with current regulatory interpretations in its deliberations:

- therapeutic: administration of an antibiotic to an animal, or group of animals, which exhibit frank clinical disease;

- control: administration of an antibiotic to animals, usually as a herd or flock, in which morbidity and/or mortality has exceeded baseline norms, i.e., early in the course of the onset of disease in the population. It must be recognized that the initial treatment might be made empirically based on the urgency of the situation, and the clinical judgment including the most likely etiological agent, and experience of the veterinarian. However, a pretreatment culture and subsequent susceptibility information should be obtained as soon as possible to guide the appropriate use of an antibiotic. Control does not necessarily consider the health status of a given individual in the population, as that will vary depending upon the disease progression. In other words, a range of clinical manifestations from mortality to overt illness, to normal will be present in a group of animals. The objective is to control the dissemination of the disease within the group while treating those with clinical signs. Certain exceptions, such as medication of one-day-old chicks, will be discussed later.

- prevention/prophylaxis: administration of an antibiotic to exposed healthy animals prior to expected onset of disease and for which no etiologic agent has yet been cultured. Generally the usage is in a herd or flock situation and not an individual animal.

- growth promotion: administration of an antibiotic, usually as a feed additive, over a period of time to growing animals that results in improved physiologic performance (i.e., weight gain, feed conversion, etc.). Although this has been sometimes referred to as "subtherapeutic" use, this is actually a misnomer since there is no disease claim associated with this use.

The claims for therapeutic and control use, but not prevention, are similar enough to be grouped together in Table 1 without a distinction between their label usage for the following reasons: the only difference between control and therapy is the timing of the administration, i.e., "early" in the course of a disease outbreak vs. "later." In other words, the number of animals affected at a particular stage in the disease progression is the only difference. The similarities are that in each case there are clinical signs (morbidity and/or mortality), a cultured-confirmed pathogen, and an antibiogram available. Since the control mode implies that there are animals already in the clinical stage of disease, the use of therapeutic breakpoints is appropriate. Any differences in doses or durations of the medications used for therapy or control will already have been adjusted during the drug-approval process and do not need to be considered herein.

Since there is no distinction between the two uses with regard to susceptibility data interpretation, it was decided that it was not necessary to have a separate table, or to note control or therapeutic, after the listing. This would simplify the laboratory's responsibility in reporting their recommendations to the practitioner and place the burden of appropriate product use on the veterinarian. Finally, the existing M37 guidelines can be applied to the development of the breakpoints and zone diameter interpretive criteria for control uses.

Prevention use is viewed as different from control/therapeutic because at the time of administration: 1) there is not a recovered pathogen; 2) there is no antibiogram for the pathogen; 3) there is no certainty that a disease outbreak will occur; and 4) it is possible that antibiotics would be used when they are not necessary. Thus, the application of therapeutic interpretations of susceptibility data was not justified. While a retrospective documentation of a given pathogen and susceptibility profile in a particular setting might provide guidance to a practitioner for future use of a particular antibiotic, the laboratory cannot be directly involved in recommending the use of a product in a manner not within the scope of this subcommittee. In other words, the laboratory can provide data to the veterinarian once an agent has been cultured and in this way help to establish a database over time. However, since there is no certainty that the same agent will be the cause of the next outbreak, it is the responsibility of the veterinarian, not the laboratory, to make a decision on whether to use a product in prevention mode.

An exception to the above is the situation with day-old chicks wherein an isolated etiologic agent and antibiogram would not be available and the administration of an antibiotic is actually more of a prevention mode. The subcommittee viewed this situation as an exception where the preventative aspect, along with the flock isolate history, and a high degree of certainty of an outbreak occurring with the known pathogen would allow the veterinarian to use clinical judgment to make a decision on which antibiotic to administer. The role of the laboratory in this case would be to provide the veterinarian with retrospective information obtained on isolates from the flock. This would serve as the historical database for the next outbreak. The laboratory would not be expected to make a recommendation on which antibiotic to administer.

Growth promotion uses of antibiotics have been determined to be outside the scope of the subcommittee and should not be included in laboratory reports. So far as is known, there is no correlation between a specific species of bacteria, or group of bacteria, their physiological effect on the animal, and how that is affected by antibiotics. There is a complex microbial ecology issue involved in the growth promotion use of antibiotics, which quite likely involves dynamic populations of bacteria. In other words, there is no one bacterial species that can be tested to predict whether an antibiotic will enhance or inhibit the performance of a group of animals. Some antibiotics are used for both therapeutic or control purposes as well as growth promotion within the same animal species. Since there can be no *in vitro* testing for growth promoter uses, the control or therapeutic uses are to be evaluated as above. The testing of growth promotion antibiotics against specific species of enteric bacteria was recognized as perhaps having research value in monitoring for antibiotic resistance, but in no case could the results be correlated to a clinical outcome.

For antimicrobial agents with enteric or diarrheal disease indications, there are a substantial number of antibiotics used to treat a variety of enteric infections in animals and every attempt to include them within M31 should be made in order to guide practitioners in the proper selection of these agents. The interpretive criteria and breakpoints can now be included in the M31 tables and footnoted to indicate that the antibiotic is used to treat enteric infections.

Given the limited number of antimicrobial agents approved for use in some animal species, "extra-label" use of antimicrobial agents is commonly practiced. The U.S. FDA has defined extra-label use as the "use of an animal drug in a food-producing animal in a manner that is not in accordance with drug labeling. This includes, but is not limited to: use in species or for indications (disease or conditions) not listed in the labeling; use at a dosage level higher than those stated in the label; use of routes of administration other than those stated in the labeling; and failure to observe the stated withdrawal time."[5] While laboratory personnel should be familiar with extra-label use of antimicrobial agents in animals, it is the responsibility of the laboratory client (veterinarian/producer/herd owner) to use the compound appropriately in the animal.

2.1 Routine and Selective Reporting

The lists of agents in Table 1 constitute current recommendations for testing and for reporting that are considered appropriate. The lists are based on various considerations, including microbiological, clinical, and pharmacological factors, as well as clinical indications and efficacy.

To avoid misinterpretation, routine reports to the laboratory client should include only those drugs appropriate for therapeutic and control use, as suggested in Table 1. Agents may be added to or removed from these basic lists as conditions demand.

Compounds listed in Table 1, Group A and Group B, are approved for use in the indicated animal. It is the responsibility of the laboratory client to use the agent appropriately for the various animal types or category (e.g., calves, lactating dairy cattle). The laboratory client assumes all responsibility for efficacy, safety, and residue avoidance with extra-label uses of antimicrobial agents.

Compounds listed in Table 1, Group C are not approved but are frequently used in an extra-label manner in the indicated animal. It is the responsibility of the laboratory client to use the compound appropriately in the indicated animal. The laboratory client assumes all responsibility for efficacy, safety, and residue avoidance with extra-label uses of antimicrobial agents.

Drugs other than those approved for use in therapy may be tested to provide taxonomic data and epidemiological information. These results should not be reported in the clinical report.

2.2 Nonproprietary Names

To minimize confusion, all antimicrobial agents should be referred to by nonproprietary names.

2.3 Selection Guidelines

To make the routine susceptibility test relevant and practical, the number of agents tested should be limited. In general, routine tests should include only one representative of each group of related drugs with activity against a nearly identical spectrum of organisms and for which interpretive results would be nearly always the same. The laboratory should report the specific drug tested and footnote other compounds represented by that drug.

Some of the selection boxes presented in Table 1 include certain agents or groups of agents with comparable clinical indications and activity against a similar but not identical spectrum of pathogens. Table 1 lists those drugs that should fulfill the basic requirements for routine use in most clinical veterinary laboratories.

The following guidelines are to be used for the selection and reporting of agents from some of the larger groups to be tested routinely:

2.3.1 β-Lactams

β-lactam antimicrobial agents all share a common, central, four-membered β-lactam ring. The principal mode of action is inhibition of cell wall synthesis. Additional ring structures or substituent groups added to the β-lactam ring determine whether the agent is a penicillin, cephem (cephalosporin), carbapenem, or monobactam. The substitutions affect the antibacterial spectrum and the pharmacokinetics of the individual compounds.

2.3.1.1 Penicillins

The spectrum of penicillin is directed primarily against non-β-lactamase-producing gram-positive and some gram-negative bacteria. Ampicillin and amoxicillin (the aminobenzylpenicillins) have activity against more gram-negative species, including non-β-lactamase-producing members of the Enterobacteriaceae. Carbenicillin and ticarcillin (carboxy-penicillins) as well as mezlocillin and piperacillin (ureido-penicillins) have a considerably expanded gram-negative spectrum, including activity against many *Pseudomonas* spp. Penicillinase-resistant penicillins (PRPs) (cloxacillin, dicloxacillin, methicillin, nafcillin, and oxacillin) are used specifically for treating the penicillinase-producing, methicillin-susceptible staphylococci.

Staphylococci should be tested against penicillin G and may be screened for β-lactamase production, especially in strains with borderline MICs (0.06 to 0.25 μg/mL; see Section 7). One PRP should be tested; usually, oxacillin is preferable to methicillin because of its storage stability and better reliability in the detection of methicillin-resistant *Staphylococcus aureus* (MRSA; see Section 4.3.7). Other penicillins need not be tested against staphylococci.

Test either penicillin or ampicillin against streptococci: testing for both is not necessary. Testing of secondary agents, such as cephalosporins, erythromycin, clindamycin, or tetracycline can be useful in the treatment of the penicillin-allergic animal.

For testing non-β-lactamase-producing enterococci, susceptibility to penicillin G predicts susceptibility to ampicillin, ampicillin analogues, and amoxicillin. For blood and cerebrospinal fluid (CSF) isolates, a β-lactamase test using an inoculum of $\geq 10^7$ colony-forming units per milliliter (CFU/mL) (or direct colony growth) is also recommended.

To provide synergistic killing activity, combination therapy with penicillin G or ampicillin plus an aminoglycoside is indicated for serious enterococcal infections in companion animals. Enterococci, which exhibit high-level aminoglycoside resistance are not reliably subject to synergy with that agent; such strains are detected by screening with high levels of streptomycin (1,000 μg/mL with broth or 2,000 μg/mL with agar) or gentamicin (500 μg) with agar or broth dilution tests.

For enterococci, tests against other agents, such as cephalosporins and clindamycin should not be reported because of lack of clinical correlation. Vancomycin is the accepted agent for treatment of enterococcal infection in the human penicillin-allergic patient. However, data concerning the efficacy of vancomycin in veterinary medicine are lacking and extra-label use of glycopeptides in food producing animals has been specifically prohibited by the U.S. FDA. Because of this, a footnote could be used to simply indicate that vancomycin is indicated for penicillin-allergic companion animal patients.

2.3.1.2 β-Lactam/β-Lactamase Inhibitor Combinations

These antimicrobial combinations include a penicillin and a second agent that has minimal antimicrobial activity but functions as an inhibitor of some β-lactamases. For some organisms, the results of tests of only the penicillin portion of the combination might not be predictive of susceptibility to the two-drug combination.

2.3.1.3 Cephalosporins and Other Cephems

The different cephalosporins and other cephem antimicrobial agents often have a slightly different spectrum of activity against the gram-positive and gram-negative bacteria. These agents are often referred to as "first-," "second-," "third-," or "fourth-" generation cephalosporins, depending in large part on the extent of their activity against the more resistant, gram-negative bacteria. Because of the differences in activities of some members of these groups, representatives of each group may be selected for routine testing.

Staphylococci are usually susceptible to the cephalosporins, except for MRSA. Although *in vitro* tests with methicillin-resistant staphylococci can suggest susceptibility, they should be considered resistant. The current information with coagulase-negative staphylococci is conflicting and, thus, this approach is a conservative one.

Enterococci are considered resistant to the cephalosporins, although some can appear to be susceptible under some test conditions, and some cephalosporins have produced clinical cures in some infection sites. Currently, the results of tests with enterococci against the cephalosporins should not be reported routinely.

2.3.1.4 Carbapenems

Carbapenems differ slightly in structure from penicillins and are much more resistant to β-lactamase hydrolysis, which provides them with broad-spectrum activity against many gram-positive and gram-negative bacteria.

2.3.1.5 Monobactams

Monobactam antimicrobial agents are structurally unique and show significant activity only against aerobic, gram-negative bacteria. The only monobactam approved for use in human medicine is aztreonam. None are approved for use in veterinary medicine.

2.3.2 Tetracyclines

These compounds inhibit bacterial protein synthesis at the ribosomal level. Drugs in this group are closely related and, with rare exception, only tetracycline should be tested routinely (see table footnotes).

2.3.3 Aminoglycosides/Aminocyclitols

This group of chemically related drugs includes, among others, streptomycin, amikacin, apramycin, gentamicin, kanamycin, netilmicin, tobramycin and spectinomycin. Members of this group inhibit bacterial protein synthesis at the ribosomal level. This group includes members that are affected in various ways by aminoglycoside-inactivating enzymes, which results in some differences in the spectrum of activity between agents. They are used primarily to treat aerobic gram-negative infections or in synergistic combinations with cell-wall active compounds against some resistant gram-positive bacteria. Aminoglycosides, such as gentamicin, have the potential to produce extended residue times in some animals, i.e., the bovine; therefore, their use should be monitored carefully.

2.3.4 Macrolides

Macrolides are structurally related antimicrobial agents that inhibit protein synthesis at the ribosomal level. This group includes erythromycin, clarithromycin, azythromycin, tylosin, and tilmicosin. Only erythromycin and tilmicosin should be tested.

2.3.5 Lincosamides

The lincosamides (lincosaminides) inhibit protein synthesis at the ribosomal level. This group includes lincomycin, clindamycin, and pirlimycin. Clindamycin should be tested routinely instead of lincomycin. However, clindamycin can be more active than lincomycin against some strains of *S. aureus*. Pirlimycin should be tested separately.

2.3.6 Quinolones

This group of antimicrobial agents functions primarily by inhibiting DNA-gyrase activity of many gram-positive and gram-negative bacteria. This group of compounds includes the older quinolones (i.e., nalidixic acid) and the newer fluoroquinolones, such as enrofloxacin, sarafloxacin, orbifloxacin, and difloxacin. Currently, only nalidixic acid, enrofloxacin, sarafloxacin, orbifloxacin, and difloxacin are approved for use in veterinary medicine. Both enrofloxacin and sarafloxacin are approved for use in food animals. Recently, the U.S. FDA has banned extra-label use of fluoroquinolones in veterinary medicine.

2.3.7 Sulfonamides and Trimethoprim/Ormetoprim

This group of compounds encompasses a wide variety of chemotherapeutic agents with similar spectra of activity resulting from inhibition of bacterial folate metabolism. Sulfachlorpyridazine and sulfisoxazole are the most commonly used sulfonamides in veterinary medicine and thus can be the appropriate selection for *in vitro* testing. Sulfadimethoxine is the only sulfa drug approved for use in dairy animals over 20 months of age and should be included in a panel if the species and age of an animal is unknown.

When sulfonamides are combined with trimethoprim, two sequential steps in folate metabolism are inhibited. Although trimethoprim/sulfadiazine is the usual combination in veterinary medicine, trimethoprim/sulfamethoxazole may be used for susceptibility testing. Ormetoprim/sulfadimethoxine activity is tested with trimethoprim/sulfamethoxazole.

2.3.8 Chloramphenicol and Related Analogs

Chloramphenicol, florfenicol, and thiamphenicol are a group of compounds that are broad spectrum, bacteriostatic agents which inhibit bacterial growth by blocking the transfer of soluble ribonucleic acid to ribosomes. While chloramphenicol should not be tested, or reported, for any isolate from food animals, florfenicol has been approved for treating pathogens associated with acute bovine respiratory disease. Thiamphenicol is not approved for use in the United States, but is approved for use in Europe.

2.3.9 Single Drug Classes

Currently, vancomycin, rifampin, novobiocin, tiamulin, polymyxin, and nitrofurantoin represent antimicrobial agents for which there are no related compounds that are appropriate for *in vitro* testing. Metronidazole and nitrofurantoin should not be reported for any isolate from food animals.

2.4 Guidelines for Routine Reporting

As listed in Table 1, agents in Group A and B are considered appropriate for inclusion in a routine primary panel for food and companion animals. Compounds in both Groups A and B may be reported routinely or selectively as outlined in Section 2.5.

Group C comprises agents that are frequently used in an extra-label fashion in the indicated animal species. It is the laboratory client's responsibility to use these compounds appropriately in the host animal species.

Compounds with prevention or growth promotion claims are not listed.

2.5 Guidelines for Selective Reporting

Each laboratory should decide which agents (Table 1) to report routinely from each group in accordance with the needs of their clientele. Selective reporting should help improve the clinical relevance of test reports and it should help to minimize the selection of multiresistant strains by overuse of broad-spectrum agents.

2.5.1 Examples

Examples of possible guidelines for selective reporting, as outlined for agents listed in Table 1, are as follows:

- Testing of an enteric bacillus susceptible to ampicillin should not include carbenicillin or ticarcillin, mezlocillin or piperacillin, amoxicillin/clavulanic acid, ampicillin/ sulbactam or ticarcillin/clavulanic acid.
- Testing of an enteric bacillus susceptible to a first-generation cephalosporin should not include a second-, third-, or fourth-generation cephalosporin.
- Testing of an enteric bacillus susceptible to gentamicin should not include tobramycin or amikacin.
- Testing of enterococci from nonurinary sites should not include agents other than

penicillin or ampicillin, except vancomycin as requested for penicillin-allergic animals.

- Staphylococci resistant to methicillin/oxacillin should not include any cephalosporins, amoxicillin/clavulanic acid, imipenem, ampicillin/ sulbactam, or other β-lactam antibiotic, regardless of *in vitro* results.
- Fluoroquinolones should not be reported for extra-label use in food animals.

2.6 Interpretive Categories

2.6.1 Susceptible

This category implies that an infection due to the strain of bacterium can be inhibited by achievable serum or tissue levels of the dosage of antimicrobial agent recommended for that type of infection and infecting species, unless otherwise contraindicated.

2.6.2 Intermediate

This category provides a "buffer zone." This buffer zone should prevent small, uncontrolled technical factors from causing discrepancies in interpretations (e.g., a resistant organism being categorized as susceptible [termed a *very major error*] or a susceptible organism being categorized as resistant [termed a *major error*]), especially for drugs with narrow pharmacotoxicity margins.

This category includes strains with MICs that approach or can exceed usually attainable blood or tissue levels but do not have flexible labeling; and for which response rates can be lower than for strains in the "susceptible" category. These strains can be inhibited by attainable concentrations of certain antimicrobial agents:

In body sites, such as the urinary tract, where drugs are physiologically concentrated (e.g., quinolones, β-lactams).

- Provided the drug has a wide pharmacotoxicity margin and is administered at maximal dosage (e.g., β-lactams).

If the organism is not susceptible to alternative clinically feasible drugs, if the site of infection is not one where the drug is concentrated, or if the high dose cannot be used, the test should be repeated.

2.6.3 Flexible Label

Indicates the availability of U.S. FDA-approved flexible labeling; this organism could be considered susceptible if appropriate dosing modifications found in the product packaging insert are applied.

2.6.4 Resistant

Resistant strains are not inhibited by the usually achievable systemic concentrations of the agent with normal dosage schedules and/or fall in the range where specific microbial resistance mechanisms are likely (e.g., β-lactamases), and clinical efficacy has not been reliable in treatment studies.

3 Susceptibility Testing

3.1 Indications for Performing Susceptibility Tests

3.1.1 Limitations of Disk Diffusion and Dilution Methods

The disk diffusion and dilution methods described in this document have been standardized for testing the rapidly growing pathogens, which include *Staphylococcus* spp., *Enterococcus* spp., the Enterobacteriaceae, *P. aeruginosa*, and *Acinetobacter* spp., and they have been modified for testing some fastidious organisms such as *S. pneumoniae* as outlined in Table 5. Studies are not yet adequate to develop reproducible, definitive standards to interpret disk tests with other microorganisms not listed in the tables that could require different media, different atmospheres, or indicate marked strain-to-strain variation in growth rate. Such organisms should not be tested by the disk diffusion method because the results cannot be interpreted reliably.

Dangerously misleading results can occur when certain antimicrobial agents are tested against specific organisms. These combinations include, but might not be limited to the following: first- and second-generation cephalosporins and aminoglycosides against *Salmonella* spp.; all β-lactam antimicrobial agents (except oxacillin, methicillin, and nafcillin) against methicillin-resistant staphylococci; cephalosporins, aminoglycosides (except high-level testing for resistance), clindamycin, and trimethoprim/sulfamethoxazole against enterococci; and cephalosporins against *Listeria* spp.

In addition to the above pitfalls, some antimicrobial agents are associated with the emergence of resistance during prolonged therapy. Therefore, isolates that are initially susceptible can become resistant within three to four days after initiation of therapy. This occurs most frequently in *Enterobacter* spp., *Citrobacter* spp., and *Serratia* spp. with third-generation cephalosporins; in *P. aeruginosa* with all antimicrobial agents; and in staphylococci with quinolones.

Detection of β-lactamase production in enterococci is possible only by a direct β-lactamase test. Members of the Enterobacteriaceae, *Pseudomonas* spp., and other aerobic gram-negative bacilli are not to be tested routinely for β-lactamase production because the results might not be predictive of susceptibility to the β-lactams most often used for therapy. Recommended β-lactamase test methods are indicated in Section 7.

Any organism identified as a causal agent is a candidate for susceptibility testing. This may not be necessary if the identity of the organism suggests a choice of chemotherapeutic agents. Etiologic organisms will, however, normally be identified at the same time the susceptibility test is performed. Susceptibility tests are most often indicated when the causative organism is thought to belong to a species known to be capable of exhibiting resistance to commonly used antimicrobial agents (e.g., *Staphylococcus* spp. and the Enterobacteriaceae). Some organisms have predictable susceptibility to antimicrobial agents. Susceptibility tests are seldom necessary when the infection is due to a microorganism that is susceptible to a highly effective drug (e.g., the universal susceptibility of Group C and Group G streptococci and *Arcanobacterium* [*"Actinomyces"*] *pyogenes* to penicillin). Erythromycin, vancomycin, and tetracycline may be tested against streptococci from animals that are allergic to penicillin to detect those strains resistant to these alternative drugs.

Isolated colonies of each type of organism that might be playing a pathogenic role should be selected from primary agar plates and tested for susceptibility. Identification procedures may be performed at the same time. Mixtures of different types of microorganisms should not be tested on the same susceptibility test plate. The practice of conducting susceptibility tests directly with clinical material should be avoided. When the nature of the infection is not clear and the specimen contains mixed growth or normal flora, in which the organisms probably bear little relationship to the infectious process being treated, susceptibility tests are often not necessary; the results can even be grossly misleading.

4 Disk Diffusion Susceptibility Tests

4.1 Zone Size Interpretive Standards

Table 2 shows interpretive guidelines for the sizes of the zones of inhibition for use with agar disk diffusion susceptibility tests and MIC breakpoints for use with dilution susceptibility tests. For those agents for which veterinary-specific guidelines are not available, the use of these values in relation to veterinary bacterial isolates must be done with caution for three reasons. First, the categories listed in Table 2 were developed in human medicine by comparing zone diameters to MICs in broth or agar dilution tests and from population distributions of zones and/or MICs of known susceptible and resistant strains. Second, the MICs and correlated zone-size distributions were analyzed in relation to the clinical pharmacokinetics of the drug from normal dose-range schedules in humans. Third, the *in vitro* and pharmacologic data have been analyzed in relation to studies of clinical outcome of treatment of specific human pathogens.

4.2 Equivalent MIC Breakpoints

Disk diffusion zone diameters correlate inversely with MICs from standard dilution tests, usually broth microdilution. Table 2 lists the zone diameters and MIC breakpoints used for the interpretive guidelines. Zone diameters and MIC breakpoints are correlated based upon zone-diameter versus MIC regression, population distributions, pharmacokinetics, and clinical efficacy studies.[6] However, the zone

(5) Just before use, agitate this turbidity standard vigorously on a mechanical vortex mixer.

(6) Replace standards or recheck their densities three months after preparation.

4.3.4 Inoculation of Test Plates

4.3.4.1 Growth Method Inoculum Preparation

The steps of the standard method are as follows:

(1) Select at least four to five well-isolated colonies of the same morphological type from an agar plate culture. Touch the top of each colony with a wire loop (or nontoxic cotton or Dacron swab) and transfer the growth to a tube containing 4 to 5 mL of a suitable broth medium, such as tryptic-soy broth.

(2) Allow the broth culture to incubate at 35 °C until it achieves or exceeds the turbidity of the standard described in Section 4.3.3 (usually two to eight hours).

(3) Adjust the turbidity of the active growing broth culture with sterile saline or broth to obtain a turbidity visually comparable to that of the 0.5 McFarland turbidity standard described in Section 4.3.3. To perform this step properly, use adequate light, and to aid in the visual comparison, read the tube against a white background with contrasting black lines.

(4) Within 15 minutes after adjusting the turbidity of the inoculum suspension, dip a sterile nontoxic swab on an applicator into the adjusted suspension. Rotate the swab several times, pressing firmly on the inside wall of the tube above the fluid level to remove excess inoculum from the swab.

(5) Inoculate the dry surface of a Mueller-Hinton agar plate by streaking the swab over the entire sterile agar surface. Repeat this streaking procedure two more times, and rotate the plate approximately 60° each time to ensure an even distribution of inoculum. Replace the plate top and allow three to five minutes, but no longer than 15 minutes, for any excess surface moisture to be absorbed before applying the drug-impregnated disks. If the plate is streaked satisfactorily, and the inoculum was correct, the zones of inhibition will be uniformly circular and there will be a confluent—or an almost confluent—lawn of growth. If only isolated colonies grow, the inoculum was too light and the test should be repeated.

NOTE: Avoid extremes in inoculum density. Never use undiluted overnight broth cultures for streaking plates.

4.3.4.2 Direct Colony Suspension Method Inoculum Preparation

For routine susceptibility tests, the inoculum is standardized by making a direct saline or broth suspension of colonies that are selected from an 18- to 24-hour agar plate (a nutrient, nonselective medium, such as blood agar, is used).[8,9] The suspension is adjusted to match the turbidity standard, as outlined in Section 4.3.3. This approach is the method of choice for testing species that fail to grow satisfactorily in broth media (i.e., *Actinobacillus pleuropneumoniae* and *Streptococcus* spp. [see Sections 4.3.5 and 4.3.6]) or for testing *Staphylococcus* spp. for methicillin resistance (see Section 4.3.7).

When testing trimethoprim/sulfamethoxazole disks using this method, colonies obtained from the nonselective medium can carry over enough antagonistic substances to produce a haze of growth inside a zone of inhibition produced by susceptible strains.

Devices that permit direct standardization of inocula without adjustment of turbidity and without preincubation in a broth medium have been found to be acceptable for routine testing purposes.[10,11]

4.3.4.3 Test Procedure for All Methods of Inoculation

The test procedure for all methods of inoculation is as follows:

(1) Place the appropriate drug-impregnated disks on the surface of the agar plate inoculated by one of the methods described in Section 4.3.4.1 or 4.3.4.2. With sterile

forceps or needle tip, gently press down each disk to ensure complete contact with the agar surface. The disks may be placed individually or with a dispensing apparatus, but they must be distributed evenly so that they are no closer than 24 mm from center to center. *No more than 12 disks should be placed on one 150-mm plate or more than five disks on a 100-mm plate.* Because some of the drug diffuses almost instantaneously, a disk is not to be moved once it has come in contact with the agar surface.

(2) Invert the plates and place them in an incubator at 35 °C within 15 minutes after the disks are applied. The plates should not be incubated under an increased concentration of CO_2, because the interpretive standards were developed by using aerobic incubation and, with some agents (i.e., macrolides, lincosaminides, tetracyclines), CO_2 will significantly alter the size of the inhibitory zones due to pH changes. Organisms requiring CO_2 for standardized testing, such as *Haemophilus somnus* and *Actinobacillus pleuropneumoniae* should be incubated in an environment of 3 to 7% CO_2. If a CO_2 incubator is not available, a candle extinction jar is an acceptable alternative. Control strains, which are tested concurrently, will indicate whether the pH has changed unacceptably. Only those antimicrobial agents for which acceptable quality control values have been achieved should be reported.

(3) After 16 to 18 hours of incubation, examine each plate and measure the diameters of the zones of complete inhibition (as judged by the unaided eye), including the diameter of the disk. Measure the zones to the nearest whole millimeter, using sliding calipers, a ruler, or a template prepared for this purpose. Hold the measuring device onto the back of the petri plate illuminated with a reflected light against a black, nonreflecting background. If the test organism is a *Staphylococcus* or *Enterococcus* spp., 24 hours of incubation are required and transmitted light is used to examine the oxacillin and vancomycin zones for light growth of methicillin- or vancomycin-resistant colonies, respectively, within apparent zones of inhibition. If blood is added to the agar base, measure the zones from the surface illuminated with reflected light and with the cover removed.

(4) The end point should be taken as the area showing no obvious, visible growth that can be detected with the unaided eye, not including faint growth or tiny colonies that can be detected only with difficulty at the edge of the zone of inhibited growth. Large colonies growing within a clear zone of inhibition should be subcultured, reidentified, and retested. Strains of *Proteus mirabilis* and *Proteus vulgaris* may swarm into areas of inhibited growth around certain antimicrobial agents. The zones of inhibition are usually clearly outlined and the veil of swarming growth is ignored. With trimethoprim and the sulfonamides, antagonists can allow some growth; therefore, with these drugs, disregard slight growth (i.e., the density of the growth is 20% or less than that seen outside the zone of inhibition), and measure the margin of heavy growth (80 to 100% of the density seen outside the zone of inhibition) to determine the zone diameter.

(5) Interpret the sizes of the zones of inhibition by referring to Table 2, and report the organism to be susceptible, intermediate, or resistant.

4.3.5 Fastidious Organisms

4.3.5.1 Indications for Testing Fastidious Organisms

Mueller-Hinton medium described above for the rapidly growing aerobic pathogens is not adequate for fastidious organisms. If susceptibility testing is to be done with fastidious organisms, the medium, quality control procedures, and interpretive criteria must be modified to fit each organism.

4.3.5.2 Disk Diffusion Testing of *Haemophilus somnus and Actinobacillus pleuropneumoniae*

The procedures described here have been shown to be accurate and provide reproducible results in accordance with the quality control guidelines outlined in Section 6. The medium of choice for performing disk diffusion testing with these organisms is chocolate Mueller-

Hinton. One liter of this medium consists of the following ingredients:

Mueller-Hinton agar (38.0 g):	
+ Beef Extract	2.0 g (from 300 g of beef infusion)
+ Acid Hydrolysis of Casein	17.5 g
+ Starch	1.5 g
+ Agar	17.0 g
Hemoglobin (10.0 g)	
Nutritional Supplement (10.0 mL):[12]	
+ Vitamin B_{12}	0.01 g
+ L-Glutamine	10.00 g
+ Adenine	1.00 g
+ Guanine HCL	0.03 g
+ p-Aminobenzoic Acid	0.013 g
+ NAD	0.25 g
+ Thiamine pyrophosphate	0.10 g
+ Ferric Nitrate - $8H_2O$	0.02 g
+ Thiamine HCL	0.003 g
+ L-Cysteine HCL	25.90 g
+ L-Cystine	1.10 g
+ Dextrose	100.00 g

The Mueller-Hinton agar is mixed with 60% of the total water volume and steam sterilized. The hemoglobin is mixed with 40% of the total water volume and steam sterilized. The two mixtures are then combined at >50 °C. The mixture is cooled to 48 °C with constant stirring, at which time the nutritional supplement is added aseptically. The medium is allowed to mix for ten minutes and then poured into flat-bottomed petri dishes on a level, horizontal surface to a uniform depth of approximately 4 mm, in accordance with Section 4.3.1.4 of this document.

4.3.5.3 Test Procedure

The direct colony suspension procedure should be used when testing *H. somnus* and *A. pleuropneumoniae*. Using colonies taken directly from an overnight (preferably 20 to 24 hours) chocolate agar culture plate, a suspension of the test organism is prepared in sterile Mueller-Hinton broth, water or 0.9% saline. The suspension should be adjusted to a turbidity equivalent to a 0.5 McFarland standard. This suspension will contain approximately 1 to 4 x 10^8 CFU/mL. Care must be exercised in preparing this suspension because higher inoculum concentrations may lead to false-resistant results. Within 15 minutes after adjusting the turbidity of the inoculum suspension, it should be used for plate inoculation.

The procedure for the disk test should be followed as described, beginning with Section 4.3.4 for nonfastidious bacteria, except that no more than nine disks should be applied to the surface of a 150-mm plate or no more than four disks on a 100-mm plate.

Plates are incubated at 35 °C in an atmosphere of 5% CO_2 for 20 to 24 hours before measuring the zones of inhibition.

The innermost zone of obvious growth inhibition should be regarded as the zone margin.

4.3.5.4 Quality Control Testing of *Haemophilus somnus* and *Actinobacillus pleuropneumoniae*

The antimicrobial agents for which quality control testing has been established for *H. somnus* and *A. pleuropneumoniae* are indicated in Table 3A. Disk diffusion testing of these isolates with other agents is not recommended until appropriate quality control parameters have been established.

4.3.6 *Streptococcus* spp.

4.3.6.1 Agar Medium

The recommended medium for testing *S. pneumoniae* and other streptococci is Mueller-Hinton agar supplemented with 5% defibrinated sheep blood.

4.3.6.2 Test Procedure

(1) The direct colony suspension procedure should be employed as follows: growth from an overnight (16- to 18-hour) sheep blood agar plate is suspended in sterile Mueller-Hinton broth, water, or 0.9% saline to a density equivalent to the turbidity of the 0.5 McFarland standard. Within 15 minutes after adjusting the turbidity of the inoculum suspension, it should be used for plate inoculation.

(2) The disk diffusion procedure steps described, beginning with Section 4.3.4, should be followed except that not more than nine disks should be placed on a 150-mm agar plate or four disks on a 100-mm plate.

(3) The plates are incubated at 35 °C in an atmosphere of 5% CO_2 for 20 to 24 hours before measuring the zones of inhibition.

4.3.6.3 Zone Diameter Interpretive Criteria

The zone interpretive criteria to be used when testing *S. pneumoniae* and other streptococci are included in Table 2.

NOTE: Isolates of *S. pneumoniae* with oxacillin zone sizes of ≥ 20 mm are susceptible (MIC ≤ 0.06 µg/mL) to penicillin. Because zones of ≤ 19 mm with the oxacillin disk screening test occur with penicillin resistant, intermediate, and certain susceptible strains, a penicillin MIC should be determined on isolates of *S. pneumoniae* with oxacillin zones of ≤ 19 mm.[13] Isolates should not be reported as penicillin resistant or intermediate based solely on an oxacillin zone of ≤ 19 mm. Oxacillin disk testing for the purpose of determining penicillin susceptibility of streptococci other than *S. pneumoniae* is not recommended. A penicillin MIC should be determined on isolates of viridans group streptococci from normally sterile body sites (e.g., cerebrospinal fluid, blood, bone, etc.). Penicillin (and oxacillin) disk diffusion testing is not reliable with viridans group streptococci.

4.3.7 Methicillin-Resistant Staphylococci[14]

Problems associated with detection of methicillin-resistant (heteroresistant) staphylococci when using the disk diffusion and dilution tests have recently emerged. Some of these problems could be related to changes in the organisms, some to change in test culture media, and some to the limitations of the method itself. The most evident problems now are difficulties in detecting cross-resistance among the penicillinase-resistant penicillins (PRP) and failure of the older interpretive criteria to correlate with the genotypic profiles of organisms (mecA genes). The subcommittee makes the following recommendations:

- Currently, because the oxacillin test is more likely to detect cross-resistance than methicillin, oxacillin is recommended unless it is shown that the hospital-endemic, PRP-resistant staphylococcal population is one that is detected better with methicillin. Nafcillin should not be used if blood or blood products are in the test medium.
- To prepare the inoculum from an 18-to-24-hour agar plate, use the alternative direct method rather than the standard method.[10,11]
- The user should be aware that most heteroresistant (oxacillin-resistant) staphylococci are usually resistant to multiple antimicrobial agents, including β-lactams, aminoglycosides, macrolides, clindamycin, and tetracycline; and this should be used as a clue to PRP-resistance. Another clue to PRP heteroresistance is the presence of a "film" of growth within a zone of inhibition around a methicillin, oxacillin, nafcillin, or cephalothin disk.
- Methicillin-resistant *Staphylococcus aureus* (MRSA) and methicillin-resistant coagulase-negative staphylococci should be reported as resistant to all β-lactams regardless of the *in vitro* test result. The justification for this is that, in most cases of documented MRSA infection, the patient has responded poorly to the cephalosporin therapy or clinical data have yet to be derived confirming clinical efficacy (imipenem and sulbactam and clavulanic acid combinations). Methicillin-resistant, coagulase-negative *Staphylococcus* spp. also appear not to respond well to these drugs, but fewer data are available than with MRSA and the breakpoint for mecA positive strains (PCR) may be lower for oxacillin (e.g. ≤ 0.25 or ≤ 0.5 µg/mL).
- See Table 5 for a method for tests of organisms with PRPs. This includes the recommendation for addition of 2% NaCl to the medium.
- Intrinsic oxacillin resistance in *S. aureus* can be confirmed by inoculating the organism onto Mueller-Hinton agar that has been supplemented with 4% NaCl and 6 µg oxacillin/mL.[15] The agar is inoculated as a "spot"; or a quadrant of the plate is streaked using a cotton swab that has been dipped into a suspension equivalent to a 0.5 McFarland standard and from which the excess fluid has been expressed. It is incubated at 35 °C for 24 hours and

observed for the presence of any colony formation that indicates intrinsic oxacillin resistance. This method (oxacillin agar screen plate) has been used extensively with acceptable predictive value for *S. aureus*. Experience with coagulase-negative staphylococci is less extensive. *Staphylococcus* epidermidis appears to react differently with a lower breakpoint MIC,[16,17] and may require 48 hours of incubation using the oxacillin agar screen plate.

4.3.8 Other Organisms

4.3.8.1 *Listeria* spp.

Listeria spp. should be tested with the broth microdilution method using Mueller-Hinton broth supplemented with 2 to 5% lysed horse blood. Due to the slow growth rate of these organisms, the results of the disk diffusion test are to be considered "invalid."

4.3.8.2 *Arcanobacterium ("Actinomyces") pyogenes*

Because *A. pyogenes* is routinely susceptible to penicillin, susceptibility testing should not be necessary. This organism should be tested by a microdilution MIC method. Due to the slow growth rate of the organism, the results of the disk diffusion test are to be considered "invalid." When isolated from a mixed infection, combination therapy including penicillin can be warranted. Isolates from penicillin-allergic animals can respond to drugs in the macrolide class of antimicrobial agents.

4.3.9 Anaerobic Organisms

Susceptibility testing of anaerobic bacteria isolated from animals should be performed in accordance with procedures outlined in the most current edition of NCCLS document M11 — *Methods for Antimicrobial Susceptibility Testing of Anaerobic Bacteria*. The interpretive categories and correlative minimal inhibitory concentrations (MICs) for antimicrobial agents appropriate to treat infections caused by anaerobic bacteria are listed in Table 2A.

5 Broth and Agar Dilution Susceptibility Testing

5.1 Indications for Performing Broth and Agar Dilution Susceptibility Tests

Clinically, an *in vitro* antimicrobial agent susceptibility test is useful as a guide for determining chemotherapy whenever the susceptibility of a pathogen is unpredictable or when an infection has not responded to therapy that otherwise appears appropriate. The MIC obtained by a dilution test can give a clinician an indication as to the concentration of antimicrobial agent needed at the site of infection to eradicate or inhibit the infecting organism. The MIC, however, does not represent an absolute value. The "true" MIC is somewhere between the lowest test concentration that inhibits the organism's growth (i.e., the "observed" MIC) and the next lower test concentration. If, for example, twofold dilutions were used and the "observed" MIC was 16 µg/mL, the "true" MIC would be between 8 and 16 µg/mL. Even under the best of controlled conditions, a dilution test might not yield the same end point each time it is performed. Generally, the acceptable reproducibility of the test is within one twofold dilution of the actual end point. To avoid greater variability, the dilution test must be standardized and carefully controlled.

MICs have been determined using concentrations derived traditionally from serial twofold dilutions of a starting concentration. In recent years, this starting concentration usually has been chosen to be an integral power of 2 (e.g., 128 µg/mL). Other dilution schemes have been used, including use of as few as two widely separated concentrations, and results from these alternative methods can be equally useful clinically.[18] When MICs are reported, however, it is important that the user know or be able to determine what dilution scheme was used. For example, when there is inhibition of growth at the lowest concentration tested, the true numerical result cannot be accurately determined and should be interpreted as equal to or less than the lowest concentration tested. The frequency of indeterminate results increases as fewer dilutions (concentrations) are tested. In tests in which four or fewer consecutive concentrations are tested, or in which nonconsecutive concentrations are tested, it is advisable to report a qualitative result (i.e., susceptible, intermediate, or resistant) but the MIC range can be reported if desired.

Dilution susceptibility tests can play a role in:

- The study of new antimicrobial agents.
- Defining intermediate levels of susceptibility when higher doses of antimicrobial agent might be feasible or preferable to conventional doses of potentially toxic agents, or when the agent might be physiologically concentrated (as in the urinary tract).

The techniques described in this document are intended primarily for testing commonly isolated bacteria that will grow well after overnight incubation in Mueller-Hinton medium, either unsupplemented or supplemented, as described in Section 5.2.3.[19] For some more fastidious and special problem pathogens that can require MIC tests, alternative methods are included in Table 5. These are not intended to be standard methods, but they are acceptable alternatives with which members of the subcommittee have had substantial experience. In some of these methods, lysed horse blood was used as a blood additive because it contained thymidine phosphorylase (thus making media more suitable for sulfonamide and trimethoprim testing), but it is likely that either lysed sheep or rabbit blood could be used instead. For tests with staphylococci, 2 g/L NaCl should be added only to the wells containing oxacillin or methicillin because it interferes with the growth of some organisms and alters the results obtained with aminoglycosides (2 g/L NaCl should be used in the agar-based MIC method). Although organisms other than staphylococci might not grow adequately in those wells, it is of little significance because these antibiotics are primarily antistaphylococcal drugs. NCCLS document M11 is an agar dilution reference standard for anaerobic bacteria.

Section 5.2.3.4 describes commercially available microdilution systems that contain either frozen or dried antimicrobial agents. These may also be used as a reference method as long as they adhere to standard NCCLS methodologies.

5.1.1 Reporting of Results

For laboratories utilizing dilution-MIC methods, the interpretive category should always be reported and if desired, the specific MIC can be reported along with the interpretive result. (This lessens the chances of clinical errors from mis- or overinterpretation of exact MICs.)

5.1.2 Rapid β-lactamase Test

A rapid β-lactamase test can clarify the susceptibility test results of staphylococci to penicillin determined by broth microdilution, especially in strains with borderline MICs (0.06 to 0.25 μg/mL). Detection of β-lactamase production in enterococci is possible only by a direct β-lactamase test. Do not test members of the Enterobacteriaceae, *Pseudomonas* spp., and other aerobic gram-negative bacilli because the results might not be predictive of susceptibility to the β-lactams most often used for therapy. Recommended β-lactamase test methods are indicated in Section 7.

5.2 Methodologies

5.2.1 Antimicrobial Agents

5.2.1.1 Source

Antimicrobial agent standards or reference powders can be obtained commercially, directly from the drug manufacturer, or from the United States Pharmacopeia (12601 Twinbrook Parkway, Rockville, MD 20852). Pharmacy stock or other clinical preparations are *not* to be used. Acceptable powders bear a label that states the drug's nonproprietary name, its assay potency (usually expressed in micrograms [μg] or International Units [IU] per milligram [μg] of powder), and its expiration date. The powders are to be stored as recommended by the manufacturers, or at -20 °C or below in a desiccator (preferably in a vacuum). When the desiccator is removed from the freezer, it should be warmed to room temperature before it is opened (to avoid condensation of water).

5.2.1.2 Weighing Antimicrobial Agent Powders

All antimicrobial agents are assayed for standard units of activity. The assay units can differ widely from the actual weight of the powder, and they often differ within a drug production lot. Thus, a laboratory must standardize its antimicrobial agent solutions based on assays of the lots of antimicrobial agent powders that are being used. Either of the following formulae may be used to determine the amount of powder or diluent needed for a standard solution:

$$\text{Weight (mg)} = \frac{\text{Volume (mL)} \cdot \text{Concentration } (\mu g/mL)}{\text{Assay Potency } (\mu g/mg)}$$

or

$$\text{Volume (mL)} = \frac{\text{Weight (mg)} \cdot \text{Assay Potency } (\mu g/mg)}{\text{Concentration } (\mu g/mL)}$$

The antimicrobial agent powder should be weighed on an analytical balance that has been calibrated with weights traceable to approved standard reference weights. If possible, more than 100 mg of powder is to be weighed. Usually, it is advisable to weigh accurately a portion of the antimicrobial agent in excess of that required and to calculate the volume of diluent needed to obtain the concentration desired.

Example: To prepare 100 mL of a stock solution containing 1,280 µg/mL of antimicrobial agent with antimicrobial agent powder that has a potency of 750 µg/mg, 170 to 200 mg of the antimicrobial agent powder is weighed accurately. If the actual weight is 182.6 mg, the volume of diluent needed is then:

$$\text{Volume} = \frac{\underset{\text{(Actual Weight)}}{182.6\ \mu g} \cdot \underset{\text{(Potency)}}{750\ \mu g/mg}}{\underset{\text{(Desired Concentration)}}{1{,}280\ \mu g/mL}}$$

Therefore, the 182.6 mg of antimicrobial agent powder is to be dissolved in 107.0 mL of diluent.

5.2.1.3 Preparing Stock Solutions

Antimicrobial agent stock solutions are to be prepared at concentrations of at least 1,000 µg/mL (for example: 1,280 µg/mL) or 10 times the highest concentration to be tested, whichever is greater. There are some antimicrobial agents, however, of limited solubility that can require lower concentrations.[18-20] In all cases, consider directions provided by the drug manufacturer as part of determining solubility.

Some drugs must be dissolved in solvents other than water. In such cases, it is necessary to:

(1) Use only enough solvent to solubilize the antimicrobial agent powder.

(2) Dilute to the final stock concentration with water or appropriate buffer as indicated in Table 6.[20]

Since contamination is extremely rare, solutions that have not been sterilized may be used. If, however, sterilized solutions are desired, they are to be filtered through a membrane filter. Paper, asbestos, or sintered glass filters, which may adsorb appreciable amounts of certain antimicrobial agents, are *not* to be used. Whenever filtration is used, it is important that the absence of adsorption by appropriate assay procedures be documented.

Small volumes of the sterile stock solutions are dispensed into sterile polypropylene or polyethylene vials, sealed carefully, and stored (preferably at -70 °C or colder). Vials are to be removed as needed and used the same day. Any unused drug is to be discarded at the end of the day. Stock solutions of most antimicrobial agents can be stored at -70 °C or colder for six months or more without significant loss of activity. In all cases, directions provided by the drug manufacturer are to be considered as a part of these general recommendations. Any deterioration of an antimicrobial agent may be ascertained from the results of susceptibility testing using quality control strains.

5.2.1.4 Number of Concentrations Tested

The concentrations to be tested for a particular antimicrobial agent should, at a minimum, encompass the breakpoints shown in Table 2. Unusual concentrations may be tested for special purposes (e.g., high concentrations of streptomycin and gentamicin may be tested to indicate whether either drug might have a synergistic effect with a penicillin against an enterococcus).

5.2.2 Agar-Dilution Procedure

The agar-dilution method for determining antimicrobial agent susceptibility is well established.[1, 21] The antimicrobial agent is incorporated into the agar, with each plate containing a different concentration of the agent. The inoculum can be applied rapidly and simultaneously to the agar surfaces using an inoculum-replicating apparatus.[22] Commercial replicators that are currently available usually transfer 32 to 37 inocula to each plate.

If agar dilution tests are to be performed with fastidious organisms, the medium, quality control procedures and interpretive criteria must be modified to fit each organism. Agar dilution testing of *Haemophilus somnus* and *Actinobacillus pleuropneumoniae* has been shown to be reliable when using Veterinary Fastidious Medium (VFM). It is important to note that the direct inoculum suspension method of preparing the test inoculum must be used with these species. The direct inoculum suspension method consists of making a direct broth or saline suspension of colonies selected from 18- to 24-hour agar plates (a nonselective medium, such as blood agar or chocolate agar should be used). The suspension is adjusted to match the 0.5 McFarland turbidity standard as outlined in Section 5.2.2.6. The medium and important technical aspects of testing these fastidious species are described in relevant sections above and outlined in Table 5. The quality control ranges for these two fastidious organisms are indicated in Table 4A.

5.2.2.1 Reagents and Materials

Mueller-Hinton agar is recommended for routine susceptibility testing of aerobic and facultative anaerobic bacteria. To avoid some of the problems with this medium in supporting growth of some fastidious organisms, various supplements are added (see Table 5). New lots of Mueller-Hinton agar are to be performance tested before use as outlined in Section 6. Media are used that have been tested according to, and meet the acceptance limits described in NCCLS document M6—*Protocols for Evaluating Dehydrated Mueller-Hinton Agar*.

Test media are to be prepared from a dehydrated base in accordance with the manufacturer's recommendations. After the agar is autoclaved, it is cooled to 48 to 50 °C in a water bath before adding antimicrobial agent solutions and unautoclaved supplements. The agar is then poured into the appropriate plates. The liquid agar may also be dispensed into smaller sterile containers, these containers sealed, and the agar allowed to equilibrate to 48 to 50 °C in a water bath before antimicrobial agent solutions are added and the agar is poured into the plates.

The pH of each batch of test medium is to be checked after it is sterilized. If a pH is out of range, the procedure for preparing the medium should be investigated. To ensure that the pH of the medium is between 7.2 and 7.4 at 25 °C, the pH of the medium is measured after it gels. The measurement is made with a standard combination pH electrode or with a surface electrode. If a standard combination electrode is used, it is necessary to:

(1) Submerge it in a small amount of gelled medium that has been macerated, or

(2) Allow a small amount of liquid agar in a small beaker to solidify around the electrode.

In either case, the electrode is supported so that its measuring tip does not press against the container walls. A thermometer is placed into the agar to determine the temperature.

Unlike the broth method, supplemental cations, (e.g., Ca^{++} and Mg^{++}) are not to be added to Mueller-Hinton agar. Mueller-Hinton agar may be supplemented with 5% (v/v) defibrinated sheep, rabbit, bovine or horse blood. The pH is checked after addition of the supplements. Autoclaving is not to be performed after these additions are made. These supplemented media are used only for:

- Testing those organisms that do *not* grow on the unsupplemented medium
- Appropriate control strains, which must be tested at the same time.

Information on dilution tests for some important fastidious or problem organisms is presented in Table 5.

5.2.2.2 Preparing Agar Plates

The procedure for preparing agar plates includes the following steps:

(1) Add appropriate dilutions of antimicrobial agent solution to molten test media that

have been equilibrated in a water bath to 48 to 50 °C.

(2) After mixing the agar and antimicrobial agent solution thoroughly, pour the mixture into petri dishes on a level surface as quickly as possible to prevent cooling and partial solidification in the mixing container (the agar should be approximately 4-mm deep [see Section 4.3.1.4]).

(3) Allow the agar to solidify at room temperature and use the plates immediately, or store them in sealed plastic bags at 2 to 8 °C for up to five days for reference work, or longer for routine tests (see Section 4.3.1.4). (It cannot be assumed that new antimicrobial agents will maintain their potency under these storage conditions. The user should evaluate the stability of these agar plates from results obtained with reference strains and should develop applicable shelf-life criteria. Data generated by drug manufacturers should be consulted for this information if it is available.)

(4) After storage, allow the agar plates to equilibrate to room temperature before using them.

(5) Ensure that the agar surface is dry before inoculating the plates (see Section 4.3.1.6).

5.2.2.3 Dilution Scheme for Reference Method

Although several dilution schemes can be appropriate for routine agar dilution testing, a scheme in which one part of antimicrobial solution is added to nine parts of liquid agar should be used for the reference method (Table 7).

5.2.2.4 Reference Work

For reference work, the agar plates should be used within five days. However, the appropriate reference control strains (Table 4) are to be tested each time tests are performed to ensure that no deterioration of antimicrobial agents has occurred. β-lactams and tetracyclines are generally the drugs most susceptible to deterioration. For routine tests, it is not necessary to limit storage to this time period as long as reference strains are used concurrently to control the tests as described in Section 6.5.

5.2.2.5 Control Agar Plates

Drug-free control agar plates (with or without supplements) are to be prepared.

5.2.2.6 Growth Method Inoculum Preparation

Because variations in the density of inoculum can alter the end points by one or more concentrations or dilutions, the preparation of a standardized inoculum is critical. It is necessary to:

- Select at least four or five well-isolated colonies of the same morphological type from the agar plate. Touch the top of each colony with a wire loop (or nontoxic cotton or dacron swab) and transfer growth to a tube containing 4 to 5 mL of a suitable broth medium, such as tryptic soy broth. (For *H. somnus* and *A. pleuropneumoniae*, prepare the inoculum in accordance with the procedures described in Section 4.3.5.3.) Allow the broth culture to incubate at 35 °C until it achieves or exceeds the turbidity of the standard described in Section 4.3.3. Adjust the density of this culture to a turbidity equivalent to that of a 0.5 McFarland standard by adding sterile broth, saline, or distilled water. Staphylococci should be tested by the direct inoculum procedure.

- Make the adjustment with an adequate light source and, to aid in the visual comparison, examine the fluid in the tubes against a white background with contrasting black lines. Turbidity adjusted to this standard contains approximately 1 to 2 × 10^8 CFU/mL. Most inoculum replicators deposit approximately 0.1 (1 mm pin) to 2.0 (3 mm pin) µL on the agar surface. If a 3-mm pin is used, dilute the adjusted suspensions 1:10 in sterile broth or saline to obtain the desired inoculum concentration of 1.0 × 10^7 CFU/mL. The final inoculum on the agar will then be approximately 1.0 × 10^4 (for the 1 mm pin) to 2.0 × 10^4 (for the 3 mm pin) CFU/mL in an agar area of 2 to 5 mm in diameter.

- If desired, use of photometric or other alternative systems to adjust the inoculum density of the culture has been demonso that, if another broth were to be selected, most of the previous studies would have to be repeated. Mueller-Hinton broth may be supplemented to support the growth of fastidious bacteria. Blood or blood constituents may be added for testing certain streptococci. Recommendations for susceptibility testing of *A. pleuropneumoniae* and *H. somnus* are in Section 5.2.3.2.

MIC performance and chemical characteristics of the broth are to be monitored routinely. The pH of each batch of Mueller-Hinton broth is to be checked with a pH meter when the medium is prepared; the pH should be between 7.2 and 7.4 at room temperature (25 °C). MIC performance characteristics of each batch of broth are evaluated using a standard set of quality control organisms (see Section 6).

Unless Mueller-Hinton broth has the correct concentrations of the divalent cations Ca^{++} and Mg^{++} (20 to 25 mg of Ca^{++}/L and 10 to 12.5 mg of Mg^{++}/L), MICs of aminoglycosides for *P. aeruginosa* and MICs of tetracycline for all bacteria will be different from those obtained on Mueller-Hinton agar.[15] Many manufacturers provide Mueller-Hinton broth that has already been adjusted. Therefore, the instructions for cation adjustments (see Section 5.2.3.1.1) should be followed only when the initial Mueller-Hinton broth has been certified by the manufacturer or measured by the user to contain no or inadequate amounts of Ca^{++} and Mg^{++} when assayed for total divalent cation content by atomic absorption spectrophotometry. Adding excess cations to Mueller-Hinton broth may result in erroneous results. Reliable susceptibility test results are achievable by disk diffusion or agar dilution with Mueller-Hinton agar that meet performance criteria specified in NCCLS document M6.

If a new lot of broth does not yield the expected MICs, the cation content is investigated or another lot is obtained. To determine the suitability of the medium for sulfonamide and trimethoprim tests, MICs are performed with *Enterococcus faecalis* ATCC® 29212 or *Enterococcus faecalis* ATCC®33186 (a more thymidine-sensitive strain). The end points should be easy to read (either as no growth or approximately 80% reduction as compared to the control). If MICs obtained with thymidine-free medium are ≤0.5 µg/mL, the medium is probably adequate for clinical use. If needed, thymidine phosphorylase or lysed horse blood (which contains thymidine phosphorylase) may be added to the medium to aid in tests with sulfonamides.[23]

In a routine setting, such as the clinical microbiology laboratory, some antimicrobial agent-broth combinations may require more frequent quality control tests than once weekly because of relatively rapid degradation of the drug.

5.2.3.1.1 Cation Adjustments[15]

The procedure for preparing magnesium stock solution is to dissolve 8.36 g of $MgCl_2 \cdot 6H_2O$ in 100 mL of deionized water. This solution will contain 10 mg of Mg^{++}/mL.

For preparing calcium chloride stock solution, the procedure is to dissolve 3.68 g of $CaCl_2 \cdot 2H_2O$ in 100 mL of deionized water. This solution will contain 10 mg of Ca^{++}/mL.

Stock solutions are sterilized by membrane filtration and stored at 4 °C.

Mueller-Hinton broth is prepared as the manufacturer directs, autoclaved, and chilled overnight at 4 °C or in an ice bath if it is to be used the same day.

With stirring, 0.1 mL of chilled Ca^{++} or Mg^{++} stock solution per liter of broth is added for each desired increment of 1 mg/L in the final concentration of Ca^{++} or Mg^{++} in the adjusted Mueller-Hinton broth. This medium is designated cation-adjusted Mueller-Hinton broth (CAMHB). Adjustments of Ca^{++} or Mg^{++} or both are not necessary when Mueller-Hinton broth from the manufacturer already contains the correct concentrations (20 to 25 mg of Ca^{++}/L and 10 to 12.5 mg of Mg^{++}/L) of divalent cations.

5.2.3.2 Broth Dilution Susceptibility Testing of Fastidious Organisms

The Mueller-Hinton broth used to test rapidly growing aerobic pathogens is not adequate for testing many of the fastidious organisms encountered in veterinary medicine. When a medium has been defined for testing a fastidious organism, quality control procedures and interpretive criteria must be established for testing that organism in that medium.

5.2.3.2.1 Microdilution Broth Testing of *Haemophilus somnus* and *Actinobacillus pleuropneumoniae*

The medium of choice for microdilution broth testing of these organisms is veterinary fastidious medium (VFM). One liter of this medium consists of the following ingredients:

Mueller-Hinton broth (22.0 g)	
+Beef Extract	3.0 g (from 300 gm of beef infusion)
+Acid Hydrolysis of Casein	17.5 g
+Starch	1.5 g
Yeast Extract (20.0 g)	
Lysed horse blood (20.0 mL)	
Supplement C™ [b] (yeast concentrate) (20.0 mL)	

Unless the Mueller-Hinton broth has the correct concentrations of divalent cations, Ca^{++} and Mg^{++}, appropriate salts need to be added to provide 20 to 25 mg per liter of calcium and 10 to 12.5 mg per liter of magnesium.

The Mueller-Hinton broth, with yeast extract (water-soluble portion of autolyzed yeast containing vitamin B complex), is mixed with 95.5% of total water volume and steam sterilized. It is then cooled to 8°C and the lysed horse blood and Supplement C™ are added aseptically. The blood is laked by three cycles of alternating freezing (at -20° or lower) and thawing followed by centrifugation at 3000 x g for 20 minutes for clarification.

5.2.3.2.2 Standardizing the Inoculum for Broth Dilution testing of *Haemophilus somnus* and *Actinobacillus pleuropneumoniae*.

Direct colony suspensions should be used when testing. Using colonies taken directly from an overnight (20 to 24 hours) chocolate agar culture plate, a suspension of the test organism is prepared in sterile Mueller-Hinton broth, water or 0.9% saline. The turbidity should be adjusted to a turbidity equivalent to a 0.5 McFarland standard using a photometric or commercial volumetric inoculum-preparation device. When a volumetric inoculum device is used, the manufacturer's instructions should be followed explicitly. This suspension may then be diluted as described in Section 5.2.2.6 to obtain a desired final concentration of 5 x 10^5 CFU/mL in each well or tube. Inoculum concentrations higher than 5 x 10^5 CFU/ml often lead to inappropriately high MICs with certain cephalosporin antimicrobial agents. Because of this inoculum effect determination of colony forming units should be performed on a regular basis (e.g., once weekly) to ensure that the final inoculum concentration is approximately 5 x 10^5 CFU/mL. The procedure for determining colony-forming units may be found in Section 5.2.3.5 (3).

Acceptable quality control ranges for these two organisms are indicated in Table 4A.

5.2.3.3 Methicillin-Resistant Staphylococci

See Section 4.3.7 for testing of methicillin-resistant staphylococci.

5.2.3.4 Preparing and Storing Diluted Antimicrobial Agents

- Macrodilution (Tube) Broth Method

For this method, it is necessary to:

- Use sterile 13 x 100-mm test tubes to perform the tests.
- Use a control tube containing broth without antimicrobial agent for each organism tested.
- Close the tubes with cotton plugs, loose screw caps, or plastic or metal caps.

When twofold dilutions are used, they may be prepared volumetrically in broth. The subcommittee recommends consulting the schedule in Table 7 when running a small number of tests. The total volume of each antimicrobial agent dilution to be prepared depends upon the number of tests to be performed. A minimum of 1 mL of each antimicrobial agent dilution is needed for each antimicrobial agent tested. A single pipet is used to prepare all diluents and then for adding the stock antimicrobial agent solution to the first tube. A separate pipet is used for each remaining dilution in that set. Because there will be a 1:2 dilution of the drugs when an equal volume of inoculum is

[b] Supplement C is a registered trademark of Difco.

used, the antimicrobial agent solutions are prepared double strength.

- Microdilution Broth Method

This method is named "microdilution" because it involves the use of small volumes of broth. Sterile plastic microdilution trays that have round or truncated-v bottom wells, each containing 0.05 to 0.1 mL of broth are used. The drugs may be diluted as described in Section 5.2.1 and in Table 7.

Microdilution trays can be made in the laboratory, or purchased commercially ready to use. If made in the laboratory, one of the available systems that automatically fills the wells can be obtained. In these systems, the desired media and antimicrobial agents are made in larger volumes and a dispenser automatically fills each well of the tray with the desired volume. Two types of commercial trays have been made. In one, the media-antimicrobial solutions are dispensed into trays and frozen for delivery to the user.[24] The user stores them in the frozen state (preferably at -70 °C or colder) and thaws them as needed. The other kind of commercial tray has dried antimicrobial agents in its wells.[25] The agents are put into solution by adding diluent and inoculum together, or separately, to each well.

The antimicrobial dilutions are to be made so that each concentration is contained in at least 10 mL of broth and, with a dispensing device, the wells of the microdilution trays are filled with 0.1 (± 0.02) mL each from these tubes. If the inoculum is to be added by pipet as described in Section 5.2.3.6, the antimicrobial agent solution is prepared double strength and the wells are filled with 0.05 mL instead of 0.1 mL. The filled trays are sealed in plastic bags and immediately placed in a freezer at -70 °C or colder until needed. Although the antimicrobial agents in frozen trays usually remain stable for several months, if they are to be used for reference work, they are to be used within four weeks after they are prepared. Trays are not to be stored in a self-defrosting freezer or thawed solutions refrozen; repeated freeze-thaw cycles accelerate the degradation of some antimicrobial agents, particularly β-lactams.

5.2.3.5 Standardizing Inoculum for Broth Dilution Testing

To standardize inoculum, follow these procedures:

(1) With the exception of *A. pleuropneumoniae*, *H. somnus*, and possible methicillin-resistant staphylococci, adjust the turbidity of the inoculated broth culture (see Section 5.2.2.6) to obtain a turbidity visually comparable to that of the 0.5 McFarland turbidity standard. Dilute the adjusted culture in broth (macrodilution method) or sterile water, saline, or broth (microdilution method) so that, after inoculation, each well or tube contains approximately 5×10^5 CFU/mL. The dilution procedure to obtain this final inoculum will vary according to the method and must be calculated for each system. The exact inoculum volume delivered to the wells must be known before this calculation can be done. For example, if the volume of medium in the well is 0.1 mL and the inoculum is 0.05 mL, then dilute the adjusted culture (10^8 CFU/mL) 1:100 with water, or saline, to yield 10^6 CFU/mL. When 0.05 mL of this suspension (10^6 CFU/mL) is inoculated into the broth, the final concentration of bacteria will be approximately 5×10^5 CFU/mL (or 5×10^4 CFU/well).

(2) With *A. pleuropneumoniae* and *H. somnus*, prepare a suspension of test organism in sterile Mueller-Hinton broth, water or 0.9% saline using colonies taken directly from an overnight (20 to 24 hour) culture. This suspension should be adjusted to a turbidity equivalent to a 0.5 McFarland standard using a photometric or commercial volumetric inoculum-preparation device. When a volumetric inoculum device is used, the manufacturer's instructions should be followed explicitly. The precise concentration of organisms in the starting suspension will depend on the conditions of incubation of the overnight blood agar culture; in particular, the length of incubation. The user should be aware that some *A. pleuropneumoniae* strains are adherent and, thus, it can be difficult to obtain a consistent inoculum.

The desired final inoculum concentration of 5×10^5 CFU/mL in each well or tube is achieved from the initial inoculum suspension as described in Section 5.2.3.5.(1). Inoculum concentrations higher than 5×10^5 CFU/mL often lead to inappropriately high MICs with certain cephalosporin antimicrobial agents.

(3) Laboratories are encouraged to determine colony-forming units on inoculum suspensions periodically to ensure that the final inoculum concentration routinely obtained approximates 5×10^5 CFU/mL. This can be easily accomplished by removing a 0.01-mL aliquot from the growth-control well or tube immediately after inoculation and diluting it in 10 mL of 0.9% saline. After mixing, a 0.1-mL aliquot is spread over the surface of a suitable agar medium. Following incubation, the presence of approximately 50 colonies would indicate an inoculum density of 5×10^5 CFU/mL.

5.2.3.6 Inoculating Broth

- Macrodilution (Tube) Broth Method

Before adjusting the inoculum, 1 mL of the various antimicrobial agent concentrations is placed in 13 x 100-mm tubes (a growth control without antimicrobial agent is included). Within 15 minutes after the inoculum has been standardized, 1 mL of the adjusted inoculum is added to each tube in the dilution series and mixed. This results in a 1:2 dilution of each antimicrobial agent concentration and a 1:2 dilution of the inoculum.

- Microdilution Broth Method

Each well of a freshly prepared or thawed tray is inoculated with a 0.05-mL pipet dropper or an inoculum replicator. As in macrodilution, the inoculum is diluted and the broth is inoculated within 15 minutes after the inoculum is standardized. If the volume of the inoculum exceeds 10% of the volume of the well, the diluting effect of the inoculum on the antimicrobial agent must be taken into account. If a pipet is used to inoculate the broth in a well, the resulting dilution is usually 1:2 (0.05 mL antimicrobial solution + 0.05 mL inoculum); but if a replicator is used, the resulting dilution is usually negligible (generally <5 µL of inoculum in 0.1 mL antimicrobial solution). To prevent drying, each tray is sealed in a plastic bag, with plastic tape, or with a tight-fitting plastic cover before it is incubated.

- Incubation

In both the macrodilution and the microdilution broth methods, the tubes or trays are incubated at 35 °C for 16 to 20 hours in a forced air incubator except with *H. somnus*, *A. pleuropneumoniae* and methicillin-resistant staphylococci (see Table 5). When testing *H. somnus* and *A. pleuropneumoniae*, tubes or trays should be incubated for a total of 20 to 24 hours before determining results. With methicillin-resistant staphylococci, the direct inoculum method is recommended, and incubation should be for a full 24 hours. To maintain the same incubation temperature for all cultures, microdilution trays are not to be stacked more than four high.

- Interpreting Results

The MIC is the lowest concentration of antimicrobial agent that completely inhibits growth of the organism as detected by the unaided eye. Viewing devices that make it easier to read microdilution tests are available. The amount of turbidity in the wells or tubes containing the antimicrobial agent is compared with the amount of turbidity in the growth-control wells or tubes (no antimicrobial agent) used in each set of tests. Microdilution MICs for gram-negative bacilli tend to be the same or one $\log_2$ dilution lower than the comparable macrodilution MICs.[6]

6 Quality Control Guidelines

6.1 Purpose

The goals of a quality control program are to monitor the following:

- The precision and accuracy of the susceptibility test procedure.
- The performance of reagents and the viability of the microorganisms used in the test.
- The performances of persons who carry out the tests and interpret the results.

The goals are best realized by, but not limited to, the use of reference strains selected for their genetic stability and for their usefulness in the particular method being controlled.

6.2 Quality Control Responsibilities

6.2.1 Responsibilities of the Manufacturer (Commercial and/or "In-house" Products)

The following are the responsibilities of the manufacturer (commercial and/or in-house products):

- Antimicrobial agent stability
- Antimicrobial agent identification
- Potency of antimicrobial agent
- Compliance with good manufacturing practices
- Integrity of product
- Accountability and traceability to consignee
- Batch-to-batch media uniformity
- Media preparation
- Potency of antimicrobial agent stock solutions.

Manufacturers should design and recommend a quality control program that allows the user to evaluate those variables (e.g., inoculum levels, storage/shipping conditions) that most likely will cause user performance problems and to determine that the assay is performing accurately when used according to directions for use.

6.2.2 Responsibilities of the Laboratory (User)

The following are the responsibilities of the laboratory (user):

- Storage (drug deterioration)
- Personnel proficiency
- Adherence to procedure (e.g., inoculum, incubation conditions [time, temperature, and atmosphere])
- Media storage

6.2.3 Batch or Lot Control

For batch or lot control, the procedure is as follows:

(1) Test each new batch or lot of media, lot of disks, macrodilution tubes, microdilution trays, or agar dilution plates with the appropriate reference strains to determine if zone sizes or MICs obtained with the media/batch fall within the expected range (see Table 3); if they do not, reject the media/batch.

(2) Incubate overnight at least one uninoculated tube, microdilution tray, or agar plate from each batch to ascertain the sterility of the medium.

(3) Variations in divalent cations, principally magnesium and calcium, will affect results with aminoglycosides and tetracyclines with *P. aeruginosa* strains. Excessive cation content will reduce zones sizes, whereas low cation content may result in unacceptably large zones of inhibition. Performance tests with each lot of Mueller-Hinton agar and broth must conform to the control limits in Tables 3 and 4 using *Pseudomonas aeruginosa* ATCC® 27853. Most media manufacturers are aware of the need for cation supplementation and have adjusted their medium accordingly. Such supplementation is indicated on the medium label. However, if a medium requires an increase in cation concentration, follow the procedure outlined in Section 5.2.3.1.1.

(4) Keep a record of the lot numbers of all of the materials and reagents used in these tests.

6.3 Agar Disk Diffusion Tests

6.3.1 Frequency of Testing

Each time a new lot of Mueller-Hinton agar or a new lot of susceptibility disks is introduced, it must be tested with appropriate control strains. Ideally, testing appropriate control strains each day that susceptibility tests are performed is the preferred method of analyzing the overall performance of susceptibility testing. Because this is not always practical, the frequency of test monitoring can be performed less frequently if the laboratory can document that its susceptibility testing procedures are reproducible. To document that the laboratory can provide reproducible susceptibility testing results, the laboratory should perform daily quality control tests. A form is provided in the Appendix that can be used to record susceptibility test results for the quality control organisms. To demonstrate the ability to generate reproducible susceptibility testing results, the following procedure should be used:

(1) Test all applicable control strains for 30 consecutive test days.

(2) For each drug/microorganism combination, no more than 3 of the 30 zone diameters (i.e., zone diameters obtained from one drug/microorganism combination for 30 consecutive test days) may be outside the accuracy control limits stated in Table 3.

Once the laboratory demonstrates the reproducibility of their susceptibility testing procedure by the above criteria, it may begin testing each quality control strain on a weekly basis. When using once-a-week testing, if a one diameter falls outside the acceptable control limits for any drug/microorganism combination, the laboratory must determine the cause of such an error. If the out-of-control result is due to an obvious error, e.g., use of the wrong disk, the wrong control strain, obvious contamination of the strain, or incorrect atmosphere of incubation, the quality control test should be repeated. If, however, the aberrant result is not due to an obvious error, the laboratory should return to daily control testing long enough to define the source of the aberrant results and to document resolution of the problem. Resolution of the problem may be documented by the following actions:

Testing with appropriate quality control strains for five consecutive test days.

Documenting that, for each of these drug/microorganism combinations, the five zone diameters (i.e., zone diameters obtained from one drug/microorganism combination for five consecutive test days) were within the acceptable ranges, as defined in Table 3.

If the problem cannot be resolved immediately (i.e., at least one zone diameter is still observed outside the acceptable control limits), daily control tests must be continued until final resolution of the problem can be achieved. To return to weekly quality control testing in the future will require documentation of satisfactory performance for another 30 consecutive test days.

Results for individual antimicrobial agents for which the quality control strain values are outside the control ranges should not be reported. The tests should be repeated and results reported only when quality control organisms yield values within the accepted ranges.

6.3.2 Zone Size Limits

Listed in Table 3 are the minimum and maximum zone diameters that should be observed with a single control test. In general, when performing susceptibility testing, either on a daily or weekly basis, 1 out of 20 consecutive tests for each drug/microorganism combination might be out of control (i.e., outside the stated accuracy control limits). Any more than one out-of-control result in 20 consecutive control tests requires corrective action (i.e., if a second out-of-control result occurs, corrective action must be taken).

6.3.3 Reference Strains

To control the precision and accuracy of the test procedure, the procedure is as follows:

(1) Maintain stock cultures (see Section 6.5.2) of *Staphylococcus aureus* ATCC® 25923, *Escherichia coli* ATCC® 25922, and *Pseudomonas aeruginosa* ATCC® 27853 from the ATCC or derivatives of these cultures obtained from reliable sources.

(2) Test these reference organisms by the previously described procedure using antimicrobial disks representative of those used to test clinical isolates.

(3) A β-lactamase producing *Escherichia coli* ATCC® 35218 has been designated for quality control of disks containing combinations of β-lactams and β-lactamase inhibitors. When used in conjunction with *Escherichia coli* ATCC® 25922, both components of the combination disks can be monitored (see Section 7).

in a series of 20 tests for each drug/microorganism combination might be out of control (i.e., outside the stated range). If two out-of-control results occur within the series of 20 consecutive tests, corrective action must be taken. When corrective action is taken, the count of 20 begins again.

6.4.3 Other Control Procedures

6.4.3.1 Growth Control

Each microdilution broth tray, macrodilution broth series, and agar dilution series should include a growth control of basal medium without antimicrobial agent to assess viability of the test organisms. With the broth tests, the growth control also serves as a turbidity control for determining end points.

6.4.3.2 Purity Control

A sample of each inoculum is streaked on a suitable agar plate and incubated overnight to detect mixed cultures and to provide freshly isolated colonies in case retesting proves necessary. This step is particularly important for broth dilutions where mixed cultures are likely to be unrecognized.

6.4.3.3 Inoculum Control

Plate counts are performed on representative inocula periodically to ensure that the $BaSO_4$ standard and the procedures for standardizing and diluting inoculum remain under control. Samples for plate counts are removed immediately from the positive control well of microdilution trays, the positive control tube of a macrodilution series, or (in agar dilution) from a random reservoir well of the replicator seed plate.

6.4.3.4 End Point Interpretation Control

End point interpretation is monitored periodically to minimize variation in the interpretation of MIC end points among observers. All laboratory personnel who perform these tests should read independently a selected set of dilution tests. The results from each person's readings are recorded and compared. Where aberrant results occur, the source of these results should be determined and corrected.

6.5 Suggested Reference Strains

6.5.1 Selecting Reference Strains

Reference strains are obtained from a reliable source (for example, from the American Type Culture Collection (ATCC), reliable commercial sources, or institutions with demonstrated reliability to store and use the organisms correctly).

A full set of quality control strains that have adequate or optimal zone sizes or end points for all the commonly used antibiotics is not yet available. There are however, a number of strains that have been tested repeatedly over the years and have proved to be genetically stable.

- Many reference strains used in the standard agar diffusion method (see Section 6.3.3) have also been used often as reference strains for dilution susceptibility tests.[27] The *Staphylococcus aureus* ATCC® 25923 strain, however, is of little value in dilution testing because of its extreme susceptibility to the drugs it is used to monitor. The *Pseudomonas aeruginosa* ATCC® 27853 strain develops resistance to carbenicillin after repeated transfers onto laboratory media, but this problem can be circumvented by removing a new culture from storage at appropriate intervals, or whenever the strain begins to show resistance. Additional strains that may be used for the dilution tests include *Escherichia coli* ATCC® 25922 and *Staphylococcus aureus* ATCC® 29213, which is a weak β-lactamase-producing strain.
- Currently, the subcommittee recommends the following reference strains for controlling susceptibility tests:

- *Escherichia coli* ATCC® 25922
- *Escherichia coli* ATCC® 35218
- *Pseudomonas aeruginosa* ATCC® 27853
- *Staphylococcus aureus* ATCC® 29213 (dilution)
- *Staphylococcus aureus* ATCC® 25923 (disk diffusion)

- *Enterococcus faecalis* ATCC® 29212
- *Enterococcus faecalis* ATCC® 33186
- *Actinobacillus pleuropneumoniae* ATCC® 27090
- *Haemophilus somnus* ATCC® 700025.

Tables 3 and 4 indicate the expected zone sizes and MICs (obtained by either agar dilution or CAMHB dilution) of various antimicrobial agents for these strains. With repeated testing, more than 95% of the zone sizes and MICs should fall within the ranges reported in Tables 3 and 4. Most of the MICs should be at values close to the center of the pertinent range. *Escherichia coli* ATCC® 35218 is recommended as the control organism for β-lactamase inhibitor combinations, such as those containing clavulanic acid or sulbactam. As an alternative, *Acinetobacter baumanii* (ATCC® pending) might be more appropriate for some β-lactam and β-lactamase inhibitor combinations.

Use such cultures to monitor precision and accuracy as long as there is no significant change in the mean zone diameter or MIC that cannot be attributed to methodology. Such a significant change indicates contamination or change in the organism's inherent susceptibility. Obtain fresh cultures if such changes occur.

When sulfonamides, trimethoprim, or trimethoprim/sulfamethoxazole are tested routinely, monitor each new lot of Mueller-Hinton agar for unsatisfactory levels of inhibitors. Perform the tests with *Enterococcus faecalis* ATCC® 29212 or *Enterococcus faecalis* ATCC® 33186 (a more thymidine-sensitive strain). This is especially important for some veterinary pathogens such as *Staphylococcus hyicus* or *Pasteurella haemolytica*. Satisfactory media will produce a zone of inhibition of 20 mm or more (see Section 4.3.1.2).

When selecting reference strains for dilution testing, select strains that have MICs that fall near the midrange of the concentration for all antimicrobial agents tested. An ideal control strain is inhibited at the fourth dilution of a seven-dilution $\log_2$ series, but strains with MICs at either the third or fifth dilution are acceptable. When three or fewer adjacent doubling dilutions of an antimicrobial agent are tested with these methods, quality control methods must be altered. One possible alternative is to use one control organism whose modal MIC is equal to or no less than one doubling dilution of the lower concentration and a second control organism whose modal MIC is equal to or no greater than one doubling dilution of the higher concentration. The combination of these two results provides for at least one on-scale end point. For commercial systems, this strategy might be best used selectively by testing the most labile agents (e.g., clavulanic acid combinations, methicillin, imipenem, and cefaclor) included in the panels. Before a strain is accepted as a reference, it is to be tested for as long as is necessary to demonstrate that its antimicrobial agent susceptibility pattern is stable genetically (see NCCLS document M37—*Development of In Vitro Susceptibility Testing Criteria and Quality Control Parameters for Veterinary Antimicrobial Agents*). The strains listed in Tables 3 and 4 have proven useful for quality control.

6.5.2 Storing Reference Strains

Reference strains are stored to minimize the possibility of mutation in the organism. There are two preferred methods for prolonged storage of reference strains.[28]

- One is to suspend the organisms in a stabilizer (for example, defibrinated whole blood, 50% fetal calf serum in broth, or 10% glycerol in broth) and store them in a freezer at a temperature of lower than −20 °C (preferably -60 °C or lower) or in liquid nitrogen.
- The other preferred method is to lyophilize the organism.

An alternative method, which is used for short-term storage of stock cultures, is to subculture the organisms on tryptic soy agar slants, and store them at 2 to 8 °C. Fresh slants are prepared at two-week intervals. Whenever aberrant results occur, a new stock culture is obtained.

To prepare strains for storage, it is necessary to perform the following steps:

performance for another 30 consecutive test days, as outlined in Section 6.3.1 of this document.

7 β-Lactamase Tests

7.1 Purpose

A positive result to a β-lactamase test can predict resistance to penicillin as well as amino-, carboxy-, and ureido-penicillins with staphylococci and enterococci.

7.1.1 Selecting a β-Lactamase Test

Chromogenic cephalosporin-based tests (either liquid or paper disk formats) or equivalent methods provide reliable results with staphylococci and enterococci.[29, 30] Acidimetric penicillinase tests have produced unacceptably high error rates generally when used to test staphylococci, *Moraxella catarrhalis*, and some anaerobic bacteria.

The β-lactamase test is preferred to the disk diffusion and the agar dilution tests for detection of β-lactamase-mediated resistance among enterococci.

8 Cumulative Antimicrobial Susceptibility Profile

Clinicians can benefit greatly from periodic summaries of selected microbiological results. Tables summarizing the antimicrobial agent susceptibility profiles of the most commonly isolated pathogens and selected fastidious or slow-growing (difficult to test) isolates, by anatomic site, are useful in guiding empiric therapy and in following general trends in antimicrobial agent susceptibility within clinical practice. If cumulative antimicrobial agent susceptibility profiles are to be constructed, it is recommended that the percentage of isolates *susceptible* to each antimicrobial agent be used. To avoid introducing biases in the data, care should be taken to exclude identical strains from the same animal or large numbers of isolates from a single herd. Inclusion of antibiotic cost information can also be appropriate as an aid in the reduction of the expense of antimicrobial therapy.

Table 1. Suggested Groupings of Antimicrobial Agents That Should Be Considered for Routine Testing by Veterinary Microbiology Laboratories

Group	Cattle[a]	Swine	Horses	Dogs	Poultry[c]	Bovine Mastitis[d]
Group A – (US-FDA Approved Veterinary Specific Interpretive Criteria) Primary Test and Report	Ceftiofur	Ceftiofur		Enrofloxacin[b]	Enrofloxacin[m,n]	Penicillin/novobiocin
	Tilmicosin			Spectinomycin		
Group B – (US-FDA Approved; NCCLS Approved Provisional Veterinary or Human Interpretive Criteria) Primary Test and Report	Ampicillin[e] ✓	Ampicillin[e] ✓	Amikacin ✓	Amikacin ✓	Ceftiofur[n]	Ampicillin[e] ✓
	Erythromycin	Erythromycin	Ampicillin[e] ✓	Ampicillin[e] ✓	Erythromycin	Cephalothin[f,g]
	Penicillin	Gentamicin ✓	Ceftiofur	Amoxicillin/clavulanate	Gentamicin ✓	Erythromycin
	Sulfamethazine	Lincomycin[j]	Gentamicin ✓	Ceftiofur	Penicillin	Penicillin
	Sulfadimethoxine	Penicillin	Penicillin	Cephalothin[g]	Sarafloxacin[m,n]	Pirlimycin
	Sulfachlorpyridazine	Sulfadimethoxine	Sulfadimethoxine	Clindamycin[i]	Spectinomycin	Oxacillin[f]
	Tetracycline[k] ✓	Tetracycline[k] ✓	Trimethoprim/ ✓ sulfamethoxazole[l]	Chloramphenicol[h] ✓		Tetracycline[k] ✓
				Erythromycin	Sulfadimethoxine	
				Gentamicin ✓	Tetracycline ✓	
				Kanamycin ✓		
				Penicillin		
				Sulfadimethoxine		
				Tetracycline[k] ✓		
				Trimethoprim/ ✓ sulfamethoxazole[l]		
Group C – Supplemental (Extra Label)	Amikacin ✓	Amikacin ✓	Erythromycin	Cefazolin	Trimethoprim/ ✓ sulfamethoxazole[l]	
	Gentamicin[i] ✓	Sulfamethoxine	Imipenem	Cefoxitin		
	Trimethoprim/ ✓ sulfamethoxazole[l]	Trimethoprim/ ✓ sulfamethoxazole[l]	Oxacillin	Imipenem		
				Tobramycin		
			Rifampin	Vancomycin		
			Tetracycline[k] ✓			
			Ticarcillin			
			Ticarcillin/clavulanic acid			
			Vancomycin			

Table 1. (Continued)

NOTE 1: This table contains those compounds used for therapeutic and control treatment of animal diseases. Compounds with prophylactic or prevention indications are not listed.

NOTE 2: Selection of the most appropriate antimicrobial agent to test and to report is a decision best made by each veterinary laboratory in consultation with pharmacy and veterinarians. Compounds listed in Group A and B are those compounds approved by the U.S. FDA for use in the United States for diseases in the indicated host animal. It is the responsibility of the laboratory client to ensure that compounds are used appropriately for host categories for each animal (e.g., lactating cows, calves) in accordance with the approved indication. Compounds listed in Group C are not approved but are frequently used in an extra-label manner in the indicated animal. The laboratory client assumes all responsibility for efficacy, safety, and residue avoidance with extra-label use of antimicrobial agents.

NOTE 3: Information in boldface type is considered provisional.

Footnotes

a. **Does not include goats or sheep.**
b. **Includes cats.**
c. **Includes chickens and turkeys.**
d. Compounds listed are for lactating dairy cattle only.
e. **The results of ampicillin susceptibility tests may be used to predict susceptibility to amoxicillin and hetacillin.**
f. **Oxacillin is used to detect methicillin-resistant staphylococci and is preferred to methicillin or cloxacillin. Methicillin-resistant staphylococci should be reported as resistant to all β-lactams, including cephalosporins and β-lactamase inhibitor combinations despite apparent *in vitro* susceptibility.**
g. **Cephalothin can be tested to represent the first-generation cephalosporins, such as cephapirin and cefadroxil. Cefazolin should be tested separately against the Enterobacteriaceae.**
h. Chloramphenicol must not be reported with any food-producing animal.
i. **Trimethoprim/sulfamethoxazole can be tested to represent the potentiated sulfonamides, including trimethoprim/sulfadiazine and ormetoprim/sulfamethoxine.**
j. Clindamycin is tested as the class representative for both lincomycin and clindamycin.
k. Tetracycline is tested as the class representative for chlortetracycline and oxytetracycline.
l. Due to extended residue times, use of gentamicin in cattle should be carefully monitored.
m. The U.S. FDA has recommended that fluoroquinolones not be reported for **extra-label use.**
n. **Approved for enteric disease treatment.**

Table 2. Zone Diameter Interpretive Standards and Minimum Inhibitory Concentration (MIC) Breakpoints for Veterinary Pathogens

Antimicrobial Agent	Disk Content	Zone Diameter (mm)				MIC Breakpoint (µg/mL)			
		Susceptible	Intermediate	Flexible Label	Resistant	Susceptible	Intermediate	Flexible Label	Resistant
β-Lactams Penicillins									
Ampicillin[*,g]									
Enterobacteriaceae	10 µg	≥ 17	14-16		≤ 13	≤ 8	16		≥ 32
Staphylococci[*]	10 µg	≥ 29	—		≤ 28	≤ 0.25	—		≥ 0.5
Enterococci[*]	10 µg	≥ 17	—		≤ 16	≤ 8	—		≥ 16
Streptococci (not *S. pneumoniae*)[*]	10 µg	≥ 26	19-25		≤ 18	≤ 0.25	0.5-4		≥ 8
Listeria monocytogenes[*]	—	—	—		—	≤ 2	—		≥ 4
Oxacillin[b,g]									
Staphylococci[*]	1 µg	≥ 13	11-12		≤ 10	≤ 2	—		≥ 4
Penicillin G[g]									
Staphylococci[*]	10 units	≥ 29	—		≤ 28	≤ 0.12	—		≥ 0.25
Enterococci[*]	10 units	≥ 15	—		≤ 14	≤ 8	—		≥ 16
S. pneumoniae[*,i]	1 µg oxacillin	≥ 20	—		—	≤ 0.06	0.12-1		≥ 2
Streptococci (not *S. pneumoniae*)[*,j]	10 units	≥ 28	20-27		≤ 19	≤ 0.12	0.25-2		≥ 4
Listeria monocytogenes[*]	—	—	—		—	≤ 2	—		≥ 4
Ticarcillin									
Pseudomonas aeruginosa[*]	75 µg	≥ 15	—		≤ 14	≤ 64	—		≥ 128
Gram-negative enteric organisms[*]	75 µg	≥ 20	15-19		≤ 14	≤ 16	32-64		≥ 128
β-Lactam/β-Lactamase Inhibitor Combinations									
Amoxicillin/clavulanic acid									
Canine (dermal, UTI)									
Staphylococci[*]	20/10 µg	≥ 20	—		≤ 19	≤ 4/2	—		
Other organisms[*]	20/10 µg	≥ 18	14-17		≤ 13	≤ 8/4	16/8		≥ 8/4
Ticarcillin/clavulanic acid									≥ 32/16
Pseudomonas aeruginosa[*]	75/10 µg	≥ 15	—		≤ 14	≤ 64/2	—		≥ 128/2
Gram-negative enteric organisms[*]	75/10 µg	≥ 20	15-19		≤ 14	≤ 16/2	32-64		≥ 128/2
Cephalosporins									
Cephalothin[*,c,g]	30 µg	≥ 18	15-17		≤ 14	≤ 8	16		≥ 32
Cefazolin[*]	30 µg	≥ 18	15-17		≤ 14	≤ 8	16		≥ 32
Cefoxitin[*]	30 µg	≥ 18	15-17		≤ 14	≤ 8	16		≥ 32

Table 2. (Continued)

Antimicrobial Agent	Disk Content	Zone Diameter (mm) Susceptible	Intermediate	Flexible Label	Resistant	MIC Breakpoint (µg/mL) Susceptible	Intermediate	Flexible Label	Resistant
Ceftiofur									
Cattle (Bovine Respiratory Disease)	30 µg	≥ 21	18-20		≤ 17	≤ 2	4		≥ 8
Pasteurella haemolytica									
Pasteurella multocida									
Haemophilus somnus									
Swine (Swine Respiratory Disease)	30 µg	≥ 21	18-20		≤ 17	≤ 2	4		≥ 8
Actinobacillus pleuropneumoniae									
Pasteurella multocida									
Salmonella choleraesuis									
Streptococcus suis									
Carbapenems									
Imipenem	10 µg	≥ 16	14-15		≤ 13	≤ 4	8		≥ 16
Aminoglycosides									
Amikacin*	30 µg	≥ 17	15-16		≤ 14	≤ 16	32		≥ 64
Gentamicin*	10 µg	≥ 15	13-14		≤ 12	≤ 4	8		≥ 16
Kanamycin*	30 µg	≥ 18	14-17		≤ 13	≤ 16	32		≥ 64
Macrolides									
Erythromycin*									
Organisms other than streptococci	15 µg	≥ 23	14-22		≤ 13	≤ 0.5	1-4		≥ 8
Streptococci[f]	15 µg	≥ 21	16-20		≤ 15	≤ 0.25	0.5		≥ 1
Tilmicosin[i]									
Cattle (Bovine Respiratory Disease)	15 µg	≥ 14	11-13		≤ 10	≤ 8	16		≥ 32
Pasteurella haemolytica									
Tetracyclines									
Tetracycline*,4a									
Organisms other than streptococci	30 µg	≥ 19	15-18		≤ 14	≤ 4	8		≥ 16
Streptococci[f]	30 µg	≥ 23	19-22		≤ 18	≤ 2	4		≥ 8
Quinolones									
Enrofloxacin									
Canine and feline (dermal, URI, UTI)	5 µg	≥ 23		17-22	≤ 16	≤ 0.5		1-2	≥ 4
Gram-negative enteric bacilli									
Staphylococcus spp.									
Other susceptible organisms									

Table 2. (Continued)

Antimicrobial Agent	Disk Content	Zone Diameter (mm) Susceptible	Zone Diameter (mm) Intermediate	Zone Diameter (mm) Flexible Label	Zone Diameter (mm) Resistant	MIC Breakpoint (µg/mL) Susceptible	MIC Breakpoint (µg/mL) Intermediate	MIC Breakpoint (µg/mL) Flexible Label	MIC Breakpoint (µg/mL) Resistant
Tiamulin[e]									
Swine Respiratory Disease		–	–		–	≤ 8	–		≥ 16
Actinobacillus pleuropneumoniae									
Sulfonamides*	250 or 300 µg	≥ 17	13-16		≤ 12	≤ 256	–		≥ 512
Trimethoprim/Sulfamethoxazole*[,f]									
Organisms other than *S. pneumoniae*	1.25/23.75 µg	≥ 16	11-15		≤ 10	≤ 2/38	–		≥ 4/76
Streptococcus pneumoniae[j]	**1.25/23.75 µg**	**≥ 19**	**16-18**		**≤ 15**	**≤ 0.5/9.5**	**1/19-2/38**		**≥ 4/76**
Vancomycin*									
Enterococci	30 µg	≥ 17	15-16		≤ 14	≤4	8-16		≥ 32
Streptococci[j]	30 µg	≥ 17	–		–	≤1	–		–
Other gram-positive organisms	30 µg	≥ 12	10-11		≤ 9	≤4	8-16		≥ 32

NOTE 1: Zone interpretive criteria and MIC breakpoints for antimicrobial agents with an asterisk and/or gray shading are human data taken from M2 and M7.
NOTE 2: Veterinary-specific interpretive guidelines are valid only for indicated organisms.
NOTE 3: Interpretive guidelines in bold are provisional.
NOTE 4: **Flexible label indicates the availability of FDA-approved labeling; this organism should be considered susceptible if appropriate dosing modifications found in the packaging insert are applied.**

Footnotes

a. Ampicillin is used to test for susceptibility to amoxicillin and hetacillin.
b. Oxacillin is used to test for susceptibility to methicillin, nafcillin, and cloxacillin.
c. Cephalothin is used to test all first-generation cephalosporins, such as cephapirin and cefadroxil. Cefazolin should be tested separately with the gram-negative enteric organisms.
d. Tetracycline is used to test for susceptibility to chlortetracycline, oxytetracycline, minocycline, and doxycycline.
e. Zone interpretive criteria for tiamulin are not available for 6-mm paper disks.
f. Trimethoprim/sulfamethoxazole is used to test for susceptibility to trimethoprim/sulfadiazine and ormetoprim/sulfadimethoxine. A breakpoint of ≤2/38 should be used for isolates from urinary tract infections. For systemic disease, isolates with MICs of ≤0.5/9/5 should be considered susceptible.
g. Available as an infusion product for treatment of bovine masititis during lactation.
h. Clindamycin is used to test for susceptibility to clindamycin and lincomycin. However, clindamycin can be more active against some staphylococcal strains.
i. Tilmicosin interpretive criteria are also applicable to *P. multocida*.
j. **The interpretive standards for *Streptococcus* spp. including *S. pneumoniae* only apply to disk susceptibility testing performed using Mueller-Hinton agar supplemented with 5% CO_2 and broth with 2 to 5% lysed horse blood.**
k. For control use, only in chickens and turkeys.

Table 3. Control Limits for Monitoring Antimicrobial Disk Susceptibility Tests With Veterinary Pathogens; Zone Diameter (mm) Limits for Individual Tests on Mueller-Hinton Medium Without Blood or Other Supplements

Antimicrobial Agent	Disk Contents	*Escherichia coli* ATCC® 25922	*Staphylococcus aureus* ATCC® 25923	*Pseudomonas aeruginosa* ATCC® 27853	*Escherichia coli* ATCC® 35218	*Streptococcus pneumoniae* ATCC® 49619
Amikacin	30 µg	19–26	20–26	18–26	–	–
Amoxicillin/clavulanic acid	20/10 µg	19–25	28–36	–	18–22	–
Ampicillin	10 µg	16–22	27–35	–	–	30–36[c]
Apramycin	**15 µg**	**15–20**	**17–24**	**13–18**	**–**	**–**
Cefazolin	30 µg	23–29	29–35	–	–	–
Cefoxitin	30 µg	23–29	23–29	–	–	–
Ceftiofur	**30 µg**	**26–31**	**27–31**	**14–18**	**–**	**–**
Cephalothin	30 µµg	15–21	29–37	–	–	26–32[c]
Chloramphenicol	30 µµg	21–27	19–26	–	–	23–27[c]
Clindamycin	2 µg	–	24–30	–	–	19–25[c]
Enrofloxacin	**5 µg**	**32–40**	**27–31**	**15–19**	**–**	**–**
Erythromycin	15 µg	–	22–30	–	–	25–30[c]
Gentamicin	10 µg	19–26	19–27	16–21	–	–
Imipenem	10 µg	26–32	–	20–28	–	–
Kanamycin	30 µg	17–25	19–26	–	–	–
Oxacillin	1 µg	–	18–24	–	–	8–12[c]
Penicillin G	10 units	–	26–37	–	–	–
Penicillin/novobiocin	10 units/30 µg	–	30–36	–	–	24–30[c]
Pirlimycin	2 µg	–	20–25	–	–	–
Premafloxacin	**1 µg**	**26–34**	**29–37**	**11–17**	**–**	**–**
Rifampin	5 µg	8–10	26–34	–	–	25–30[c]
Tetracycline	30 µg	18–25	24–30	–	–	27–31[c]
Ticarcillin	75 µg	24–30	–	22–28	–	–
Ticarcillin/clavulanic acid	75/10 µg	25–29	29–37	20–28	21–25	–
Tilmicosin[a]	15 µg	–	17–21[a]	–	–	–
Sarafloxacin	**5 µg**	**30–36**	**25–30**	**23–29**	**–**	**–**
Spectinomycin	**100 µg**	**21–25**	**13–17**	**10–14**	**–**	**–**
Sulfisoxazole	250 or 300 µg	15–23	24–34	–	–	–
Trimethoprim/ Sulfamethoxazole (1/19)[b]	1.25/23.75 µg	24–32	24–32	–	–	22–27[c]
Vancomycin	30 µg	–	17–21	–	–	20–27[c]

Table 3. (Continued)

NOTE 1: Information with gray shading is taken from NCCLS document M2.
NOTE 2: Information in boldface type is considered provisional.
NOTE 3: To determine whether the Mueller-Hinton medium contains excessive levels of thymine, an *E. faecalis* (ATCC® 29212 or 33186) should be tested with trimethoprim, sulfa compounds, or trimethoprim/sulfamethoxazole especially when testing *Staphylococcus hyicus* or *Pasteurella haemolytica*. An inhibition zone of ≥ 20 mm that is free of fine colonies is acceptable.

<u>Footnotes</u>

a. Quality control guidelines for tilmicosin were developed using Mueller-Hinton agar supplemented with 5% defibrinated sheep blood and incubated aerobically.

b. Very medium-dependent, especially with enterococci.

c. **These quality control ranges for *Streptococcus pneumoniae* ATCC® 49619 are applicable only to tests performed by disk diffusion using Mueller-Hinton agar supplemented with 5% defibrinated sheep blood, incubated in 5% CO_2.**

Table 4. (Continued)

Antimicrobial Agent	*Staphylococcus aureus* ATCC® 29213	*Enterococcus faecalis* ATCC® 29212	*Escherichia coli* ATCC® 25922	*Pseudomonas aeruginosa* ATCC® 27853	*Escherichia coli* ATCC® 35218	*Streptococcus pneumoniae*[b] ATCC® 49619
Premafloxacin	0.002-0.008	0.008-0.03	0.004-0.03	0.5-2	—	—
Rifampin	0.004-0.015	0.5-4	4-16	16-64	—	0.015-0.06
Sarafloxacin	0.06-0.25	0.5-2	0.008-0.03	0.12-1	—	—
Spectinomycin	64-256	64-256	8-64	256->512	—	—
Tetracycline	0.25-1	8-32	0.5-2	8-32	—	0.12-0.5
Ticarcillin	2-8	16-64	2-8	8-32	—	—
Ticarcillin/clavulanic acid	0.5/2-2/2	16/2-64/2	2/2-8/2	8/2-32/2	4/2-16/2	—
Tilmicosin	1-4[a]	≥ 32	≥64	>64	—	—
Tylosin	0.5-4	0.5-4	>32	>32	—	—
Tiamulin	0.5-2	—	—	—	—	—
Sulfisoxazole	32-128	32-128	8-32	—	—	—
Trimethoprim/ Sulfamethoxazole (1/19)	≤0.5/9.5	≤0.5/9.5	≤0.5/9.5	8/152-32/608	—	0.12/2.4-1/19
Vancomycin	0.5-2	1-4	—	—	—	0.12-0.5

NOTE 1: Information with gray shading is taken from NCCLS document M7.

NOTE 2: Information in boldface type is considered provisional.

NOTE 3: To determine whether the Mueller-Hinton medium contains excessive levels of thymidine or thymine, an *E. faecalis* (ATCC® 29212 or 33186) should be tested with trimethoprim, sulfa compounds, or trimethoprim/sulfamethoxazole especially when testing *Staphylococcus hyicus* or *Pasteurella haemolytica*. An inhibition zone of ≥ 20 mm that is free of fine colonies is acceptable. If excessive thymidine is present, an expected MIC within the susceptible category (trimethoprim/sulfamethoxazole MIC ≤ 0.5/9.5 µg/mL) will shift to the resistant category (trimethoprim/sulfamethoxazole MIC > 4/76 µg/mL).

Footnotes

a. An MIC for tilmicosin of 0.5 or 8 µg/mL may indicate a medium or pH problem. The methodology should be reexamined.

b. These quality control ranges for *Streptococcus pneumoniae* ATCC® 49619 are applicable only to tests performed by the broth microdilution method using cation-adjusted Mueller-Hinton broth with 2 to 5% lysed horse blood.

Appendix. Antimicrobial Susceptibility Quality Control Record

ORGANISM TESTED______________________________ ATCC #__________

TEST METHOD: BROTH DILUTION/DISK DIFFUSION

ANTIMICROBIAL AGENT	DISK DIFFUSION CONTROL LIMITS*	DISK DIFFUSION TEST RESULTS	BROTH DILUTION CONTROL LIMITS*	BROTH DILUTION TEST RESULTS

*CONTROL LIMITS AS DEFINED IN TABLES 3, 3A, 4, and 4A OF M31.

TECHNOLOGIST____________________ DATE TESTED____________

APPENDIX B
RIBOTYPING DATA

Ribotyping Data

Isolate	Station	Date	Runoff	Category	Super-Category
68971	Alameda Drain @ El Caminito Crossing	7/10/2002	Y	Avian	Avian
68832	Alameda Drain @ El Caminito Crossing	7/20/2002	Y	Sewage	Human/ Sewage
68833	Alameda Drain @ El Caminito Crossing	7/20/2002	Y	Sewage	Human/ Sewage
69375	Alameda Drain @ El Caminito Crossing	8/3/2002	Y	Bovine	Livestock
69376	Alameda Drain @ El Caminito Crossing	8/3/2002	Y	Canine	Pets
69377	Alameda Drain @ El Caminito Crossing	8/3/2002	Y	Canine	Pets
97513	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Avian	Avian
97514	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Avian	Avian
97515	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Rodent	Non-avian wildlife
97516	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Canine	Pets
97517	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Avian	Avian
97518	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Canine	Pets
97519	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Rodent	Non-avian wildlife
97520	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Avian	Avian
97521	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Rodent	Non-avian wildlife
97522	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Rodent	Non-avian wildlife
97523	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Avian	Avian
97524	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Avian	Avian
97525	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Unknown	Unknown
97526	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Avian	Avian
97527	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Canine	Pets
97529	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Raccoon	Non-avian wildlife
97908	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Deer	Non-avian wildlife
97909	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Avian	Avian
97910	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Sewage	Human/ Sewage
97911	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Avian	Avian
97912	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Avian	Avian
97914	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Rodent	Non-avian wildlife
97915	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Canine	Pets
97917	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Avian	Avian
97918	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Avian	Avian
97919	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Canine	Pets

Isolate	Station	Date	Runoff	Category	Super-Category
97920	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Canine	Pets
97921	Alameda Drain @ El Caminito Crossing	7/18/2004	Y	Avian	Avian
98503	Alameda Drain @ El Caminito Crossing	7/27/2004	Y	Canine	Pets
98504	Alameda Drain @ El Caminito Crossing	7/27/2004	Y	Unknown	Unknown
68817	Alameda Drain @ Ranchitos Rd.	7/10/2002	Y	Waterfowl	Avian
68975	Alameda Drain @ Ranchitos Rd.	7/10/2002	Y	Canine	Pets
68976	Alameda Drain @ Ranchitos Rd.	7/10/2002	Y	Horse	Livestock
68977	Alameda Drain @ Ranchitos Rd.	7/10/2002	Y	Sewage	Human/ Sewage
69367	Alameda Drain @ Ranchitos Rd.	8/3/2002	Y	Avian	Avian
69368	Alameda Drain @ Ranchitos Rd.	8/3/2002	Y	Sheep	Livestock
69369	Alameda Drain @ Ranchitos Rd.	8/3/2002	Y	Canine	Pets
97497	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Canine	Pets
97498	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Avian	Avian
97499	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Rodent	Non-avian wildlife
97500	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Goat	Livestock
97501	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Goat	Livestock
97502	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Avian	Avian
97503	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Rodent	Non-avian wildlife
97504	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Sewage	Human/ Sewage
97506	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Avian	Avian
97507	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Avian	Avian
97508	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Canine	Pets
97509	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Canine	Pets
97510	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Canine	Pets
97511	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Canine	Pets
97512	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Avian	Avian
97939	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Rodent	Non-avian wildlife
97940	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Avian	Avian
97941	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Rodent	Non-avian wildlife
97942	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Unknown	Unknown
97943	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Avian	Avian
97944	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Avian	Avian
97945	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Waterfowl	Avian
97946	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Canine	Pets

Isolate	Station	Date	Runoff	Category	Super-Category
97947	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Unknown	Unknown
97948	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Sewage	Human/ Sewage
97949	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Rodent	Non-avian wildlife
97950	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Rodent	Non-avian wildlife
97951	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Avian	Avian
97952	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Rodent	Non-avian wildlife
97953	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Rodent	Non-avian wildlife
97955	Alameda Drain @ Ranchitos Rd.	7/18/2004	Y	Sewage	Human/ Sewage
97770	Alameda Drain @ Ranchitos Rd.	7/21/2004	Y	Waterfowl	Avian
98420	Alameda Drain @ Ranchitos Rd.	7/25/2004	Y	Sewage	Human/ Sewage
98421	Alameda Drain @ Ranchitos Rd.	7/25/2004	Y	Sewage	Human/ Sewage
98423	Alameda Drain @ Ranchitos Rd.	7/25/2004	Y	Avian	Avian
98425	Alameda Drain @ Ranchitos Rd.	7/25/2004	Y	Horse	Livestock
98426	Alameda Drain @ Ranchitos Rd.	7/25/2004	Y	Avian	Avian
98427	Alameda Drain @ Ranchitos Rd.	7/25/2004	Y	Bovine	Livestock
98428	Alameda Drain @ Ranchitos Rd.	7/25/2004	Y	Avian	Avian
98429	Alameda Drain @ Ranchitos Rd.	7/25/2004	Y	Avian	Avian
98431	Alameda Drain @ Ranchitos Rd.	7/25/2004	Y	Avian	Avian
98432	Alameda Drain @ Ranchitos Rd.	7/25/2004	Y	Avian	Avian
98433	Alameda Drain @ Ranchitos Rd.	7/25/2004	Y	Unknown	Unknown
98434	Alameda Drain @ Ranchitos Rd.	7/25/2004	Y	Horse	Livestock
98435	Alameda Drain @ Ranchitos Rd.	7/25/2004	Y	Avian	Avian
98436	Alameda Drain @ Ranchitos Rd.	7/25/2004	Y	Avian	Avian
98437	Alameda Drain @ Ranchitos Rd.	7/25/2004	Y	Canine	Pets
98438	Alameda Drain @ Ranchitos Rd.	7/25/2004	Y	Waterfowl	Avian
98439	Alameda Drain @ Ranchitos Rd.	7/25/2004	Y	Canine	Pets
84028	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Canine	Pets
84029	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Sewage	Human/ Sewage
84030	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Bovine	Livestock
84031	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Avian	Avian
84032	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Avian	Avian
84033	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Avian	Avian
84034	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Human	Human/ Sewage
84035	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Horse	Livestock

Isolate	Station	Date	Runoff	Category	Super-Category
84036	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Horse	Livestock
84037	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Unknown	Unknown
84038	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Unknown	Unknown
84039	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Unknown	Unknown
84040	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Avian	Avian
84041	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Avian	Avian
84045	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Avian	Avian
84046	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Sewage	Human/ Sewage
84047	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Sewage	Human/ Sewage
84048	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Sewage	Human/ Sewage
84049	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Sewage	Human/ Sewage
84050	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Sewage	Human/ Sewage
84051	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Sewage	Human/ Sewage
84052	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Sewage	Human/ Sewage
84053	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Waterfowl	Avian
84054	Amole del Norte Channel above Amole Dam	10/7/2003	Y	Sewage	Human/ Sewage
69333	Cabezon Channel	8/2/2002	Y	Sewage	Human/ Sewage
69334	Cabezon Channel	8/2/2002	Y	Canine	Pets
69335	Cabezon Channel	8/2/2002	Y	Bovine	Livestock
97469	Cabezon Channel	7/18/2004	Y	Avian	Avian
97470	Cabezon Channel	7/18/2004	Y	Canine	Pets
97471	Cabezon Channel	7/18/2004	Y	Canine	Pets
97472	Cabezon Channel	7/18/2004	Y	Horse	Livestock
97473	Cabezon Channel	7/18/2004	Y	Rodent	Non-avian wildlife
97474	Cabezon Channel	7/18/2004	Y	Avian	Avian
97475	Cabezon Channel	7/18/2004	Y	Bovine	Livestock
97476	Cabezon Channel	7/18/2004	Y	Rodent	Non-avian wildlife
97477	Cabezon Channel	7/18/2004	Y	Avian	Avian
97478	Cabezon Channel	7/18/2004	Y	Sewage	Human/ Sewage
97479	Cabezon Channel	7/18/2004	Y	Avian	Avian
97480	Cabezon Channel	7/18/2004	Y	Canine	Pets
97481	Cabezon Channel	7/18/2004	Y	Canine	Pets
97868	Cabezon Channel	7/18/2004	Y	Sewage	Human/ Sewage
97869	Cabezon Channel	7/18/2004	Y	Rodent	Non-avian wildlife

Isolate	Station	Date	Runoff	Category	Super-Category
97871	Cabezon Channel	7/18/2004	Y	Rodent	Non-avian wildlife
97872	Cabezon Channel	7/18/2004	Y	Avian	Avian
97873	Cabezon Channel	7/18/2004	Y	Horse	Livestock
97744	Cabezon Channel	7/21/2004	Y	Rabbit	Non-avian wildlife
97745	Cabezon Channel	7/21/2004	Y	Avian	Avian
97746	Cabezon Channel	7/21/2004	Y	Avian	Avian
97747	Cabezon Channel	7/21/2004	Y	Sludge	Human/ Sewage
97748	Cabezon Channel	7/21/2004	Y	Avian	Avian
97750	Cabezon Channel	7/21/2004	Y	Sludge	Human/ Sewage
97751	Cabezon Channel	7/21/2004	Y	Avian	Avian
97752	Cabezon Channel	7/21/2004	Y	Canine	Pets
97753	Cabezon Channel	7/21/2004	Y	Rodent	Non-avian wildlife
97754	Cabezon Channel	7/21/2004	Y	Canine	Pets
97755	Cabezon Channel	7/21/2004	Y	Canine	Pets
97757	Cabezon Channel	7/21/2004	Y	Canine	Pets
98397	Cabezon Channel	7/25/2004	Y	Bovine	Livestock
69336	Calabacillas Arroyo @ Coors Rd.	8/2/2002	Y	Sewage	Human/ Sewage
69337	Calabacillas Arroyo @ Coors Rd.	8/2/2002	Y	Feline	Pets
69338	Calabacillas Arroyo @ Coors Rd.	8/2/2002	Y	Bovine	Livestock
72846	Calabacillas Arroyo @ Coors Rd.	2/20/2003	Y	Rodent	Non-avian wildlife
72847	Calabacillas Arroyo @ Coors Rd.	2/20/2003	Y	Avian	Avian
72848	Calabacillas Arroyo @ Coors Rd.	2/20/2003	Y	Human	Human/ Sewage
72849	Calabacillas Arroyo @ Coors Rd.	2/20/2003	Y	Avian	Avian
72850	Calabacillas Arroyo @ Coors Rd.	2/20/2003	Y	Canine	Pets
72851	Calabacillas Arroyo @ Coors Rd.	2/20/2003	Y	Human	Human/ Sewage
72852	Calabacillas Arroyo @ Coors Rd.	2/20/2003	Y	Rodent	Non-avian wildlife
72853	Calabacillas Arroyo @ Coors Rd.	2/20/2003	Y	Unknown	Unknown
72854	Calabacillas Arroyo @ Coors Rd.	2/20/2003	Y	Unknown	Unknown
72855	Calabacillas Arroyo @ Coors Rd.	2/20/2003	Y	Unknown	Unknown
72856	Calabacillas Arroyo @ Coors Rd.	2/20/2003	Y	Unknown	Unknown
72857	Calabacillas Arroyo @ Coors Rd.	2/20/2003	Y	Unknown	Unknown
72858	Calabacillas Arroyo @ Coors Rd.	2/20/2003	Y	Human	Human/ Sewage
72859	Calabacillas Arroyo @ Coors Rd.	2/20/2003	Y	Avian	Avian
72860	Calabacillas Arroyo @ Coors Rd.	2/20/2003	Y	Rodent	Non-avian wildlife

Isolate	Station	Date	Runoff	Category	Super-Category
72861	Calabacillas Arroyo @ Coors Rd.	2/20/2003	Y	Avian	Avian
72862	Calabacillas Arroyo @ Coors Rd.	2/20/2003	Y	Unknown	Unknown
72863	Calabacillas Arroyo @ Coors Rd.	2/20/2003	Y	Rodent	Non-avian wildlife
72864	Calabacillas Arroyo @ Coors Rd.	2/20/2003	Y	Unknown	Unknown
72865	Calabacillas Arroyo @ Coors Rd.	2/20/2003	Y	Unknown	Unknown
72866	Calabacillas Arroyo @ Swinburne Dam	2/20/2003	Y	Unknown	Unknown
72867	Calabacillas Arroyo @ Swinburne Dam	2/20/2003	Y	Unknown	Unknown
72868	Calabacillas Arroyo @ Swinburne Dam	2/20/2003	Y	Unknown	Unknown
72869	Calabacillas Arroyo @ Swinburne Dam	2/20/2003	Y	Unknown	Unknown
72871	Calabacillas Arroyo @ Swinburne Dam	2/20/2003	Y	Canine	Pets
72872	Calabacillas Arroyo @ Swinburne Dam	2/20/2003	Y	Canine	Pets
72873	Calabacillas Arroyo @ Swinburne Dam	2/20/2003	Y	Canine	Pets
72874	Calabacillas Arroyo @ Swinburne Dam	2/20/2003	Y	Canine	Pets
72876	Calabacillas Arroyo @ Swinburne Dam	2/20/2003	Y	Unknown	Unknown
72877	Calabacillas Arroyo @ Swinburne Dam	2/20/2003	Y	Canine	Pets
72878	Calabacillas Arroyo @ Swinburne Dam	2/20/2003	Y	Canine	Pets
72879	Calabacillas Arroyo @ Swinburne Dam	2/20/2003	Y	Canine	Pets
72880	Calabacillas Arroyo @ Swinburne Dam	2/20/2003	Y	Canine	Pets
72881	Calabacillas Arroyo @ Swinburne Dam	2/20/2003	Y	Canine	Pets
72882	Calabacillas Arroyo @ Swinburne Dam	2/20/2003	Y	Canine	Pets
72883	Calabacillas Arroyo @ Swinburne Dam	2/20/2003	Y	Canine	Pets
72884	Calabacillas Arroyo @ Swinburne Dam	2/20/2003	Y	Canine	Pets
72885	Calabacillas Arroyo @ Swinburne Dam	2/20/2003	Y	Canine	Pets
72886	Calabacillas Arroyo @ Swinburne Dam	2/20/2003	Y	Canine	Pets
68819	Embudo Channel above confluence with North Diversion Channel	7/8/2002	Y	Avian	Avian
68982	Embudo Channel above confluence with North Diversion Channel	7/8/2002	Y	Horse	Livestock
68983	Embudo Channel above confluence with North Diversion Channel	7/8/2002	Y	Canine	Pets
68984	Embudo Channel above confluence with North Diversion Channel	7/8/2002	Y	Sewage	Human/ Sewage
68959	Embudo Channel above confluence with North Diversion Channel	7/19/2002	Y	Sewage	Human/ Sewage
68960	Embudo Channel above confluence with North Diversion Channel	7/19/2002	Y	Avian	Avian

Isolate	Station	Date	Runoff	Category	Super-Category
68961	Embudo Channel above confluence with North Diversion Channel	7/19/2002	Y	Sewage	Human/ Sewage
69354	Embudo Channel above confluence with North Diversion Channel	8/2/2002	Y	Avian	Avian
69355	Embudo Channel above confluence with North Diversion Channel	8/2/2002	Y	Bovine	Livestock
69356	Embudo Channel above confluence with North Diversion Channel	8/2/2002	Y	Horse	Livestock
72969	Embudo Channel above confluence with North Diversion Channel	2/20/2003	Y	Rodent	Non-avian wildlife
72970	Embudo Channel above confluence with North Diversion Channel	2/20/2003	Y	Rodent	Non-avian wildlife
72971	Embudo Channel above confluence with North Diversion Channel	2/20/2003	Y	Rodent	Non-avian wildlife
72972	Embudo Channel above confluence with North Diversion Channel	2/20/2003	Y	Rodent	Non-avian wildlife
72973	Embudo Channel above confluence with North Diversion Channel	2/20/2003	Y	Avian	Avian
72974	Embudo Channel above confluence with North Diversion Channel	2/20/2003	Y	Sewage	Human/ Sewage
72975	Embudo Channel above confluence with North Diversion Channel	2/20/2003	Y	Avian	Avian
72976	Embudo Channel above confluence with North Diversion Channel	2/20/2003	Y	Rodent	Non-avian wildlife
72977	Embudo Channel above confluence with North Diversion Channel	2/20/2003	Y	Bovine	Livestock
72978	Embudo Channel above confluence with North Diversion Channel	2/20/2003	Y	Avian	Avian
72979	Embudo Channel above confluence with North Diversion Channel	2/20/2003	Y	Sewage	Human/ Sewage
72980	Embudo Channel above confluence with North Diversion Channel	2/20/2003	Y	Bovine	Livestock
72981	Embudo Channel above confluence with North Diversion Channel	2/20/2003	Y	Canine	Pets
72982	Embudo Channel above confluence with North Diversion Channel	2/20/2003	Y	Canine	Pets
72983	Embudo Channel above confluence with North Diversion Channel	2/20/2003	Y	Canine	Pets
72984	Embudo Channel above confluence with North Diversion Channel	2/20/2003	Y	Canine	Pets
72985	Embudo Channel above confluence with North Diversion Channel	2/20/2003	Y	Avian	Avian

Isolate	Station	Date	Runoff	Category	Super-Category
72986	Embudo Channel above confluence with North Diversion Channel	2/20/2003	Y	Canine	Pets
72987	Embudo Channel above confluence with North Diversion Channel	2/20/2003	Y	Avian	Avian
72988	Embudo Channel above confluence with North Diversion Channel	2/20/2003	Y	Avian	Avian
72989	Embudo Channel above confluence with North Diversion Channel	2/20/2003	Y	Avian	Avian
97545	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Unknown	Unknown
97546	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Human	Human/ Sewage
97548	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Unknown	Unknown
97549	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Unknown	Unknown
97550	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Unknown	Unknown
97551	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Human	Human/ Sewage
97552	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Unknown	Unknown
97553	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Unknown	Unknown
97554	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Human	Human/ Sewage
97555	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Unknown	Unknown
97923	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Unknown	Unknown
97924	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Unknown	Unknown
97925	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Rodent	Non-avian wildlife
97926	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Unknown	Unknown
97927	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Unknown	Unknown
97928	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Rodent	Non-avian wildlife
97929	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Unknown	Unknown

Isolate	Station	Date	Runoff	Category	Super-Category
97930	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Unknown	Unknown
97931	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Canine	Pets
97932	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Unknown	Unknown
97933	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Unknown	Unknown
97934	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Unknown	Unknown
97935	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Unknown	Unknown
97937	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Unknown	Unknown
97938	Embudo Channel above confluence with North Diversion Channel	7/18/2004	Y	Unknown	Unknown
98231	Embudo Channel above confluence with North Diversion Channel	7/25/2004	Y	Unknown	Unknown
98232	Embudo Channel above confluence with North Diversion Channel	7/25/2004	Y	Rodent	Non-avian wildlife
98233	Embudo Channel above confluence with North Diversion Channel	7/25/2004	Y	Canine	Pets
98234	Embudo Channel above confluence with North Diversion Channel	7/25/2004	Y	Rodent	Non-avian wildlife
98235	Embudo Channel above confluence with North Diversion Channel	7/25/2004	Y	Unknown	Unknown
98236	Embudo Channel above confluence with North Diversion Channel	7/25/2004	Y	Canine	Pets
98237	Embudo Channel above confluence with North Diversion Channel	7/25/2004	Y	Avian	Avian
98238	Embudo Channel above confluence with North Diversion Channel	7/25/2004	Y	Rodent	Non-avian wildlife
98239	Embudo Channel above confluence with North Diversion Channel	7/25/2004	Y	Avian	Avian
98240	Embudo Channel above confluence with North Diversion Channel	7/25/2004	Y	Rodent	Non-avian wildlife
98241	Embudo Channel above confluence with North Diversion Channel	7/25/2004	Y	Canine	Pets
98242	Embudo Channel above confluence with North Diversion Channel	7/25/2004	Y	Canine	Pets
98243	Embudo Channel above confluence with North Diversion Channel	7/25/2004	Y	Avian	Avian

Isolate	Station	Date	Runoff	Category	Super-Category
98244	Embudo Channel above confluence with North Diversion Channel	7/25/2004	Y	Canine	Pets
98245	Embudo Channel above confluence with North Diversion Channel	7/25/2004	Y	Avian	Avian
98246	Embudo Channel above confluence with North Diversion Channel	7/25/2004	Y	Canine	Pets
98247	Embudo Channel above confluence with North Diversion Channel	7/25/2004	Y	Canine	Pets
98248	Embudo Channel above confluence with North Diversion Channel	7/25/2004	Y	Canine	Pets
98249	Embudo Channel above confluence with North Diversion Channel	7/25/2004	Y	Avian	Avian
68803	Hahn Arroyo above N. Diversion Channel at Carlisle	7/19/2002	Y	Avian	Avian
68804	Hahn Arroyo above N. Diversion Channel at Carlisle	7/19/2002	Y	Canine	Pets
68805	Hahn Arroyo above N. Diversion Channel at Carlisle	7/19/2002	Y	Bovine	Livestock
68806	Hahn Arroyo above N. Diversion Channel at Carlisle	7/19/2002	Y	Avian	Avian
68962	Hahn Arroyo above N. Diversion Channel at Carlisle	7/19/2002	Y	Avian	Avian
68963	Hahn Arroyo above N. Diversion Channel at Carlisle	7/19/2002	Y	Avian	Avian
68964	Hahn Arroyo above N. Diversion Channel at Carlisle	7/19/2002	Y	Rodent	Non-avian wildlife
69357	Hahn Arroyo above N. Diversion Channel at Carlisle	8/2/2002	Y	Bovine	Livestock
69358	Hahn Arroyo above N. Diversion Channel at Carlisle	8/2/2002	Y	Bovine	Livestock
69359	Hahn Arroyo above N. Diversion Channel at Carlisle	8/2/2002	Y	Avian	Avian
69360	Hahn Arroyo above N. Diversion Channel at Carlisle	8/2/2002	Y	Sewage	Human/ Sewage
69361	Hahn Arroyo above N. Diversion Channel at Carlisle	8/2/2002	Y	Sewage	Human/ Sewage
72990	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003	Y	Waterfowl	Avian
72991	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003	Y	Avian	Avian
72992	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003	Y	Avian	Avian

Isolate	Station	Date	Runoff	Category	Super-Category
72993	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003	Y	Rodent	Non-avian wildlife
72994	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003	Y	Avian	Avian
72995	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003	Y	Horse	Livestock
72996	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003	Y	Rodent	Non-avian wildlife
72997	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003	Y	Avian	Avian
72998	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003	Y	Goat	Livestock
72999	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003	Y	Sheep	Livestock
73000	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003	Y	Avian	Avian
73001	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003	Y	Canine	Pets
73002	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003	Y	Feline	Pets
73003	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003	Y	Bovine	Livestock
73004	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003	Y	Sewage	Human/ Sewage
73005	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003	Y	Canine	Pets
73006	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003	Y	Unknown	Unknown
73008	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003	Y	Avian	Avian
73009	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003	Y	Avian	Avian
73010	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003	Y	Avian	Avian
97530	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004	Y	Canine	Pets
97531	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004	Y	Canine	Pets
97532	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004	Y	Sewage	Human/ Sewage
97533	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004	Y	Sewage	Human/ Sewage

Isolate	Station	Date	Runoff	Category	Super-Category
97535	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004	Y	Canine	Pets
97536	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004	Y	Avian	Avian
97537	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004	Y	Coyote	Non-avian wildlife
97538	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004	Y	Avian	Avian
97539	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004	Y	Rodent	Non-avian wildlife
97540	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004	Y	Rodent	Non-avian wildlife
97541	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004	Y	Avian	Avian
97542	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004	Y	Sewage	Human/ Sewage
97543	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004	Y	Avian	Avian
97544	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004	Y	Unknown	Unknown
97876	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004	Y	Unknown	Unknown
97877	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004	Y	Sewage	Human/ Sewage
97878	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004	Y	Avian	Avian
97879	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004	Y	Canine	Pets
97880	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004	Y	Rodent	Non-avian wildlife
97881	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004	Y	Avian	Avian
97882	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004	Y	Sewage	Human/ Sewage
97883	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004	Y	Avian	Avian
98251	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004	Y	Raccoon	Non-avian wildlife
98252	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004	Y	Unknown	Unknown
98253	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004	Y	Unknown	Unknown

Isolate	Station	Date	Runoff	Category	Super-Category
98254	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004	Y	Unknown	Unknown
98255	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004	Y	Unknown	Unknown
98256	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004	Y	Canine	Pets
98257	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004	Y	Raccoon	Non-avian wildlife
98258	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004	Y	Unknown	Unknown
98260	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004	Y	Bovine	Livestock
98261	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004	Y	Bovine	Livestock
98263	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004	Y	Avian	Avian
98264	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004	Y	Unknown	Unknown
98265	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004	Y	Bovine	Livestock
98266	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004	Y	Sewage	Human/ Sewage
98267	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004	Y	Unknown	Unknown
98268	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004	Y	Coyote	Non-avian wildlife
98269	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004	Y	Unknown	Unknown
98270	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004	Y	Bovine	Livestock
98271	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004	Y	Coyote	Non-avian wildlife
68818	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/8/2002	Y	Bovine	Livestock
68978	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/8/2002	Y	Porcine	Livestock
68979	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/8/2002	Y	Avian	Avian
68980	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/8/2002	Y	Horse	Livestock
68981	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/8/2002	Y	Horse	Livestock

Isolate	Station	Date	Runoff	Category	Super-Category
84076	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003	Y	Avian	Avian
84077	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003	Y	Sewage	Human/ Sewage
84078	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003	Y	Sheep	Livestock
84079	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003	Y	Avian	Avian
84080	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003	Y	Canine	Pets
84081	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003	Y	Avian	Avian
84082	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003	Y	Avian	Avian
84083	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003	Y	Sewage	Human/ Sewage
84084	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003	Y	Avian	Avian
84085	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003	Y	Sewage	Human/ Sewage
84086	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003	Y	Avian	Avian
84087	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003	Y	Sheep	Livestock
84137	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/8/2003	Y	Avian	Avian
84138	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/8/2003	Y	Avian	Avian
84139	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/8/2003	Y	Sewage	Human/ Sewage
84140	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/8/2003	Y	Canine	Pets
97353	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004	Y	Rodent	Non-avian wildlife
97354	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004	Y	Avian	Avian
97356	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004	Y	Canine	Pets
97358	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004	Y	Rodent	Non-avian wildlife
97359	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004	Y	Rodent	Non-avian wildlife

Isolate	Station	Date	Runoff	Category	Super-Category
97360	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004	Y	Avian	Avian
97361	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004	Y	Bovine	Livestock
97362	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004	Y	Avian	Avian
97364	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004	Y	Avian	Avian
97366	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004	Y	Avian	Avian
97367	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004	Y	Avian	Avian
97370	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004	Y	Avian	Avian
97371	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004	Y	Avian	Avian
97372	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004	Y	Canine	Pets
97373	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004	Y	Avian	Avian
98472	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/25/2004	Y	Avian	Avian
98473	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/25/2004	Y	Rodent	Non-avian wildlife
98474	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/25/2004	Y	Porcine	Livestock
98475	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/25/2004	Y	Sewage	Human/ Sewage
98476	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/25/2004	Y	Rodent	Non-avian wildlife
98477	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/25/2004	Y	Rodent	Non-avian wildlife
98478	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/25/2004	Y	Canine	Pets
98479	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/25/2004	Y	Canine	Pets
98480	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/25/2004	Y	Rodent	Non-avian wildlife
98481	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/25/2004	Y	Sewage	Human/ Sewage
68820	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/8/2002	Y	Avian	Avian

Isolate	Station	Date	Runoff	Category	Super-Category
68821	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/8/2002	Y	Sewage	Human/ Sewage
68822	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/8/2002	Y	Waterfowl	Avian
84055	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003	Y	Unknown	Unknown
84057	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003	Y	Unknown	Unknown
84058	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003	Y	Unknown	Unknown
84059	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003	Y	Bovine	Livestock
84060	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003	Y	Bovine	Livestock
84062	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003	Y	Avian	Avian
84063	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003	Y	Canine	Pets
84064	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003	Y	Unknown	Unknown
84065	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003	Y	Unknown	Unknown
84067	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003	Y	Bovine	Livestock
84069	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003	Y	Avian	Avian
84070	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003	Y	Unknown	Unknown
84071	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003	Y	Unknown	Unknown
84072	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003	Y	Avian	Avian
84073	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003	Y	Avian	Avian
84074	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003	Y	Avian	Avian
84075	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003	Y	Raccoon	Non-avian wildlife
83976	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Bovine	Livestock
83977	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Unknown	Unknown

Isolate	Station	Date	Runoff	Category	Super-Category
83978	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Unknown	Unknown
83979	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Raccoon	Non-avian wildlife
83980	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Waterfowl	Avian
83981	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Bovine	Livestock
83982	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Bovine	Livestock
83983	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Bovine	Livestock
83984	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Unknown	Unknown
83985	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Rodent	Non-avian wildlife
83986	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Unknown	Unknown
83987	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Avian	Avian
83988	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Unknown	Unknown
83989	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Canine	Pets
83990	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Canine	Pets
83991	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Unknown	Unknown
83992	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Canine	Pets
83993	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Unknown	Unknown
83994	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Canine	Pets
83995	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Avian	Avian
83996	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Canine	Pets
83997	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Canine	Pets
83998	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Canine	Pets

Isolate	Station	Date	Runoff	Category	Super-Category
83999	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Canine	Pets
84000	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Human	Human/ Sewage
84001	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Avian	Avian
84002	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Canine	Pets
84003	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Unknown	Unknown
84004	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Avian	Avian
84005	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Sewage	Human/ Sewage
84006	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Sewage	Human/ Sewage
84007	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Sewage	Human/ Sewage
84008	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Bovine	Livestock
84009	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Unknown	Unknown
84010	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Avian	Avian
84011	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Unknown	Unknown
84012	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Unknown	Unknown
84013	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Bovine	Livestock
84015	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Unknown	Unknown
84016	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Sewage	Human/ Sewage
84017	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Sewage	Human/ Sewage
84018	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Canine	Pets
84019	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Avian	Avian
84020	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Unknown	Unknown

Isolate	Station	Date	Runoff	Category	Super-Category
84021	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Unknown	Unknown
84022	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Unknown	Unknown
84023	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Unknown	Unknown
84024	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Avian	Avian
84025	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Avian	Avian
84026	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Avian	Avian
84027	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003	Y	Avian	Avian
97884	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/19/2004	Y	Unknown	Unknown
97885	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/19/2004	Y	Canine	Pets
97886	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/19/2004	Y	Canine	Pets
97887	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/19/2004	Y	Canine	Pets
98463	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/25/2004	Y	Canine	Pets
98465	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/25/2004	Y	Avian	Avian
98467	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/25/2004	Y	Canine	Pets
98468	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/25/2004	Y	Unknown	Unknown
68807	North Diversion Channel @ Roy	7/10/2002	Y	Human	Human/ Sewage
68824	North Diversion Channel @ Roy	7/10/2002	Y	Human	Human/ Sewage
68825	North Diversion Channel @ Roy	7/10/2002	Y	Avian	Avian
68968	North Diversion Channel @ Roy	7/10/2002	Y	Sewage	Human/ Sewage
68969	North Diversion Channel @ Roy	7/10/2002	Y	Porcine	Livestock
69339	North Diversion Channel @ Roy	8/3/2002	Y	Horse	Livestock
69340	North Diversion Channel @ Roy	8/3/2002	Y	Sewage	Human/ Sewage
69341	North Diversion Channel @ Roy	8/3/2002	Y	Avian	Avian
69342	North Diversion Channel @ Roy	8/3/2002	Y	Sewage	Human/ Sewage
88655	North Diversion Channel @ Roy	2/22/2004	N	Canine	Pets

Isolate	Station	Date	Runoff	Category	Super-Category
88656	North Diversion Channel @ Roy	2/22/2004	N	Canine	Pets
88657	North Diversion Channel @ Roy	2/22/2004	N	Sewage	Human/ Sewage
88658	North Diversion Channel @ Roy	2/22/2004	N	Sewage	Human/ Sewage
88659	North Diversion Channel @ Roy	2/22/2004	N	Canine	Pets
88660	North Diversion Channel @ Roy	2/22/2004	N	Unknown	Unknown
88661	North Diversion Channel @ Roy	2/22/2004	N	Unknown	Unknown
88662	North Diversion Channel @ Roy	2/22/2004	N	Rodent	Non-avian wildlife
88663	North Diversion Channel @ Roy	2/22/2004	N	Sewage	Human/ Sewage
88664	North Diversion Channel @ Roy	2/22/2004	N	Sewage	Human/ Sewage
88665	North Diversion Channel @ Roy	2/22/2004	N	Canine	Pets
88666	North Diversion Channel @ Roy	2/22/2004	N	Rodent	Non-avian wildlife
88667	North Diversion Channel @ Roy	2/22/2004	N	Avian	Avian
88668	North Diversion Channel @ Roy	2/22/2004	N	Avian	Avian
88669	North Diversion Channel @ Roy	2/22/2004	N	Canine	Pets
88670	North Diversion Channel @ Roy	2/22/2004	N	Canine	Pets
88671	North Diversion Channel @ Roy	2/22/2004	N	Canine	Pets
88672	North Diversion Channel @ Roy	2/22/2004	N	Canine	Pets
88673	North Diversion Channel @ Roy	2/22/2004	N	Waterfowl	Avian
88674	North Diversion Channel @ Roy	2/22/2004	N	Avian	Avian
88675	North Diversion Channel @ Roy	2/22/2004	N	Canine	Pets
88676	North Diversion Channel @ Roy	2/22/2004	N	Avian	Avian
88677	North Diversion Channel @ Roy	2/22/2004	N	Canine	Pets
88678	North Diversion Channel @ Roy	2/22/2004	N	Sewage	Human/ Sewage
89153	North Diversion Channel @ Roy	2/29/2004	N	Canine	Pets
89154	North Diversion Channel @ Roy	2/29/2004	N	Avian	Avian
89155	North Diversion Channel @ Roy	2/29/2004	N	Avian	Avian
89156	North Diversion Channel @ Roy	2/29/2004	N	Canine	Pets
89157	North Diversion Channel @ Roy	2/29/2004	N	Avian	Avian
89158	North Diversion Channel @ Roy	2/29/2004	N	Horse	Livestock
89433	North Diversion Channel @ Roy	3/5/2004	Y	Rodent	Non-avian wildlife
89434	North Diversion Channel @ Roy	3/5/2004	Y	Canine	Pets
89435	North Diversion Channel @ Roy	3/5/2004	Y	Human	Human/ Sewage
89436	North Diversion Channel @ Roy	3/5/2004	Y	Deer	Non-avian wildlife
89437	North Diversion Channel @ Roy	3/5/2004	Y	Rodent	Non-avian wildlife

Isolate	Station	Date	Runoff	Category	Super-Category
89438	North Diversion Channel @ Roy	3/5/2004	Y	Rodent	Non-avian wildlife
89439	North Diversion Channel @ Roy	3/5/2004	Y	Porcine	Livestock
89440	North Diversion Channel @ Roy	3/5/2004	Y	Human	Human/ Sewage
89441	North Diversion Channel @ Roy	3/5/2004	Y	Rodent	Non-avian wildlife
89442	North Diversion Channel @ Roy	3/5/2004	Y	Porcine	Livestock
89443	North Diversion Channel @ Roy	3/5/2004	Y	Avian	Avian
89444	North Diversion Channel @ Roy	3/5/2004	Y	Sewage	Human/ Sewage
89445	North Diversion Channel @ Roy	3/5/2004	Y	Unknown	Unknown
89446	North Diversion Channel @ Roy	3/5/2004	Y	Avian	Avian
89447	North Diversion Channel @ Roy	3/5/2004	Y	Coyote	Non-avian wildlife
89448	North Diversion Channel @ Roy	3/5/2004	Y	Sewage	Human/ Sewage
89449	North Diversion Channel @ Roy	3/5/2004	Y	Human	Human/ Sewage
89450	North Diversion Channel @ Roy	3/5/2004	Y	Canine	Pets
89451	North Diversion Channel @ Roy	3/5/2004	Y	Canine	Pets
89452	North Diversion Channel @ Roy	3/5/2004	Y	Canine	Pets
89453	North Diversion Channel @ Roy	3/5/2004	Y	Unknown	Unknown
89454	North Diversion Channel @ Roy	3/5/2004	Y	Canine	Pets
89455	North Diversion Channel @ Roy	3/5/2004	Y	Canine	Pets
89456	North Diversion Channel @ Roy	3/5/2004	Y	Horse	Livestock
89457	North Diversion Channel @ Roy	3/5/2004	Y	Canine	Pets
89458	North Diversion Channel @ Roy	3/5/2004	Y	Rabbit	Non-avian wildlife
89459	North Diversion Channel @ Roy	3/5/2004	Y	Rabbit	Non-avian wildlife
89784	North Diversion Channel @ Roy	3/12/2004	N	Sewage	Human/ Sewage
89785	North Diversion Channel @ Roy	3/12/2004	N	Avian	Avian
89786	North Diversion Channel @ Roy	3/12/2004	N	Unknown	Unknown
89787	North Diversion Channel @ Roy	3/12/2004	N	Avian	Avian
89788	North Diversion Channel @ Roy	3/12/2004	N	Waterfowl	Avian
89789	North Diversion Channel @ Roy	3/12/2004	N	Unknown	Unknown
89790	North Diversion Channel @ Roy	3/12/2004	N	Avian	Avian
89791	North Diversion Channel @ Roy	3/12/2004	N	Rodent	Non-avian wildlife
89792	North Diversion Channel @ Roy	3/12/2004	N	Sewage	Human/ Sewage
89793	North Diversion Channel @ Roy	3/12/2004	N	Sewage	Human/ Sewage
89794	North Diversion Channel @ Roy	3/12/2004	N	Waterfowl	Avian
89795	North Diversion Channel @ Roy	3/12/2004	N	Sewage	Human/ Sewage

Isolate	Station	Date	Runoff	Category	Super-Category
89796	North Diversion Channel @ Roy	3/12/2004	N	Sewage	Human/ Sewage
89797	North Diversion Channel @ Roy	3/12/2004	N	Avian	Avian
89798	North Diversion Channel @ Roy	3/12/2004	N	Avian	Avian
89799	North Diversion Channel @ Roy	3/12/2004	N	Sewage	Human/ Sewage
89800	North Diversion Channel @ Roy	3/12/2004	N	Avian	Avian
89801	North Diversion Channel @ Roy	3/12/2004	N	Rodent	Non-avian wildlife
89802	North Diversion Channel @ Roy	3/12/2004	N	Rodent	Non-avian wildlife
89803	North Diversion Channel @ Roy	3/12/2004	N	Rodent	Non-avian wildlife
89804	North Diversion Channel @ Roy	3/12/2004	N	Sewage	Human/ Sewage
89805	North Diversion Channel @ Roy	3/12/2004	N	Sewage	Human/ Sewage
89806	North Diversion Channel @ Roy	3/12/2004	N	Rodent	Non-avian wildlife
98293	North Diversion Channel @ Roy	7/25/2004	Y	Rodent	Non-avian wildlife
98294	North Diversion Channel @ Roy	7/25/2004	Y	Horse	Livestock
98296	North Diversion Channel @ Roy	7/25/2004	Y	Avian	Avian
98297	North Diversion Channel @ Roy	7/25/2004	Y	Avian	Avian
98298	North Diversion Channel @ Roy	7/25/2004	Y	Avian	Avian
98299	North Diversion Channel @ Roy	7/25/2004	Y	Horse	Livestock
98300	North Diversion Channel @ Roy	7/25/2004	Y	Unknown	Unknown
98301	North Diversion Channel @ Roy	7/25/2004	Y	Unknown	Unknown
98302	North Diversion Channel @ Roy	7/25/2004	Y	Avian	Avian
98303	North Diversion Channel @ Roy	7/25/2004	Y	Rodent	Non-avian wildlife
98305	North Diversion Channel @ Roy	7/25/2004	Y	Canine	Pets
98306	North Diversion Channel @ Roy	7/25/2004	Y	Avian	Avian
98307	North Diversion Channel @ Roy	7/25/2004	Y	Rodent	Non-avian wildlife
98308	North Diversion Channel @ Roy	7/25/2004	Y	Rodent	Non-avian wildlife
98310	North Diversion Channel @ Roy	7/25/2004	Y	Canine	Pets
98311	North Diversion Channel @ Roy	7/25/2004	Y	Unknown	Unknown
98312	North Diversion Channel @ Roy	7/25/2004	Y	Canine	Pets
68815	North Domingo Baca Arroyo Dam @primary spillway	7/11/2002	Y	Rodent	Non-avian wildlife
68816	North Domingo Baca Arroyo Dam @primary spillway	7/11/2002	Y	Canine	Pets
68988	North Domingo Baca Arroyo Dam @primary spillway	7/11/2002	Y	Unknown	Unknown
68989	North Domingo Baca Arroyo Dam @primary	7/11/2002	Y	Canine	Pets

Isolate	Station	Date	Runoff	Category	Super-Category
	spillway				
68990	North Domingo Baca Arroyo Dam @primary spillway	7/11/2002	Y	Bovine	Livestock
69365	North Domingo Baca Arroyo Dam @primary spillway	8/2/2002	Y	Horse	Livestock
69366	North Domingo Baca Arroyo Dam @primary spillway	8/2/2002	Y	Canine	Pets
98272	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004	Y	Avian	Avian
98273	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004	Y	Canine	Pets
98274	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004	Y	Canine	Pets
98275	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004	Y	Canine	Pets
98276	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004	Y	Canine	Pets
98278	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004	Y	Avian	Avian
98279	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004	Y	Avian	Avian
98282	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004	Y	Canine	Pets
98283	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004	Y	Canine	Pets
98284	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004	Y	Canine	Pets
98285	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004	Y	Canine	Pets
98286	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004	Y	Canine	Pets
98287	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004	Y	Canine	Pets
98288	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004	Y	Canine	Pets
98289	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004	Y	Unknown	Unknown
98290	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004	Y	Rodent	Non-avian wildlife
98291	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004	Y	Canine	Pets
98292	North Domingo Baca Arroyo Dam @primary	7/25/2004	Y	Avian	Avian

Isolate	Station	Date	Runoff	Category	Super-Category
	spillway				
68823	North Pino Arroyo above North Diversion Channel	7/10/2002	Y	Avian	Avian
68985	North Pino Arroyo above North Diversion Channel	7/10/2002	Y	Unknown	Unknown
68986	North Pino Arroyo above North Diversion Channel	7/10/2002	Y	Unknown	Unknown
68987	North Pino Arroyo above North Diversion Channel	7/10/2002	Y	Rodent	Non-avian wildlife
68965	North Pino Arroyo above North Diversion Channel	7/11/2002	Y	Canine	Pets
68966	North Pino Arroyo above North Diversion Channel	7/11/2002	Y	Avian	Avian
68967	North Pino Arroyo above North Diversion Channel	7/11/2002	Y	Avian	Avian
68826	North Pino Arroyo above North Diversion Channel	7/20/2002	Y	Avian	Avian
69362	North Pino Arroyo above North Diversion Channel	8/2/2002	Y	Avian	Avian
69363	North Pino Arroyo above North Diversion Channel	8/2/2002	Y	Avian	Avian
69364	North Pino Arroyo above North Diversion Channel	8/2/2002	Y	Avian	Avian
73011	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Waterfowl	Avian
73012	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Bovine	Livestock
73013	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Avian	Avian
73014	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Avian	Avian
73015	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Sewage	Human/ Sewage
73016	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Avian	Avian
73017	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Avian	Avian
73018	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Waterfowl	Avian
73019	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Avian	Avian
73020	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Avian	Avian
73021	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Avian	Avian
73022	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Canine	Pets
73023	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Avian	Avian
73024	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Feline	Pets
73025	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Horse	Livestock
73026	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Avian	Avian
73027	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Canine	Pets
73028	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Avian	Avian
73029	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Avian	Avian
73030	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Avian	Avian
73031	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Sewage	Human/ Sewage
73032	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Sewage	Human/ Sewage

Isolate	Station	Date	Runoff	Category	Super-Category
73033	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Sewage	Human/ Sewage
73034	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Sewage	Human/ Sewage
73035	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Sewage	Human/ Sewage
73036	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Sewage	Human/ Sewage
73037	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Deer	Non-avian wildlife
73038	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Sewage	Human/ Sewage
73039	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Avian	Avian
73040	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Avian	Avian
73041	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Avian	Avian
73042	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Avian	Avian
73043	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Sewage	Human/ Sewage
73044	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Sewage	Human/ Sewage
73045	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Avian	Avian
73046	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Sewage	Human/ Sewage
73047	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Sewage	Human/ Sewage
73048	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Avian	Avian
73049	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Waterfowl	Avian
73050	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Canine	Pets
73051	North Pino Arroyo above North Diversion Channel	2/20/2003	Y	Sewage	Human/ Sewage
97711	North Pino Arroyo above North Diversion Channel	7/23/2004	Y	Canine	Pets
97712	North Pino Arroyo above North Diversion Channel	7/23/2004	Y	Canine	Pets
97713	North Pino Arroyo above North Diversion Channel	7/23/2004	Y	Unknown	Unknown
97714	North Pino Arroyo above North Diversion Channel	7/23/2004	Y	Avian	Avian
97715	North Pino Arroyo above North Diversion Channel	7/23/2004	Y	Canine	Pets
98502	North Pino Arroyo above North Diversion Channel	7/27/2004	Y	Raccoon	Non-avian wildlife
69373	Paseo del Norte Pump Station	8/3/2002	Y	Canine	Pets
69374	Paseo del Norte Pump Station	8/3/2002	Y	Canine	Pets
68831	Ranchitos de Albuquerque Storm Drain	7/20/2002	Y	Avian	Avian
68998	Ranchitos de Albuquerque Storm Drain	7/20/2002	Y	Bovine	Livestock
68999	Ranchitos de Albuquerque Storm Drain	7/20/2002	Y	Canine	Pets
84133	Ranchitos de Albuquerque Storm Drain	10/7/2003	Y	Rodent	Non-avian wildlife
84134	Ranchitos de Albuquerque Storm Drain	10/7/2003	Y	Rodent	Non-avian wildlife
84135	Ranchitos de Albuquerque Storm Drain	10/7/2003	Y	Canine	Pets
84136	Ranchitos de Albuquerque Storm Drain	10/7/2003	Y	Rodent	Non-avian wildlife

Isolate	Station	Date	Runoff	Category	Super-Category
68993	Rio Grande @ Alameda Bridge	7/11/2002	Y	Bovine	Livestock
68994	Rio Grande @ Alameda Bridge	7/11/2002	Y	Avian	Avian
69370	Rio Grande @ Alameda Bridge	8/3/2002	Y	Avian	Avian
69371	Rio Grande @ Alameda Bridge	8/3/2002	Y	Avian	Avian
69372	Rio Grande @ Alameda Bridge	8/3/2002	Y	Horse	Livestock
72839	Rio Grande @ Alameda Bridge	2/20/2003	Y	Canine	Pets
72840	Rio Grande @ Alameda Bridge	2/20/2003	Y	Sewage	Human/ Sewage
72841	Rio Grande @ Alameda Bridge	2/20/2003	Y	Waterfowl	Avian
72842	Rio Grande @ Alameda Bridge	2/20/2003	Y	Canine	Pets
72843	Rio Grande @ Alameda Bridge	2/20/2003	Y	Canine	Pets
72844	Rio Grande @ Alameda Bridge	2/20/2003	Y	Canine	Pets
72845	Rio Grande @ Alameda Bridge	2/20/2003	Y	Horse	Livestock
73052	Rio Grande @ Alameda Bridge	2/20/2003	Y	Avian	Avian
73053	Rio Grande @ Alameda Bridge	2/20/2003	Y	Horse	Livestock
73054	Rio Grande @ Alameda Bridge	2/20/2003	Y	Horse	Livestock
73055	Rio Grande @ Alameda Bridge	2/20/2003	Y	Horse	Livestock
73056	Rio Grande @ Alameda Bridge	2/20/2003	Y	Avian	Avian
73057	Rio Grande @ Alameda Bridge	2/20/2003	Y	Horse	Livestock
73058	Rio Grande @ Alameda Bridge	2/20/2003	Y	Feline	Pets
73059	Rio Grande @ Alameda Bridge	2/20/2003	Y	Horse	Livestock
73060	Rio Grande @ Alameda Bridge	2/20/2003	Y	Canine	Pets
73061	Rio Grande @ Alameda Bridge	2/20/2003	Y	Canine	Pets
73062	Rio Grande @ Alameda Bridge	2/20/2003	Y	Canine	Pets
88442	Rio Grande @ Alameda Bridge	2/17/2004	N	Avian	Avian
88443	Rio Grande @ Alameda Bridge	2/17/2004	N	Rodent	Non-avian wildlife
88444	Rio Grande @ Alameda Bridge	2/17/2004	N	Rodent	Non-avian wildlife
88653	Rio Grande @ Alameda Bridge	2/22/2004	N	Unknown	Unknown
89151	Rio Grande @ Alameda Bridge	2/29/2004	N	Avian	Avian
89152	Rio Grande @ Alameda Bridge	2/29/2004	N	Unknown	Unknown
89405	Rio Grande @ Alameda Bridge	3/5/2004	Y	Horse	Livestock
89406	Rio Grande @ Alameda Bridge	3/5/2004	Y	Sewage	Human/ Sewage
89407	Rio Grande @ Alameda Bridge	3/5/2004	Y	Horse	Livestock
89408	Rio Grande @ Alameda Bridge	3/5/2004	Y	Sewage	Human/ Sewage
89409	Rio Grande @ Alameda Bridge	3/5/2004	Y	Canine	Pets

Isolate	Station	Date	Runoff	Category	Super-Category
89410	Rio Grande @ Alameda Bridge	3/5/2004	Y	Rodent	Non-avian wildlife
89411	Rio Grande @ Alameda Bridge	3/5/2004	Y	Sewage	Human/ Sewage
89412	Rio Grande @ Alameda Bridge	3/5/2004	Y	Waterfowl	Avian
89413	Rio Grande @ Alameda Bridge	3/5/2004	Y	Sewage	Human/ Sewage
89414	Rio Grande @ Alameda Bridge	3/5/2004	Y	Avian	Avian
89415	Rio Grande @ Alameda Bridge	3/5/2004	Y	Avian	Avian
89416	Rio Grande @ Alameda Bridge	3/5/2004	Y	Sewage	Human/ Sewage
89417	Rio Grande @ Alameda Bridge	3/5/2004	Y	Sewage	Human/ Sewage
89418	Rio Grande @ Alameda Bridge	3/5/2004	Y	Sewage	Human/ Sewage
89419	Rio Grande @ Alameda Bridge	3/5/2004	Y	Sewage	Human/ Sewage
89420	Rio Grande @ Alameda Bridge	3/5/2004	Y	Rodent	Non-avian wildlife
89421	Rio Grande @ Alameda Bridge	3/5/2004	Y	Canine	Pets
89422	Rio Grande @ Alameda Bridge	3/5/2004	Y	Sewage	Human/ Sewage
89423	Rio Grande @ Alameda Bridge	3/5/2004	Y	Avian	Avian
89424	Rio Grande @ Alameda Bridge	3/5/2004	Y	Sewage	Human/ Sewage
89425	Rio Grande @ Alameda Bridge	3/5/2004	Y	Bovine	Livestock
89426	Rio Grande @ Alameda Bridge	3/5/2004	Y	Avian	Avian
89427	Rio Grande @ Alameda Bridge	3/5/2004	Y	Sewage	Human/ Sewage
89428	Rio Grande @ Alameda Bridge	3/5/2004	Y	Canine	Pets
89429	Rio Grande @ Alameda Bridge	3/5/2004	Y	Avian	Avian
89430	Rio Grande @ Alameda Bridge	3/5/2004	Y	Sewage	Human/ Sewage
89431	Rio Grande @ Alameda Bridge	3/5/2004	Y	Goat	Livestock
89432	Rio Grande @ Alameda Bridge	3/5/2004	Y	Avian	Avian
89778	Rio Grande @ Alameda Bridge	3/12/2004	N	Avian	Avian
89779	Rio Grande @ Alameda Bridge	3/12/2004	N	Avian	Avian
89780	Rio Grande @ Alameda Bridge	3/12/2004	N	Avian	Avian
89781	Rio Grande @ Alameda Bridge	3/12/2004	N	Horse	Livestock
89782	Rio Grande @ Alameda Bridge	3/12/2004	N	Sheep	Livestock
89783	Rio Grande @ Alameda Bridge	3/12/2004	N	Avian	Avian
97482	Rio Grande @ Alameda Bridge	7/18/2004	Y	Sewage	Human/ Sewage
97483	Rio Grande @ Alameda Bridge	7/18/2004	Y	Bovine	Livestock
97484	Rio Grande @ Alameda Bridge	7/18/2004	Y	Avian	Avian
97486	Rio Grande @ Alameda Bridge	7/18/2004	Y	Canine	Pets
97488	Rio Grande @ Alameda Bridge	7/18/2004	Y	Sewage	Human/ Sewage

Isolate	Station	Date	Runoff	Category	Super-Category
97489	Rio Grande @ Alameda Bridge	7/18/2004	Y	Rodent	Non-avian wildlife
97490	Rio Grande @ Alameda Bridge	7/18/2004	Y	Opossum	Non-avian wildlife
97491	Rio Grande @ Alameda Bridge	7/18/2004	Y	Unknown	Unknown
97492	Rio Grande @ Alameda Bridge	7/18/2004	Y	Avian	Avian
97494	Rio Grande @ Alameda Bridge	7/18/2004	Y	Canine	Pets
97495	Rio Grande @ Alameda Bridge	7/18/2004	Y	Bovine	Livestock
97848	Rio Grande @ Alameda Bridge	7/18/2004	Y	Unknown	Unknown
97849	Rio Grande @ Alameda Bridge	7/18/2004	Y	Avian	Avian
97851	Rio Grande @ Alameda Bridge	7/18/2004	Y	Feline	Pets
97852	Rio Grande @ Alameda Bridge	7/18/2004	Y	Canine	Pets
97853	Rio Grande @ Alameda Bridge	7/18/2004	Y	Rodent	Non-avian wildlife
97854	Rio Grande @ Alameda Bridge	7/18/2004	Y	Bovine	Livestock
97855	Rio Grande @ Alameda Bridge	7/18/2004	Y	Feline	Pets
97856	Rio Grande @ Alameda Bridge	7/18/2004	Y	Canine	Pets
97857	Rio Grande @ Alameda Bridge	7/18/2004	Y	Canine	Pets
97858	Rio Grande @ Alameda Bridge	7/18/2004	Y	Canine	Pets
97859	Rio Grande @ Alameda Bridge	7/18/2004	Y	Rodent	Non-avian wildlife
97860	Rio Grande @ Alameda Bridge	7/18/2004	Y	Feline	Pets
97861	Rio Grande @ Alameda Bridge	7/18/2004	Y	Feline	Pets
97864	Rio Grande @ Alameda Bridge	7/18/2004	Y	Canine	Pets
97866	Rio Grande @ Alameda Bridge	7/18/2004	Y	Avian	Avian
97867	Rio Grande @ Alameda Bridge	7/18/2004	Y	Feline	Pets
97758	Rio Grande @ Alameda Bridge	7/21/2004	Y	Sewage	Human/ Sewage
97759	Rio Grande @ Alameda Bridge	7/21/2004	Y	Canine	Pets
97760	Rio Grande @ Alameda Bridge	7/21/2004	Y	Avian	Avian
97761	Rio Grande @ Alameda Bridge	7/21/2004	Y	Avian	Avian
97764	Rio Grande @ Alameda Bridge	7/21/2004	Y	Canine	Pets
97765	Rio Grande @ Alameda Bridge	7/21/2004	Y	Sewage	Human/ Sewage
97767	Rio Grande @ Alameda Bridge	7/21/2004	Y	Canine	Pets
97768	Rio Grande @ Alameda Bridge	7/21/2004	Y	Sewage	Human/ Sewage
97769	Rio Grande @ Alameda Bridge	7/21/2004	Y	Rodent	Non-avian wildlife
98399	Rio Grande @ Alameda Bridge	7/25/2004	Y	Avian	Avian
98400	Rio Grande @ Alameda Bridge	7/25/2004	Y	Waterfowl	Avian
98401	Rio Grande @ Alameda Bridge	7/25/2004	Y	Waterfowl	Avian

Isolate	Station	Date	Runoff	Category	Super-Category
98402	Rio Grande @ Alameda Bridge	7/25/2004	Y	Rodent	Non-avian wildlife
98403	Rio Grande @ Alameda Bridge	7/25/2004	Y	Avian	Avian
98404	Rio Grande @ Alameda Bridge	7/25/2004	Y	Bovine	Livestock
98405	Rio Grande @ Alameda Bridge	7/25/2004	Y	Horse	Livestock
98406	Rio Grande @ Alameda Bridge	7/25/2004	Y	Canine	Pets
98407	Rio Grande @ Alameda Bridge	7/25/2004	Y	Canine	Pets
98408	Rio Grande @ Alameda Bridge	7/25/2004	Y	Canine	Pets
98409	Rio Grande @ Alameda Bridge	7/25/2004	Y	Horse	Livestock
98410	Rio Grande @ Alameda Bridge	7/25/2004	Y	Canine	Pets
98411	Rio Grande @ Alameda Bridge	7/25/2004	Y	Avian	Avian
98412	Rio Grande @ Alameda Bridge	7/25/2004	Y	Avian	Avian
98413	Rio Grande @ Alameda Bridge	7/25/2004	Y	Rodent	Non-avian wildlife
98414	Rio Grande @ Alameda Bridge	7/25/2004	Y	Bovine	Livestock
98415	Rio Grande @ Alameda Bridge	7/25/2004	Y	Sewage	Human/ Sewage
98416	Rio Grande @ Alameda Bridge	7/25/2004	Y	Avian	Avian
98418	Rio Grande @ Alameda Bridge	7/25/2004	Y	Rodent	Non-avian wildlife
98419	Rio Grande @ Alameda Bridge	7/25/2004	Y	Canine	Pets
68828	Rio Grande @ Angostura Diversion Dam	7/20/2002	Y	Canine	Pets
68829	Rio Grande @ Angostura Diversion Dam	7/20/2002	Y	Bovine	Livestock
68830	Rio Grande @ Angostura Diversion Dam	7/20/2002	Y	Bovine	Livestock
69328	Rio Grande @ Angostura Diversion Dam	7/30/2002	Y	Canine	Pets
69329	Rio Grande @ Angostura Diversion Dam	7/30/2002	Y	Waterfowl	Avian
69330	Rio Grande @ Angostura Diversion Dam	7/30/2002	Y	Horse	Livestock
69332	Rio Grande @ Angostura Diversion Dam	7/30/2002	Y	Canine	Pets
69378	Rio Grande @ Angostura Diversion Dam	8/4/2002	Y	Unknown	Unknown
69379	Rio Grande @ Angostura Diversion Dam	8/4/2002	Y	Canine	Pets
69380	Rio Grande @ Angostura Diversion Dam	8/4/2002	Y	Canine	Pets
69381	Rio Grande @ Angostura Diversion Dam	8/4/2002	Y	Canine	Pets
89150	Rio Grande @ Angostura Diversion Dam	2/29/2004	N	Bovine	Livestock
89371	Rio Grande @ Angostura Diversion Dam	3/5/2004	Y	Deer	Non-avian wildlife
89372	Rio Grande @ Angostura Diversion Dam	3/5/2004	Y	Avian	Avian
89373	Rio Grande @ Angostura Diversion Dam	3/5/2004	Y	Bovine	Livestock
89756	Rio Grande @ Angostura Diversion Dam	3/12/2004	N	Bovine	Livestock
89757	Rio Grande @ Angostura Diversion Dam	3/12/2004	N	Canine	Pets

Isolate	Station	Date	Runoff	Category	Super-Category
97719	Rio Grande @ Angostura Diversion Dam	7/21/2004	Y	Rodent	Non-avian wildlife
97720	Rio Grande @ Angostura Diversion Dam	7/21/2004	Y	Canine	Pets
97721	Rio Grande @ Angostura Diversion Dam	7/21/2004	Y	Canine	Pets
98316	Rio Grande @ Angostura Diversion Dam	7/25/2004	Y	Avian	Avian
98317	Rio Grande @ Angostura Diversion Dam	7/25/2004	Y	Rodent	Non-avian wildlife
98318	Rio Grande @ Angostura Diversion Dam	7/25/2004	Y	Sewage	Human/ Sewage
98319	Rio Grande @ Angostura Diversion Dam	7/25/2004	Y	Bovine	Livestock
98320	Rio Grande @ Angostura Diversion Dam	7/25/2004	Y	Avian	Avian
98321	Rio Grande @ Angostura Diversion Dam	7/25/2004	Y	Rodent	Non-avian wildlife
98322	Rio Grande @ Angostura Diversion Dam	7/25/2004	Y	Rodent	Non-avian wildlife
98323	Rio Grande @ Angostura Diversion Dam	7/25/2004	Y	Avian	Avian
98324	Rio Grande @ Angostura Diversion Dam	7/25/2004	Y	Canine	Pets
98325	Rio Grande @ Angostura Diversion Dam	7/25/2004	Y	Canine	Pets
98326	Rio Grande @ Angostura Diversion Dam	7/25/2004	Y	Avian	Avian
98327	Rio Grande @ Angostura Diversion Dam	7/25/2004	Y	Bovine	Livestock
98328	Rio Grande @ Angostura Diversion Dam	7/25/2004	Y	Sewage	Human/ Sewage
98329	Rio Grande @ Angostura Diversion Dam	7/25/2004	Y	Canine	Pets
98330	Rio Grande @ Angostura Diversion Dam	7/25/2004	Y	Canine	Pets
98331	Rio Grande @ Angostura Diversion Dam	7/25/2004	Y	Avian	Avian
98332	Rio Grande @ Angostura Diversion Dam	7/25/2004	Y	Canine	Pets
98333	Rio Grande @ Angostura Diversion Dam	7/25/2004	Y	Bovine	Livestock
98334	Rio Grande @ Angostura Diversion Dam	7/25/2004	Y	Sewage	Human/ Sewage
98335	Rio Grande @ Angostura Diversion Dam	7/25/2004	Y	Feline	Pets
98336	Rio Grande @ Angostura Diversion Dam	7/25/2004	Y	Porcine	Livestock
89374	Rio Grande @ HW 44 (US 550)	3/5/2004	Y	Sewage	Human/ Sewage
89375	Rio Grande @ HW 44 (US 550)	3/5/2004	Y	Avian	Avian
89376	Rio Grande @ HW 44 (US 550)	3/5/2004	Y	Waterfowl	Avian
89377	Rio Grande @ HW 44 (US 550)	3/5/2004	Y	Canine	Pets
89378	Rio Grande @ HW 44 (US 550)	3/5/2004	Y	Avian	Avian
89380	Rio Grande @ HW 44 (US 550)	3/5/2004	Y	Feline	Pets
89381	Rio Grande @ HW 44 (US 550)	3/5/2004	Y	Canine	Pets
89382	Rio Grande @ HW 44 (US 550)	3/5/2004	Y	Unknown	Unknown
89384	Rio Grande @ HW 44 (US 550)	3/5/2004	Y	Sewage	Human/ Sewage
89385	Rio Grande @ HW 44 (US 550)	3/5/2004	Y	Canine	Pets

Isolate	Station	Date	Runoff	Category	Super-Category
89386	Rio Grande @ HW 44 (US 550)	3/5/2004	Y	Horse	Livestock
89388	Rio Grande @ HW 44 (US 550)	3/5/2004	Y	Horse	Livestock
89758	Rio Grande @ HW 44 (US 550)	3/12/2004	N	Bovine	Livestock
89759	Rio Grande @ HW 44 (US 550)	3/12/2004	N	Bovine	Livestock
89760	Rio Grande @ HW 44 (US 550)	3/12/2004	N	Avian	Avian
89761	Rio Grande @ HW 44 (US 550)	3/12/2004	N	Avian	Avian
89762	Rio Grande @ HW 44 (US 550)	3/12/2004	N	Sewage	Human/ Sewage
89763	Rio Grande @ HW 44 (US 550)	3/12/2004	N	Sewage	Human/ Sewage
89764	Rio Grande @ HW 44 (US 550)	3/12/2004	N	Rodent	Non-avian wildlife
89765	Rio Grande @ HW 44 (US 550)	3/12/2004	N	Avian	Avian
89766	Rio Grande @ HW 44 (US 550)	3/12/2004	N	Avian	Avian
89767	Rio Grande @ HW 44 (US 550)	3/12/2004	N	Avian	Avian
97419	Rio Grande @ HW 44 (US 550)	7/18/2004	Y	Sewage	Human/ Sewage
97421	Rio Grande @ HW 44 (US 550)	7/18/2004	Y	Canine	Pets
97422	Rio Grande @ HW 44 (US 550)	7/18/2004	Y	Sewage	Human/ Sewage
97424	Rio Grande @ HW 44 (US 550)	7/18/2004	Y	Rodent	Non-avian wildlife
97429	Rio Grande @ HW 44 (US 550)	7/18/2004	Y	Rodent	Non-avian wildlife
97431	Rio Grande @ HW 44 (US 550)	7/18/2004	Y	Bovine	Livestock
97432	Rio Grande @ HW 44 (US 550)	7/18/2004	Y	Bovine	Livestock
97433	Rio Grande @ HW 44 (US 550)	7/18/2004	Y	Avian	Avian
97771	Rio Grande @ HW 44 (US 550)	7/18/2004	Y	Avian	Avian
97772	Rio Grande @ HW 44 (US 550)	7/18/2004	Y	Canine	Pets
97773	Rio Grande @ HW 44 (US 550)	7/18/2004	Y	Rodent	Non-avian wildlife
97774	Rio Grande @ HW 44 (US 550)	7/18/2004	Y	Rodent	Non-avian wildlife
97775	Rio Grande @ HW 44 (US 550)	7/18/2004	Y	Sewage	Human/ Sewage
97776	Rio Grande @ HW 44 (US 550)	7/18/2004	Y	Canine	Pets
97777	Rio Grande @ HW 44 (US 550)	7/18/2004	Y	Sewage	Human/ Sewage
97778	Rio Grande @ HW 44 (US 550)	7/18/2004	Y	Canine	Pets
97779	Rio Grande @ HW 44 (US 550)	7/18/2004	Y	Canine	Pets
97780	Rio Grande @ HW 44 (US 550)	7/18/2004	Y	Avian	Avian
97781	Rio Grande @ HW 44 (US 550)	7/18/2004	Y	Avian	Avian
97782	Rio Grande @ HW 44 (US 550)	7/18/2004	Y	Rodent	Non-avian wildlife
97784	Rio Grande @ HW 44 (US 550)	7/18/2004	Y	Avian	Avian
97785	Rio Grande @ HW 44 (US 550)	7/18/2004	Y	Unknown	Unknown

Isolate	Station	Date	Runoff	Category	Super-Category
97723	Rio Grande @ HW 44 (US 550)	7/21/2004	Y	Rodent	Non-avian wildlife
97724	Rio Grande @ HW 44 (US 550)	7/21/2004	Y	Unknown	Unknown
97725	Rio Grande @ HW 44 (US 550)	7/21/2004	Y	Rodent	Non-avian wildlife
97726	Rio Grande @ HW 44 (US 550)	7/21/2004	Y	Horse	Livestock
97728	Rio Grande @ HW 44 (US 550)	7/21/2004	Y	Canine	Pets
98337	Rio Grande @ HW 44 (US 550)	7/25/2004	Y	Canine	Pets
98338	Rio Grande @ HW 44 (US 550)	7/25/2004	Y	Canine	Pets
98339	Rio Grande @ HW 44 (US 550)	7/25/2004	Y	Bovine	Livestock
98340	Rio Grande @ HW 44 (US 550)	7/25/2004	Y	Rodent	Non-avian wildlife
98341	Rio Grande @ HW 44 (US 550)	7/25/2004	Y	Human	Human/ Sewage
98342	Rio Grande @ HW 44 (US 550)	7/25/2004	Y	Waterfowl	Avian
98343	Rio Grande @ HW 44 (US 550)	7/25/2004	Y	Canine	Pets
98344	Rio Grande @ HW 44 (US 550)	7/25/2004	Y	Waterfowl	Avian
98345	Rio Grande @ HW 44 (US 550)	7/25/2004	Y	Waterfowl	Avian
98346	Rio Grande @ HW 44 (US 550)	7/25/2004	Y	Canine	Pets
98347	Rio Grande @ HW 44 (US 550)	7/25/2004	Y	Waterfowl	Avian
98348	Rio Grande @ HW 44 (US 550)	7/25/2004	Y	Canine	Pets
98349	Rio Grande @ HW 44 (US 550)	7/25/2004	Y	Raccoon	Non-avian wildlife
98350	Rio Grande @ HW 44 (US 550)	7/25/2004	Y	Canine	Pets
98351	Rio Grande @ HW 44 (US 550)	7/25/2004	Y	Canine	Pets
98352	Rio Grande @ HW 44 (US 550)	7/25/2004	Y	Canine	Pets
98354	Rio Grande @ HW 44 (US 550)	7/25/2004	Y	Canine	Pets
98355	Rio Grande @ HW 44 (US 550)	7/25/2004	Y	Feline	Pets
69351	Rio Grande @ I-25 Crossing	8/3/2002	Y	Bovine	Livestock
69352	Rio Grande @ I-25 Crossing	8/3/2002	Y	Avian	Avian
69353	Rio Grande @ I-25 Crossing	8/3/2002	Y	Unknown	Unknown
72908	Rio Grande @ I-25 Crossing	2/20/2003	Y	Rodent	Non-avian wildlife
72909	Rio Grande @ I-25 Crossing	2/20/2003	Y	Sewage	Human/ Sewage
72910	Rio Grande @ I-25 Crossing	2/20/2003	Y	Avian	Avian
72911	Rio Grande @ I-25 Crossing	2/20/2003	Y	Canine	Pets
72912	Rio Grande @ I-25 Crossing	2/20/2003	Y	Deer	Non-avian wildlife
72913	Rio Grande @ I-25 Crossing	2/20/2003	Y	Sewage	Human/ Sewage
72914	Rio Grande @ I-25 Crossing	2/20/2003	Y	Canine	Pets
72915	Rio Grande @ I-25 Crossing	2/20/2003	Y	Bovine	Livestock

Isolate	Station	Date	Runoff	Category	Super-Category
72916	Rio Grande @ I-25 Crossing	2/20/2003	Y	Bovine	Livestock
72917	Rio Grande @ I-25 Crossing	2/20/2003	Y	Canine	Pets
72918	Rio Grande @ I-25 Crossing	2/20/2003	Y	Canine	Pets
72919	Rio Grande @ I-25 Crossing	2/20/2003	Y	Canine	Pets
72920	Rio Grande @ I-25 Crossing	2/20/2003	Y	Rodent	Non-avian wildlife
72921	Rio Grande @ I-25 Crossing	2/20/2003	Y	Rodent	Non-avian wildlife
72922	Rio Grande @ I-25 Crossing	2/20/2003	Y	Sewage	Human/ Sewage
72923	Rio Grande @ I-25 Crossing	2/20/2003	Y	Sewage	Human/ Sewage
72924	Rio Grande @ I-25 Crossing	2/20/2003	Y	Horse	Livestock
72925	Rio Grande @ I-25 Crossing	2/20/2003	Y	Canine	Pets
72926	Rio Grande @ I-25 Crossing	2/20/2003	Y	Human	Human/ Sewage
72927	Rio Grande @ I-25 Crossing	2/20/2003	Y	Bovine	Livestock
88679	Rio Grande @ I-25 Crossing	2/22/2004	N	Rodent	Non-avian wildlife
88680	Rio Grande @ I-25 Crossing	2/22/2004	N	Waterfowl	Avian
88681	Rio Grande @ I-25 Crossing	2/22/2004	N	Waterfowl	Avian
88682	Rio Grande @ I-25 Crossing	2/22/2004	N	Avian	Avian
88683	Rio Grande @ I-25 Crossing	2/22/2004	N	Rodent	Non-avian wildlife
88684	Rio Grande @ I-25 Crossing	2/22/2004	N	Avian	Avian
88685	Rio Grande @ I-25 Crossing	2/22/2004	N	Avian	Avian
88686	Rio Grande @ I-25 Crossing	2/22/2004	N	Avian	Avian
88687	Rio Grande @ I-25 Crossing	2/22/2004	N	Avian	Avian
88688	Rio Grande @ I-25 Crossing	2/22/2004	N	Bovine	Livestock
88689	Rio Grande @ I-25 Crossing	2/22/2004	N	Avian	Avian
88690	Rio Grande @ I-25 Crossing	2/22/2004	N	Avian	Avian
88691	Rio Grande @ I-25 Crossing	2/22/2004	N	Waterfowl	Avian
88692	Rio Grande @ I-25 Crossing	2/22/2004	N	Avian	Avian
88693	Rio Grande @ I-25 Crossing	2/22/2004	N	Avian	Avian
88694	Rio Grande @ I-25 Crossing	2/22/2004	N	Avian	Avian
88695	Rio Grande @ I-25 Crossing	2/22/2004	N	Avian	Avian
88696	Rio Grande @ I-25 Crossing	2/22/2004	N	Rodent	Non-avian wildlife
88697	Rio Grande @ I-25 Crossing	2/22/2004	N	Waterfowl	Avian
88698	Rio Grande @ I-25 Crossing	2/22/2004	N	Rodent	Non-avian wildlife
88699	Rio Grande @ I-25 Crossing	2/22/2004	N	Sewage	Human/ Sewage
88700	Rio Grande @ I-25 Crossing	2/22/2004	N	Canine	Pets

Isolate	Station	Date	Runoff	Category	Super-Category
88701	Rio Grande @ I-25 Crossing	2/22/2004	N	Avian	Avian
88702	Rio Grande @ I-25 Crossing	2/22/2004	N	Avian	Avian
88703	Rio Grande @ I-25 Crossing	2/22/2004	N	Human	Human/ Sewage
88704	Rio Grande @ I-25 Crossing	2/22/2004	N	Avian	Avian
88705	Rio Grande @ I-25 Crossing	2/22/2004	N	Horse	Livestock
89159	Rio Grande @ I-25 Crossing	2/29/2004	N	Sewage	Human/ Sewage
89160	Rio Grande @ I-25 Crossing	2/29/2004	N	Avian	Avian
89161	Rio Grande @ I-25 Crossing	2/29/2004	N	Avian	Avian
89162	Rio Grande @ I-25 Crossing	2/29/2004	N	Sewage	Human/ Sewage
89163	Rio Grande @ I-25 Crossing	2/29/2004	N	Feline	Pets
89164	Rio Grande @ I-25 Crossing	2/29/2004	N	Avian	Avian
89165	Rio Grande @ I-25 Crossing	2/29/2004	N	Porcine	Livestock
89166	Rio Grande @ I-25 Crossing	2/29/2004	N	Canine	Pets
89167	Rio Grande @ I-25 Crossing	2/29/2004	N	Horse	Livestock
89168	Rio Grande @ I-25 Crossing	2/29/2004	N	Canine	Pets
89169	Rio Grande @ I-25 Crossing	2/29/2004	N	Sewage	Human/ Sewage
89170	Rio Grande @ I-25 Crossing	2/29/2004	N	Avian	Avian
89171	Rio Grande @ I-25 Crossing	2/29/2004	N	Canine	Pets
89172	Rio Grande @ I-25 Crossing	2/29/2004	N	Canine	Pets
89173	Rio Grande @ I-25 Crossing	2/29/2004	N	Avian	Avian
89174	Rio Grande @ I-25 Crossing	2/29/2004	N	Canine	Pets
89175	Rio Grande @ I-25 Crossing	2/29/2004	N	Sewage	Human/ Sewage
89176	Rio Grande @ I-25 Crossing	2/29/2004	N	Avian	Avian
89177	Rio Grande @ I-25 Crossing	2/29/2004	N	Feline	Pets
89178	Rio Grande @ I-25 Crossing	2/29/2004	N	Deer	Non-avian wildlife
89179	Rio Grande @ I-25 Crossing	2/29/2004	N	Feline	Pets
89180	Rio Grande @ I-25 Crossing	2/29/2004	N	Avian	Avian
89181	Rio Grande @ I-25 Crossing	2/29/2004	N	Avian	Avian
89182	Rio Grande @ I-25 Crossing	2/29/2004	N	Sewage	Human/ Sewage
89487	Rio Grande @ I-25 Crossing	3/5/2004	Y	Canine	Pets
89488	Rio Grande @ I-25 Crossing	3/5/2004	Y	Sewage	Human/ Sewage
89489	Rio Grande @ I-25 Crossing	3/5/2004	Y	Sewage	Human/ Sewage
89490	Rio Grande @ I-25 Crossing	3/5/2004	Y	Bovine	Livestock
89491	Rio Grande @ I-25 Crossing	3/5/2004	Y	Bovine	Livestock

Isolate	Station	Date	Runoff	Category	Super-Category
89492	Rio Grande @ I-25 Crossing	3/5/2004	Y	Porcine	Livestock
89493	Rio Grande @ I-25 Crossing	3/5/2004	Y	Rodent	Non-avian wildlife
89494	Rio Grande @ I-25 Crossing	3/5/2004	Y	Human	Human/ Sewage
89495	Rio Grande @ I-25 Crossing	3/5/2004	Y	Sewage	Human/ Sewage
89496	Rio Grande @ I-25 Crossing	3/5/2004	Y	Avian	Avian
89497	Rio Grande @ I-25 Crossing	3/5/2004	Y	Avian	Avian
89498	Rio Grande @ I-25 Crossing	3/5/2004	Y	Rodent	Non-avian wildlife
89499	Rio Grande @ I-25 Crossing	3/5/2004	Y	Horse	Livestock
89500	Rio Grande @ I-25 Crossing	3/5/2004	Y	Avian	Avian
89501	Rio Grande @ I-25 Crossing	3/5/2004	Y	Sheep	Livestock
89502	Rio Grande @ I-25 Crossing	3/5/2004	Y	Horse	Livestock
89503	Rio Grande @ I-25 Crossing	3/5/2004	Y	Porcine	Livestock
89504	Rio Grande @ I-25 Crossing	3/5/2004	Y	Horse	Livestock
89505	Rio Grande @ I-25 Crossing	3/5/2004	Y	Avian	Avian
89506	Rio Grande @ I-25 Crossing	3/5/2004	Y	Feline	Pets
89507	Rio Grande @ I-25 Crossing	3/5/2004	Y	Avian	Avian
89508	Rio Grande @ I-25 Crossing	3/5/2004	Y	Human	Human/ Sewage
89509	Rio Grande @ I-25 Crossing	3/5/2004	Y	Horse	Livestock
89510	Rio Grande @ I-25 Crossing	3/5/2004	Y	Canine	Pets
89511	Rio Grande @ I-25 Crossing	3/5/2004	Y	Canine	Pets
89512	Rio Grande @ I-25 Crossing	3/5/2004	Y	Sewage	Human/ Sewage
89513	Rio Grande @ I-25 Crossing	3/5/2004	Y	Human	Human/ Sewage
89820	Rio Grande @ I-25 Crossing	3/12/2004	N	Canine	Pets
89821	Rio Grande @ I-25 Crossing	3/12/2004	N	Avian	Avian
89822	Rio Grande @ I-25 Crossing	3/12/2004	N	Avian	Avian
89823	Rio Grande @ I-25 Crossing	3/12/2004	N	Bovine	Livestock
89824	Rio Grande @ I-25 Crossing	3/12/2004	N	Avian	Avian
89825	Rio Grande @ I-25 Crossing	3/12/2004	N	Rodent	Non-avian wildlife
89826	Rio Grande @ I-25 Crossing	3/12/2004	N	Avian	Avian
89827	Rio Grande @ I-25 Crossing	3/12/2004	N	Unknown	Unknown
89828	Rio Grande @ I-25 Crossing	3/12/2004	N	Sewage	Human/ Sewage
89829	Rio Grande @ I-25 Crossing	3/12/2004	N	Sewage	Human/ Sewage
89830	Rio Grande @ I-25 Crossing	3/12/2004	N	Avian	Avian
89831	Rio Grande @ I-25 Crossing	3/12/2004	N	Avian	Avian

Isolate	Station	Date	Runoff	Category	Super-Category
89832	Rio Grande @ I-25 Crossing	3/12/2004	N	Bovine	Livestock
89833	Rio Grande @ I-25 Crossing	3/12/2004	N	Canine	Pets
89834	Rio Grande @ I-25 Crossing	3/12/2004	N	Sewage	Human/ Sewage
89835	Rio Grande @ I-25 Crossing	3/12/2004	N	Sewage	Human/ Sewage
89836	Rio Grande @ I-25 Crossing	3/12/2004	N	Bovine	Livestock
89840	Rio Grande @ I-25 Crossing	3/12/2004	N	Bovine	Livestock
89841	Rio Grande @ I-25 Crossing	3/12/2004	N	Bovine	Livestock
89842	Rio Grande @ I-25 Crossing	3/12/2004	N	Rodent	Non-avian wildlife
89843	Rio Grande @ I-25 Crossing	3/12/2004	N	Avian	Avian
89844	Rio Grande @ I-25 Crossing	3/12/2004	N	Rodent	Non-avian wildlife
89845	Rio Grande @ I-25 Crossing	3/12/2004	N	Avian	Avian
89846	Rio Grande @ I-25 Crossing	3/12/2004	N	Sewage	Human/ Sewage
97375	Rio Grande @ I-25 Crossing	7/19/2004	Y	Canine	Pets
97377	Rio Grande @ I-25 Crossing	7/19/2004	Y	Avian	Avian
97380	Rio Grande @ I-25 Crossing	7/19/2004	Y	Sewage	Human/ Sewage
97381	Rio Grande @ I-25 Crossing	7/19/2004	Y	Sewage	Human/ Sewage
97382	Rio Grande @ I-25 Crossing	7/19/2004	Y	Avian	Avian
97383	Rio Grande @ I-25 Crossing	7/19/2004	Y	Canine	Pets
97384	Rio Grande @ I-25 Crossing	7/19/2004	Y	Sewage	Human/ Sewage
97385	Rio Grande @ I-25 Crossing	7/19/2004	Y	Avian	Avian
97386	Rio Grande @ I-25 Crossing	7/19/2004	Y	Sewage	Human/ Sewage
97387	Rio Grande @ I-25 Crossing	7/19/2004	Y	Feline	Pets
97388	Rio Grande @ I-25 Crossing	7/19/2004	Y	Avian	Avian
97389	Rio Grande @ I-25 Crossing	7/19/2004	Y	Avian	Avian
97888	Rio Grande @ I-25 Crossing	7/19/2004	Y	Unknown	Unknown
97889	Rio Grande @ I-25 Crossing	7/19/2004	Y	Avian	Avian
97890	Rio Grande @ I-25 Crossing	7/19/2004	Y	Bovine	Livestock
97892	Rio Grande @ I-25 Crossing	7/19/2004	Y	Coyote	Non-avian wildlife
97894	Rio Grande @ I-25 Crossing	7/19/2004	Y	Avian	Avian
97895	Rio Grande @ I-25 Crossing	7/19/2004	Y	Avian	Avian
97896	Rio Grande @ I-25 Crossing	7/19/2004	Y	Avian	Avian
97898	Rio Grande @ I-25 Crossing	7/19/2004	Y	Avian	Avian
97900	Rio Grande @ I-25 Crossing	7/19/2004	Y	Avian	Avian
97901	Rio Grande @ I-25 Crossing	7/19/2004	Y	Bovine	Livestock

Isolate	Station	Date	Runoff	Category	Super-Category
97903	Rio Grande @ I-25 Crossing	7/19/2004	Y	Avian	Avian
97904	Rio Grande @ I-25 Crossing	7/19/2004	Y	Sewage	Human/ Sewage
97906	Rio Grande @ I-25 Crossing	7/19/2004	Y	Porcine	Livestock
98500	Rio Grande @ I-25 Crossing	7/25/2004	Y	Canine	Pets
98501	Rio Grande @ I-25 Crossing	7/25/2004	Y	Canine	Pets
69343	Rio Grande @ Isleta Diversion Dam	8/3/2002	Y	Bovine	Livestock
69344	Rio Grande @ Isleta Diversion Dam	8/3/2002	Y	Sewage	Human/ Sewage
69345	Rio Grande @ Isleta Diversion Dam	8/3/2002	Y	Bovine	Livestock
69346	Rio Grande @ Isleta Diversion Dam	8/3/2002	Y	Sewage	Human/ Sewage
69347	Rio Grande @ Isleta Diversion Dam	8/3/2002	Y	Avian	Avian
69348	Rio Grande @ Isleta Diversion Dam	8/3/2002	Y	Avian	Avian
72928	Rio Grande @ Isleta Diversion Dam	2/20/2003	Y	Rodent	Non-avian wildlife
72929	Rio Grande @ Isleta Diversion Dam	2/20/2003	Y	Unknown	Unknown
72930	Rio Grande @ Isleta Diversion Dam	2/20/2003	Y	Avian	Avian
72931	Rio Grande @ Isleta Diversion Dam	2/20/2003	Y	Avian	Avian
72932	Rio Grande @ Isleta Diversion Dam	2/20/2003	Y	Avian	Avian
72933	Rio Grande @ Isleta Diversion Dam	2/20/2003	Y	Rodent	Non-avian wildlife
72934	Rio Grande @ Isleta Diversion Dam	2/20/2003	Y	Bovine	Livestock
72935	Rio Grande @ Isleta Diversion Dam	2/20/2003	Y	Sewage	Human/ Sewage
72936	Rio Grande @ Isleta Diversion Dam	2/20/2003	Y	Sewage	Human/ Sewage
72937	Rio Grande @ Isleta Diversion Dam	2/20/2003	Y	Unknown	Unknown
72938	Rio Grande @ Isleta Diversion Dam	2/20/2003	Y	Unknown	Unknown
72939	Rio Grande @ Isleta Diversion Dam	2/20/2003	Y	Unknown	Unknown
72940	Rio Grande @ Isleta Diversion Dam	2/20/2003	Y	Bovine	Livestock
72941	Rio Grande @ Isleta Diversion Dam	2/20/2003	Y	Bovine	Livestock
72942	Rio Grande @ Isleta Diversion Dam	2/20/2003	Y	Sewage	Human/ Sewage
72943	Rio Grande @ Isleta Diversion Dam	2/20/2003	Y	Avian	Avian
72944	Rio Grande @ Isleta Diversion Dam	2/20/2003	Y	Unknown	Unknown
72945	Rio Grande @ Isleta Diversion Dam	2/20/2003	Y	Bovine	Livestock
72946	Rio Grande @ Isleta Diversion Dam	2/20/2003	Y	Bovine	Livestock
72947	Rio Grande @ Isleta Diversion Dam	2/20/2003	Y	Horse	Livestock
72948	Rio Grande @ Isleta Diversion Dam	2/20/2003	Y	Sewage	Human/ Sewage
84088	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Rodent	Non-avian wildlife
84089	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Bovine	Livestock

Isolate	Station	Date	Runoff	Category	Super-Category
84090	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Avian	Avian
84091	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Avian	Avian
84092	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Avian	Avian
84093	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Horse	Livestock
84094	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Avian	Avian
84095	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Avian	Avian
84096	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Avian	Avian
84097	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Avian	Avian
84098	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Avian	Avian
84099	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Avian	Avian
84100	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Waterfowl	Avian
84101	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Waterfowl	Avian
84102	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Sheep	Livestock
84103	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Avian	Avian
84104	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Avian	Avian
84105	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Canine	Pets
84106	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Avian	Avian
84107	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Canine	Pets
84108	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Waterfowl	Avian
84109	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Bovine	Livestock
84110	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Avian	Avian
84111	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Porcine	Livestock
84112	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Waterfowl	Avian
84113	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Waterfowl	Avian
84114	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Bovine	Livestock
84115	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Bovine	Livestock
84116	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Horse	Livestock
84117	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Avian	Avian
84118	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Avian	Avian
84119	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Avian	Avian
84120	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Horse	Livestock
84121	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Horse	Livestock
84122	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Feline	Pets
84123	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Avian	Avian

Isolate	Station	Date	Runoff	Category	Super-Category
84124	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Avian	Avian
84125	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Avian	Avian
84126	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Unknown	Unknown
84127	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Unknown	Unknown
84128	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Canine	Pets
84129	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Canine	Pets
84131	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Canine	Pets
84132	Rio Grande @ Isleta Diversion Dam	10/7/2003	Y	Canine	Pets
88706	Rio Grande @ Isleta Diversion Dam	2/22/2004	N	Avian	Avian
88707	Rio Grande @ Isleta Diversion Dam	2/22/2004	N	Avian	Avian
88708	Rio Grande @ Isleta Diversion Dam	2/22/2004	N	Canine	Pets
88709	Rio Grande @ Isleta Diversion Dam	2/22/2004	N	Rodent	Non-avian wildlife
88710	Rio Grande @ Isleta Diversion Dam	2/22/2004	N	Sewage	Human/ Sewage
88711	Rio Grande @ Isleta Diversion Dam	2/22/2004	N	Porcine	Livestock
88712	Rio Grande @ Isleta Diversion Dam	2/22/2004	N	Porcine	Livestock
88713	Rio Grande @ Isleta Diversion Dam	2/22/2004	N	Canine	Pets
88714	Rio Grande @ Isleta Diversion Dam	2/22/2004	N	Bovine	Livestock
88715	Rio Grande @ Isleta Diversion Dam	2/22/2004	N	Bovine	Livestock
88716	Rio Grande @ Isleta Diversion Dam	2/22/2004	N	Avian	Avian
89183	Rio Grande @ Isleta Diversion Dam	2/29/2004	N	Avian	Avian
89184	Rio Grande @ Isleta Diversion Dam	2/29/2004	N	Waterfowl	Avian
89185	Rio Grande @ Isleta Diversion Dam	2/29/2004	N	Bovine	Livestock
89186	Rio Grande @ Isleta Diversion Dam	2/29/2004	N	Human	Human/ Sewage
89187	Rio Grande @ Isleta Diversion Dam	2/29/2004	N	Avian	Avian
89545	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Canine	Pets
89546	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Sewage	Human/ Sewage
89547	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Horse	Livestock
89548	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Bovine	Livestock
89549	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Avian	Avian
89550	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Avian	Avian
89551	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Avian	Avian
89552	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Deer	Non-avian wildlife
89553	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Sewage	Human/ Sewage
89554	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Avian	Avian

Isolate	Station	Date	Runoff	Category	Super-Category
89555	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Sewage	Human/ Sewage
89556	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Avian	Avian
89557	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Horse	Livestock
89558	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Canine	Pets
89559	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Waterfowl	Avian
89560	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Avian	Avian
89561	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Avian	Avian
89562	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Waterfowl	Avian
89563	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Horse	Livestock
89564	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Avian	Avian
89565	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Avian	Avian
89566	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Unknown	Unknown
89568	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Avian	Avian
89569	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Bear	Non-avian wildlife
89570	Rio Grande @ Isleta Diversion Dam	3/5/2004	Y	Canine	Pets
89847	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Avian	Avian
89848	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Bovine	Livestock
89849	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Human	Human/ Sewage
89850	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Avian	Avian
89851	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Avian	Avian
89852	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Sewage	Human/ Sewage
89853	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Porcine	Livestock
89854	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Rodent	Non-avian wildlife
89855	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Sewage	Human/ Sewage
89856	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Bovine	Livestock
89857	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Avian	Avian
89858	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Avian	Avian
89859	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Avian	Avian
89860	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Avian	Avian
89861	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Canine	Pets
89862	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Porcine	Livestock
89863	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Avian	Avian
89864	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Porcine	Livestock
89865	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Sewage	Human/ Sewage

Isolate	Station	Date	Runoff	Category	Super-Category
89866	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Avian	Avian
89867	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Avian	Avian
89868	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Horse	Livestock
89869	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Horse	Livestock
89870	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Horse	Livestock
89871	Rio Grande @ Isleta Diversion Dam	3/12/2004	N	Avian	Avian
97314	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Rodent	Non-avian wildlife
97315	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Rodent	Non-avian wildlife
97316	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Avian	Avian
97317	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Raccoon	Non-avian wildlife
97318	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Rodent	Non-avian wildlife
97319	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Canine	Pets
97320	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Rodent	Non-avian wildlife
97321	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Rodent	Non-avian wildlife
97322	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Rodent	Non-avian wildlife
97323	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Rodent	Non-avian wildlife
97324	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Rodent	Non-avian wildlife
97326	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Canine	Pets
97327	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Unknown	Unknown
97328	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Rodent	Non-avian wildlife
97329	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Canine	Pets
97330	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Canine	Pets
97331	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Rodent	Non-avian wildlife
97333	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Canine	Pets
97334	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Canine	Pets
97336	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Canine	Pets
97337	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Avian	Avian
97338	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Rodent	Non-avian wildlife
97339	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Rodent	Non-avian wildlife
97340	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Avian	Avian
97341	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Avian	Avian
97342	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Avian	Avian
97344	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Avian	Avian
97345	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Avian	Avian

Isolate	Station	Date	Runoff	Category	Super-Category
97346	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Horse	Livestock
97347	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Avian	Avian
97348	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Horse	Livestock
97349	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Avian	Avian
97350	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Avian	Avian
97351	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Avian	Avian
97983	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Sewage	Human/ Sewage
97984	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Unknown	Unknown
97985	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Unknown	Unknown
97986	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Unknown	Unknown
97987	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Avian	Avian
97989	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Avian	Avian
97990	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Canine	Pets
97991	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Sewage	Human/ Sewage
97992	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Avian	Avian
97993	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Unknown	Unknown
97994	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Sewage	Human/ Sewage
97995	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Canine	Pets
97996	Rio Grande @ Isleta Diversion Dam	7/19/2004	Y	Sewage	Human/ Sewage
98469	Rio Grande @ Isleta Diversion Dam	7/25/2004	Y	Sewage	Human/ Sewage
98470	Rio Grande @ Isleta Diversion Dam	7/25/2004	Y	Sewage	Human/ Sewage
98471	Rio Grande @ Isleta Diversion Dam	7/25/2004	Y	Avian	Avian
98483	Rio Grande @ Isleta Diversion Dam	7/25/2004	Y	Canine	Pets
98484	Rio Grande @ Isleta Diversion Dam	7/25/2004	Y	Canine	Pets
98486	Rio Grande @ Isleta Diversion Dam	7/25/2004	Y	Avian	Avian
98487	Rio Grande @ Isleta Diversion Dam	7/25/2004	Y	Avian	Avian
98488	Rio Grande @ Isleta Diversion Dam	7/25/2004	Y	Avian	Avian
98489	Rio Grande @ Isleta Diversion Dam	7/25/2004	Y	Canine	Pets
98490	Rio Grande @ Isleta Diversion Dam	7/25/2004	Y	Avian	Avian
98491	Rio Grande @ Isleta Diversion Dam	7/25/2004	Y	Unknown	Unknown
98492	Rio Grande @ Isleta Diversion Dam	7/25/2004	Y	Unknown	Unknown
98493	Rio Grande @ Isleta Diversion Dam	7/25/2004	Y	Rodent	Non-avian wildlife
98494	Rio Grande @ Isleta Diversion Dam	7/25/2004	Y	Rodent	Non-avian wildlife
98496	Rio Grande @ Isleta Diversion Dam	7/25/2004	Y	Avian	Avian

Isolate	Station	Date	Runoff	Category	Super-Category
98497	Rio Grande @ Isleta Diversion Dam	7/25/2004	Y	Avian	Avian
98498	Rio Grande @ Isleta Diversion Dam	7/25/2004	Y	Avian	Avian
98499	Rio Grande @ Isleta Diversion Dam	7/25/2004	Y	Rodent	Non-avian wildlife
68995	Rio Grande @ Rio Bravo Bridge	7/8/2002	Y	Waterfowl	Avian
68996	Rio Grande @ Rio Bravo Bridge	7/8/2002	Y	Avian	Avian
68997	Rio Grande @ Rio Bravo Bridge	7/8/2002	Y	Avian	Avian
72887	Rio Grande @ Rio Bravo Bridge	2/20/2003	Y	Bovine	Livestock
72888	Rio Grande @ Rio Bravo Bridge	2/20/2003	Y	Bovine	Livestock
72889	Rio Grande @ Rio Bravo Bridge	2/20/2003	Y	Canine	Pets
72890	Rio Grande @ Rio Bravo Bridge	2/20/2003	Y	Avian	Avian
72891	Rio Grande @ Rio Bravo Bridge	2/20/2003	Y	Bovine	Livestock
72892	Rio Grande @ Rio Bravo Bridge	2/20/2003	Y	Avian	Avian
72893	Rio Grande @ Rio Bravo Bridge	2/20/2003	Y	Sewage	Human/ Sewage
72894	Rio Grande @ Rio Bravo Bridge	2/20/2003	Y	Avian	Avian
72895	Rio Grande @ Rio Bravo Bridge	2/20/2003	Y	Avian	Avian
72896	Rio Grande @ Rio Bravo Bridge	2/20/2003	Y	Canine	Pets
72897	Rio Grande @ Rio Bravo Bridge	2/20/2003	Y	Rodent	Non-avian wildlife
72898	Rio Grande @ Rio Bravo Bridge	2/20/2003	Y	Avian	Avian
72899	Rio Grande @ Rio Bravo Bridge	2/20/2003	Y	Avian	Avian
72900	Rio Grande @ Rio Bravo Bridge	2/20/2003	Y	Canine	Pets
72901	Rio Grande @ Rio Bravo Bridge	2/20/2003	Y	Horse	Livestock
72902	Rio Grande @ Rio Bravo Bridge	2/20/2003	Y	Avian	Avian
72903	Rio Grande @ Rio Bravo Bridge	2/20/2003	Y	Bovine	Livestock
72904	Rio Grande @ Rio Bravo Bridge	2/20/2003	Y	Avian	Avian
72905	Rio Grande @ Rio Bravo Bridge	2/20/2003	Y	Bovine	Livestock
72906	Rio Grande @ Rio Bravo Bridge	2/20/2003	Y	Avian	Avian
72907	Rio Grande @ Rio Bravo Bridge	2/20/2003	Y	Avian	Avian
88717	Rio Grande @ Rio Bravo Bridge	2/22/2004	N	Bovine	Livestock
89188	Rio Grande @ Rio Bravo Bridge	2/29/2004	N	Canine	Pets
89460	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Rodent	Non-avian wildlife
89461	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Rodent	Non-avian wildlife
89462	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Rodent	Non-avian wildlife
89463	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Sewage	Human/ Sewage
89464	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Bovine	Livestock

Isolate	Station	Date	Runoff	Category	Super-Category
89465	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Bovine	Livestock
89466	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Sewage	Human/ Sewage
89467	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Avian	Avian
89468	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Avian	Avian
89469	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Avian	Avian
89470	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Sewage	Human/ Sewage
89471	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Avian	Avian
89472	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Porcine	Livestock
89473	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Bovine	Livestock
89474	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Sewage	Human/ Sewage
89475	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Avian	Avian
89476	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Avian	Avian
89477	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Avian	Avian
89478	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Porcine	Livestock
89479	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Avian	Avian
89480	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Horse	Livestock
89481	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Avian	Avian
89482	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Sewage	Human/ Sewage
89483	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Feline	Pets
89484	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Sewage	Human/ Sewage
89485	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Sewage	Human/ Sewage
89486	Rio Grande @ Rio Bravo Bridge	3/5/2004	Y	Feline	Pets
89807	Rio Grande @ Rio Bravo Bridge	3/12/2004	N	Avian	Avian
89808	Rio Grande @ Rio Bravo Bridge	3/12/2004	N	Porcine	Livestock
89809	Rio Grande @ Rio Bravo Bridge	3/12/2004	N	Deer/elk	Non-avian wildlife
89810	Rio Grande @ Rio Bravo Bridge	3/12/2004	N	Feline	Pets
89811	Rio Grande @ Rio Bravo Bridge	3/12/2004	N	Waterfowl	Avian
89812	Rio Grande @ Rio Bravo Bridge	3/12/2004	N	Canine	Pets
89813	Rio Grande @ Rio Bravo Bridge	3/12/2004	N	Avian	Avian
89814	Rio Grande @ Rio Bravo Bridge	3/12/2004	N	Avian	Avian
89815	Rio Grande @ Rio Bravo Bridge	3/12/2004	N	Avian	Avian
89816	Rio Grande @ Rio Bravo Bridge	3/12/2004	N	Avian	Avian
89817	Rio Grande @ Rio Bravo Bridge	3/12/2004	N	Avian	Avian
89818	Rio Grande @ Rio Bravo Bridge	3/12/2004	N	Avian	Avian

Isolate	Station	Date	Runoff	Category	Super-Category
89819	Rio Grande @ Rio Bravo Bridge	3/12/2004	N	Horse	Livestock
97407	Rio Grande @ Rio Bravo Bridge	7/19/2004	Y	Avian	Avian
97409	Rio Grande @ Rio Bravo Bridge	7/19/2004	Y	Sewage	Human/ Sewage
97410	Rio Grande @ Rio Bravo Bridge	7/19/2004	Y	Canine	Pets
97412	Rio Grande @ Rio Bravo Bridge	7/19/2004	Y	Canine	Pets
97413	Rio Grande @ Rio Bravo Bridge	7/19/2004	Y	Feline	Pets
97414	Rio Grande @ Rio Bravo Bridge	7/19/2004	Y	Goat	Livestock
97415	Rio Grande @ Rio Bravo Bridge	7/19/2004	Y	Avian	Avian
97416	Rio Grande @ Rio Bravo Bridge	7/19/2004	Y	Horse	Livestock
97417	Rio Grande @ Rio Bravo Bridge	7/19/2004	Y	Rodent	Non-avian wildlife
98440	Rio Grande @ Rio Bravo Bridge	7/25/2004	Y	Canine	Pets
98441	Rio Grande @ Rio Bravo Bridge	7/25/2004	Y	Canine	Pets
98442	Rio Grande @ Rio Bravo Bridge	7/25/2004	Y	Unknown	Unknown
98443	Rio Grande @ Rio Bravo Bridge	7/25/2004	Y	Canine	Pets
98443	Rio Grande @ Rio Bravo Bridge	7/25/2004	Y	Sewage	Human/ Sewage
98445	Rio Grande @ Rio Bravo Bridge	7/25/2004	Y	Canine	Pets
98446	Rio Grande @ Rio Bravo Bridge	7/25/2004	Y	Canine	Pets
98447	Rio Grande @ Rio Bravo Bridge	7/25/2004	Y	Avian	Avian
98448	Rio Grande @ Rio Bravo Bridge	7/25/2004	Y	Bovine	Livestock
98449	Rio Grande @ Rio Bravo Bridge	7/25/2004	Y	Canine	Pets
98450	Rio Grande @ Rio Bravo Bridge	7/25/2004	Y	Waterfowl	Avian
98451	Rio Grande @ Rio Bravo Bridge	7/25/2004	Y	Rodent	Non-avian wildlife
98452	Rio Grande @ Rio Bravo Bridge	7/25/2004	Y	Unknown	Unknown
98453	Rio Grande @ Rio Bravo Bridge	7/25/2004	Y	Waterfowl	Avian
98454	Rio Grande @ Rio Bravo Bridge	7/25/2004	Y	Avian	Avian
88445	Rio Grande above Rio Rancho Utility #2	2/17/2004	N	Avian	Avian
88446	Rio Grande above Rio Rancho Utility #2	2/17/2004	N	Avian	Avian
88447	Rio Grande above Rio Rancho Utility #2	2/17/2004	N	Rodent	Non-avian wildlife
88649	Rio Grande above Rio Rancho Utility #2	2/22/2004	N	Sewage	Human/ Sewage
88650	Rio Grande above Rio Rancho Utility #2	2/22/2004	N	Sewage	Human/ Sewage
88651	Rio Grande above Rio Rancho Utility #2	2/22/2004	N	Sewage	Human/ Sewage
88652	Rio Grande above Rio Rancho Utility #2	2/22/2004	N	Sewage	Human/ Sewage
89396	Rio Grande above Rio Rancho Utility #2	3/5/2004	Y	Horse	Livestock
89397	Rio Grande above Rio Rancho Utility #2	3/5/2004	Y	Sewage	Human/ Sewage

Isolate	Station	Date	Runoff	Category	Super-Category
89398	Rio Grande above Rio Rancho Utility #2	3/5/2004	Y	Bovine	Livestock
89399	Rio Grande above Rio Rancho Utility #2	3/5/2004	Y	Bovine	Livestock
89400	Rio Grande above Rio Rancho Utility #2	3/5/2004	Y	Human	Human/ Sewage
89401	Rio Grande above Rio Rancho Utility #2	3/5/2004	Y	Human	Human/ Sewage
89402	Rio Grande above Rio Rancho Utility #2	3/5/2004	Y	Avian	Avian
89403	Rio Grande above Rio Rancho Utility #2	3/5/2004	Y	Avian	Avian
89404	Rio Grande above Rio Rancho Utility #2	3/5/2004	Y	Avian	Avian
89774	Rio Grande above Rio Rancho Utility #2	3/12/2004	N	Deer	Non-avian wildlife
89775	Rio Grande above Rio Rancho Utility #2	3/12/2004	N	Sewage	Human/ Sewage
89776	Rio Grande above Rio Rancho Utility #2	3/12/2004	N	Sewage	Human/ Sewage
89777	Rio Grande above Rio Rancho Utility #2	3/12/2004	N	Rodent	Non-avian wildlife
97435	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Sewage	Human/ Sewage
97436	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Feline	Pets
97438	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Unknown	Unknown
97439	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Unknown	Unknown
97440	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Unknown	Unknown
97441	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Unknown	Unknown
97443	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Unknown	Unknown
97444	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Rodent	Non-avian wildlife
97446	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Canine	Pets
97447	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Avian	Avian
97448	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Unknown	Unknown
97449	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Canine	Pets
97819	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Sewage	Human/ Sewage
97820	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Unknown	Unknown
97821	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Unknown	Unknown
97822	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Sewage	Human/ Sewage
97823	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Canine	Pets
97824	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Unknown	Unknown
97825	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Avian	Avian
97826	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Sheep	Livestock
97827	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Avian	Avian
97828	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Canine	Pets
97829	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Avian	Avian

Isolate	Station	Date	Runoff	Category	Super-Category
97830	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Sewage	Human/ Sewage
97831	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Horse	Livestock
97832	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Canine	Pets
97833	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Canine	Pets
97834	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Avian	Avian
97835	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Canine	Pets
97836	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Bovine	Livestock
97837	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Sewage	Human/ Sewage
97838	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Avian	Avian
97839	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Canine	Pets
97840	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Canine	Pets
97841	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Unknown	Unknown
97842	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Canine	Pets
97843	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Unknown	Unknown
97844	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Avian	Avian
97845	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Avian	Avian
97846	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Canine	Pets
97847	Rio Grande above Rio Rancho Utility #2	7/18/2004	Y	Unknown	Unknown
97736	Rio Grande above Rio Rancho Utility #2	7/21/2004	Y	Avian	Avian
97737	Rio Grande above Rio Rancho Utility #2	7/21/2004	Y	Feline	Pets
97738	Rio Grande above Rio Rancho Utility #2	7/21/2004	Y	Canine	Pets
97739	Rio Grande above Rio Rancho Utility #2	7/21/2004	Y	Porcine	Livestock
97740	Rio Grande above Rio Rancho Utility #2	7/21/2004	Y	Sewage	Human/ Sewage
97741	Rio Grande above Rio Rancho Utility #2	7/21/2004	Y	Sewage	Human/ Sewage
97742	Rio Grande above Rio Rancho Utility #2	7/21/2004	Y	Canine	Pets
98376	Rio Grande above Rio Rancho Utility #2	7/25/2004	Y	Avian	Avian
98377	Rio Grande above Rio Rancho Utility #2	7/25/2004	Y	Canine	Pets
98378	Rio Grande above Rio Rancho Utility #2	7/25/2004	Y	Canine	Pets
98379	Rio Grande above Rio Rancho Utility #2	7/25/2004	Y	Sewage	Human/ Sewage
98380	Rio Grande above Rio Rancho Utility #2	7/25/2004	Y	Canine	Pets
98381	Rio Grande above Rio Rancho Utility #2	7/25/2004	Y	Canine	Pets
98382	Rio Grande above Rio Rancho Utility #2	7/25/2004	Y	Canine	Pets
98383	Rio Grande above Rio Rancho Utility #2	7/25/2004	Y	Coyote	Non-avian wildlife
98384	Rio Grande above Rio Rancho Utility #2	7/25/2004	Y	Canine	Pets

Isolate	Station	Date	Runoff	Category	Super-Category
98385	Rio Grande above Rio Rancho Utility #2	7/25/2004	Y	Canine	Pets
98386	Rio Grande above Rio Rancho Utility #2	7/25/2004	Y	Avian	Avian
98387	Rio Grande above Rio Rancho Utility #2	7/25/2004	Y	Canine	Pets
98388	Rio Grande above Rio Rancho Utility #2	7/25/2004	Y	Rodent	Non-avian wildlife
98389	Rio Grande above Rio Rancho Utility #2	7/25/2004	Y	Avian	Avian
98390	Rio Grande above Rio Rancho Utility #2	7/25/2004	Y	Sewage	Human/ Sewage
98391	Rio Grande above Rio Rancho Utility #2	7/25/2004	Y	Horse	Livestock
98392	Rio Grande above Rio Rancho Utility #2	7/25/2004	Y	Rabbit	Non-avian wildlife
98393	Rio Grande above Rio Rancho Utility #2	7/25/2004	Y	Unknown	Unknown
98394	Rio Grande above Rio Rancho Utility #2	7/25/2004	Y	Sewage	Human/ Sewage
98395	Rio Grande above Rio Rancho Utility #2	7/25/2004	Y	Unknown	Unknown
98396	Rio Grande above Rio Rancho Utility #2	7/25/2004	Y	Canine	Pets
88439	Rio Grande above Rio Rancho Utility #3	2/17/2004	N	Rodent	Non-avian wildlife
88440	Rio Grande above Rio Rancho Utility #3	2/17/2004	N	Canine	Pets
88441	Rio Grande above Rio Rancho Utility #3	2/17/2004	N	Canine	Pets
89389	Rio Grande above Rio Rancho Utility #3	3/5/2004	Y	Avian	Avian
89390	Rio Grande above Rio Rancho Utility #3	3/5/2004	Y	Sewage	Human/ Sewage
89391	Rio Grande above Rio Rancho Utility #3	3/5/2004	Y	Sewage	Human/ Sewage
89392	Rio Grande above Rio Rancho Utility #3	3/5/2004	Y	Human	Human/ Sewage
89393	Rio Grande above Rio Rancho Utility #3	3/5/2004	Y	Sewage	Human/ Sewage
89394	Rio Grande above Rio Rancho Utility #3	3/5/2004	Y	Sewage	Human/ Sewage
89395	Rio Grande above Rio Rancho Utility #3	3/5/2004	Y	Horse	Livestock
89768	Rio Grande above Rio Rancho Utility #3	3/12/2004	N	Avian	Avian
89769	Rio Grande above Rio Rancho Utility #3	3/12/2004	N	Unknown	Unknown
89770	Rio Grande above Rio Rancho Utility #3	3/12/2004	N	Rodent	Non-avian wildlife
89771	Rio Grande above Rio Rancho Utility #3	3/12/2004	N	Sewage	Human/ Sewage
89772	Rio Grande above Rio Rancho Utility #3	3/12/2004	N	Rodent	Non-avian wildlife
89773	Rio Grande above Rio Rancho Utility #3	3/12/2004	N	Rodent	Non-avian wildlife
97451	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Avian	Avian
97452	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Sewage	Human/ Sewage
97453	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Rodent	Non-avian wildlife
97454	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Canine	Pets
97455	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Sewage	Human/ Sewage
97456	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Canine	Pets

Isolate	Station	Date	Runoff	Category	Super-Category
97457	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Feline	Pets
97458	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Rodent	Non-avian wildlife
97459	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Avian	Avian
97460	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Feline	Pets
97461	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Avian	Avian
97463	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Canine	Pets
97464	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Sewage	Human/ Sewage
97465	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Sewage	Human/ Sewage
97466	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Canine	Pets
97467	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Rodent	Non-avian wildlife
97468	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Avian	Avian
97786	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Feline	Pets
97787	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Avian	Avian
97788	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Avian	Avian
97789	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Canine	Pets
97790	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Bovine	Livestock
97791	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Sewage	Human/ Sewage
97792	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Avian	Avian
97793	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Canine	Pets
97794	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Sewage	Human/ Sewage
97795	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Canine	Pets
97799	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Canine	Pets
97800	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Avian	Avian
97801	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Canine	Pets
97802	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Canine	Pets
97804	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Avian	Avian
97805	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Canine	Pets
97806	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Avian	Avian
97807	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Canine	Pets
97808	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Canine	Pets
97809	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Avian	Avian
97810	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Avian	Avian
97811	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Porcine	Livestock
97812	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Feline	Pets

Isolate	Station	Date	Runoff	Category	Super-Category
97815	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Avian	Avian
97816	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Avian	Avian
97817	Rio Grande above Rio Rancho Utility #3	7/18/2004	Y	Avian	Avian
97729	Rio Grande above Rio Rancho Utility #3	7/21/2004	Y	Avian	Avian
97730	Rio Grande above Rio Rancho Utility #3	7/21/2004	Y	Bovine	Livestock
97731	Rio Grande above Rio Rancho Utility #3	7/21/2004	Y	Rodent	Non-avian wildlife
97734	Rio Grande above Rio Rancho Utility #3	7/21/2004	Y	Rodent	Non-avian wildlife
97735	Rio Grande above Rio Rancho Utility #3	7/21/2004	Y	Unknown	Unknown
98356	Rio Grande above Rio Rancho Utility #3	7/25/2004	Y	Rodent	Non-avian wildlife
98357	Rio Grande above Rio Rancho Utility #3	7/25/2004	Y	Canine	Pets
98358	Rio Grande above Rio Rancho Utility #3	7/25/2004	Y	Rodent	Non-avian wildlife
98359	Rio Grande above Rio Rancho Utility #3	7/25/2004	Y	Avian	Avian
98360	Rio Grande above Rio Rancho Utility #3	7/25/2004	Y	Avian	Avian
98361	Rio Grande above Rio Rancho Utility #3	7/25/2004	Y	Avian	Avian
98362	Rio Grande above Rio Rancho Utility #3	7/25/2004	Y	Bovine	Livestock
98363	Rio Grande above Rio Rancho Utility #3	7/25/2004	Y	Avian	Avian
98364	Rio Grande above Rio Rancho Utility #3	7/25/2004	Y	Avian	Avian
98366	Rio Grande above Rio Rancho Utility #3	7/25/2004	Y	Unknown	Unknown
98367	Rio Grande above Rio Rancho Utility #3	7/25/2004	Y	Bovine	Livestock
98368	Rio Grande above Rio Rancho Utility #3	7/25/2004	Y	Canine	Pets
98369	Rio Grande above Rio Rancho Utility #3	7/25/2004	Y	Waterfowl	Avian
98371	Rio Grande above Rio Rancho Utility #3	7/25/2004	Y	Canine	Pets
98372	Rio Grande above Rio Rancho Utility #3	7/25/2004	Y	Avian	Avian
98373	Rio Grande above Rio Rancho Utility #3	7/25/2004	Y	Sewage	Human/ Sewage
98374	Rio Grande above Rio Rancho Utility #3	7/25/2004	Y	Canine	Pets
98375	Rio Grande above Rio Rancho Utility #3	7/25/2004	Y	Rodent	Non-avian wildlife
68991	Sandia Pueblo Natural Arroyo @I-25 Crossing	7/10/2002	Y	Canine	Pets
68992	Sandia Pueblo Natural Arroyo @I-25 Crossing	7/10/2002	Y	Avian	Avian
98314	Sandia Pueblo Natural Arroyo @I-25 Crossing	7/25/2004	Y	Avian	Avian
98315	Sandia Pueblo Natural Arroyo @I-25 Crossing	7/25/2004	Y	Feline	Pets
69350	South Diversion Channel @ Tijeras Arroyo	8/3/2002	Y	Bovine	Livestock
88654	South Diversion Channel @ Tijeras Arroyo	2/22/2004	N	Sewage	Human/ Sewage
89189	South Diversion Channel @ Tijeras Arroyo	2/29/2004	N	Canine	Pets
89190	South Diversion Channel @ Tijeras Arroyo	2/29/2004	N	Avian	Avian

Isolate	Station	Date	Runoff	Category	Super-Category
89191	South Diversion Channel @ Tijeras Arroyo	2/29/2004	N	Feline	Pets
89192	South Diversion Channel @ Tijeras Arroyo	2/29/2004	N	Canine	Pets
89193	South Diversion Channel @ Tijeras Arroyo	2/29/2004	N	Canine	Pets
89194	South Diversion Channel @ Tijeras Arroyo	2/29/2004	N	Human	Human/ Sewage
89195	South Diversion Channel @ Tijeras Arroyo	2/29/2004	N	Feline	Pets
89196	South Diversion Channel @ Tijeras Arroyo	2/29/2004	N	Feline	Pets
89197	South Diversion Channel @ Tijeras Arroyo	2/29/2004	N	Human	Human/ Sewage
89198	South Diversion Channel @ Tijeras Arroyo	2/29/2004	N	Feline	Pets
89514	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Rodent	Non-avian wildlife
89516	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Avian	Avian
89517	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Canine	Pets
89518	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Canine	Pets
89519	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Canine	Pets
89520	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Human	Human/ Sewage
89521	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Human	Human/ Sewage
89522	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Human	Human/ Sewage
89523	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Avian	Avian
89524	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Sludge	Human/ Sewage
89525	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Avian	Avian
89526	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Human	Human/ Sewage
89527	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Human	Human/ Sewage
89528	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Rodent	Non-avian wildlife
89529	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Avian	Avian
89530	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Avian	Avian
89531	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Human	Human/ Sewage
89532	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Sewage	Human/ Sewage
89533	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Canine	Pets
89534	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Human	Human/ Sewage
89535	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Canine	Pets
89536	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Canine	Pets
89537	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Rodent	Non-avian wildlife
89538	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Canine	Pets
89539	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Rodent	Non-avian wildlife
89540	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Canine	Pets

Isolate	Station	Date	Runoff	Category	Super-Category
89541	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Canine	Pets
89542	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Canine	Pets
89543	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Avian	Avian
89544	South Diversion Channel @ Tijeras Arroyo	3/5/2004	Y	Rodent	Non-avian wildlife
97391	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Canine	Pets
97392	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Avian	Avian
97394	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Rodent	Non-avian wildlife
97395	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Rodent	Non-avian wildlife
97396	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Avian	Avian
97397	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Rodent	Non-avian wildlife
97398	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Rodent	Non-avian wildlife
97399	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Avian	Avian
97400	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Canine	Pets
97401	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Canine	Pets
97402	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Canine	Pets
97403	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Avian	Avian
97404	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Canine	Pets
97405	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Canine	Pets
97406	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Canine	Pets
97956	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Unknown	Unknown
97957	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Coyote	Non-avian wildlife
97958	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Avian	Avian
97959	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Avian	Avian
97960	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Avian	Avian
97961	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Avian	Avian
97962	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Avian	Avian
97963	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Avian	Avian
97964	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Canine	Pets
97965	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Bovine	Livestock
97966	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Bovine	Livestock
97967	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Avian	Avian
97968	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Bovine	Livestock
97969	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Avian	Avian
97970	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Canine	Pets

Isolate	Station	Date	Runoff	Category	Super-Category
97971	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Canine	Pets
97972	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Avian	Avian
97973	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Avian	Avian
97974	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Avian	Avian
97975	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Avian	Avian
97976	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Bovine	Livestock
97977	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Bovine	Livestock
97978	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Avian	Avian
97980	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Canine	Pets
97981	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Canine	Pets
97982	South Diversion Channel @ Tijeras Arroyo	7/19/2004	Y	Unknown	Unknown
98455	South Diversion Channel @ Tijeras Arroyo	7/25/2004	Y	Avian	Avian
98456	South Diversion Channel @ Tijeras Arroyo	7/25/2004	Y	Sewage	Human/ Sewage
98457	South Diversion Channel @ Tijeras Arroyo	7/25/2004	Y	Avian	Avian
98458	South Diversion Channel @ Tijeras Arroyo	7/25/2004	Y	Avian	Avian
98459	South Diversion Channel @ Tijeras Arroyo	7/25/2004	Y	Avian	Avian
98460	South Diversion Channel @ Tijeras Arroyo	7/25/2004	Y	Canine	Pets
98461	South Diversion Channel @ Tijeras Arroyo	7/25/2004	Y	Canine	Pets
98462	South Diversion Channel @ Tijeras Arroyo	7/25/2004	Y	Sewage	Human/ Sewage
72949	Vita Romero Pump Station	2/20/2003	Y	Rodent	Non-avian wildlife
72950	Vita Romero Pump Station	2/20/2003	Y	Avian	Avian
72951	Vita Romero Pump Station	2/20/2003	Y	Avian	Avian
72952	Vita Romero Pump Station	2/20/2003	Y	Canine	Pets
72953	Vita Romero Pump Station	2/20/2003	Y	Canine	Pets
72954	Vita Romero Pump Station	2/20/2003	Y	Canine	Pets
72955	Vita Romero Pump Station	2/20/2003	Y	Rodent	Non-avian wildlife
72956	Vita Romero Pump Station	2/20/2003	Y	Avian	Avian
72957	Vita Romero Pump Station	2/20/2003	Y	Sewage	Human/ Sewage
72958	Vita Romero Pump Station	2/20/2003	Y	Rodent	Non-avian wildlife
72959	Vita Romero Pump Station	2/20/2003	Y	Rodent	Non-avian wildlife
72960	Vita Romero Pump Station	2/20/2003	Y	Avian	Avian
72961	Vita Romero Pump Station	2/20/2003	Y	Human	Human/ Sewage
72962	Vita Romero Pump Station	2/20/2003	Y	Avian	Avian
72963	Vita Romero Pump Station	2/20/2003	Y	Avian	Avian

Isolate	Station	Date	Runoff	Category	Super-Category
72964	Vita Romero Pump Station	2/20/2003	Y	Sewage	Human/ Sewage
72965	Vita Romero Pump Station	2/20/2003	Y	Avian	Avian
72966	Vita Romero Pump Station	2/20/2003	Y	Avian	Avian
72967	Vita Romero Pump Station	2/20/2003	Y	Rodent	Non-avian wildlife
72968	Vita Romero Pump Station	2/20/2003	Y	Sewage	Human/ Sewage

APPENDIX C
ANTIBIOTIC RESISTANCE PROFILE DATA

Antibiotic Resistance Profile Data

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	68832	Alameda Drain @ El Caminito Crossing	7/20/2002
O	000000000000	Ambient Water	68833	Alameda Drain @ El Caminito Crossing	7/20/2002
O	000000000000	Ambient Water	68971	Alameda Drain @ El Caminito Crossing	7/10/2002
O	000000000000	Ambient Water	69375	Alameda Drain @ El Caminito Crossing	8/3/2002
O	000000000000	Ambient Water	69376	Alameda Drain @ El Caminito Crossing	8/3/2002
O	000000000000	Ambient Water	69377	Alameda Drain @ El Caminito Crossing	8/3/2002
O	000000000000	Ambient Water	97513	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97514	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97516	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97517	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97518	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97519	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97520	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97521	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97522	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97523	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97524	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97525	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97526	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97527	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97528	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97529	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97908	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97909	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97910	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97911	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97912	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97914	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97915	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97916	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97917	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97918	Alameda Drain @ El Caminito Crossing	7/18/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	97919	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97920	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97921	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	97922	Alameda Drain @ El Caminito Crossing	7/18/2004
O	000000000000	Ambient Water	98503	Alameda Drain @ El Caminito Crossing	7/27/2004
O	000000000000	Ambient Water	98505	Alameda Drain @ El Caminito Crossing	7/27/2004
O	000000000000	Ambient Water	68817	Alameda Drain @ Ranchitos Rd.	7/10/2002
O	000000000000	Ambient Water	68975	Alameda Drain @ Ranchitos Rd.	7/10/2002
O	000000000000	Ambient Water	68976	Alameda Drain @ Ranchitos Rd.	7/10/2002
O	000000000000	Ambient Water	68977	Alameda Drain @ Ranchitos Rd.	7/10/2002
O	000000000000	Ambient Water	69368	Alameda Drain @ Ranchitos Rd.	8/3/2002
O	000000000000	Ambient Water	69369	Alameda Drain @ Ranchitos Rd.	8/3/2002
O	000000000000	Ambient Water	97496	Alameda Drain @ Ranchitos Rd.	7/18/2004
O	000000000000	Ambient Water	97497	Alameda Drain @ Ranchitos Rd.	7/18/2004
O	000000000000	Ambient Water	97498	Alameda Drain @ Ranchitos Rd.	7/18/2004
O	000000000000	Ambient Water	97499	Alameda Drain @ Ranchitos Rd.	7/18/2004
O	000000000000	Ambient Water	97500	Alameda Drain @ Ranchitos Rd.	7/18/2004
O	000000000000	Ambient Water	97501	Alameda Drain @ Ranchitos Rd.	7/18/2004
O	000000000000	Ambient Water	97502	Alameda Drain @ Ranchitos Rd.	7/18/2004
O	000000000000	Ambient Water	97503	Alameda Drain @ Ranchitos Rd.	7/18/2004
O	000000000000	Ambient Water	97504	Alameda Drain @ Ranchitos Rd.	7/18/2004
O	000000000000	Ambient Water	97506	Alameda Drain @ Ranchitos Rd.	7/18/2004
O	000000000000	Ambient Water	97507	Alameda Drain @ Ranchitos Rd.	7/18/2004
O	000000000000	Ambient Water	97508	Alameda Drain @ Ranchitos Rd.	7/18/2004
O	000000000000	Ambient Water	97509	Alameda Drain @ Ranchitos Rd.	7/18/2004
O	000000000000	Ambient Water	97510	Alameda Drain @ Ranchitos Rd.	7/18/2004
O	000000000000	Ambient Water	97511	Alameda Drain @ Ranchitos Rd.	7/18/2004
O	000000000000	Ambient Water	97512	Alameda Drain @ Ranchitos Rd.	7/18/2004
O	000000000000	Ambient Water	97770	Alameda Drain @ Ranchitos Rd.	7/21/2004
O	000000000000	Ambient Water	98420	Alameda Drain @ Ranchitos Rd.	7/25/2004
O	000000000000	Ambient Water	98421	Alameda Drain @ Ranchitos Rd.	7/25/2004
O	000000000000	Ambient Water	98422	Alameda Drain @ Ranchitos Rd.	7/25/2004
O	000000000000	Ambient Water	98423	Alameda Drain @ Ranchitos Rd.	7/25/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	98425	Alameda Drain @ Ranchitos Rd.	7/25/2004
O	000000000000	Ambient Water	98426	Alameda Drain @ Ranchitos Rd.	7/25/2004
O	000000000000	Ambient Water	98427	Alameda Drain @ Ranchitos Rd.	7/25/2004
O	000000000000	Ambient Water	98428	Alameda Drain @ Ranchitos Rd.	7/25/2004
O	000000000000	Ambient Water	98429	Alameda Drain @ Ranchitos Rd.	7/25/2004
O	000000000000	Ambient Water	98430	Alameda Drain @ Ranchitos Rd.	7/25/2004
O	000000000000	Ambient Water	98431	Alameda Drain @ Ranchitos Rd.	7/25/2004
O	000000000000	Ambient Water	98432	Alameda Drain @ Ranchitos Rd.	7/25/2004
O	000000000000	Ambient Water	98433	Alameda Drain @ Ranchitos Rd.	7/25/2004
O	000000000000	Ambient Water	98434	Alameda Drain @ Ranchitos Rd.	7/25/2004
O	000000000000	Ambient Water	98436	Alameda Drain @ Ranchitos Rd.	7/25/2004
O	000000000000	Ambient Water	98437	Alameda Drain @ Ranchitos Rd.	7/25/2004
O	000000000000	Ambient Water	98438	Alameda Drain @ Ranchitos Rd.	7/25/2004
O	000000000000	Ambient Water	98439	Alameda Drain @ Ranchitos Rd.	7/25/2004
O	000000000000	Ambient Water	97939	Alameda Drain @ Ranchitos Road	7/18/2004
O	000000000000	Ambient Water	97940	Alameda Drain @ Ranchitos Road	7/18/2004
O	000000000000	Ambient Water	97941	Alameda Drain @ Ranchitos Road	7/18/2004
O	000000000000	Ambient Water	97942	Alameda Drain @ Ranchitos Road	7/18/2004
O	000000000000	Ambient Water	97943	Alameda Drain @ Ranchitos Road	7/18/2004
O	000000000000	Ambient Water	97944	Alameda Drain @ Ranchitos Road	7/18/2004
O	000000000000	Ambient Water	97945	Alameda Drain @ Ranchitos Road	7/18/2004
O	000000000000	Ambient Water	97946	Alameda Drain @ Ranchitos Road	7/18/2004
O	000000000000	Ambient Water	97947	Alameda Drain @ Ranchitos Road	7/18/2004
O	000000000000	Ambient Water	97948	Alameda Drain @ Ranchitos Road	7/18/2004
O	000000000000	Ambient Water	97949	Alameda Drain @ Ranchitos Road	7/18/2004
O	000000000000	Ambient Water	97951	Alameda Drain @ Ranchitos Road	7/18/2004
O	000000000000	Ambient Water	97952	Alameda Drain @ Ranchitos Road	7/18/2004
O	000000000000	Ambient Water	97953	Alameda Drain @ Ranchitos Road	7/18/2004
O	000000000000	Ambient Water	97954	Alameda Drain @ Ranchitos Road	7/18/2004
O	000000000000	Ambient Water	97955	Alameda Drain @ Ranchitos Road	7/18/2004
O	000000000000	Ambient Water	84028	Amole del Norte Channel above Amole Dam	10/7/2003
O	000000000000	Ambient Water	84032	Amole del Norte Channel above Amole Dam	10/7/2003
O	000000000000	Ambient Water	84033	Amole del Norte Channel above Amole Dam	10/7/2003

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	84034	Amole del Norte Channel above Amole Dam	10/7/2003
O	000000000000	Ambient Water	84035	Amole del Norte Channel above Amole Dam	10/7/2003
O	000000000000	Ambient Water	84041	Amole del Norte Channel above Amole Dam	10/7/2003
O	000000000000	Ambient Water	84046	Amole del Norte Channel above Amole Dam	10/7/2003
O	000000000000	Ambient Water	84049	Amole del Norte Channel above Amole Dam	10/7/2003
O	000000000000	Ambient Water	84050	Amole del Norte Channel above Amole Dam	10/7/2003
O	000000000000	Ambient Water	84053	Amole del Norte Channel above Amole Dam	10/7/2003
O	000000000000	Ambient Water	69333	Cabezon Channel	8/2/2002
O	000000000000	Ambient Water	69335	Cabezon Channel	8/2/2002
O	000000000000	Ambient Water	97469	Cabezon Channel	7/18/2004
O	000000000000	Ambient Water	97470	Cabezon Channel	7/18/2004
O	000000000000	Ambient Water	97471	Cabezon Channel	7/18/2004
O	000000000000	Ambient Water	97472	Cabezon Channel	7/18/2004
O	000000000000	Ambient Water	97473	Cabezon Channel	7/18/2004
O	000000000000	Ambient Water	97474	Cabezon Channel	7/18/2004
O	000000000000	Ambient Water	97475	Cabezon Channel	7/18/2004
O	000000000000	Ambient Water	97476	Cabezon Channel	7/18/2004
O	000000000000	Ambient Water	97477	Cabezon Channel	7/18/2004
O	000000000000	Ambient Water	97478	Cabezon Channel	7/18/2004
O	000000000000	Ambient Water	97479	Cabezon Channel	7/18/2004
O	000000000000	Ambient Water	97480	Cabezon Channel	7/18/2004
O	000000000000	Ambient Water	97481	Cabezon Channel	7/18/2004
O	000000000000	Ambient Water	97746	Cabezon Channel	7/21/2004
O	000000000000	Ambient Water	97748	Cabezon Channel	7/21/2004
O	000000000000	Ambient Water	97749	Cabezon Channel	7/21/2004
O	000000000000	Ambient Water	97750	Cabezon Channel	7/21/2004
O	000000000000	Ambient Water	97751	Cabezon Channel	7/21/2004
O	000000000000	Ambient Water	97752	Cabezon Channel	7/21/2004
O	000000000000	Ambient Water	97753	Cabezon Channel	7/21/2004
O	000000000000	Ambient Water	97754	Cabezon Channel	7/21/2004
O	000000000000	Ambient Water	97755	Cabezon Channel	7/21/2004
O	000000000000	Ambient Water	97756	Cabezon Channel	7/21/2004
O	000000000000	Ambient Water	97757	Cabezon Channel	7/21/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	97868	Cabezon Channel	7/18/2004
O	000000000000	Ambient Water	97869	Cabezon Channel	7/18/2004
O	000000000000	Ambient Water	97870	Cabezon Channel	7/18/2004
O	000000000000	Ambient Water	97871	Cabezon Channel	7/18/2004
O	000000000000	Ambient Water	97872	Cabezon Channel	7/18/2004
O	000000000000	Ambient Water	97873	Cabezon Channel	7/18/2004
O	000000000000	Ambient Water	97874	Cabezon Channel	7/18/2004
O	000000000000	Ambient Water	98397	Cabezon Channel	7/25/2004
O	000000000000	Ambient Water	69336	Calabacillas Arroyo @ Coors Rd.	8/2/2002
O	000000000000	Ambient Water	69337	Calabacillas Arroyo @ Coors Rd.	8/2/2002
O	000000000000	Ambient Water	69338	Calabacillas Arroyo @ Coors Rd.	8/2/2002
O	000000000000	Ambient Water	72846	Calabacillas Arroyo @ Coors Rd.	2/20/2003
O	000000000000	Ambient Water	72847	Calabacillas Arroyo @ Coors Rd.	2/20/2003
O	000000000000	Ambient Water	72848	Calabacillas Arroyo @ Coors Rd.	2/20/2003
O	000000000000	Ambient Water	72849	Calabacillas Arroyo @ Coors Rd.	2/20/2003
O	000000000000	Ambient Water	72850	Calabacillas Arroyo @ Coors Rd.	2/20/2003
O	000000000000	Ambient Water	72852	Calabacillas Arroyo @ Coors Rd.	2/20/2003
O	000000000000	Ambient Water	72859	Calabacillas Arroyo @ Coors Rd.	2/20/2003
O	000000000000	Ambient Water	72860	Calabacillas Arroyo @ Coors Rd.	2/20/2003
O	000000000000	Ambient Water	72861	Calabacillas Arroyo @ Coors Rd.	2/20/2003
O	000000000000	Ambient Water	72863	Calabacillas Arroyo @ Coors Rd.	2/20/2003
O	000000000000	Ambient Water	72866	Calabacillas Arroyo @ Swinburne Dam	2/20/2003
O	000000000000	Ambient Water	72867	Calabacillas Arroyo @ Swinburne Dam	2/20/2003
O	000000000000	Ambient Water	72868	Calabacillas Arroyo @ Swinburne Dam	2/20/2003
O	000000000000	Ambient Water	72869	Calabacillas Arroyo @ Swinburne Dam	2/20/2003
O	000000000000	Ambient Water	72870	Calabacillas Arroyo @ Swinburne Dam	2/20/2003
O	000000000000	Ambient Water	72871	Calabacillas Arroyo @ Swinburne Dam	2/20/2003
O	000000000000	Ambient Water	72872	Calabacillas Arroyo @ Swinburne Dam	2/20/2003
O	000000000000	Ambient Water	72873	Calabacillas Arroyo @ Swinburne Dam	2/20/2003
O	000000000000	Ambient Water	72874	Calabacillas Arroyo @ Swinburne Dam	2/20/2003
O	000000000000	Ambient Water	72875	Calabacillas Arroyo @ Swinburne Dam	2/20/2003
O	000000000000	Ambient Water	72876	Calabacillas Arroyo @ Swinburne Dam	2/20/2003
O	000000000000	Ambient Water	72877	Calabacillas Arroyo @ Swinburne Dam	2/20/2003

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	72878	Calabacillas Arroyo @ Swinburne Dam	2/20/2003
O	000000000000	Ambient Water	72880	Calabacillas Arroyo @ Swinburne Dam	2/20/2003
O	000000000000	Ambient Water	72881	Calabacillas Arroyo @ Swinburne Dam	2/20/2003
O	000000000000	Ambient Water	72882	Calabacillas Arroyo @ Swinburne Dam	2/20/2003
O	000000000000	Ambient Water	72883	Calabacillas Arroyo @ Swinburne Dam	2/20/2003
O	000000000000	Ambient Water	72884	Calabacillas Arroyo @ Swinburne Dam	2/20/2003
O	000000000000	Ambient Water	72885	Calabacillas Arroyo @ Swinburne Dam	2/20/2003
O	000000000000	Ambient Water	72886	Calabacillas Arroyo @ Swinburne Dam	2/20/2003
O	000000000000	Ambient Water	68819	Embudo Channel above confluence with North Diversion Channel	7/8/2002
O	000000000000	Ambient Water	68959	Embudo Channel above confluence with North Diversion Channel	7/19/2002
O	000000000000	Ambient Water	68960	Embudo Channel above confluence with North Diversion Channel	7/19/2002
O	000000000000	Ambient Water	68961	Embudo Channel above confluence with North Diversion Channel	7/19/2002
O	000000000000	Ambient Water	68982	Embudo Channel above confluence with North Diversion Channel	7/8/2002
O	000000000000	Ambient Water	68984	Embudo Channel above confluence with North Diversion Channel	7/8/2002
O	000000000000	Ambient Water	69355	Embudo Channel above confluence with North Diversion Channel	8/2/2002
O	000000000000	Ambient Water	69356	Embudo Channel above confluence with North Diversion Channel	8/2/2002
O	000000000000	Ambient Water	72969	Embudo Channel above confluence with North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	72970	Embudo Channel above confluence with North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	72971	Embudo Channel above confluence with North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	72972	Embudo Channel above confluence with North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	72973	Embudo Channel above confluence with North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	72974	Embudo Channel above confluence with North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	72975	Embudo Channel above confluence with North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	72976	Embudo Channel above confluence with North Diversion Channel	2/20/2003

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	72977	Embudo Channel above confluence with North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	72978	Embudo Channel above confluence with North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	72979	Embudo Channel above confluence with North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	72980	Embudo Channel above confluence with North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	72981	Embudo Channel above confluence with North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	72982	Embudo Channel above confluence with North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	72983	Embudo Channel above confluence with North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	72984	Embudo Channel above confluence with North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	72985	Embudo Channel above confluence with North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	72986	Embudo Channel above confluence with North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	72987	Embudo Channel above confluence with North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	72988	Embudo Channel above confluence with North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	72989	Embudo Channel above confluence with North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	97545	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97546	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97547	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97548	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97549	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97550	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97551	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97552	Embudo Channel above confluence with North Diversion Channel	7/18/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	97553	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97554	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97555	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97717	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97923	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97924	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97925	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97926	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97927	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97928	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97929	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97930	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97931	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97932	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97933	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97934	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97935	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97937	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	97938	Embudo Channel above confluence with North Diversion Channel	7/18/2004
O	000000000000	Ambient Water	98230	Embudo Channel above confluence with North Diversion Channel	7/25/2004
O	000000000000	Ambient Water	98231	Embudo Channel above confluence with North Diversion Channel	7/25/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	98232	Embudo Channel above confluence with North Diversion Channel	7/25/2004
O	000000000000	Ambient Water	98233	Embudo Channel above confluence with North Diversion Channel	7/25/2004
O	000000000000	Ambient Water	98235	Embudo Channel above confluence with North Diversion Channel	7/25/2004
O	000000000000	Ambient Water	98236	Embudo Channel above confluence with North Diversion Channel	7/25/2004
O	000000000000	Ambient Water	98237	Embudo Channel above confluence with North Diversion Channel	7/25/2004
O	000000000000	Ambient Water	98238	Embudo Channel above confluence with North Diversion Channel	7/25/2004
O	000000000000	Ambient Water	98239	Embudo Channel above confluence with North Diversion Channel	7/25/2004
O	000000000000	Ambient Water	98240	Embudo Channel above confluence with North Diversion Channel	7/25/2004
O	000000000000	Ambient Water	98241	Embudo Channel above confluence with North Diversion Channel	7/25/2004
O	000000000000	Ambient Water	98242	Embudo Channel above confluence with North Diversion Channel	7/25/2004
O	000000000000	Ambient Water	98244	Embudo Channel above confluence with North Diversion Channel	7/25/2004
O	000000000000	Ambient Water	98245	Embudo Channel above confluence with North Diversion Channel	7/25/2004
O	000000000000	Ambient Water	98246	Embudo Channel above confluence with North Diversion Channel	7/25/2004
O	000000000000	Ambient Water	98247	Embudo Channel above confluence with North Diversion Channel	7/25/2004
O	000000000000	Ambient Water	98248	Embudo Channel above confluence with North Diversion Channel	7/25/2004
O	000000000000	Ambient Water	98249	Embudo Channel above confluence with North Diversion Channel	7/25/2004
O	000000000000	Ambient Water	98250	Embudo Channel above confluence with North Diversion Channel	7/25/2004
O	000000000000	Ambient Water	68803	Hahn Arroyo above N. Diversion Channel at Carlisle	7/19/2002
O	000000000000	Ambient Water	68804	Hahn Arroyo above N. Diversion Channel at Carlisle	7/19/2002
O	000000000000	Ambient Water	68805	Hahn Arroyo above N. Diversion Channel at Carlisle	7/19/2002
O	000000000000	Ambient Water	68806	Hahn Arroyo above N. Diversion Channel at Carlisle	7/19/2002

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	68962	Hahn Arroyo above N. Diversion Channel at Carlisle	7/19/2002
O	000000000000	Ambient Water	68963	Hahn Arroyo above N. Diversion Channel at Carlisle	7/19/2002
O	000000000000	Ambient Water	68964	Hahn Arroyo above N. Diversion Channel at Carlisle	7/19/2002
O	000000000000	Ambient Water	69358	Hahn Arroyo above N. Diversion Channel at Carlisle	8/2/2002
O	000000000000	Ambient Water	69359	Hahn Arroyo above N. Diversion Channel at Carlisle	8/2/2002
O	000000000000	Ambient Water	69360	Hahn Arroyo above N. Diversion Channel at Carlisle	8/2/2002
O	000000000000	Ambient Water	69361	Hahn Arroyo above N. Diversion Channel at Carlisle	8/2/2002
O	000000000000	Ambient Water	72990	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003
O	000000000000	Ambient Water	72991	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003
O	000000000000	Ambient Water	72992	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003
O	000000000000	Ambient Water	72993	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003
O	000000000000	Ambient Water	72994	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003
O	000000000000	Ambient Water	72995	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003
O	000000000000	Ambient Water	72996	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003
O	000000000000	Ambient Water	72999	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003
O	000000000000	Ambient Water	73000	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003
O	000000000000	Ambient Water	73002	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003
O	000000000000	Ambient Water	73004	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003
O	000000000000	Ambient Water	73007	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003
O	000000000000	Ambient Water	73008	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003
O	000000000000	Ambient Water	73009	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	73010	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003
O	000000000000	Ambient Water	97530	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004
O	000000000000	Ambient Water	97531	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004
O	000000000000	Ambient Water	97532	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004
O	000000000000	Ambient Water	97533	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004
O	000000000000	Ambient Water	97534	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004
O	000000000000	Ambient Water	97535	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004
O	000000000000	Ambient Water	97536	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004
O	000000000000	Ambient Water	97537	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004
O	000000000000	Ambient Water	97538	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004
O	000000000000	Ambient Water	97539	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004
O	000000000000	Ambient Water	97540	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004
O	000000000000	Ambient Water	97541	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004
O	000000000000	Ambient Water	97542	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004
O	000000000000	Ambient Water	97543	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004
O	000000000000	Ambient Water	97544	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004
O	000000000000	Ambient Water	97877	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004
O	000000000000	Ambient Water	97878	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004
O	000000000000	Ambient Water	97879	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004
O	000000000000	Ambient Water	97880	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004
O	000000000000	Ambient Water	97881	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	97882	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004
O	000000000000	Ambient Water	97883	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004
O	000000000000	Ambient Water	98251	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004
O	000000000000	Ambient Water	98252	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004
O	000000000000	Ambient Water	98253	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004
O	000000000000	Ambient Water	98254	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004
O	000000000000	Ambient Water	98255	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004
O	000000000000	Ambient Water	98256	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004
O	000000000000	Ambient Water	98257	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004
O	000000000000	Ambient Water	98258	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004
O	000000000000	Ambient Water	98259	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004
O	000000000000	Ambient Water	98260	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004
O	000000000000	Ambient Water	98261	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004
O	000000000000	Ambient Water	98262	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004
O	000000000000	Ambient Water	98263	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004
O	000000000000	Ambient Water	98264	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004
O	000000000000	Ambient Water	98265	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004
O	000000000000	Ambient Water	98266	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004
O	000000000000	Ambient Water	98267	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004
O	000000000000	Ambient Water	98268	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004
O	000000000000	Ambient Water	98269	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	98270	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004
O	000000000000	Ambient Water	98271	Hahn Arroyo above N. Diversion Channel at Carlisle	7/25/2004
O	000000000000	Ambient Water	68818	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/8/2002
O	000000000000	Ambient Water	68978	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/8/2002
O	000000000000	Ambient Water	68980	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/8/2002
O	000000000000	Ambient Water	68981	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/8/2002
O	000000000000	Ambient Water	84076	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003
O	000000000000	Ambient Water	84077	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003
O	000000000000	Ambient Water	84078	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003
O	000000000000	Ambient Water	84079	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003
O	000000000000	Ambient Water	84080	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003
O	000000000000	Ambient Water	84081	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003
O	000000000000	Ambient Water	84082	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003
O	000000000000	Ambient Water	84083	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003
O	000000000000	Ambient Water	84084	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003
O	000000000000	Ambient Water	84086	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003
O	000000000000	Ambient Water	84087	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003
O	000000000000	Ambient Water	84138	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/8/2003
O	000000000000	Ambient Water	97353	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004
O	000000000000	Ambient Water	97354	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004
O	000000000000	Ambient Water	97355	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	97356	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004
O	000000000000	Ambient Water	97358	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004
O	000000000000	Ambient Water	97359	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004
O	000000000000	Ambient Water	97360	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004
O	000000000000	Ambient Water	97361	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004
O	000000000000	Ambient Water	97362	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004
O	000000000000	Ambient Water	97363	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004
O	000000000000	Ambient Water	97367	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004
O	000000000000	Ambient Water	97368	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004
O	000000000000	Ambient Water	97369	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004
O	000000000000	Ambient Water	97370	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004
O	000000000000	Ambient Water	97371	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004
O	000000000000	Ambient Water	97373	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004
O	000000000000	Ambient Water	98473	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/25/2004
O	000000000000	Ambient Water	98474	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/25/2004
O	000000000000	Ambient Water	98475	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/25/2004
O	000000000000	Ambient Water	98476	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/25/2004
O	000000000000	Ambient Water	98477	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/25/2004
O	000000000000	Ambient Water	98479	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/25/2004
O	000000000000	Ambient Water	98480	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/25/2004
O	000000000000	Ambient Water	98481	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/25/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	68820	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/8/2002
O	000000000000	Ambient Water	68821	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/8/2002
O	000000000000	Ambient Water	83977	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	83978	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	83980	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	83982	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	83983	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	83984	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	83985	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	83987	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	83988	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	83989	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	83991	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	83992	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	83993	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	83996	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	83997	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	84000	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	84001	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	84003	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	84004	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	84005	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	84006	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	84007	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	84010	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	84011	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	84012	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	84020	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	84023	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	84024	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	84027	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
O	000000000000	Ambient Water	84055	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003
O	000000000000	Ambient Water	84074	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003
O	000000000000	Ambient Water	84075	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003
O	000000000000	Ambient Water	97885	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/19/2004
O	000000000000	Ambient Water	97886	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/19/2004
O	000000000000	Ambient Water	97887	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/19/2004
O	000000000000	Ambient Water	98463	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/25/2004
O	000000000000	Ambient Water	98464	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/25/2004
O	000000000000	Ambient Water	98465	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/25/2004
O	000000000000	Ambient Water	98466	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/25/2004
O	000000000000	Ambient Water	68807	North Diversion Channel @ Roy	7/10/2002

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	68824	North Diversion Channel @ Roy	7/10/2002
O	000000000000	Ambient Water	68825	North Diversion Channel @ Roy	7/10/2002
O	000000000000	Ambient Water	68969	North Diversion Channel @ Roy	7/10/2002
O	000000000000	Ambient Water	68970	North Diversion Channel @ Roy	7/10/2002
O	000000000000	Ambient Water	69339	North Diversion Channel @ Roy	8/3/2002
O	000000000000	Ambient Water	69340	North Diversion Channel @ Roy	8/3/2002
O	000000000000	Ambient Water	69341	North Diversion Channel @ Roy	8/3/2002
O	000000000000	Ambient Water	69342	North Diversion Channel @ Roy	8/3/2002
O	000000000000	Ambient Water	88655	North Diversion Channel @ Roy	2/22/2004
O	000000000000	Ambient Water	88656	North Diversion Channel @ Roy	2/22/2004
O	000000000000	Ambient Water	88658	North Diversion Channel @ Roy	2/22/2004
O	000000000000	Ambient Water	88660	North Diversion Channel @ Roy	2/22/2004
O	000000000000	Ambient Water	88661	North Diversion Channel @ Roy	2/22/2004
O	000000000000	Ambient Water	88662	North Diversion Channel @ Roy	2/22/2004
O	000000000000	Ambient Water	88666	North Diversion Channel @ Roy	2/22/2004
O	000000000000	Ambient Water	88667	North Diversion Channel @ Roy	2/22/2004
O	000000000000	Ambient Water	88668	North Diversion Channel @ Roy	2/22/2004
O	000000000000	Ambient Water	88669	North Diversion Channel @ Roy	2/22/2004
O	000000000000	Ambient Water	88670	North Diversion Channel @ Roy	2/22/2004
O	000000000000	Ambient Water	88673	North Diversion Channel @ Roy	2/22/2004
O	000000000000	Ambient Water	88674	North Diversion Channel @ Roy	2/22/2004
O	000000000000	Ambient Water	88675	North Diversion Channel @ Roy	2/22/2004
O	000000000000	Ambient Water	88676	North Diversion Channel @ Roy	2/22/2004
O	000000000000	Ambient Water	88677	North Diversion Channel @ Roy	2/22/2004
O	000000000000	Ambient Water	88678	North Diversion Channel @ Roy	2/22/2004
O	000000000000	Ambient Water	89153	North Diversion Channel @ Roy	2/29/2004
O	000000000000	Ambient Water	89154	North Diversion Channel @ Roy	2/29/2004
O	000000000000	Ambient Water	89155	North Diversion Channel @ Roy	2/29/2004
O	000000000000	Ambient Water	89156	North Diversion Channel @ Roy	2/29/2004
O	000000000000	Ambient Water	89158	North Diversion Channel @ Roy	2/29/2004
O	000000000000	Ambient Water	89433	North Diversion Channel @ Roy	3/5/2004
O	000000000000	Ambient Water	89434	North Diversion Channel @ Roy	3/5/2004
O	000000000000	Ambient Water	89436	North Diversion Channel @ Roy	3/5/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	89437	North Diversion Channel @ Roy	3/5/2004
O	000000000000	Ambient Water	89438	North Diversion Channel @ Roy	3/5/2004
O	000000000000	Ambient Water	89439	North Diversion Channel @ Roy	3/5/2004
O	000000000000	Ambient Water	89441	North Diversion Channel @ Roy	3/5/2004
O	000000000000	Ambient Water	89442	North Diversion Channel @ Roy	3/5/2004
O	000000000000	Ambient Water	89444	North Diversion Channel @ Roy	3/5/2004
O	000000000000	Ambient Water	89445	North Diversion Channel @ Roy	3/5/2004
O	000000000000	Ambient Water	89446	North Diversion Channel @ Roy	3/5/2004
O	000000000000	Ambient Water	89449	North Diversion Channel @ Roy	3/5/2004
O	000000000000	Ambient Water	89450	North Diversion Channel @ Roy	3/5/2004
O	000000000000	Ambient Water	89451	North Diversion Channel @ Roy	3/5/2004
O	000000000000	Ambient Water	89452	North Diversion Channel @ Roy	3/5/2004
O	000000000000	Ambient Water	89454	North Diversion Channel @ Roy	3/5/2004
O	000000000000	Ambient Water	89455	North Diversion Channel @ Roy	3/5/2004
O	000000000000	Ambient Water	89456	North Diversion Channel @ Roy	3/5/2004
O	000000000000	Ambient Water	89458	North Diversion Channel @ Roy	3/5/2004
O	000000000000	Ambient Water	89459	North Diversion Channel @ Roy	3/5/2004
O	000000000000	Ambient Water	89784	North Diversion Channel @ Roy	3/12/2004
O	000000000000	Ambient Water	89785	North Diversion Channel @ Roy	3/12/2004
O	000000000000	Ambient Water	89786	North Diversion Channel @ Roy	3/12/2004
O	000000000000	Ambient Water	89787	North Diversion Channel @ Roy	3/12/2004
O	000000000000	Ambient Water	89788	North Diversion Channel @ Roy	3/12/2004
O	000000000000	Ambient Water	89789	North Diversion Channel @ Roy	3/12/2004
O	000000000000	Ambient Water	89792	North Diversion Channel @ Roy	3/12/2004
O	000000000000	Ambient Water	89793	North Diversion Channel @ Roy	3/12/2004
O	000000000000	Ambient Water	89794	North Diversion Channel @ Roy	3/12/2004
O	000000000000	Ambient Water	89795	North Diversion Channel @ Roy	3/12/2004
O	000000000000	Ambient Water	89796	North Diversion Channel @ Roy	3/12/2004
O	000000000000	Ambient Water	89797	North Diversion Channel @ Roy	3/12/2004
O	000000000000	Ambient Water	89798	North Diversion Channel @ Roy	3/12/2004
O	000000000000	Ambient Water	89799	North Diversion Channel @ Roy	3/12/2004
O	000000000000	Ambient Water	89800	North Diversion Channel @ Roy	3/12/2004
O	000000000000	Ambient Water	89801	North Diversion Channel @ Roy	3/12/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	89802	North Diversion Channel @ Roy	3/12/2004
O	000000000000	Ambient Water	89803	North Diversion Channel @ Roy	3/12/2004
O	000000000000	Ambient Water	89804	North Diversion Channel @ Roy	3/12/2004
O	000000000000	Ambient Water	89806	North Diversion Channel @ Roy	3/12/2004
O	000000000000	Ambient Water	98293	North Diversion Channel @ Roy	7/25/2004
O	000000000000	Ambient Water	98296	North Diversion Channel @ Roy	7/25/2004
O	000000000000	Ambient Water	98298	North Diversion Channel @ Roy	7/25/2004
O	000000000000	Ambient Water	98299	North Diversion Channel @ Roy	7/25/2004
O	000000000000	Ambient Water	98300	North Diversion Channel @ Roy	7/25/2004
O	000000000000	Ambient Water	98301	North Diversion Channel @ Roy	7/25/2004
O	000000000000	Ambient Water	98304	North Diversion Channel @ Roy	7/25/2004
O	000000000000	Ambient Water	98305	North Diversion Channel @ Roy	7/25/2004
O	000000000000	Ambient Water	98307	North Diversion Channel @ Roy	7/25/2004
O	000000000000	Ambient Water	98308	North Diversion Channel @ Roy	7/25/2004
O	000000000000	Ambient Water	98309	North Diversion Channel @ Roy	7/25/2004
O	000000000000	Ambient Water	98310	North Diversion Channel @ Roy	7/25/2004
O	000000000000	Ambient Water	98311	North Diversion Channel @ Roy	7/25/2004
O	000000000000	Ambient Water	98312	North Diversion Channel @ Roy	7/25/2004
O	000000000000	Ambient Water	98313	North Diversion Channel @ Roy	7/25/2004
O	000000000000	Ambient Water	68815	North Domingo Baca Arroyo Dam @primary spillway	7/11/2002
O	000000000000	Ambient Water	68816	North Domingo Baca Arroyo Dam @primary spillway	7/11/2002
O	000000000000	Ambient Water	68988	North Domingo Baca Arroyo Dam @primary spillway	7/11/2002
O	000000000000	Ambient Water	68989	North Domingo Baca Arroyo Dam @primary spillway	7/11/2002
O	000000000000	Ambient Water	68990	North Domingo Baca Arroyo Dam @primary spillway	7/11/2002
O	000000000000	Ambient Water	69365	North Domingo Baca Arroyo Dam @primary spillway	8/2/2002
O	000000000000	Ambient Water	69366	North Domingo Baca Arroyo Dam @primary spillway	8/2/2002
O	000000000000	Ambient Water	98272	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004
O	000000000000	Ambient Water	98273	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	98274	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004
O	000000000000	Ambient Water	98275	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004
O	000000000000	Ambient Water	98277	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004
O	000000000000	Ambient Water	98278	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004
O	000000000000	Ambient Water	98279	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004
O	000000000000	Ambient Water	98280	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004
O	000000000000	Ambient Water	98281	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004
O	000000000000	Ambient Water	98282	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004
O	000000000000	Ambient Water	98283	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004
O	000000000000	Ambient Water	98284	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004
O	000000000000	Ambient Water	98285	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004
O	000000000000	Ambient Water	98286	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004
O	000000000000	Ambient Water	98287	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004
O	000000000000	Ambient Water	98288	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004
O	000000000000	Ambient Water	98289	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004
O	000000000000	Ambient Water	98290	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004
O	000000000000	Ambient Water	98291	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004
O	000000000000	Ambient Water	98292	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004
O	000000000000	Ambient Water	68823	North Pino Arroyo above North Diversion Channel	7/10/2002
O	000000000000	Ambient Water	68826	North Pino Arroyo above North Diversion Channel	7/20/2002
O	000000000000	Ambient Water	68965	North Pino Arroyo above North Diversion Channel	7/11/2002

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	68966	North Pino Arroyo above North Diversion Channel	7/11/2002
O	000000000000	Ambient Water	68967	North Pino Arroyo above North Diversion Channel	7/11/2002
O	000000000000	Ambient Water	68985	North Pino Arroyo above North Diversion Channel	7/10/2002
O	000000000000	Ambient Water	68986	North Pino Arroyo above North Diversion Channel	7/10/2002
O	000000000000	Ambient Water	68987	North Pino Arroyo above North Diversion Channel	7/10/2002
O	000000000000	Ambient Water	69363	North Pino Arroyo above North Diversion Channel	8/2/2002
O	000000000000	Ambient Water	69364	North Pino Arroyo above North Diversion Channel	8/2/2002
O	000000000000	Ambient Water	73011	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73012	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73013	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73014	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73015	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73016	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73017	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73018	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73019	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73020	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73021	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73022	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73023	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73024	North Pino Arroyo above North Diversion Channel	2/20/2003

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	73025	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73026	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73027	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73028	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73029	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73030	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73031	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73032	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73033	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73036	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73037	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73041	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73042	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73043	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73045	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73046	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73047	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73048	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73049	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	73051	North Pino Arroyo above North Diversion Channel	2/20/2003
O	000000000000	Ambient Water	97711	North Pino Arroyo above North Diversion Channel	7/23/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	97712	North Pino Arroyo above North Diversion Channel	7/23/2004
O	000000000000	Ambient Water	97713	North Pino Arroyo above North Diversion Channel	7/23/2004
O	000000000000	Ambient Water	97715	North Pino Arroyo above North Diversion Channel	7/23/2004
O	000000000000	Ambient Water	97716	North Pino Arroyo above North Diversion Channel	7/23/2004
O	000000000000	Ambient Water	69373	Paseo del Norte Pump Station	8/3/2002
O	000000000000	Ambient Water	69374	Paseo del Norte Pump Station	8/3/2002
O	000000000000	Ambient Water	68831	Ranchitos de Albuquerque Storm Drain	7/20/2002
O	000000000000	Ambient Water	68998	Ranchitos de Albuquerque Storm Drain	7/20/2002
O	000000000000	Ambient Water	68999	Ranchitos de Albuquerque Storm Drain	7/20/2002
O	000000000000	Ambient Water	68993	Rio Grande @ Alameda Bridge	7/11/2002
O	000000000000	Ambient Water	68994	Rio Grande @ Alameda Bridge	7/11/2002
O	000000000000	Ambient Water	69370	Rio Grande @ Alameda Bridge	8/3/2002
O	000000000000	Ambient Water	69372	Rio Grande @ Alameda Bridge	8/3/2002
O	000000000000	Ambient Water	72839	Rio Grande @ Alameda Bridge	2/20/2003
O	000000000000	Ambient Water	72840	Rio Grande @ Alameda Bridge	2/20/2003
O	000000000000	Ambient Water	72841	Rio Grande @ Alameda Bridge	2/20/2003
O	000000000000	Ambient Water	72842	Rio Grande @ Alameda Bridge	2/20/2003
O	000000000000	Ambient Water	72843	Rio Grande @ Alameda Bridge	2/20/2003
O	000000000000	Ambient Water	72844	Rio Grande @ Alameda Bridge	2/20/2003
O	000000000000	Ambient Water	72845	Rio Grande @ Alameda Bridge	2/20/2003
O	000000000000	Ambient Water	73052	Rio Grande @ Alameda Bridge	2/20/2003
O	000000000000	Ambient Water	73053	Rio Grande @ Alameda Bridge	2/20/2003
O	000000000000	Ambient Water	73054	Rio Grande @ Alameda Bridge	2/20/2003
O	000000000000	Ambient Water	73055	Rio Grande @ Alameda Bridge	2/20/2003
O	000000000000	Ambient Water	73056	Rio Grande @ Alameda Bridge	2/20/2003
O	000000000000	Ambient Water	73057	Rio Grande @ Alameda Bridge	2/20/2003
O	000000000000	Ambient Water	73058	Rio Grande @ Alameda Bridge	2/20/2003
O	000000000000	Ambient Water	73059	Rio Grande @ Alameda Bridge	2/20/2003
O	000000000000	Ambient Water	73060	Rio Grande @ Alameda Bridge	2/20/2003
O	000000000000	Ambient Water	73061	Rio Grande @ Alameda Bridge	2/20/2003
O	000000000000	Ambient Water	73062	Rio Grande @ Alameda Bridge	2/20/2003

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	88442	Rio Grande @ Alameda Bridge	2/17/2004
O	000000000000	Ambient Water	88653	Rio Grande @ Alameda Bridge	2/22/2004
O	000000000000	Ambient Water	89406	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89409	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89410	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89411	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89412	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89413	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89414	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89415	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89416	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89417	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89418	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89419	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89420	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89421	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89422	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89423	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89424	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89425	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89426	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89427	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89428	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89429	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89430	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89432	Rio Grande @ Alameda Bridge	3/5/2004
O	000000000000	Ambient Water	89779	Rio Grande @ Alameda Bridge	3/12/2004
O	000000000000	Ambient Water	89780	Rio Grande @ Alameda Bridge	3/12/2004
O	000000000000	Ambient Water	89781	Rio Grande @ Alameda Bridge	3/12/2004
O	000000000000	Ambient Water	89782	Rio Grande @ Alameda Bridge	3/12/2004
O	000000000000	Ambient Water	89783	Rio Grande @ Alameda Bridge	3/12/2004
O	000000000000	Ambient Water	97482	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97483	Rio Grande @ Alameda Bridge	7/18/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	97484	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97485	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97486	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97487	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97488	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97489	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97490	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97492	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97493	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97494	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97495	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97758	Rio Grande @ Alameda Bridge	7/21/2004
O	000000000000	Ambient Water	97759	Rio Grande @ Alameda Bridge	7/21/2004
O	000000000000	Ambient Water	97761	Rio Grande @ Alameda Bridge	7/21/2004
O	000000000000	Ambient Water	97762	Rio Grande @ Alameda Bridge	7/21/2004
O	000000000000	Ambient Water	97764	Rio Grande @ Alameda Bridge	7/21/2004
O	000000000000	Ambient Water	97766	Rio Grande @ Alameda Bridge	7/21/2004
O	000000000000	Ambient Water	97767	Rio Grande @ Alameda Bridge	7/21/2004
O	000000000000	Ambient Water	97769	Rio Grande @ Alameda Bridge	7/21/2004
O	000000000000	Ambient Water	97849	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97851	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97852	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97853	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97854	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97855	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97856	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97857	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97858	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97859	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97860	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97861	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97862	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97863	Rio Grande @ Alameda Bridge	7/18/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	97864	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97865	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97866	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	97867	Rio Grande @ Alameda Bridge	7/18/2004
O	000000000000	Ambient Water	98399	Rio Grande @ Alameda Bridge	7/25/2004
O	000000000000	Ambient Water	98400	Rio Grande @ Alameda Bridge	7/25/2004
O	000000000000	Ambient Water	98401	Rio Grande @ Alameda Bridge	7/25/2004
O	000000000000	Ambient Water	98402	Rio Grande @ Alameda Bridge	7/25/2004
O	000000000000	Ambient Water	98403	Rio Grande @ Alameda Bridge	7/25/2004
O	000000000000	Ambient Water	98405	Rio Grande @ Alameda Bridge	7/25/2004
O	000000000000	Ambient Water	98406	Rio Grande @ Alameda Bridge	7/25/2004
O	000000000000	Ambient Water	98407	Rio Grande @ Alameda Bridge	7/25/2004
O	000000000000	Ambient Water	98408	Rio Grande @ Alameda Bridge	7/25/2004
O	000000000000	Ambient Water	98409	Rio Grande @ Alameda Bridge	7/25/2004
O	000000000000	Ambient Water	98410	Rio Grande @ Alameda Bridge	7/25/2004
O	000000000000	Ambient Water	98411	Rio Grande @ Alameda Bridge	7/25/2004
O	000000000000	Ambient Water	98412	Rio Grande @ Alameda Bridge	7/25/2004
O	000000000000	Ambient Water	98413	Rio Grande @ Alameda Bridge	7/25/2004
O	000000000000	Ambient Water	98414	Rio Grande @ Alameda Bridge	7/25/2004
O	000000000000	Ambient Water	98415	Rio Grande @ Alameda Bridge	7/25/2004
O	000000000000	Ambient Water	98416	Rio Grande @ Alameda Bridge	7/25/2004
O	000000000000	Ambient Water	98417	Rio Grande @ Alameda Bridge	7/25/2004
O	000000000000	Ambient Water	98418	Rio Grande @ Alameda Bridge	7/25/2004
O	000000000000	Ambient Water	98419	Rio Grande @ Alameda Bridge	7/25/2004
O	000000000000	Ambient Water	68828	Rio Grande @ Angostura Diversion Dam	7/20/2002
O	000000000000	Ambient Water	68830	Rio Grande @ Angostura Diversion Dam	7/20/2002
O	000000000000	Ambient Water	69328	Rio Grande @ Angostura Diversion Dam	7/30/2002
O	000000000000	Ambient Water	69329	Rio Grande @ Angostura Diversion Dam	7/30/2002
O	000000000000	Ambient Water	69330	Rio Grande @ Angostura Diversion Dam	7/30/2002
O	000000000000	Ambient Water	69331	Rio Grande @ Angostura Diversion Dam	7/30/2002
O	000000000000	Ambient Water	69332	Rio Grande @ Angostura Diversion Dam	7/30/2002
O	000000000000	Ambient Water	69378	Rio Grande @ Angostura Diversion Dam	8/4/2002
O	000000000000	Ambient Water	69379	Rio Grande @ Angostura Diversion Dam	8/4/2002

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	69380	Rio Grande @ Angostura Diversion Dam	8/4/2002
O	000000000000	Ambient Water	69381	Rio Grande @ Angostura Diversion Dam	8/4/2002
O	000000000000	Ambient Water	89150	Rio Grande @ Angostura Diversion Dam	2/29/2004
O	000000000000	Ambient Water	89371	Rio Grande @ Angostura Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89372	Rio Grande @ Angostura Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89373	Rio Grande @ Angostura Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89756	Rio Grande @ Angostura Diversion Dam	3/12/2004
O	000000000000	Ambient Water	89757	Rio Grande @ Angostura Diversion Dam	3/12/2004
O	000000000000	Ambient Water	97718	Rio Grande @ Angostura Diversion Dam	7/21/2004
O	000000000000	Ambient Water	97719	Rio Grande @ Angostura Diversion Dam	7/21/2004
O	000000000000	Ambient Water	97720	Rio Grande @ Angostura Diversion Dam	7/21/2004
O	000000000000	Ambient Water	97721	Rio Grande @ Angostura Diversion Dam	7/21/2004
O	000000000000	Ambient Water	97722	Rio Grande @ Angostura Diversion Dam	7/21/2004
O	000000000000	Ambient Water	98316	Rio Grande @ Angostura Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98317	Rio Grande @ Angostura Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98318	Rio Grande @ Angostura Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98319	Rio Grande @ Angostura Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98320	Rio Grande @ Angostura Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98321	Rio Grande @ Angostura Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98322	Rio Grande @ Angostura Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98323	Rio Grande @ Angostura Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98324	Rio Grande @ Angostura Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98325	Rio Grande @ Angostura Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98327	Rio Grande @ Angostura Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98328	Rio Grande @ Angostura Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98329	Rio Grande @ Angostura Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98330	Rio Grande @ Angostura Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98331	Rio Grande @ Angostura Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98332	Rio Grande @ Angostura Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98333	Rio Grande @ Angostura Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98334	Rio Grande @ Angostura Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98336	Rio Grande @ Angostura Diversion Dam	7/25/2004
O	000000000000	Ambient Water	89374	Rio Grande @ HW 44 (US 550)	3/5/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	89376	Rio Grande @ HW 44 (US 550)	3/5/2004
O	000000000000	Ambient Water	89377	Rio Grande @ HW 44 (US 550)	3/5/2004
O	000000000000	Ambient Water	89378	Rio Grande @ HW 44 (US 550)	3/5/2004
O	000000000000	Ambient Water	89380	Rio Grande @ HW 44 (US 550)	3/5/2004
O	000000000000	Ambient Water	89381	Rio Grande @ HW 44 (US 550)	3/5/2004
O	000000000000	Ambient Water	89382	Rio Grande @ HW 44 (US 550)	3/5/2004
O	000000000000	Ambient Water	89385	Rio Grande @ HW 44 (US 550)	3/5/2004
O	000000000000	Ambient Water	89388	Rio Grande @ HW 44 (US 550)	3/5/2004
O	000000000000	Ambient Water	89758	Rio Grande @ HW 44 (US 550)	3/12/2004
O	000000000000	Ambient Water	89759	Rio Grande @ HW 44 (US 550)	3/12/2004
O	000000000000	Ambient Water	89760	Rio Grande @ HW 44 (US 550)	3/12/2004
O	000000000000	Ambient Water	89761	Rio Grande @ HW 44 (US 550)	3/12/2004
O	000000000000	Ambient Water	89762	Rio Grande @ HW 44 (US 550)	3/12/2004
O	000000000000	Ambient Water	89763	Rio Grande @ HW 44 (US 550)	3/12/2004
O	000000000000	Ambient Water	89764	Rio Grande @ HW 44 (US 550)	3/12/2004
O	000000000000	Ambient Water	89765	Rio Grande @ HW 44 (US 550)	3/12/2004
O	000000000000	Ambient Water	89766	Rio Grande @ HW 44 (US 550)	3/12/2004
O	000000000000	Ambient Water	89767	Rio Grande @ HW 44 (US 550)	3/12/2004
O	000000000000	Ambient Water	97418	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97419	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97421	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97423	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97424	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97425	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97426	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97427	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97428	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97429	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97430	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97431	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97432	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97433	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97434	Rio Grande @ HW 44 (US 550)	7/18/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	97724	Rio Grande @ HW 44 (US 550)	7/21/2004
O	000000000000	Ambient Water	97725	Rio Grande @ HW 44 (US 550)	7/21/2004
O	000000000000	Ambient Water	97726	Rio Grande @ HW 44 (US 550)	7/21/2004
O	000000000000	Ambient Water	97727	Rio Grande @ HW 44 (US 550)	7/21/2004
O	000000000000	Ambient Water	97728	Rio Grande @ HW 44 (US 550)	7/21/2004
O	000000000000	Ambient Water	97771	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97772	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97773	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97774	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97775	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97776	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97777	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97778	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97779	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97780	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97781	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97782	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97783	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97784	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	97785	Rio Grande @ HW 44 (US 550)	7/18/2004
O	000000000000	Ambient Water	98337	Rio Grande @ HW 44 (US 550)	7/25/2004
O	000000000000	Ambient Water	98338	Rio Grande @ HW 44 (US 550)	7/25/2004
O	000000000000	Ambient Water	98339	Rio Grande @ HW 44 (US 550)	7/25/2004
O	000000000000	Ambient Water	98340	Rio Grande @ HW 44 (US 550)	7/25/2004
O	000000000000	Ambient Water	98341	Rio Grande @ HW 44 (US 550)	7/25/2004
O	000000000000	Ambient Water	98342	Rio Grande @ HW 44 (US 550)	7/25/2004
O	000000000000	Ambient Water	98343	Rio Grande @ HW 44 (US 550)	7/25/2004
O	000000000000	Ambient Water	98344	Rio Grande @ HW 44 (US 550)	7/25/2004
O	000000000000	Ambient Water	98345	Rio Grande @ HW 44 (US 550)	7/25/2004
O	000000000000	Ambient Water	98346	Rio Grande @ HW 44 (US 550)	7/25/2004
O	000000000000	Ambient Water	98347	Rio Grande @ HW 44 (US 550)	7/25/2004
O	000000000000	Ambient Water	98349	Rio Grande @ HW 44 (US 550)	7/25/2004
O	000000000000	Ambient Water	98350	Rio Grande @ HW 44 (US 550)	7/25/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	98351	Rio Grande @ HW 44 (US 550)	7/25/2004
O	000000000000	Ambient Water	98352	Rio Grande @ HW 44 (US 550)	7/25/2004
O	000000000000	Ambient Water	98353	Rio Grande @ HW 44 (US 550)	7/25/2004
O	000000000000	Ambient Water	98354	Rio Grande @ HW 44 (US 550)	7/25/2004
O	000000000000	Ambient Water	98355	Rio Grande @ HW 44 (US 550)	7/25/2004
O	000000000000	Ambient Water	69351	Rio Grande @ I-25 Crossing	8/3/2002
O	000000000000	Ambient Water	69352	Rio Grande @ I-25 Crossing	8/3/2002
O	000000000000	Ambient Water	72908	Rio Grande @ I-25 Crossing	2/20/2003
O	000000000000	Ambient Water	72909	Rio Grande @ I-25 Crossing	2/20/2003
O	000000000000	Ambient Water	72911	Rio Grande @ I-25 Crossing	2/20/2003
O	000000000000	Ambient Water	72912	Rio Grande @ I-25 Crossing	2/20/2003
O	000000000000	Ambient Water	72913	Rio Grande @ I-25 Crossing	2/20/2003
O	000000000000	Ambient Water	72914	Rio Grande @ I-25 Crossing	2/20/2003
O	000000000000	Ambient Water	72915	Rio Grande @ I-25 Crossing	2/20/2003
O	000000000000	Ambient Water	72916	Rio Grande @ I-25 Crossing	2/20/2003
O	000000000000	Ambient Water	72917	Rio Grande @ I-25 Crossing	2/20/2003
O	000000000000	Ambient Water	72918	Rio Grande @ I-25 Crossing	2/20/2003
O	000000000000	Ambient Water	72919	Rio Grande @ I-25 Crossing	2/20/2003
O	000000000000	Ambient Water	72920	Rio Grande @ I-25 Crossing	2/20/2003
O	000000000000	Ambient Water	72921	Rio Grande @ I-25 Crossing	2/20/2003
O	000000000000	Ambient Water	72922	Rio Grande @ I-25 Crossing	2/20/2003
O	000000000000	Ambient Water	72923	Rio Grande @ I-25 Crossing	2/20/2003
O	000000000000	Ambient Water	72924	Rio Grande @ I-25 Crossing	2/20/2003
O	000000000000	Ambient Water	72925	Rio Grande @ I-25 Crossing	2/20/2003
O	000000000000	Ambient Water	72926	Rio Grande @ I-25 Crossing	2/20/2003
O	000000000000	Ambient Water	72927	Rio Grande @ I-25 Crossing	2/20/2003
O	000000000000	Ambient Water	88679	Rio Grande @ I-25 Crossing	2/22/2004
O	000000000000	Ambient Water	88680	Rio Grande @ I-25 Crossing	2/22/2004
O	000000000000	Ambient Water	88681	Rio Grande @ I-25 Crossing	2/22/2004
O	000000000000	Ambient Water	88682	Rio Grande @ I-25 Crossing	2/22/2004
O	000000000000	Ambient Water	88683	Rio Grande @ I-25 Crossing	2/22/2004
O	000000000000	Ambient Water	88684	Rio Grande @ I-25 Crossing	2/22/2004
O	000000000000	Ambient Water	88685	Rio Grande @ I-25 Crossing	2/22/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	88687	Rio Grande @ I-25 Crossing	2/22/2004
O	000000000000	Ambient Water	88689	Rio Grande @ I-25 Crossing	2/22/2004
O	000000000000	Ambient Water	88690	Rio Grande @ I-25 Crossing	2/22/2004
O	000000000000	Ambient Water	88692	Rio Grande @ I-25 Crossing	2/22/2004
O	000000000000	Ambient Water	88693	Rio Grande @ I-25 Crossing	2/22/2004
O	000000000000	Ambient Water	88694	Rio Grande @ I-25 Crossing	2/22/2004
O	000000000000	Ambient Water	88695	Rio Grande @ I-25 Crossing	2/22/2004
O	000000000000	Ambient Water	88696	Rio Grande @ I-25 Crossing	2/22/2004
O	000000000000	Ambient Water	88697	Rio Grande @ I-25 Crossing	2/22/2004
O	000000000000	Ambient Water	88698	Rio Grande @ I-25 Crossing	2/22/2004
O	000000000000	Ambient Water	88699	Rio Grande @ I-25 Crossing	2/22/2004
O	000000000000	Ambient Water	88700	Rio Grande @ I-25 Crossing	2/22/2004
O	000000000000	Ambient Water	88701	Rio Grande @ I-25 Crossing	2/22/2004
O	000000000000	Ambient Water	88702	Rio Grande @ I-25 Crossing	2/22/2004
O	000000000000	Ambient Water	88703	Rio Grande @ I-25 Crossing	2/22/2004
O	000000000000	Ambient Water	88704	Rio Grande @ I-25 Crossing	2/22/2004
O	000000000000	Ambient Water	88705	Rio Grande @ I-25 Crossing	2/22/2004
O	000000000000	Ambient Water	89159	Rio Grande @ I-25 Crossing	2/29/2004
O	000000000000	Ambient Water	89162	Rio Grande @ I-25 Crossing	2/29/2004
O	000000000000	Ambient Water	89163	Rio Grande @ I-25 Crossing	2/29/2004
O	000000000000	Ambient Water	89164	Rio Grande @ I-25 Crossing	2/29/2004
O	000000000000	Ambient Water	89167	Rio Grande @ I-25 Crossing	2/29/2004
O	000000000000	Ambient Water	89168	Rio Grande @ I-25 Crossing	2/29/2004
O	000000000000	Ambient Water	89169	Rio Grande @ I-25 Crossing	2/29/2004
O	000000000000	Ambient Water	89170	Rio Grande @ I-25 Crossing	2/29/2004
O	000000000000	Ambient Water	89171	Rio Grande @ I-25 Crossing	2/29/2004
O	000000000000	Ambient Water	89172	Rio Grande @ I-25 Crossing	2/29/2004
O	000000000000	Ambient Water	89173	Rio Grande @ I-25 Crossing	2/29/2004
O	000000000000	Ambient Water	89174	Rio Grande @ I-25 Crossing	2/29/2004
O	000000000000	Ambient Water	89175	Rio Grande @ I-25 Crossing	2/29/2004
O	000000000000	Ambient Water	89176	Rio Grande @ I-25 Crossing	2/29/2004
O	000000000000	Ambient Water	89178	Rio Grande @ I-25 Crossing	2/29/2004
O	000000000000	Ambient Water	89179	Rio Grande @ I-25 Crossing	2/29/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	89180	Rio Grande @ I-25 Crossing	2/29/2004
O	000000000000	Ambient Water	89181	Rio Grande @ I-25 Crossing	2/29/2004
O	000000000000	Ambient Water	89182	Rio Grande @ I-25 Crossing	2/29/2004
O	000000000000	Ambient Water	89488	Rio Grande @ I-25 Crossing	3/5/2004
O	000000000000	Ambient Water	89489	Rio Grande @ I-25 Crossing	3/5/2004
O	000000000000	Ambient Water	89490	Rio Grande @ I-25 Crossing	3/5/2004
O	000000000000	Ambient Water	89493	Rio Grande @ I-25 Crossing	3/5/2004
O	000000000000	Ambient Water	89494	Rio Grande @ I-25 Crossing	3/5/2004
O	000000000000	Ambient Water	89495	Rio Grande @ I-25 Crossing	3/5/2004
O	000000000000	Ambient Water	89496	Rio Grande @ I-25 Crossing	3/5/2004
O	000000000000	Ambient Water	89497	Rio Grande @ I-25 Crossing	3/5/2004
O	000000000000	Ambient Water	89498	Rio Grande @ I-25 Crossing	3/5/2004
O	000000000000	Ambient Water	89499	Rio Grande @ I-25 Crossing	3/5/2004
O	000000000000	Ambient Water	89500	Rio Grande @ I-25 Crossing	3/5/2004
O	000000000000	Ambient Water	89501	Rio Grande @ I-25 Crossing	3/5/2004
O	000000000000	Ambient Water	89502	Rio Grande @ I-25 Crossing	3/5/2004
O	000000000000	Ambient Water	89504	Rio Grande @ I-25 Crossing	3/5/2004
O	000000000000	Ambient Water	89505	Rio Grande @ I-25 Crossing	3/5/2004
O	000000000000	Ambient Water	89507	Rio Grande @ I-25 Crossing	3/5/2004
O	000000000000	Ambient Water	89508	Rio Grande @ I-25 Crossing	3/5/2004
O	000000000000	Ambient Water	89509	Rio Grande @ I-25 Crossing	3/5/2004
O	000000000000	Ambient Water	89510	Rio Grande @ I-25 Crossing	3/5/2004
O	000000000000	Ambient Water	89511	Rio Grande @ I-25 Crossing	3/5/2004
O	000000000000	Ambient Water	89512	Rio Grande @ I-25 Crossing	3/5/2004
O	000000000000	Ambient Water	89513	Rio Grande @ I-25 Crossing	3/5/2004
O	000000000000	Ambient Water	89820	Rio Grande @ I-25 Crossing	3/12/2004
O	000000000000	Ambient Water	89821	Rio Grande @ I-25 Crossing	3/12/2004
O	000000000000	Ambient Water	89822	Rio Grande @ I-25 Crossing	3/12/2004
O	000000000000	Ambient Water	89823	Rio Grande @ I-25 Crossing	3/12/2004
O	000000000000	Ambient Water	89824	Rio Grande @ I-25 Crossing	3/12/2004
O	000000000000	Ambient Water	89825	Rio Grande @ I-25 Crossing	3/12/2004
O	000000000000	Ambient Water	89826	Rio Grande @ I-25 Crossing	3/12/2004
O	000000000000	Ambient Water	89827	Rio Grande @ I-25 Crossing	3/12/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	89828	Rio Grande @ I-25 Crossing	3/12/2004
O	000000000000	Ambient Water	89829	Rio Grande @ I-25 Crossing	3/12/2004
O	000000000000	Ambient Water	89830	Rio Grande @ I-25 Crossing	3/12/2004
O	000000000000	Ambient Water	89831	Rio Grande @ I-25 Crossing	3/12/2004
O	000000000000	Ambient Water	89836	Rio Grande @ I-25 Crossing	3/12/2004
O	000000000000	Ambient Water	89837	Rio Grande @ I-25 Crossing	3/12/2004
O	000000000000	Ambient Water	89838	Rio Grande @ I-25 Crossing	3/12/2004
O	000000000000	Ambient Water	89839	Rio Grande @ I-25 Crossing	3/12/2004
O	000000000000	Ambient Water	89842	Rio Grande @ I-25 Crossing	3/12/2004
O	000000000000	Ambient Water	89843	Rio Grande @ I-25 Crossing	3/12/2004
O	000000000000	Ambient Water	89844	Rio Grande @ I-25 Crossing	3/12/2004
O	000000000000	Ambient Water	89846	Rio Grande @ I-25 Crossing	3/12/2004
O	000000000000	Ambient Water	97374	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97375	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97376	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97378	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97379	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97380	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97381	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97382	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97383	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97384	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97386	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97387	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97388	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97389	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97390	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97888	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97889	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97890	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97891	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97893	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97894	Rio Grande @ I-25 Crossing	7/19/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	97895	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97897	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97898	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97899	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97900	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97901	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97902	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97903	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97904	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97905	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97906	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	97907	Rio Grande @ I-25 Crossing	7/19/2004
O	000000000000	Ambient Water	98500	Rio Grande @ I-25 Crossing	7/25/2004
O	000000000000	Ambient Water	98501	Rio Grande @ I-25 Crossing	7/25/2004
O	000000000000	Ambient Water	69343	Rio Grande @ Isleta Diversion Dam	8/3/2002
O	000000000000	Ambient Water	69344	Rio Grande @ Isleta Diversion Dam	8/3/2002
O	000000000000	Ambient Water	69345	Rio Grande @ Isleta Diversion Dam	8/3/2002
O	000000000000	Ambient Water	69346	Rio Grande @ Isleta Diversion Dam	8/3/2002
O	000000000000	Ambient Water	69348	Rio Grande @ Isleta Diversion Dam	8/3/2002
O	000000000000	Ambient Water	72928	Rio Grande @ Isleta Diversion Dam	2/20/2003
O	000000000000	Ambient Water	72929	Rio Grande @ Isleta Diversion Dam	2/20/2003
O	000000000000	Ambient Water	72930	Rio Grande @ Isleta Diversion Dam	2/20/2003
O	000000000000	Ambient Water	72931	Rio Grande @ Isleta Diversion Dam	2/20/2003
O	000000000000	Ambient Water	72932	Rio Grande @ Isleta Diversion Dam	2/20/2003
O	000000000000	Ambient Water	72933	Rio Grande @ Isleta Diversion Dam	2/20/2003
O	000000000000	Ambient Water	72934	Rio Grande @ Isleta Diversion Dam	2/20/2003
O	000000000000	Ambient Water	72935	Rio Grande @ Isleta Diversion Dam	2/20/2003
O	000000000000	Ambient Water	72936	Rio Grande @ Isleta Diversion Dam	2/20/2003
O	000000000000	Ambient Water	72937	Rio Grande @ Isleta Diversion Dam	2/20/2003
O	000000000000	Ambient Water	72938	Rio Grande @ Isleta Diversion Dam	2/20/2003
O	000000000000	Ambient Water	72939	Rio Grande @ Isleta Diversion Dam	2/20/2003
O	000000000000	Ambient Water	72940	Rio Grande @ Isleta Diversion Dam	2/20/2003
O	000000000000	Ambient Water	72941	Rio Grande @ Isleta Diversion Dam	2/20/2003

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	72942	Rio Grande @ Isleta Diversion Dam	2/20/2003
O	000000000000	Ambient Water	72943	Rio Grande @ Isleta Diversion Dam	2/20/2003
O	000000000000	Ambient Water	72944	Rio Grande @ Isleta Diversion Dam	2/20/2003
O	000000000000	Ambient Water	72945	Rio Grande @ Isleta Diversion Dam	2/20/2003
O	000000000000	Ambient Water	72946	Rio Grande @ Isleta Diversion Dam	2/20/2003
O	000000000000	Ambient Water	72948	Rio Grande @ Isleta Diversion Dam	2/20/2003
O	000000000000	Ambient Water	84088	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84089	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84090	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84091	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84092	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84093	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84094	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84095	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84096	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84097	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84098	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84099	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84102	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84103	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84104	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84105	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84106	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84107	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84109	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84110	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84112	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84113	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84114	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84115	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84116	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84117	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84118	Rio Grande @ Isleta Diversion Dam	10/7/2003

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	84119	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84120	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84121	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84122	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84123	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84124	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84125	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84129	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84131	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	84132	Rio Grande @ Isleta Diversion Dam	10/7/2003
O	000000000000	Ambient Water	88706	Rio Grande @ Isleta Diversion Dam	2/22/2004
O	000000000000	Ambient Water	88707	Rio Grande @ Isleta Diversion Dam	2/22/2004
O	000000000000	Ambient Water	88708	Rio Grande @ Isleta Diversion Dam	2/22/2004
O	000000000000	Ambient Water	88709	Rio Grande @ Isleta Diversion Dam	2/22/2004
O	000000000000	Ambient Water	88713	Rio Grande @ Isleta Diversion Dam	2/22/2004
O	000000000000	Ambient Water	88714	Rio Grande @ Isleta Diversion Dam	2/22/2004
O	000000000000	Ambient Water	88715	Rio Grande @ Isleta Diversion Dam	2/22/2004
O	000000000000	Ambient Water	88716	Rio Grande @ Isleta Diversion Dam	2/22/2004
O	000000000000	Ambient Water	89183	Rio Grande @ Isleta Diversion Dam	2/29/2004
O	000000000000	Ambient Water	89184	Rio Grande @ Isleta Diversion Dam	2/29/2004
O	000000000000	Ambient Water	89185	Rio Grande @ Isleta Diversion Dam	2/29/2004
O	000000000000	Ambient Water	89187	Rio Grande @ Isleta Diversion Dam	2/29/2004
O	000000000000	Ambient Water	89545	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89546	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89547	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89548	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89549	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89550	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89551	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89552	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89553	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89554	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89555	Rio Grande @ Isleta Diversion Dam	3/5/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	89557	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89558	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89559	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89560	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89561	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89562	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89563	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89564	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89565	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89566	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89567	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89568	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89569	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89570	Rio Grande @ Isleta Diversion Dam	3/5/2004
O	000000000000	Ambient Water	89847	Rio Grande @ Isleta Diversion Dam	3/12/2004
O	000000000000	Ambient Water	89848	Rio Grande @ Isleta Diversion Dam	3/12/2004
O	000000000000	Ambient Water	89850	Rio Grande @ Isleta Diversion Dam	3/12/2004
O	000000000000	Ambient Water	89856	Rio Grande @ Isleta Diversion Dam	3/12/2004
O	000000000000	Ambient Water	89857	Rio Grande @ Isleta Diversion Dam	3/12/2004
O	000000000000	Ambient Water	89858	Rio Grande @ Isleta Diversion Dam	3/12/2004
O	000000000000	Ambient Water	89859	Rio Grande @ Isleta Diversion Dam	3/12/2004
O	000000000000	Ambient Water	89860	Rio Grande @ Isleta Diversion Dam	3/12/2004
O	000000000000	Ambient Water	89861	Rio Grande @ Isleta Diversion Dam	3/12/2004
O	000000000000	Ambient Water	89862	Rio Grande @ Isleta Diversion Dam	3/12/2004
O	000000000000	Ambient Water	89866	Rio Grande @ Isleta Diversion Dam	3/12/2004
O	000000000000	Ambient Water	89867	Rio Grande @ Isleta Diversion Dam	3/12/2004
O	000000000000	Ambient Water	89868	Rio Grande @ Isleta Diversion Dam	3/12/2004
O	000000000000	Ambient Water	89870	Rio Grande @ Isleta Diversion Dam	3/12/2004
O	000000000000	Ambient Water	89871	Rio Grande @ Isleta Diversion Dam	3/12/2004
O	000000000000	Ambient Water	97313	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97314	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97316	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97317	Rio Grande @ Isleta Diversion Dam	7/19/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	97319	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97320	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97321	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97322	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97323	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97324	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97325	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97326	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97327	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97328	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97329	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97330	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97331	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97332	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97333	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97334	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97335	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97336	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97337	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97338	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97339	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97342	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97344	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97345	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97346	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97347	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97348	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97349	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97350	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97351	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97352	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97983	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97984	Rio Grande @ Isleta Diversion Dam	7/19/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	97985	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97986	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97987	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97988	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97989	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97990	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97991	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97993	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97994	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97995	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	97996	Rio Grande @ Isleta Diversion Dam	7/19/2004
O	000000000000	Ambient Water	98469	Rio Grande @ Isleta Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98471	Rio Grande @ Isleta Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98485	Rio Grande @ Isleta Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98486	Rio Grande @ Isleta Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98487	Rio Grande @ Isleta Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98488	Rio Grande @ Isleta Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98489	Rio Grande @ Isleta Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98490	Rio Grande @ Isleta Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98491	Rio Grande @ Isleta Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98492	Rio Grande @ Isleta Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98493	Rio Grande @ Isleta Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98494	Rio Grande @ Isleta Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98495	Rio Grande @ Isleta Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98496	Rio Grande @ Isleta Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98497	Rio Grande @ Isleta Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98498	Rio Grande @ Isleta Diversion Dam	7/25/2004
O	000000000000	Ambient Water	98499	Rio Grande @ Isleta Diversion Dam	7/25/2004
O	000000000000	Ambient Water	68995	Rio Grande @ Rio Bravo Bridge	7/8/2002
O	000000000000	Ambient Water	68996	Rio Grande @ Rio Bravo Bridge	7/8/2002
O	000000000000	Ambient Water	68997	Rio Grande @ Rio Bravo Bridge	7/8/2002
O	000000000000	Ambient Water	72887	Rio Grande @ Rio Bravo Bridge	2/20/2003
O	000000000000	Ambient Water	72888	Rio Grande @ Rio Bravo Bridge	2/20/2003

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	72889	Rio Grande @ Rio Bravo Bridge	2/20/2003
O	000000000000	Ambient Water	72890	Rio Grande @ Rio Bravo Bridge	2/20/2003
O	000000000000	Ambient Water	72891	Rio Grande @ Rio Bravo Bridge	2/20/2003
O	000000000000	Ambient Water	72892	Rio Grande @ Rio Bravo Bridge	2/20/2003
O	000000000000	Ambient Water	72893	Rio Grande @ Rio Bravo Bridge	2/20/2003
O	000000000000	Ambient Water	72894	Rio Grande @ Rio Bravo Bridge	2/20/2003
O	000000000000	Ambient Water	72895	Rio Grande @ Rio Bravo Bridge	2/20/2003
O	000000000000	Ambient Water	72896	Rio Grande @ Rio Bravo Bridge	2/20/2003
O	000000000000	Ambient Water	72897	Rio Grande @ Rio Bravo Bridge	2/20/2003
O	000000000000	Ambient Water	72898	Rio Grande @ Rio Bravo Bridge	2/20/2003
O	000000000000	Ambient Water	72899	Rio Grande @ Rio Bravo Bridge	2/20/2003
O	000000000000	Ambient Water	72900	Rio Grande @ Rio Bravo Bridge	2/20/2003
O	000000000000	Ambient Water	72901	Rio Grande @ Rio Bravo Bridge	2/20/2003
O	000000000000	Ambient Water	72902	Rio Grande @ Rio Bravo Bridge	2/20/2003
O	000000000000	Ambient Water	72903	Rio Grande @ Rio Bravo Bridge	2/20/2003
O	000000000000	Ambient Water	72904	Rio Grande @ Rio Bravo Bridge	2/20/2003
O	000000000000	Ambient Water	72905	Rio Grande @ Rio Bravo Bridge	2/20/2003
O	000000000000	Ambient Water	72906	Rio Grande @ Rio Bravo Bridge	2/20/2003
O	000000000000	Ambient Water	72907	Rio Grande @ Rio Bravo Bridge	2/20/2003
O	000000000000	Ambient Water	88717	Rio Grande @ Rio Bravo Bridge	2/22/2004
O	000000000000	Ambient Water	89188	Rio Grande @ Rio Bravo Bridge	2/29/2004
O	000000000000	Ambient Water	89461	Rio Grande @ Rio Bravo Bridge	3/5/2004
O	000000000000	Ambient Water	89464	Rio Grande @ Rio Bravo Bridge	3/5/2004
O	000000000000	Ambient Water	89468	Rio Grande @ Rio Bravo Bridge	3/5/2004
O	000000000000	Ambient Water	89471	Rio Grande @ Rio Bravo Bridge	3/5/2004
O	000000000000	Ambient Water	89472	Rio Grande @ Rio Bravo Bridge	3/5/2004
O	000000000000	Ambient Water	89473	Rio Grande @ Rio Bravo Bridge	3/5/2004
O	000000000000	Ambient Water	89475	Rio Grande @ Rio Bravo Bridge	3/5/2004
O	000000000000	Ambient Water	89476	Rio Grande @ Rio Bravo Bridge	3/5/2004
O	000000000000	Ambient Water	89477	Rio Grande @ Rio Bravo Bridge	3/5/2004
O	000000000000	Ambient Water	89478	Rio Grande @ Rio Bravo Bridge	3/5/2004
O	000000000000	Ambient Water	89479	Rio Grande @ Rio Bravo Bridge	3/5/2004
O	000000000000	Ambient Water	89480	Rio Grande @ Rio Bravo Bridge	3/5/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	89481	Rio Grande @ Rio Bravo Bridge	3/5/2004
O	000000000000	Ambient Water	89482	Rio Grande @ Rio Bravo Bridge	3/5/2004
O	000000000000	Ambient Water	89483	Rio Grande @ Rio Bravo Bridge	3/5/2004
O	000000000000	Ambient Water	89484	Rio Grande @ Rio Bravo Bridge	3/5/2004
O	000000000000	Ambient Water	89485	Rio Grande @ Rio Bravo Bridge	3/5/2004
O	000000000000	Ambient Water	89486	Rio Grande @ Rio Bravo Bridge	3/5/2004
O	000000000000	Ambient Water	89807	Rio Grande @ Rio Bravo Bridge	3/12/2004
O	000000000000	Ambient Water	89808	Rio Grande @ Rio Bravo Bridge	3/12/2004
O	000000000000	Ambient Water	89809	Rio Grande @ Rio Bravo Bridge	3/12/2004
O	000000000000	Ambient Water	89811	Rio Grande @ Rio Bravo Bridge	3/12/2004
O	000000000000	Ambient Water	89812	Rio Grande @ Rio Bravo Bridge	3/12/2004
O	000000000000	Ambient Water	89814	Rio Grande @ Rio Bravo Bridge	3/12/2004
O	000000000000	Ambient Water	89815	Rio Grande @ Rio Bravo Bridge	3/12/2004
O	000000000000	Ambient Water	89816	Rio Grande @ Rio Bravo Bridge	3/12/2004
O	000000000000	Ambient Water	89817	Rio Grande @ Rio Bravo Bridge	3/12/2004
O	000000000000	Ambient Water	89818	Rio Grande @ Rio Bravo Bridge	3/12/2004
O	000000000000	Ambient Water	89819	Rio Grande @ Rio Bravo Bridge	3/12/2004
O	000000000000	Ambient Water	97407	Rio Grande @ Rio Bravo Bridge	7/19/2004
O	000000000000	Ambient Water	97408	Rio Grande @ Rio Bravo Bridge	7/19/2004
O	000000000000	Ambient Water	97409	Rio Grande @ Rio Bravo Bridge	7/19/2004
O	000000000000	Ambient Water	97410	Rio Grande @ Rio Bravo Bridge	7/19/2004
O	000000000000	Ambient Water	97411	Rio Grande @ Rio Bravo Bridge	7/19/2004
O	000000000000	Ambient Water	97412	Rio Grande @ Rio Bravo Bridge	7/19/2004
O	000000000000	Ambient Water	97413	Rio Grande @ Rio Bravo Bridge	7/19/2004
O	000000000000	Ambient Water	97414	Rio Grande @ Rio Bravo Bridge	7/19/2004
O	000000000000	Ambient Water	97415	Rio Grande @ Rio Bravo Bridge	7/19/2004
O	000000000000	Ambient Water	97416	Rio Grande @ Rio Bravo Bridge	7/19/2004
O	000000000000	Ambient Water	97417	Rio Grande @ Rio Bravo Bridge	7/19/2004
O	000000000000	Ambient Water	98440	Rio Grande @ Rio Bravo Bridge	7/25/2004
O	000000000000	Ambient Water	98441	Rio Grande @ Rio Bravo Bridge	7/25/2004
O	000000000000	Ambient Water	98442	Rio Grande @ Rio Bravo Bridge	7/25/2004
O	000000000000	Ambient Water	98443	Rio Grande @ Rio Bravo Bridge	7/25/2004
O	000000000000	Ambient Water	98444	Rio Grande @ Rio Bravo Bridge	7/25/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	98445	Rio Grande @ Rio Bravo Bridge	7/25/2004
O	000000000000	Ambient Water	98446	Rio Grande @ Rio Bravo Bridge	7/25/2004
O	000000000000	Ambient Water	98447	Rio Grande @ Rio Bravo Bridge	7/25/2004
O	000000000000	Ambient Water	98448	Rio Grande @ Rio Bravo Bridge	7/25/2004
O	000000000000	Ambient Water	98449	Rio Grande @ Rio Bravo Bridge	7/25/2004
O	000000000000	Ambient Water	98450	Rio Grande @ Rio Bravo Bridge	7/25/2004
O	000000000000	Ambient Water	98451	Rio Grande @ Rio Bravo Bridge	7/25/2004
O	000000000000	Ambient Water	98452	Rio Grande @ Rio Bravo Bridge	7/25/2004
O	000000000000	Ambient Water	98453	Rio Grande @ Rio Bravo Bridge	7/25/2004
O	000000000000	Ambient Water	98454	Rio Grande @ Rio Bravo Bridge	7/25/2004
O	000000000000	Ambient Water	88445	Rio Grande above Rio Rancho Utility #2	2/17/2004
O	000000000000	Ambient Water	88446	Rio Grande above Rio Rancho Utility #2	2/17/2004
O	000000000000	Ambient Water	89396	Rio Grande above Rio Rancho Utility #2	3/5/2004
O	000000000000	Ambient Water	89397	Rio Grande above Rio Rancho Utility #2	3/5/2004
O	000000000000	Ambient Water	89398	Rio Grande above Rio Rancho Utility #2	3/5/2004
O	000000000000	Ambient Water	89399	Rio Grande above Rio Rancho Utility #2	3/5/2004
O	000000000000	Ambient Water	89400	Rio Grande above Rio Rancho Utility #2	3/5/2004
O	000000000000	Ambient Water	89401	Rio Grande above Rio Rancho Utility #2	3/5/2004
O	000000000000	Ambient Water	89774	Rio Grande above Rio Rancho Utility #2	3/12/2004
O	000000000000	Ambient Water	89775	Rio Grande above Rio Rancho Utility #2	3/12/2004
O	000000000000	Ambient Water	89776	Rio Grande above Rio Rancho Utility #2	3/12/2004
O	000000000000	Ambient Water	89777	Rio Grande above Rio Rancho Utility #2	3/12/2004
O	000000000000	Ambient Water	97435	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97436	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97438	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97439	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97440	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97441	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97443	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97444	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97446	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97447	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97448	Rio Grande above Rio Rancho Utility #2	7/18/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	97449	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97737	Rio Grande above Rio Rancho Utility #2	7/21/2004
O	000000000000	Ambient Water	97738	Rio Grande above Rio Rancho Utility #2	7/21/2004
O	000000000000	Ambient Water	97740	Rio Grande above Rio Rancho Utility #2	7/21/2004
O	000000000000	Ambient Water	97741	Rio Grande above Rio Rancho Utility #2	7/21/2004
O	000000000000	Ambient Water	97742	Rio Grande above Rio Rancho Utility #2	7/21/2004
O	000000000000	Ambient Water	97819	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97820	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97821	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97822	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97824	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97826	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97827	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97829	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97831	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97832	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97834	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97835	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97836	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97837	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97838	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97839	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97841	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97842	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	97845	Rio Grande above Rio Rancho Utility #2	7/18/2004
O	000000000000	Ambient Water	98376	Rio Grande above Rio Rancho Utility #2	7/25/2004
O	000000000000	Ambient Water	98377	Rio Grande above Rio Rancho Utility #2	7/25/2004
O	000000000000	Ambient Water	98378	Rio Grande above Rio Rancho Utility #2	7/25/2004
O	000000000000	Ambient Water	98380	Rio Grande above Rio Rancho Utility #2	7/25/2004
O	000000000000	Ambient Water	98381	Rio Grande above Rio Rancho Utility #2	7/25/2004
O	000000000000	Ambient Water	98384	Rio Grande above Rio Rancho Utility #2	7/25/2004
O	000000000000	Ambient Water	98385	Rio Grande above Rio Rancho Utility #2	7/25/2004
O	000000000000	Ambient Water	98386	Rio Grande above Rio Rancho Utility #2	7/25/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	98387	Rio Grande above Rio Rancho Utility #2	7/25/2004
O	000000000000	Ambient Water	98388	Rio Grande above Rio Rancho Utility #2	7/25/2004
O	000000000000	Ambient Water	98389	Rio Grande above Rio Rancho Utility #2	7/25/2004
O	000000000000	Ambient Water	98390	Rio Grande above Rio Rancho Utility #2	7/25/2004
O	000000000000	Ambient Water	98391	Rio Grande above Rio Rancho Utility #2	7/25/2004
O	000000000000	Ambient Water	98392	Rio Grande above Rio Rancho Utility #2	7/25/2004
O	000000000000	Ambient Water	98393	Rio Grande above Rio Rancho Utility #2	7/25/2004
O	000000000000	Ambient Water	98394	Rio Grande above Rio Rancho Utility #2	7/25/2004
O	000000000000	Ambient Water	98395	Rio Grande above Rio Rancho Utility #2	7/25/2004
O	000000000000	Ambient Water	89390	Rio Grande above Rio Rancho Utility #3	3/5/2004
O	000000000000	Ambient Water	89391	Rio Grande above Rio Rancho Utility #3	3/5/2004
O	000000000000	Ambient Water	89393	Rio Grande above Rio Rancho Utility #3	3/5/2004
O	000000000000	Ambient Water	89394	Rio Grande above Rio Rancho Utility #3	3/5/2004
O	000000000000	Ambient Water	89395	Rio Grande above Rio Rancho Utility #3	3/5/2004
O	000000000000	Ambient Water	89768	Rio Grande above Rio Rancho Utility #3	3/12/2004
O	000000000000	Ambient Water	89769	Rio Grande above Rio Rancho Utility #3	3/12/2004
O	000000000000	Ambient Water	89770	Rio Grande above Rio Rancho Utility #3	3/12/2004
O	000000000000	Ambient Water	89771	Rio Grande above Rio Rancho Utility #3	3/12/2004
O	000000000000	Ambient Water	89772	Rio Grande above Rio Rancho Utility #3	3/12/2004
O	000000000000	Ambient Water	89773	Rio Grande above Rio Rancho Utility #3	3/12/2004
O	000000000000	Ambient Water	97451	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97452	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97453	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97454	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97455	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97456	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97457	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97458	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97459	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97460	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97461	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97462	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97463	Rio Grande above Rio Rancho Utility #3	7/18/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	97464	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97465	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97466	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97467	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97468	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97729	Rio Grande above Rio Rancho Utility #3	7/21/2004
O	000000000000	Ambient Water	97730	Rio Grande above Rio Rancho Utility #3	7/21/2004
O	000000000000	Ambient Water	97731	Rio Grande above Rio Rancho Utility #3	7/21/2004
O	000000000000	Ambient Water	97732	Rio Grande above Rio Rancho Utility #3	7/21/2004
O	000000000000	Ambient Water	97733	Rio Grande above Rio Rancho Utility #3	7/21/2004
O	000000000000	Ambient Water	97734	Rio Grande above Rio Rancho Utility #3	7/21/2004
O	000000000000	Ambient Water	97735	Rio Grande above Rio Rancho Utility #3	7/21/2004
O	000000000000	Ambient Water	97786	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97787	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97788	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97789	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97791	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97792	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97793	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97794	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97795	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97796	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97797	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97798	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97799	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97800	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97801	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97802	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97803	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97804	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97805	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97806	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97807	Rio Grande above Rio Rancho Utility #3	7/18/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	97808	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97809	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97810	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97811	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97812	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97813	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97814	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97815	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97816	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97817	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	97818	Rio Grande above Rio Rancho Utility #3	7/18/2004
O	000000000000	Ambient Water	98356	Rio Grande above Rio Rancho Utility #3	7/25/2004
O	000000000000	Ambient Water	98357	Rio Grande above Rio Rancho Utility #3	7/25/2004
O	000000000000	Ambient Water	98358	Rio Grande above Rio Rancho Utility #3	7/25/2004
O	000000000000	Ambient Water	98359	Rio Grande above Rio Rancho Utility #3	7/25/2004
O	000000000000	Ambient Water	98360	Rio Grande above Rio Rancho Utility #3	7/25/2004
O	000000000000	Ambient Water	98361	Rio Grande above Rio Rancho Utility #3	7/25/2004
O	000000000000	Ambient Water	98362	Rio Grande above Rio Rancho Utility #3	7/25/2004
O	000000000000	Ambient Water	98363	Rio Grande above Rio Rancho Utility #3	7/25/2004
O	000000000000	Ambient Water	98364	Rio Grande above Rio Rancho Utility #3	7/25/2004
O	000000000000	Ambient Water	98365	Rio Grande above Rio Rancho Utility #3	7/25/2004
O	000000000000	Ambient Water	98366	Rio Grande above Rio Rancho Utility #3	7/25/2004
O	000000000000	Ambient Water	98367	Rio Grande above Rio Rancho Utility #3	7/25/2004
O	000000000000	Ambient Water	98368	Rio Grande above Rio Rancho Utility #3	7/25/2004
O	000000000000	Ambient Water	98369	Rio Grande above Rio Rancho Utility #3	7/25/2004
O	000000000000	Ambient Water	98370	Rio Grande above Rio Rancho Utility #3	7/25/2004
O	000000000000	Ambient Water	98371	Rio Grande above Rio Rancho Utility #3	7/25/2004
O	000000000000	Ambient Water	98372	Rio Grande above Rio Rancho Utility #3	7/25/2004
O	000000000000	Ambient Water	98373	Rio Grande above Rio Rancho Utility #3	7/25/2004
O	000000000000	Ambient Water	98374	Rio Grande above Rio Rancho Utility #3	7/25/2004
O	000000000000	Ambient Water	98375	Rio Grande above Rio Rancho Utility #3	7/25/2004
O	000000000000	Ambient Water	68991	Sandia Pueblo Natural Arroyo @I-25 Crossing	7/10/2002
O	000000000000	Ambient Water	68992	Sandia Pueblo Natural Arroyo @I-25 Crossing	7/10/2002

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	98314	Sandia Pueblo Natural Arroyo @I-25 Crossing	7/25/2004
O	000000000000	Ambient Water	98315	Sandia Pueblo Natural Arroyo @I-25 Crossing	7/25/2004
O	000000000000	Ambient Water	69349	South Diversion Channel @ Tijeras Arroyo	8/3/2002
O	000000000000	Ambient Water	69350	South Diversion Channel @ Tijeras Arroyo	8/3/2002
O	000000000000	Ambient Water	89189	South Diversion Channel @ Tijeras Arroyo	2/29/2004
O	000000000000	Ambient Water	89190	South Diversion Channel @ Tijeras Arroyo	2/29/2004
O	000000000000	Ambient Water	89191	South Diversion Channel @ Tijeras Arroyo	2/29/2004
O	000000000000	Ambient Water	89192	South Diversion Channel @ Tijeras Arroyo	2/29/2004
O	000000000000	Ambient Water	89193	South Diversion Channel @ Tijeras Arroyo	2/29/2004
O	000000000000	Ambient Water	89195	South Diversion Channel @ Tijeras Arroyo	2/29/2004
O	000000000000	Ambient Water	89196	South Diversion Channel @ Tijeras Arroyo	2/29/2004
O	000000000000	Ambient Water	89198	South Diversion Channel @ Tijeras Arroyo	2/29/2004
O	000000000000	Ambient Water	89514	South Diversion Channel @ Tijeras Arroyo	3/5/2004
O	000000000000	Ambient Water	89521	South Diversion Channel @ Tijeras Arroyo	3/5/2004
O	000000000000	Ambient Water	89523	South Diversion Channel @ Tijeras Arroyo	3/5/2004
O	000000000000	Ambient Water	89524	South Diversion Channel @ Tijeras Arroyo	3/5/2004
O	000000000000	Ambient Water	89525	South Diversion Channel @ Tijeras Arroyo	3/5/2004
O	000000000000	Ambient Water	89526	South Diversion Channel @ Tijeras Arroyo	3/5/2004
O	000000000000	Ambient Water	89527	South Diversion Channel @ Tijeras Arroyo	3/5/2004
O	000000000000	Ambient Water	89528	South Diversion Channel @ Tijeras Arroyo	3/5/2004
O	000000000000	Ambient Water	89530	South Diversion Channel @ Tijeras Arroyo	3/5/2004
O	000000000000	Ambient Water	89533	South Diversion Channel @ Tijeras Arroyo	3/5/2004
O	000000000000	Ambient Water	89534	South Diversion Channel @ Tijeras Arroyo	3/5/2004
O	000000000000	Ambient Water	89535	South Diversion Channel @ Tijeras Arroyo	3/5/2004
O	000000000000	Ambient Water	89536	South Diversion Channel @ Tijeras Arroyo	3/5/2004
O	000000000000	Ambient Water	89537	South Diversion Channel @ Tijeras Arroyo	3/5/2004
O	000000000000	Ambient Water	89538	South Diversion Channel @ Tijeras Arroyo	3/5/2004
O	000000000000	Ambient Water	89539	South Diversion Channel @ Tijeras Arroyo	3/5/2004
O	000000000000	Ambient Water	89540	South Diversion Channel @ Tijeras Arroyo	3/5/2004
O	000000000000	Ambient Water	89541	South Diversion Channel @ Tijeras Arroyo	3/5/2004
O	000000000000	Ambient Water	89542	South Diversion Channel @ Tijeras Arroyo	3/5/2004
O	000000000000	Ambient Water	89544	South Diversion Channel @ Tijeras Arroyo	3/5/2004
O	000000000000	Ambient Water	97392	South Diversion Channel @ Tijeras Arroyo	7/19/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	97393	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97395	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97397	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97398	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97399	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97400	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97401	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97403	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97404	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97405	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97406	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97957	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97960	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97961	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97962	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97963	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97964	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97967	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97968	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97969	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97970	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97971	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97972	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97973	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97974	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97975	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97978	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97980	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	97981	South Diversion Channel @ Tijeras Arroyo	7/19/2004
O	000000000000	Ambient Water	98455	South Diversion Channel @ Tijeras Arroyo	7/25/2004
O	000000000000	Ambient Water	98456	South Diversion Channel @ Tijeras Arroyo	7/25/2004
O	000000000000	Ambient Water	98457	South Diversion Channel @ Tijeras Arroyo	7/25/2004
O	000000000000	Ambient Water	98458	South Diversion Channel @ Tijeras Arroyo	7/25/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Ambient Water	98459	South Diversion Channel @ Tijeras Arroyo	7/25/2004
O	000000000000	Ambient Water	98462	South Diversion Channel @ Tijeras Arroyo	7/25/2004
O	000000000000	Ambient Water	72949	Vita Romero Pump Station	2/20/2003
O	000000000000	Ambient Water	72950	Vita Romero Pump Station	2/20/2003
O	000000000000	Ambient Water	72951	Vita Romero Pump Station	2/20/2003
O	000000000000	Ambient Water	72952	Vita Romero Pump Station	2/20/2003
O	000000000000	Ambient Water	72953	Vita Romero Pump Station	2/20/2003
O	000000000000	Ambient Water	72954	Vita Romero Pump Station	2/20/2003
O	000000000000	Ambient Water	72955	Vita Romero Pump Station	2/20/2003
O	000000000000	Ambient Water	72956	Vita Romero Pump Station	2/20/2003
O	000000000000	Ambient Water	72957	Vita Romero Pump Station	2/20/2003
O	000000000000	Ambient Water	72958	Vita Romero Pump Station	2/20/2003
O	000000000000	Ambient Water	72959	Vita Romero Pump Station	2/20/2003
O	000000000000	Ambient Water	72960	Vita Romero Pump Station	2/20/2003
O	000000000000	Ambient Water	72962	Vita Romero Pump Station	2/20/2003
O	000000000000	Ambient Water	72963	Vita Romero Pump Station	2/20/2003
O	000000000000	Ambient Water	72964	Vita Romero Pump Station	2/20/2003
O	000000000000	Ambient Water	72965	Vita Romero Pump Station	2/20/2003
O	000000000000	Ambient Water	72966	Vita Romero Pump Station	2/20/2003
O	000000000000	Ambient Water	72967	Vita Romero Pump Station	2/20/2003
O	000000000000	Ambient Water	72968	Vita Romero Pump Station	2/20/2003
O	000000000000	Known Source	43021	African crested porcupine (zoo)	7/10/2002
O	000000000000	Known Source	43455	alpaca	9/20/2002
O	000000000000	Known Source	43396	Alpaca/llama (zoo)	7/25/2002
O	000000000000	Known Source	43397	Alpaca/llama (zoo)	7/25/2002
O	000000000000	Known Source	43444	American kestrel	12/18/2002
O	000000000000	Known Source	43445	American kestrel	12/18/2002
O	000000000000	Known Source	43014	ankole cattle (zoo)	7/10/2002
O	000000000000	Known Source	43033	Asian elephant (zoo)	7/11/2002
O	000000000000	Known Source	43400	beef cattle	7/25/2002
O	000000000000	Known Source	43447	beef cattle	9/20/2002
O	000000000000	Known Source	43002	Bengal tiger (zoo)	7/10/2002
O	000000000000	Known Source	43028	Bengal tiger (zoo)	7/11/2002

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Known Source	43929	bison	10/25/2002
O	000000000000	Known Source	43930	bison	10/25/2002
O	000000000000	Known Source	43931	bison	10/25/2002
O	000000000000	Known Source	43932	bison	10/25/2002
O	000000000000	Known Source	43933	bison	10/25/2002
O	000000000000	Known Source	44202	bobcat	12/30/2002
O	000000000000	Known Source	43001	brown-tufted capuchin (zoo)	7/10/2002
O	000000000000	Known Source	44086	Burrowing Owl	12/13/2002
O	000000000000	Known Source	43470	camel	9/20/2002
O	000000000000	Known Source	43015	camel (zoo)	7/10/2002
O	000000000000	Known Source	44024	Canada goose	11/22/2002
O	000000000000	Known Source	43949	cattle	11/1/2002
O	000000000000	Known Source	43950	cattle	11/1/2002
O	000000000000	Known Source	43951	cattle	11/1/2002
O	000000000000	Known Source	43952	cattle	11/1/2002
O	000000000000	Known Source	43953	cattle	11/1/2002
O	000000000000	Known Source	43955	cattle	11/1/2002
O	000000000000	Known Source	43957	cattle	11/1/2002
O	000000000000	Known Source	43959	cattle	11/1/2002
O	000000000000	Known Source	43960	cattle	11/1/2002
O	000000000000	Known Source	43961	cattle	11/1/2002
O	000000000000	Known Source	43962	cattle	11/1/2002
O	000000000000	Known Source	43963	cattle	11/1/2002
O	000000000000	Known Source	43983	cattle	11/8/2002
O	000000000000	Known Source	43988	cattle	11/8/2002
O	000000000000	Known Source	43990	cattle	11/8/2002
O	000000000000	Known Source	43995	cattle	11/8/2002
O	000000000000	Known Source	44170	cattle	12/27/2002
O	000000000000	Known Source	44172	cattle	12/27/2002
O	000000000000	Known Source	44173	cattle	12/27/2002
O	000000000000	Known Source	44174	cattle	12/27/2002
O	000000000000	Known Source	44175	cattle	12/27/2002
O	000000000000	Known Source	44177	cattle	12/27/2002

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Known Source	44178	cattle	12/27/2002
O	000000000000	Known Source	44179	cattle	12/27/2002
O	000000000000	Known Source	44180	cattle	12/27/2002
O	000000000000	Known Source	44275	cattle	1/2/2003
O	000000000000	Known Source	44277	cattle	1/2/2003
O	000000000000	Known Source	44278	cattle	1/2/2003
O	000000000000	Known Source	44279	cattle	1/22/2003
O	000000000000	Known Source	44280	cattle	1/22/2003
O	000000000000	Known Source	44282	cattle	1/22/2003
O	000000000000	Known Source	44283	cattle	1/22/2003
O	000000000000	Known Source	44284	cattle	1/22/2003
O	000000000000	Known Source	44285	cattle	1/22/2003
O	000000000000	Known Source	44286	cattle	1/22/2003
O	000000000000	Known Source	43038	cheetah (zoo)	7/11/2002
O	000000000000	Known Source	43464	chicken	9/20/2002
O	000000000000	Known Source	43466	chicken	9/20/2002
O	000000000000	Known Source	43939	chicken	10/28/2002
O	000000000000	Known Source	68843	City of Albuquerque sewer	7/25/2002
O	000000000000	Known Source	72134	City of Albuquerque sewer	12/19/2002
O	000000000000	Known Source	72135	City of Albuquerque sewer	12/19/2002
O	000000000000	Known Source	72263	City of Albuquerque sewer	12/17/2002
O	000000000000	Known Source	72265	City of Albuquerque sewer	12/17/2002
O	000000000000	Known Source	44090	Corn snake	12/13/2002
O	000000000000	Known Source	44015	coyote	11/22/2002
O	000000000000	Known Source	44087	Crow	12/13/2002
O	000000000000	Known Source	44140	Crow	12/17/2002
O	000000000000	Known Source	44166	crow	12/26/2002
O	000000000000	Known Source	43448	dairy cow	9/20/2002
O	000000000000	Known Source	43449	dairy cow	9/20/2002
O	000000000000	Known Source	43450	dairy cow	9/20/2002
O	000000000000	Known Source	43451	dairy cow	9/20/2002
O	000000000000	Known Source	44026	domestic cat	11/22/2002
O	000000000000	Known Source	44038	domestic cat	11/29/2002

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Known Source	44039	domestic cat	11/29/2002
O	000000000000	Known Source	44091	domestic cat	12/13/2002
O	000000000000	Known Source	44093	domestic cat	12/13/2002
O	000000000000	Known Source	44096	domestic cat	12/14/2002
O	000000000000	Known Source	44098	domestic cat	12/14/2002
O	000000000000	Known Source	44115	domestic cat	12/14/2002
O	000000000000	Known Source	44117	domestic cat	12/14/2002
O	000000000000	Known Source	44137	domestic cat	12/16/2002
O	000000000000	Known Source	44138	domestic cat	12/16/2002
O	000000000000	Known Source	44151	domestic cat	12/12/2002
O	000000000000	Known Source	44228	domestic cat	1/5/2003
O	000000000000	Known Source	44229	domestic cat	1/5/2003
O	000000000000	Known Source	44230	domestic cat	1/5/2003
O	000000000000	Known Source	44238	domestic cat	1/5/2003
O	000000000000	Known Source	44239	domestic cat	1/5/2003
O	000000000000	Known Source	43438	domestic dog	7/26/2002
O	000000000000	Known Source	43863	domestic dog	10/19/2002
O	000000000000	Known Source	43864	domestic dog	10/19/2002
O	000000000000	Known Source	44029	domestic dog	11/29/2002
O	000000000000	Known Source	44030	domestic dog	11/29/2002
O	000000000000	Known Source	44032	domestic dog	11/29/2002
O	000000000000	Known Source	44033	domestic dog	11/29/2002
O	000000000000	Known Source	44034	domestic dog	11/29/2002
O	000000000000	Known Source	44035	domestic dog	11/29/2002
O	000000000000	Known Source	44101	domestic dog	12/14/2002
O	000000000000	Known Source	44102	domestic dog	12/14/2002
O	000000000000	Known Source	44103	domestic dog	12/14/2002
O	000000000000	Known Source	44104	domestic dog	12/14/2002
O	000000000000	Known Source	44105	domestic dog	12/14/2002
O	000000000000	Known Source	44106	domestic dog	12/14/2002
O	000000000000	Known Source	44107	domestic dog	12/14/2002
O	000000000000	Known Source	44108	domestic dog	12/14/2002
O	000000000000	Known Source	44109	domestic dog	12/14/2002

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Known Source	44124	domestic dog	12/14/2002
O	000000000000	Known Source	44125	domestic dog	12/14/2002
O	000000000000	Known Source	44129	domestic dog	12/14/2002
O	000000000000	Known Source	44131	domestic dog	12/14/2002
O	000000000000	Known Source	44134	domestic dog	12/14/2002
O	000000000000	Known Source	44136	domestic dog	12/16/2002
O	000000000000	Known Source	44216	domestic dog	1/5/2003
O	000000000000	Known Source	44217	domestic dog	1/5/2003
O	000000000000	Known Source	44219	domestic dog	1/5/2003
O	000000000000	Known Source	44220	domestic dog	1/5/2003
O	000000000000	Known Source	44221	domestic dog	1/5/2003
O	000000000000	Known Source	44226	domestic dog	1/5/2003
O	000000000000	Known Source	44227	domestic dog	1/5/2003
O	000000000000	Known Source	44073	donkey	11/30/2002
O	000000000000	Known Source	44074	donkey	11/30/2002
O	000000000000	Known Source	45518	duck	10/9/2003
O	000000000000	Known Source	45519	duck	10/9/2003
O	000000000000	Known Source	45522	duck	10/9/2003
O	000000000000	Known Source	43934	emu	10/25/2002
O	000000000000	Known Source	43935	emu	10/25/2002
O	000000000000	Known Source	43936	emu	10/25/2002
O	000000000000	Known Source	43937	emu	10/25/2002
O	000000000000	Known Source	43004	Fennic fox (zoo)	7/10/2002
O	000000000000	Known Source	43017	ferret	7/10/2002
O	000000000000	Known Source	44244	geese, ducks	1/7/2003
O	000000000000	Known Source	44252	geese, ducks	1/7/2003
O	000000000000	Known Source	43013	giraffe (zoo)	7/10/2002
O	000000000000	Known Source	43469	goat	9/20/2002
O	000000000000	Known Source	43872	goat	10/19/2002
O	000000000000	Known Source	43989	goat	11/8/2002
O	000000000000	Known Source	44076	goat	11/30/2002
O	000000000000	Known Source	44077	goat	11/30/2002
O	000000000000	Known Source	44078	goat	11/30/2002

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Known Source	43467	goose, saddleback pomeranian	9/20/2002
O	000000000000	Known Source	43008	gorilla (zoo)	7/10/2002
O	000000000000	Known Source	45526	grackle	10/10/2003
O	000000000000	Known Source	44082	Great Horned Owl	12/13/2002
O	000000000000	Known Source	44142	Great Horned Owl	12/17/2002
O	000000000000	Known Source	44213	Great Horned Owl	12/19/2002
O	000000000000	Known Source	43393	Guanico/alpaca (zoo)	7/11/2002
O	000000000000	Known Source	43401	horse	7/25/2002
O	000000000000	Known Source	43457	horse	9/20/2002
O	000000000000	Known Source	43458	horse	9/20/2002
O	000000000000	Known Source	43459	horse	9/20/2002
O	000000000000	Known Source	43865	horse	10/19/2002
O	000000000000	Known Source	43866	horse	10/19/2002
O	000000000000	Known Source	43867	horse	10/19/2002
O	000000000000	Known Source	43869	horse	10/19/2002
O	000000000000	Known Source	43870	horse	10/19/2002
O	000000000000	Known Source	43871	horse	10/19/2002
O	000000000000	Known Source	43981	horse	11/8/2002
O	000000000000	Known Source	43982	horse	11/8/2002
O	000000000000	Known Source	44009	horse	11/8/2002
O	000000000000	Known Source	44012	horse	11/8/2002
O	000000000000	Known Source	44044	horse	11/29/2002
O	000000000000	Known Source	44045	horse	11/29/2002
O	000000000000	Known Source	44047	horse	11/29/2002
O	000000000000	Known Source	44048	horse	11/29/2002
O	000000000000	Known Source	44049	horse	11/29/2002
O	000000000000	Known Source	44050	horse	11/29/2002
O	000000000000	Known Source	44051	horse	11/29/2002
O	000000000000	Known Source	44052	horse	11/29/2002
O	000000000000	Known Source	44054	horse	11/29/2002
O	000000000000	Known Source	44055	horse	11/29/2002
O	000000000000	Known Source	44056	horse	11/29/2002
O	000000000000	Known Source	44057	horse	11/29/2002

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Known Source	44058	horse	11/29/2002
O	000000000000	Known Source	44059	horse	11/29/2002
O	000000000000	Known Source	44063	horse	11/30/2002
O	000000000000	Known Source	44064	horse	11/30/2002
O	000000000000	Known Source	44065	horse	11/30/2002
O	000000000000	Known Source	44068	horse	11/30/2002
O	000000000000	Known Source	44069	horse	11/30/2002
O	000000000000	Known Source	44270	horse	1/2/2003
O	000000000000	Known Source	44271	horse	1/2/2003
O	000000000000	Known Source	44274	horse	1/2/2003
O	000000000000	Known Source	43023	Indochina tiger (zoo)	7/11/2002
O	000000000000	Known Source	43034	Indochina tiger (zoo)	7/11/2002
O	000000000000	Known Source	43026	jaguar (zoo)	7/11/2002
O	000000000000	Known Source	44188	javelina	12/30/2002
O	000000000000	Known Source	43012	koala (zoo)	7/10/2002
O	000000000000	Known Source	43032	lion (zoo)	7/11/2002
O	000000000000	Known Source	43456	llama	9/20/2002
O	000000000000	Known Source	43019	Macaw (zoo)	7/10/2002
O	000000000000	Known Source	44017	Mallard duck	11/22/2002
O	000000000000	Known Source	44020	Mallard duck	11/22/2002
O	000000000000	Known Source	68835	Marine mammal pool (zoo)	7/25/2002
O	000000000000	Known Source	68836	Marine mammal pool (zoo)	7/25/2002
O	000000000000	Known Source	68837	Marine mammal pool (zoo)	7/25/2002
O	000000000000	Known Source	68838	Marine mammal pool (zoo)	7/25/2002
O	000000000000	Known Source	44195	mexican wolf	12/30/2002
O	000000000000	Known Source	44196	mexican wolf	12/30/2002
O	000000000000	Known Source	44198	mexican wolf	12/30/2002
O	000000000000	Known Source	44192	mountain lion	12/30/2002
O	000000000000	Known Source	44194	mountain lion	12/30/2002
O	000000000000	Known Source	43022	mountain lion (zoo)	7/11/2002
O	000000000000	Known Source	43029	mountain lion (zoo)	7/11/2002
O	000000000000	Known Source	43442	Mourning Dove	7/26/2002
O	000000000000	Known Source	43460	mule	9/20/2002

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Known Source	43862	mule	10/19/2002
O	000000000000	Known Source	44204	mule deer	12/30/2002
O	000000000000	Known Source	44207	mule deer	12/30/2002
O	000000000000	Known Source	43461	Muscovy duck	9/20/2002
O	000000000000	Known Source	43035	ocelot (zoo)	7/11/2002
O	000000000000	Known Source	43009	orangutan (zoo)	7/10/2002
O	000000000000	Known Source	43010	orangutan (zoo)	7/10/2002
O	000000000000	Known Source	44084	Peregrine Falcon	12/13/2002
O	000000000000	Known Source	43471	pig	9/20/2002
O	000000000000	Known Source	43446	pigeon	12/24/2002
O	000000000000	Known Source	44168	pigeon	12/24/2002
O	000000000000	Known Source	44340	pigeon	2/14/2003
O	000000000000	Known Source	44341	pigeon	2/14/2003
O	000000000000	Known Source	44343	pigeon	2/14/2003
O	000000000000	Known Source	44344	pigeon	2/14/2003
O	000000000000	Known Source	44345	pigeon	2/14/2003
O	000000000000	Known Source	44346	pigeon	2/14/2003
O	000000000000	Known Source	44347	pigeon	2/14/2003
O	000000000000	Known Source	45524	pigeon	10/10/2003
O	000000000000	Known Source	45525	pigeon	10/10/2003
O	000000000000	Known Source	44071	pony	11/30/2002
O	000000000000	Known Source	44072	pony	11/30/2002
O	000000000000	Known Source	45435	prairie dog	10/2/2003
O	000000000000	Known Source	45436	prairie dog	10/2/2003
O	000000000000	Known Source	45437	prairie dog	10/2/2003
O	000000000000	Known Source	45438	prairie dog	10/2/2003
O	000000000000	Known Source	45439	prairie dog	10/2/2003
O	000000000000	Known Source	45440	prairie dog	10/2/2003
O	000000000000	Known Source	45441	prairie dog	10/2/2003
O	000000000000	Known Source	43468	rabbit	9/20/2002
O	000000000000	Known Source	45430	rabbit, wild	10/1/2003
O	000000000000	Known Source	45431	rabbit, wild	10/1/2003
O	000000000000	Known Source	45432	rabbit, wild	10/1/2003

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Known Source	45433	rabbit, wild	10/1/2003
O	000000000000	Known Source	44200	raccoon	12/30/2002
O	000000000000	Known Source	44262	rat	1/2/2003
O	000000000000	Known Source	44165	raven	12/27/2002
O	000000000000	Known Source	43005	Red River hogs (zoo)	7/10/2002
O	000000000000	Known Source	44159	roadrunner	12/18/2002
O	000000000000	Known Source	44162	roadrunner	12/19/2002
O	000000000000	Known Source	44167	roadrunner	12/27/2002
O	000000000000	Known Source	43972	Sandhill crane	11/8/2002
O	000000000000	Known Source	43976	Sandhill crane	11/8/2002
O	000000000000	Known Source	43991	Sandhill crane	11/8/2002
O	000000000000	Known Source	68845	septage	7/25/2002
O	000000000000	Known Source	68846	septage	7/25/2002
O	000000000000	Known Source	72133	septage	12/19/2002
O	000000000000	Known Source	72234	septage	1/22/2003
O	000000000000	Known Source	68841	sewage	7/25/2002
O	000000000000	Known Source	72215	sewage	12/17/2002
O	000000000000	Known Source	72216	sewage	12/17/2002
O	000000000000	Known Source	72223	sewage	12/17/2002
O	000000000000	Known Source	43452	sheep	9/20/2002
O	000000000000	Known Source	43453	sheep	9/20/2002
O	000000000000	Known Source	43454	sheep	9/20/2002
O	000000000000	Known Source	43873	sheep	10/19/2002
O	000000000000	Known Source	43874	sheep	10/19/2002
O	000000000000	Known Source	44001	sheep	11/8/2002
O	000000000000	Known Source	44003	sheep	11/8/2002
O	000000000000	Known Source	43020	Spider monkey (zoo)	7/10/2002
O	000000000000	Known Source	44079	Swainson's Hawk	12/13/2002
O	000000000000	Known Source	43462	Turkey, bourbon red	9/20/2002
O	000000000000	Known Source	43006	wart hog (zoo)	7/10/2002
O	000000000000	Known Source	72156	WWTF raw sewage influent	12/19/2002
O	000000000000	Known Source	72175	WWTF raw sewage influent	12/19/2002
O	000000000000	Known Source	72183	WWTF raw sewage influent	12/19/2002

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
O	000000000000	Known Source	72206	WWTF raw sewage influent	12/19/2002
O	000000000000	Known Source	72210	WWTF raw sewage influent	12/19/2002
O	000000000000	Known Source	43024	zebra (zoo)	7/11/2002
L	000000000002	Ambient Water	69367	Alameda Drain @ Ranchitos Rd.	8/3/2002
L	000000000002	Ambient Water	84030	Amole del Norte Channel above Amole Dam	10/7/2003
L	000000000002	Ambient Water	84036	Amole del Norte Channel above Amole Dam	10/7/2003
L	000000000002	Ambient Water	84039	Amole del Norte Channel above Amole Dam	10/7/2003
L	000000000002	Ambient Water	84048	Amole del Norte Channel above Amole Dam	10/7/2003
L	000000000002	Ambient Water	72879	Calabacillas Arroyo @ Swinburne Dam	2/20/2003
L	000000000002	Ambient Water	69357	Hahn Arroyo above N. Diversion Channel at Carlisle	8/2/2002
L	000000000002	Ambient Water	84069	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003
L	000000000002	Ambient Water	73040	North Pino Arroyo above North Diversion Channel	2/20/2003
L	000000000002	Ambient Water	97340	Rio Grande @ Isleta Diversion Dam	7/19/2004
L	000000000002	Ambient Water	97341	Rio Grande @ Isleta Diversion Dam	7/19/2004
L	000000000002	Ambient Water	89462	Rio Grande @ Rio Bravo Bridge	3/5/2004
L	000000000002	Ambient Water	89465	Rio Grande @ Rio Bravo Bridge	3/5/2004
L	000000000002	Ambient Water	89466	Rio Grande @ Rio Bravo Bridge	3/5/2004
L	000000000002	Ambient Water	97847	Rio Grande above Rio Rancho Utility #2	7/18/2004
L	000000000002	Ambient Water	98460	South Diversion Channel @ Tijeras Arroyo	7/25/2004
L	000000000002	Ambient Water	98461	South Diversion Channel @ Tijeras Arroyo	7/25/2004
L	000000000002	Known Source	43868	horse	10/19/2002
L	000000000002	Known Source	44067	horse	11/30/2002
L	000000000002	Known Source	44070	horse	11/30/2002
L	000000000002	Known Source	72211	sewage	12/17/2002
L	000000000004	Ambient Water	84040	Amole del Norte Channel above Amole Dam	10/7/2003
K	000000000020	Ambient Water	84139	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/8/2003
K	000000000020	Ambient Water	84015	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
K	000000000020	Ambient Water	84025	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
K	000000000020	Ambient Water	84062	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
K	000000000020	Ambient Water	88665	North Diversion Channel @ Roy	2/22/2004
K	000000000020	Ambient Water	89790	North Diversion Channel @ Roy	3/12/2004
K	000000000020	Ambient Water	89805	North Diversion Channel @ Roy	3/12/2004
K	000000000020	Ambient Water	73034	North Pino Arroyo above North Diversion Channel	2/20/2003
K	000000000020	Ambient Water	73039	North Pino Arroyo above North Diversion Channel	2/20/2003
K	000000000020	Ambient Water	73044	North Pino Arroyo above North Diversion Channel	2/20/2003
K	000000000020	Ambient Water	97714	North Pino Arroyo above North Diversion Channel	7/23/2004
K	000000000020	Ambient Water	84134	Ranchitos de Albuquerque Storm Drain	10/7/2003
K	000000000020	Ambient Water	84136	Ranchitos de Albuquerque Storm Drain	10/7/2003
K	000000000020	Ambient Water	98326	Rio Grande @ Angostura Diversion Dam	7/25/2004
K	000000000020	Ambient Water	89166	Rio Grande @ I-25 Crossing	2/29/2004
K	000000000020	Ambient Water	89492	Rio Grande @ I-25 Crossing	3/5/2004
K	000000000020	Ambient Water	89832	Rio Grande @ I-25 Crossing	3/12/2004
K	000000000020	Ambient Water	89869	Rio Grande @ Isleta Diversion Dam	3/12/2004
K	000000000020	Ambient Water	89518	South Diversion Channel @ Tijeras Arroyo	3/5/2004
K	000000000020	Ambient Water	89519	South Diversion Channel @ Tijeras Arroyo	3/5/2004
K	000000000020	Ambient Water	89529	South Diversion Channel @ Tijeras Arroyo	3/5/2004
K	000000000020	Ambient Water	89543	South Diversion Channel @ Tijeras Arroyo	3/5/2004
K	000000000020	Known Source	43940	chicken	10/28/2002
K	000000000020	Known Source	68842	City of Albuquerque sewer	7/25/2002
K	000000000020	Known Source	43970	horse	11/8/2002
K	000000000020	Known Source	45434	rabbit, wild	10/1/2003
K	000000000020	Known Source	43875	turkey	10/19/2002
KL	000000000022	Ambient Water	69354	Embudo Channel above confluence with North Diversion Channel	8/2/2002
KL	000000000022	Ambient Water	98306	North Diversion Channel @ Roy	7/25/2004
KL	000000000022	Known Source	44336	pigeon	2/14/2003
KL	000000000022	Known Source	44337	pigeon	2/14/2003
J	000000000200	Ambient Water	98424	Alameda Drain @ Ranchitos Rd.	7/25/2004
J	000000000200	Ambient Water	98398	Cabezon Channel	7/25/2004
J	000000000200	Ambient Water	72853	Calabacillas Arroyo @ Coors Rd.	2/20/2003

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
J	000000000200	Ambient Water	72854	Calabacillas Arroyo @ Coors Rd.	2/20/2003
J	000000000200	Ambient Water	72855	Calabacillas Arroyo @ Coors Rd.	2/20/2003
J	000000000200	Ambient Water	72856	Calabacillas Arroyo @ Coors Rd.	2/20/2003
J	000000000200	Ambient Water	72857	Calabacillas Arroyo @ Coors Rd.	2/20/2003
J	000000000200	Ambient Water	72858	Calabacillas Arroyo @ Coors Rd.	2/20/2003
J	000000000200	Ambient Water	72862	Calabacillas Arroyo @ Coors Rd.	2/20/2003
J	000000000200	Ambient Water	72864	Calabacillas Arroyo @ Coors Rd.	2/20/2003
J	000000000200	Ambient Water	72865	Calabacillas Arroyo @ Coors Rd.	2/20/2003
J	000000000200	Ambient Water	72997	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003
J	000000000200	Ambient Water	72998	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003
J	000000000200	Ambient Water	84085	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/7/2003
J	000000000200	Ambient Water	97357	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004
J	000000000200	Ambient Water	97372	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004
J	000000000200	Ambient Water	98482	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/25/2004
J	000000000200	Ambient Water	83994	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
J	000000000200	Ambient Water	84008	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
J	000000000200	Ambient Water	98467	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/25/2004
J	000000000200	Ambient Water	98468	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/25/2004
J	000000000200	Ambient Water	98302	North Diversion Channel @ Roy	7/25/2004
J	000000000200	Ambient Water	98303	North Diversion Channel @ Roy	7/25/2004
J	000000000200	Ambient Water	73035	North Pino Arroyo above North Diversion Channel	2/20/2003
J	000000000200	Ambient Water	73050	North Pino Arroyo above North Diversion Channel	2/20/2003
J	000000000200	Ambient Water	69371	Rio Grande @ Alameda Bridge	8/3/2002
J	000000000200	Ambient Water	97768	Rio Grande @ Alameda Bridge	7/21/2004
J	000000000200	Ambient Water	68829	Rio Grande @ Angostura Diversion Dam	7/20/2002
J	000000000200	Ambient Water	69353	Rio Grande @ I-25 Crossing	8/3/2002

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
J	000000000200	Ambient Water	89503	Rio Grande @ I-25 Crossing	3/5/2004
J	000000000200	Ambient Water	89833	Rio Grande @ I-25 Crossing	3/12/2004
J	000000000200	Ambient Water	88712	Rio Grande @ Isleta Diversion Dam	2/22/2004
J	000000000200	Ambient Water	89863	Rio Grande @ Isleta Diversion Dam	3/12/2004
J	000000000200	Ambient Water	89864	Rio Grande @ Isleta Diversion Dam	3/12/2004
J	000000000200	Ambient Water	97992	Rio Grande @ Isleta Diversion Dam	7/19/2004
J	000000000200	Ambient Water	98483	Rio Grande @ Isleta Diversion Dam	7/25/2004
J	000000000200	Ambient Water	98484	Rio Grande @ Isleta Diversion Dam	7/25/2004
J	000000000200	Ambient Water	97739	Rio Grande above Rio Rancho Utility #2	7/21/2004
J	000000000200	Ambient Water	97823	Rio Grande above Rio Rancho Utility #2	7/18/2004
J	000000000200	Ambient Water	97843	Rio Grande above Rio Rancho Utility #2	7/18/2004
J	000000000200	Ambient Water	98379	Rio Grande above Rio Rancho Utility #2	7/25/2004
J	000000000200	Ambient Water	98382	Rio Grande above Rio Rancho Utility #2	7/25/2004
J	000000000200	Ambient Water	97790	Rio Grande above Rio Rancho Utility #3	7/18/2004
J	000000000200	Ambient Water	89532	South Diversion Channel @ Tijeras Arroyo	3/5/2004
J	000000000200	Ambient Water	97391	South Diversion Channel @ Tijeras Arroyo	7/19/2004
J	000000000200	Ambient Water	97396	South Diversion Channel @ Tijeras Arroyo	7/19/2004
J	000000000200	Ambient Water	97402	South Diversion Channel @ Tijeras Arroyo	7/19/2004
J	000000000200	Ambient Water	97956	South Diversion Channel @ Tijeras Arroyo	7/19/2004
J	000000000200	Ambient Water	97965	South Diversion Channel @ Tijeras Arroyo	7/19/2004
J	000000000200	Ambient Water	97966	South Diversion Channel @ Tijeras Arroyo	7/19/2004
J	000000000200	Ambient Water	97976	South Diversion Channel @ Tijeras Arroyo	7/19/2004
J	000000000200	Ambient Water	97977	South Diversion Channel @ Tijeras Arroyo	7/19/2004
J	000000000200	Known Source	43036	Arctic fox (zoo)	7/11/2002
J	000000000200	Known Source	43037	Asian elephant (zoo)	7/11/2002
J	000000000200	Known Source	43027	Bengal tiger (zoo)	7/11/2002
J	000000000200	Known Source	44201	bobcat	12/30/2002
J	000000000200	Known Source	43943	chicken	10/28/2002
J	000000000200	Known Source	43944	chicken	10/28/2002
J	000000000200	Known Source	43945	chicken	10/28/2002
J	000000000200	Known Source	44130	domestic dog	12/14/2002
J	000000000200	Known Source	44133	domestic dog	12/14/2002
J	000000000200	Known Source	45520	duck	10/9/2003

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
J	000000000200	Known Source	44021	Mallard duck	11/22/2002
J	000000000200	Known Source	45523	pigeon	10/10/2003
J	000000000200	Known Source	44000	sheep	11/8/2002
J	000000000200	Known Source	44005	sheep	11/8/2002
J	000000000200	Known Source	43993	turkey	11/8/2002
J	000000000200	Known Source	44013	turkey	11/8/2002
J	000000000200	Known Source	44014	turkey	11/8/2002
J	000000000200	Known Source	72185	WWTF raw sewage influent	12/19/2002
JL	000000000202	Ambient Water	68979	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/8/2002
JL	000000000202	Ambient Water	97364	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004
JL	000000000202	Ambient Water	89457	North Diversion Channel @ Roy	3/5/2004
JL	000000000202	Ambient Water	89865	Rio Grande @ Isleta Diversion Dam	3/12/2004
JL	000000000202	Ambient Water	89460	Rio Grande @ Rio Bravo Bridge	3/5/2004
JL	000000000202	Ambient Water	89470	Rio Grande @ Rio Bravo Bridge	3/5/2004
JL	000000000202	Ambient Water	97830	Rio Grande above Rio Rancho Utility #2	7/18/2004
JL	000000000202	Ambient Water	97844	Rio Grande above Rio Rancho Utility #2	7/18/2004
JL	000000000202	Ambient Water	89516	South Diversion Channel @ Tijeras Arroyo	3/5/2004
JL	000000000202	Ambient Water	89517	South Diversion Channel @ Tijeras Arroyo	3/5/2004
JL	000000000202	Ambient Water	89520	South Diversion Channel @ Tijeras Arroyo	3/5/2004
JL	000000000202	Ambient Water	89522	South Diversion Channel @ Tijeras Arroyo	3/5/2004
JL	000000000202	Known Source	45521	duck	10/9/2003
JK	000000000220	Ambient Water	97913	Alameda Drain @ El Caminito Crossing	7/18/2004
JK	000000000220	Ambient Water	98435	Alameda Drain @ Ranchitos Rd.	7/25/2004
JK	000000000220	Ambient Water	84031	Amole del Norte Channel above Amole Dam	10/7/2003
JK	000000000220	Ambient Water	98502	North Pino Arroyo above North Diversion Channel	7/27/2004
JK	000000000220	Ambient Water	89408	Rio Grande @ Alameda Bridge	3/5/2004
JK	000000000220	Ambient Water	98404	Rio Grande @ Alameda Bridge	7/25/2004
JK	000000000220	Ambient Water	98335	Rio Grande @ Angostura Diversion Dam	7/25/2004
JK	000000000220	Ambient Water	89375	Rio Grande @ HW 44 (US 550)	3/5/2004
JK	000000000220	Ambient Water	89165	Rio Grande @ I-25 Crossing	2/29/2004
JK	000000000220	Ambient Water	89177	Rio Grande @ I-25 Crossing	2/29/2004

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JK	000000000220	Ambient Water	97377	Rio Grande @ I-25 Crossing	7/19/2004
JK	000000000220	Ambient Water	72947	Rio Grande @ Isleta Diversion Dam	2/20/2003
JK	000000000220	Ambient Water	84108	Rio Grande @ Isleta Diversion Dam	10/7/2003
JK	000000000220	Ambient Water	89556	Rio Grande @ Isleta Diversion Dam	3/5/2004
JK	000000000220	Ambient Water	97318	Rio Grande @ Isleta Diversion Dam	7/19/2004
JK	000000000220	Ambient Water	97343	Rio Grande @ Isleta Diversion Dam	7/19/2004
JK	000000000220	Ambient Water	89402	Rio Grande above Rio Rancho Utility #2	3/5/2004
JK	000000000220	Ambient Water	89403	Rio Grande above Rio Rancho Utility #2	3/5/2004
JK	000000000220	Ambient Water	89404	Rio Grande above Rio Rancho Utility #2	3/5/2004
JK	000000000220	Ambient Water	88654	South Diversion Channel @ Tijeras Arroyo	2/22/2004
JK	000000000220	Ambient Water	89531	South Diversion Channel @ Tijeras Arroyo	3/5/2004
JK	000000000220	Known Source	43985	Canada goose	11/8/2002
JK	000000000220	Known Source	43942	chicken	10/28/2002
JK	000000000220	Known Source	44121	domestic cat	12/14/2002
JK	000000000220	Known Source	43938	emu	10/25/2002
JK	000000000220	Known Source	43003	Fennic fox (zoo)	7/10/2002
JK	000000000220	Known Source	43973	Mallard duck	11/8/2002
JK	000000000220	Known Source	43977	Mallard duck	11/8/2002
JK	000000000220	Known Source	44197	mexican wolf	12/30/2002
JK	000000000220	Known Source	44193	mountain lion	12/30/2002
JK	000000000220	Known Source	43971	Sandhill crane	11/8/2002
JK	000000000220	Known Source	72164	WWTF raw sewage influent	12/19/2002
JKL	000000000222	Ambient Water	89467	Rio Grande @ Rio Bravo Bridge	3/5/2004
JKL	000000000222	Ambient Water	97958	South Diversion Channel @ Tijeras Arroyo	7/19/2004
JKL	000000000222	Known Source	72155	WWTF raw sewage influent	12/19/2002
I	000000002000	Ambient Water	73006	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003
I	000000002000	Ambient Water	83976	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
I	000000002000	Ambient Water	83981	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
I	000000002000	Ambient Water	84009	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
I	000000002000	Ambient Water	84017	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003

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I	000000002000	Ambient Water	84059	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003
I	000000002000	Ambient Water	84065	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003
I	000000002000	Ambient Water	68827	North Pino Arroyo above North Diversion Channel	7/20/2002
I	000000002000	Ambient Water	89431	Rio Grande @ Alameda Bridge	3/5/2004
I	000000002000	Ambient Water	97765	Rio Grande @ Alameda Bridge	7/21/2004
I	000000002000	Ambient Water	84128	Rio Grande @ Isleta Diversion Dam	10/7/2003
I	000000002000	Ambient Water	98470	Rio Grande @ Isleta Diversion Dam	7/25/2004
I	000000002000	Known Source	44046	horse	11/29/2002
I	000000002000	Known Source	72199	WWTF raw sewage influent	12/19/2002
I	000000002000	Known Source	72208	WWTF raw sewage influent	12/19/2002
IL	000000002002	Ambient Water	73038	North Pino Arroyo above North Diversion Channel	2/20/2003
IK	000000002020	Ambient Water	84137	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/8/2003
IK	000000002020	Ambient Water	84126	Rio Grande @ Isleta Diversion Dam	10/7/2003
IJ	000000002200	Ambient Water	97959	South Diversion Channel @ Tijeras Arroyo	7/19/2004
IJK	000000002220	Ambient Water	83986	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
IJK	000000002220	Ambient Water	83995	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
IJK	000000002220	Ambient Water	84060	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003
IJK	000000002220	Known Source	68844	City of Albuquerque sewer	7/25/2002
IJKL	000000002222	Ambient Water	84002	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
H	000000020000	Ambient Water	73003	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003
H	000000020000	Ambient Water	84071	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003
H	000000020000	Ambient Water	97723	Rio Grande @ HW 44 (US 550)	7/21/2004
H	000000020000	Ambient Water	89854	Rio Grande @ Isleta Diversion Dam	3/12/2004
H	000000020000	Ambient Water	88447	Rio Grande above Rio Rancho Utility #2	2/17/2004
H	000000020000	Ambient Water	89389	Rio Grande above Rio Rancho Utility #3	3/5/2004
H	000000020000	Ambient Water	89392	Rio Grande above Rio Rancho Utility #3	3/5/2004
H	000000020000	Known Source	44127	domestic dog	12/14/2002

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H	000000020000	Known Source	44128	domestic dog	12/14/2002
H	000000020000	Known Source	44132	domestic dog	12/14/2002
H	000000020000	Known Source	44223	domestic dog	1/5/2003
H	000000020000	Known Source	44224	domestic dog	1/5/2003
HK	000000020020	Ambient Water	68822	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/8/2002
HKL	000000020022	Ambient Water	83979	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
HJ	000000020200	Ambient Water	72910	Rio Grande @ I-25 Crossing	2/20/2003
HJ	000000020200	Known Source	43958	cattle	11/1/2002
HJ	000000020200	Known Source	43967	pig	11/8/2002
HJ	000000020200	Known Source	43969	pig	11/8/2002
HJK	000000020220	Ambient Water	97420	Rio Grande @ HW 44 (US 550)	7/18/2004
HJK	000000020220	Known Source	43465	duck	9/20/2002
G	000000200000	Ambient Water	97744	Cabezon Channel	7/21/2004
G	000000200000	Ambient Water	72851	Calabacillas Arroyo @ Coors Rd.	2/20/2003
G	000000200000	Ambient Water	97366	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004
G	000000200000	Ambient Water	83998	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
GK	000000200020	Known Source	43025	Red panda (zoo)	7/11/2002
GJ	000000200200	Ambient Water	84063	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003
GJK	000000200220	Ambient Water	84029	Amole del Norte Channel above Amole Dam	10/7/2003
GIJKL	000000202220	Ambient Water	89474	Rio Grande @ Rio Bravo Bridge	3/5/2004
GH	000000220000	Ambient Water	84111	Rio Grande @ Isleta Diversion Dam	10/7/2003
GHJK	000000220220	Ambient Water	97763	Rio Grande @ Alameda Bridge	7/21/2004
F	000002000000	Ambient Water	83990	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
F	000002000000	Ambient Water	84133	Ranchitos de Albuquerque Storm Drain	10/7/2003
FJK	000002000220	Ambient Water	84056	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003
FI	000002002000	Known Source	72165	WWTF raw sewage influent	12/19/2002
FI	000002002000	Known Source	72174	WWTF raw sewage influent	12/19/2002
FHL	000002020002	Ambient Water	98234	Embudo Channel above confluence with North Diversion Channel	7/25/2004

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FGH	000002220000	Ambient Water	97515	Alameda Drain @ El Caminito Crossing	7/18/2004
D	000200000000	Known Source	44342	pigeon	2/14/2003
C	002000000000	Ambient Water	83999	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
C	002000000000	Ambient Water	84058	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003
C	002000000000	Ambient Water	97491	Rio Grande @ Alameda Bridge	7/18/2004
C	002000000000	Ambient Water	84127	Rio Grande @ Isleta Diversion Dam	10/7/2003
C	002000000000	Ambient Water	84130	Rio Grande @ Isleta Diversion Dam	10/7/2003
C	002000000000	Ambient Water	88652	Rio Grande above Rio Rancho Utility #2	2/17/2004
CL	002000000002	Ambient Water	84018	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
CK	002000000020	Ambient Water	88649	Rio Grande above Rio Rancho Utility #2	2/17/2004
CKL	002000000022	Ambient Water	84067	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003
CJL	002000000202	Ambient Water	89834	Rio Grande @ I-25 Crossing	3/12/2004
CJK	002000000220	Known Source	44004	sheep	11/8/2002
CJK	002000000220	Known Source	44006	sheep	11/8/2002
CJK	002000000220	Known Source	44007	sheep	11/8/2002
CHK	002000002020	Ambient Water	97422	Rio Grande @ HW 44 (US 550)	7/18/2004
CHJK	002000002220	Ambient Water	84057	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003
CG	002000200000	Ambient Water	88444	Rio Grande @ Alameda Bridge	2/17/2004
CFJ	002002000200	Ambient Water	84019	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
CFI	002002002000	Ambient Water	84061	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003
CDFJK	002202000220	Ambient Water	84073	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003
B	020000000000	Ambient Water	98504	Alameda Drain @ El Caminito Crossing	7/27/2004
B	020000000000	Ambient Water	84037	Amole del Norte Channel above Amole Dam	10/7/2003
B	020000000000	Ambient Water	84038	Amole del Norte Channel above Amole Dam	10/7/2003
B	020000000000	Ambient Water	84045	Amole del Norte Channel above Amole Dam	10/7/2003
B	020000000000	Ambient Water	84051	Amole del Norte Channel above Amole Dam	10/7/2003
B	020000000000	Ambient Water	84052	Amole del Norte Channel above Amole Dam	10/7/2003
B	020000000000	Ambient Water	84054	Amole del Norte Channel above Amole Dam	10/7/2003

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B	020000000000	Ambient Water	97876	Hahn Arroyo above N. Diversion Channel at Carlisle	7/18/2004
B	020000000000	Ambient Water	97884	Los Padillas Drain just upstream of the confluence with the Isleta Drain	7/19/2004
B	020000000000	Ambient Water	88659	North Diversion Channel @ Roy	2/22/2004
B	020000000000	Ambient Water	88671	North Diversion Channel @ Roy	2/22/2004
B	020000000000	Ambient Water	88672	North Diversion Channel @ Roy	2/22/2004
B	020000000000	Ambient Water	89157	North Diversion Channel @ Roy	2/29/2004
B	020000000000	Ambient Water	89791	North Diversion Channel @ Roy	3/12/2004
B	020000000000	Ambient Water	98297	North Diversion Channel @ Roy	7/25/2004
B	020000000000	Ambient Water	89405	Rio Grande @ Alameda Bridge	3/5/2004
B	020000000000	Ambient Water	89407	Rio Grande @ Alameda Bridge	3/5/2004
B	020000000000	Ambient Water	97848	Rio Grande @ Alameda Bridge	7/18/2004
B	020000000000	Ambient Water	97850	Rio Grande @ Alameda Bridge	7/18/2004
B	020000000000	Ambient Water	89386	Rio Grande @ HW 44 (US 550)	3/5/2004
B	020000000000	Ambient Water	89487	Rio Grande @ I-25 Crossing	3/5/2004
B	020000000000	Ambient Water	89491	Rio Grande @ I-25 Crossing	3/5/2004
B	020000000000	Ambient Water	89506	Rio Grande @ I-25 Crossing	3/5/2004
B	020000000000	Ambient Water	97896	Rio Grande @ I-25 Crossing	7/19/2004
B	020000000000	Ambient Water	89849	Rio Grande @ Isleta Diversion Dam	3/12/2004
B	020000000000	Ambient Water	89810	Rio Grande @ Rio Bravo Bridge	3/12/2004
B	020000000000	Ambient Water	97450	Rio Grande above Rio Rancho Utility #2	7/18/2004
B	020000000000	Ambient Water	97736	Rio Grande above Rio Rancho Utility #2	7/21/2004
B	020000000000	Ambient Water	97846	Rio Grande above Rio Rancho Utility #2	7/18/2004
B	020000000000	Known Source	44302	bat	12/31/2002
B	020000000000	Known Source	44022	Canada goose	11/22/2002
B	020000000000	Known Source	44176	cattle	12/27/2002
B	020000000000	Known Source	44276	cattle	1/2/2003
B	020000000000	Known Source	44095	domestic cat	12/14/2002
B	020000000000	Known Source	44116	domestic cat	12/14/2002
B	020000000000	Known Source	44247	geese, ducks	1/7/2003
B	020000000000	Known Source	44265	mouse	1/2/2003
B	020000000000	Known Source	43986	rabbit	11/8/2002
BL	020000000002	Ambient Water	89463	Rio Grande @ Rio Bravo Bridge	3/5/2004

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BK	020000000020	Ambient Water	68968	North Diversion Channel @ Roy	7/10/2002
BK	020000000020	Ambient Water	98348	Rio Grande @ HW 44 (US 550)	7/25/2004
BK	020000000020	Ambient Water	98383	Rio Grande above Rio Rancho Utility #2	7/25/2004
BK	020000000020	Known Source	44100	domestic cat	12/14/2002
BK	020000000020	Known Source	44269	ferret	1/2/2003
BK	020000000020	Known Source	72256	WWTF raw sewage influent	12/19/2003
BKL	020000000022	Ambient Water	84016	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
BKL	020000000022	Ambient Water	88664	North Diversion Channel @ Roy	2/22/2004
BKL	020000000022	Ambient Water	69347	Rio Grande @ Isleta Diversion Dam	8/3/2002
BJ	020000000200	Ambient Water	84140	Isleta Drain just upstream of the confluence with Los Padillas Drain	10/8/2003
BJ	020000000200	Ambient Water	98472	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/25/2004
BJ	020000000200	Ambient Water	88691	Rio Grande @ I-25 Crossing	2/22/2004
BJ	020000000200	Ambient Water	89840	Rio Grande @ I-25 Crossing	3/12/2004
BJ	020000000200	Ambient Water	89841	Rio Grande @ I-25 Crossing	3/12/2004
BJ	020000000200	Ambient Water	88710	Rio Grande @ Isleta Diversion Dam	2/22/2004
BJ	020000000200	Ambient Water	89851	Rio Grande @ Isleta Diversion Dam	3/12/2004
BJ	020000000200	Known Source	43031	Bengal tiger (zoo)	7/11/2002
BJ	020000000200	Known Source	44237	domestic cat	1/5/2003
BJ	020000000200	Known Source	72168	WWTF raw sewage influent	12/19/2002
BJL	020000000202	Ambient Water	97828	Rio Grande above Rio Rancho Utility #2	7/18/2004
BJK	020000000220	Ambient Water	89453	North Diversion Channel @ Roy	3/5/2004
BJK	020000000220	Ambient Water	88688	Rio Grande @ I-25 Crossing	2/22/2004
BJK	020000000220	Ambient Water	89160	Rio Grande @ I-25 Crossing	2/29/2004
BJK	020000000220	Ambient Water	89161	Rio Grande @ I-25 Crossing	2/29/2004
BJK	020000000220	Ambient Water	89813	Rio Grande @ Rio Bravo Bridge	3/12/2004
BJK	020000000220	Ambient Water	97394	South Diversion Channel @ Tijeras Arroyo	7/19/2004
BJK	020000000220	Ambient Water	97979	South Diversion Channel @ Tijeras Arroyo	7/19/2004
BJK	020000000220	Known Source	43984	goat	11/8/2002
BJK	020000000220	Known Source	43016	hedgehog (zoo)	7/10/2002
BJK	020000000220	Known Source	68834	Marine mammal pool (zoo)	7/25/2002
BJK	020000000220	Known Source	43968	pig	11/8/2002

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BJK	020000000220	Known Source	43395	polar bear (zoo)	7/25/2002
BJK	020000000220	Known Source	72139	septage	12/19/2002
BJKL	020000000222	Ambient Water	97505	Alameda Drain @ Ranchitos Rd.	7/18/2004
BJKL	020000000222	Ambient Water	97950	Alameda Drain @ Ranchitos Road	7/18/2004
BJKL	020000000222	Ambient Water	69334	Cabezon Channel	8/2/2002
BJKL	020000000222	Ambient Water	68983	Embudo Channel above confluence with North Diversion Channel	7/8/2002
BJKL	020000000222	Ambient Water	89435	North Diversion Channel @ Roy	3/5/2004
BJKL	020000000222	Ambient Water	89447	North Diversion Channel @ Roy	3/5/2004
BJKL	020000000222	Ambient Water	89448	North Diversion Channel @ Roy	3/5/2004
BJKL	020000000222	Ambient Water	89778	Rio Grande @ Alameda Bridge	3/12/2004
BJKL	020000000222	Ambient Water	89835	Rio Grande @ I-25 Crossing	3/12/2004
BJKL	020000000222	Ambient Water	97892	Rio Grande @ I-25 Crossing	7/19/2004
BJKL	020000000222	Ambient Water	89469	Rio Grande @ Rio Bravo Bridge	3/5/2004
BJKL	020000000222	Ambient Water	72961	Vita Romero Pump Station	2/20/2003
BJKL	020000000222	Known Source	43941	chicken	10/28/2002
BJKL	020000000222	Known Source	43394	wolf (zoo)	7/25/2002
BI	020000002000	Ambient Water	89151	Rio Grande @ Alameda Bridge	2/29/2004
BIJK	020000002220	Ambient Water	89440	North Diversion Channel @ Roy	3/5/2004
BHJL	020000020202	Ambient Water	84101	Rio Grande @ Isleta Diversion Dam	10/7/2003
BHIJ	020000020220	Ambient Water	84072	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003
BHIJ	020000020220	Ambient Water	97825	Rio Grande above Rio Rancho Utility #2	7/18/2004
BG	020000200000	Ambient Water	84014	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
BGK	020000200020	Ambient Water	84135	Ranchitos de Albuquerque Storm Drain	10/7/2003
BGJ	020000200200	Ambient Water	97437	Rio Grande above Rio Rancho Utility #2	7/18/2004
BGJL	020000200202	Ambient Water	97442	Rio Grande above Rio Rancho Utility #2	7/18/2004
BGJL	020000200202	Ambient Water	97445	Rio Grande above Rio Rancho Utility #2	7/18/2004
BGJL	020000200202	Ambient Water	97840	Rio Grande above Rio Rancho Utility #2	7/18/2004
BGJKL	020000200222	Ambient Water	97385	Rio Grande @ I-25 Crossing	7/19/2004
BGJKL	020000200222	Ambient Water	97833	Rio Grande above Rio Rancho Utility #2	7/18/2004
BGHJKL	020000220222	Ambient Water	97982	South Diversion Channel @ Tijeras Arroyo	7/19/2004
BF	020002000000	Ambient Water	97747	Cabezon Channel	7/21/2004

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BF	020002000000	Ambient Water	73005	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003
BF	020002000000	Ambient Water	89384	Rio Grande @ HW 44 (US 550)	3/5/2004
BF	020002000000	Ambient Water	89845	Rio Grande @ I-25 Crossing	3/12/2004
BF	020002000000	Known Source	72145	City of Albuquerque sewer	12/19/2002
BF	020002000000	Known Source	72146	City of Albuquerque sewer	12/19/2002
BF	020002000000	Known Source	72147	City of Albuquerque sewer	12/19/2002
BF	020002000000	Known Source	72148	City of Albuquerque sewer	12/19/2002
BF	020002000000	Known Source	72237	City of Albuquerque sewer	12/19/2003
BF	020002000000	Known Source	72238	City of Albuquerque sewer	12/19/2003
BF	020002000000	Known Source	72264	City of Albuquerque sewer	12/17/2002
BF	020002000000	Known Source	44155	Crow	12/17/2002
BF	020002000000	Known Source	44157	Crow	12/17/2002
BF	020002000000	Known Source	43011	rhinoceros (zoo)	7/10/2002
BF	020002000000	Known Source	72136	septage	12/19/2002
BF	020002000000	Known Source	72138	septage	12/19/2002
BF	020002000000	Known Source	72228	septage	1/22/2003
BF	020002000000	Known Source	72212	sewage	12/17/2002
BF	020002000000	Known Source	72213	sewage	12/17/2002
BF	020002000000	Known Source	72214	sewage	12/17/2002
BF	020002000000	Known Source	72218	sewage	12/17/2002
BF	020002000000	Known Source	72219	sewage	12/17/2002
BF	020002000000	Known Source	72220	sewage	12/17/2002
BF	020002000000	Known Source	72221	sewage	12/17/2002
BF	020002000000	Known Source	72224	sewage	12/17/2002
BF	020002000000	Known Source	72225	sewage	12/17/2002
BF	020002000000	Known Source	72226	sewage	12/17/2002
BF	020002000000	Known Source	72158	WWTF raw sewage influent	12/19/2002
BF	020002000000	Known Source	72162	WWTF raw sewage influent	12/19/2002
BF	020002000000	Known Source	72173	WWTF raw sewage influent	12/19/2002
BF	020002000000	Known Source	72178	WWTF raw sewage influent	12/19/2002
BF	020002000000	Known Source	72179	WWTF raw sewage influent	12/19/2002
BF	020002000000	Known Source	72182	WWTF raw sewage influent	12/19/2002
BF	020002000000	Known Source	72186	WWTF raw sewage influent	12/19/2002

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BF	020002000000	Known Source	72189	WWTF raw sewage influent	12/19/2002
BF	020002000000	Known Source	72195	WWTF raw sewage influent	12/19/2002
BF	020002000000	Known Source	72200	WWTF raw sewage influent	12/19/2002
BF	020002000000	Known Source	72203	WWTF raw sewage influent	12/19/2002
BF	020002000000	Known Source	72204	WWTF raw sewage influent	12/19/2002
BF	020002000000	Known Source	72247	WWTF raw sewage influent	12/19/2003
BF	020002000000	Known Source	72253	WWTF raw sewage influent	12/19/2003
BFL	020002000002	Ambient Water	98396	Rio Grande above Rio Rancho Utility #2	7/25/2004
BFK	020002000020	Known Source	72142	City of Albuquerque sewer	12/19/2002
BFK	020002000020	Known Source	72149	City of Albuquerque sewer	12/19/2002
BFK	020002000020	Known Source	72151	City of Albuquerque sewer	12/19/2002
BFK	020002000020	Known Source	72266	City of Albuquerque sewer	12/17/2002
BFK	020002000020	Known Source	72132	septage	12/19/2002
BFK	020002000020	Known Source	68839	sewage	7/25/2002
BFK	020002000020	Known Source	72217	sewage	12/17/2002
BFK	020002000020	Known Source	72176	WWTF raw sewage influent	12/19/2002
BFK	020002000020	Known Source	72177	WWTF raw sewage influent	12/19/2002
BFK	020002000020	Known Source	72193	WWTF raw sewage influent	12/19/2002
BFK	020002000020	Known Source	72244	WWTF raw sewage influent	12/19/2003
BFKL	020002000022	Ambient Water	88663	North Diversion Channel @ Roy	2/22/2004
BFJ	020002000200	Ambient Water	89152	Rio Grande @ Alameda Bridge	2/29/2004
BFJ	020002000200	Ambient Water	88686	Rio Grande @ I-25 Crossing	2/22/2004
BFJ	020002000200	Known Source	72267	City of Albuquerque sewer	12/17/2002
BFJ	020002000200	Known Source	72137	septage	12/19/2002
BFJ	020002000200	Known Source	68840	Waterfowl pond (zoo)	7/25/2002
BFJ	020002000200	Known Source	72169	WWTF raw sewage influent	12/19/2002
BFJ	020002000200	Known Source	72202	WWTF raw sewage influent	12/19/2002
BFJ	020002000200	Known Source	72205	WWTF raw sewage influent	12/19/2002
BFJL	020002000202	Known Source	72262	WWTF raw sewage influent	12/19/2003
BFJKL	020002000222	Ambient Water	88657	North Diversion Channel @ Roy	2/22/2004
BFI	020002002000	Known Source	72143	City of Albuquerque sewer	12/19/2002
BFI	020002002000	Known Source	72144	City of Albuquerque sewer	12/19/2002
BFI	020002002000	Known Source	72150	City of Albuquerque sewer	12/19/2002

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
BFI	020002002000	Known Source	72152	City of Albuquerque sewer	12/19/2002
BFI	020002002000	Known Source	72153	City of Albuquerque sewer	12/19/2002
BFI	020002002000	Known Source	72154	City of Albuquerque sewer	12/19/2002
BFI	020002002000	Known Source	72236	City of Albuquerque sewer	12/19/2003
BFI	020002002000	Known Source	72140	septage	12/19/2002
BFI	020002002000	Known Source	72141	septage	12/19/2002
BFI	020002002000	Known Source	72235	septage	1/22/2003
BFI	020002002000	Known Source	72222	sewage	12/17/2002
BFI	020002002000	Known Source	72159	WWTF raw sewage influent	12/19/2002
BFI	020002002000	Known Source	72160	WWTF raw sewage influent	12/19/2002
BFI	020002002000	Known Source	72161	WWTF raw sewage influent	12/19/2002
BFI	020002002000	Known Source	72167	WWTF raw sewage influent	12/19/2002
BFI	020002002000	Known Source	72170	WWTF raw sewage influent	12/19/2002
BFI	020002002000	Known Source	72171	WWTF raw sewage influent	12/19/2002
BFI	020002002000	Known Source	72180	WWTF raw sewage influent	12/19/2002
BFI	020002002000	Known Source	72181	WWTF raw sewage influent	12/19/2002
BFI	020002002000	Known Source	72184	WWTF raw sewage influent	12/19/2002
BFI	020002002000	Known Source	72188	WWTF raw sewage influent	12/19/2002
BFI	020002002000	Known Source	72198	WWTF raw sewage influent	12/19/2002
BFI	020002002000	Known Source	72201	WWTF raw sewage influent	12/19/2002
BFI	020002002000	Known Source	72207	WWTF raw sewage influent	12/19/2002
BFI	020002002000	Known Source	72209	WWTF raw sewage influent	12/19/2002
BFI	020002002000	Known Source	72239	WWTF raw sewage influent	12/19/2003
BFI	020002002000	Known Source	72245	WWTF raw sewage influent	12/19/2003
BFI	020002002000	Known Source	72246	WWTF raw sewage influent	12/19/2003
BFI	020002002000	Known Source	72260	WWTF raw sewage influent	12/19/2003
BFI	020002002000	Known Source	72261	WWTF raw sewage influent	12/19/2003
BFIK	020002002020	Known Source	72166	WWTF raw sewage influent	12/19/2002
BFIK	020002002020	Known Source	72172	WWTF raw sewage influent	12/19/2002
BFIJ	020002002200	Known Source	72157	WWTF raw sewage influent	12/19/2002
BFIJ	020002002200	Known Source	72163	WWTF raw sewage influent	12/19/2002
BFIJ	020002002200	Known Source	72190	WWTF raw sewage influent	12/19/2002
BFIJ	020002002200	Known Source	72191	WWTF raw sewage influent	12/19/2002

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
BFIJ	020002002200	Known Source	72192	WWTF raw sewage influent	12/19/2002
BFIJ	020002002200	Known Source	72196	WWTF raw sewage influent	12/19/2002
BFIJ	020002002200	Known Source	72197	WWTF raw sewage influent	12/19/2002
BFIJ	020002002200	Known Source	72248	WWTF raw sewage influent	12/19/2003
BFIJ	020002002200	Known Source	72250	WWTF raw sewage influent	12/19/2003
BFIJ	020002002200	Known Source	72255	WWTF raw sewage influent	12/19/2003
BFIJ	020002002200	Known Source	72259	WWTF raw sewage influent	12/19/2003
BFIJL	020002002202	Known Source	72187	WWTF raw sewage influent	12/19/2002
BFIJL	020002002202	Known Source	72194	WWTF raw sewage influent	12/19/2002
BFIJKL	020002002222	Ambient Water	89194	South Diversion Channel @ Tijeras Arroyo	2/29/2004
BFIJKL	020002002222	Ambient Water	89197	South Diversion Channel @ Tijeras Arroyo	2/29/2004
BFHJK	020002020220	Ambient Water	98478	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/25/2004
BFHJKL	020002020222	Ambient Water	89186	Rio Grande @ Isleta Diversion Dam	2/29/2004
BFGIJ	020002202200	Ambient Water	88711	Rio Grande @ Isleta Diversion Dam	2/22/2004
BEGJL	020020200202	Ambient Water	84100	Rio Grande @ Isleta Diversion Dam	10/7/2003
BC	022000000000	Ambient Water	97365	Isleta Drain just upstream of the confluence with Los Padillas Drain	7/19/2004
BCJ	022000000200	Ambient Water	84068	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003
BCJK	022000000220	Ambient Water	88651	Rio Grande above Rio Rancho Utility #2	2/17/2004
BCJKL	022000000222	Ambient Water	89852	Rio Grande @ Isleta Diversion Dam	3/12/2004
BCGK	022000200020	Ambient Water	84066	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003
BCFJ	022002000200	Ambient Water	97315	Rio Grande @ Isleta Diversion Dam	7/19/2004
BCFJKL	022002000222	Ambient Water	89855	Rio Grande @ Isleta Diversion Dam	3/12/2004
BCFHJKL	022002020222	Ambient Water	89853	Rio Grande @ Isleta Diversion Dam	3/12/2004
BCEFH	022022020000	Known Source	44031	domestic dog	11/29/2002
A	200000000000	Ambient Water	84021	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
A	200000000000	Ambient Water	84022	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
A	200000000000	Ambient Water	84026	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
A	200000000000	Ambient Water	89443	North Diversion Channel @ Roy	3/5/2004
AH	200000020000	Ambient Water	88650	Rio Grande above Rio Rancho Utility #2	2/17/2004

ARP group	Antibiotic Resistance Pattern	Type	Isolate	Station/Source	Date
AGJK	200000200220	Ambient Water	98276	North Domingo Baca Arroyo Dam @primary spillway	7/25/2004
AF	200002000000	Ambient Water	84013	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/8/2003
ADGHK	200200220020	Ambient Water	88443	Rio Grande @ Alameda Bridge	2/17/2004
AC	202000000000	Ambient Water	97745	Cabezon Channel	7/21/2004
ACKL	202000000022	Ambient Water	84064	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003
ACI	202000002000	Ambient Water	97760	Rio Grande @ Alameda Bridge	7/21/2004
ACIK	202000002020	Ambient Water	84047	Amole del Norte Channel above Amole Dam	10/7/2003
AB	220000000000	Ambient Water	84070	Los Padillas Drain just upstream of the confluence with the Isleta Drain	10/7/2003
ABI	220000002000	Ambient Water	98243	Embudo Channel above confluence with North Diversion Channel	7/25/2004
ABFGK	220002200020	Ambient Water	73001	Hahn Arroyo above N. Diversion Channel at Carlisle	2/20/2003

APPENDIX D
MISCELLANEOUS SCAT PHOTOS

Bison Scat

Cougar Scat

Deer Scat

Fresh Coyote Scat

Mouse Scat

Opossum Scat

Raccoon Scat

Wild Turkey Scat

APPENDIX E
NPDES DISCHARGE MONITORING REPORTS

Albuquerque WWTF Discharge Monitoring Reports
Fecal Coliform (cfu/100 mL)

Monthly Average	Maximum Day	Date of DMR
23	740	7/31/1998
25	290	8/31/1998
24	330	9/30/1998
272	23	10/31/1998
230	15	6/30/1999
106	19200	7/31/1999
64	3100	8/31/1999
14	360	9/30/1999
20	340	1/31/2000
16	372	4/30/2001
24	554	9/30/2001
56	448	10/31/2001
40	238	7/31/2002
53	16400	8/31/2002
38	320	9/30/2002
23	1120	3/31/2003
22	5600	4/30/2003
28	740	9/30/2003
16	1380	4/30/2004
40	230	7/31/2004

Rio Rancho #2 WWTF Discharge Monitoring Reports
Fecal Coliform (cfu/100 mL)

Monthly Average	Maximum Day	Date of DMR
131	405	7/31/1998
65.8	343.2	10/31/1999
111.5	135.3	2/29/2000
21.46	240.05	8/31/2000
69.41	226.94	11/30/2000
149.23	226.58	12/31/2000
26.8	311.5	1/31/2001
24.93	900	5/31/2004
22.44	1300	9/30/2004

Rio Rancho #3 WWTF Discharge Monitoring Reports
Fecal Coliform (cfu/100 mL)

Average Monthly	Daily Maximum	Date of DMR
184	10000	5/31/2001
103	501	7/31/2001
21	8300	10/31/2001
33	405	2/28/2002
55	210	3/31/2002
83	1236	4/30/2002
91	329	4/30/2003
60	350	6/30/2003

APPENDIX F
FECAL COLIFORM DATA

TAGID	DATE	WATER SAMPLE COLLECTION STATION	FECAL COLIFORM (cfu/100 ml)	STORM WATER RUNOFF
0206280-01A	6/15/2002	Hahn Arroyo above N. Diversion Channel at Carlisle	25000	Y
0206280-02A	6/15/2002	Rio Grande @ Alameda Bridge	6360	Y
0206280-03A	6/15/2002	Rio Grande above Rio Rancho Utility #3	54	Y
0206280-04A	6/14/2002	North Diversion Channel @ Roy	35000	Y
0206280-05A	6/14/2002	Embudo Channel above confluence with North Diversion Channel	120000	Y
0206280-06A	6/15/2002	Rio Grande @ I-25 Crossing	3300	Y
0206280-07A	6/15/2002	North Pino Arroyo above North Diversion Channel	631	Y
0206280-08A	6/15/2002	Isleta Drain just upstream of the confluence with Los Padillas Drain	636	Y
0206280-09A	6/15/2002	Rio Grande @ Isleta Diversion Dam	5900	Y
0206280-10A	6/15/2002	Rio Grande @ Rio Bravo Bridge	650000	Y
0207103-01A	7/8/2002	Isleta Drain just upstream of the confluence with Los Padillas Drain	721	Y
0207103-02A	7/8/2002	FIELD BLANK	<1	
0207103-03A	7/8/2002	Los Padillas Drain just upstream of the confluence with the Isleta Drain	540	Y
0207103-04A	7/8/2002	FIELD BLANK	9	
0207103-05A	7/8/2002	Rio Grande @ Rio Bravo Bridge	108	Y
0207103-06A	7/8/2002	FIELD BLANK	<1	
0207107-01A	7/8/2002	Embudo Channel above confluence with North Diversion Channel	>600000	Y
0207155-01A	7/10/2002	Sandia Pueblo Natural Arroyo @I-25 Crossing	3700	Y
0207157-01A	7/10/2002	Alameda Drain @ Ranchitos Rd.	6396	Y
0207157-02A	7/10/2002	Alameda Drain @ El Caminito Crossing	6306	Y
0207157-03A	7/10/2002	North Pino Arroyo above North Diversion Channel	140000	Y
0207157-04A	7/10/2002	North Diversion Channel @ Roy	100000	Y
0207171-01A	7/10/2002	Hahn Arroyo above N. Diversion Channel at Carlisle	140000	Y
0207173-01A	7/10/2002	North Diversion Channel @ Roy	200000	Y
0207220-01A	7/11/2002	North Pino Arroyo above North Diversion Channel	40000	Y
0207230-01A	7/11/2002	Rio Grande @ Alameda Bridge	17300	Y
0207230-02A	7/11/2002	North Domingo Baca Arroyo Dam @primary spillway	25000	Y
0207230-03A	7/11/2002	FIELD BLANK	9	
0207398-01A	7/19/2002	Hahn Arroyo above N. Diversion Channel at Carlisle	300000	Y
0207399-01A	7/19/2002	Embudo Channel above confluence with North Diversion Channel	440000	Y
0207400-01A	7/20/2002	Rio Grande @ Angostura Diversion Dam	918	Y
0207400-02A	7/20/2002	FIELD BLANK	<1	

TAGID	DATE	WATER SAMPLE COLLECTION STATION	FECAL COLIFORM (cfu/100 ml)	STORM WATER RUNOFF
0207401-01A	7/20/2002	North Pino Arroyo above North Diversion Channel	85400	Y
0207401-02A	7/20/2002	Ranchitos de Albuquerque Storm Drain	1710	Y
0207401-03A	7/20/2002	FIELD BLANK	<1	
0207401-04A	7/20/2002	Alameda Drain @ El Caminito Crossing	2300	Y
0207401-05A	7/20/2002	FIELD BLANK	<1	
0207612-01A	7/30/2002	Rio Grande @ Angostura Diversion Dam	500	Y
0208070-01A	8/2/2002	San Antonio Arroyo @ Rio Grande (Montano) Oxbow	3000	Y
0208070-02A	8/2/2002	Calabacillas Arroyo @ Coors Rd.	21000	Y
0208070-03A	8/2/2002	Cabezon Channel	70000	Y
0208070-04A	8/2/2002	Boca Negro Arroyo @ Tesuque Rd.	7270	Y
0208072-01A	8/2/2002	Embudo Channel above confluence with North Diversion Channel	110000	Y
0208072-02A	8/2/2002	FIELD BLANK	<1	
0208072-03A	8/2/2002	Hahn Arroyo above N. Diversion Channel at Carlisle	130000	Y
0208072-04A	8/2/2002	FIELD BLANK	<1	
0208072-05A	8/2/2002	North Pino Arroyo above North Diversion Channel	70000	Y
0208072-06A	8/2/2002	North Domingo Baca Arroyo Dam @primary spillway	110000	Y
0208072-07A	8/3/2002	North Diversion Channel @ Roy	1040000	Y
0208072-08A	8/3/2002	Rio Grande @ Isleta Diversion Dam	9090	Y
0208072-09A	8/3/2002	Rio Grande @ Isleta Diversion Dam (Duplicate)	13600	Y
0208072-10A	8/3/2002	Rio Grande @ I-25 Crossing	360000	Y
0208072-11A	8/3/2002	South Diversion Channel @ Tijeras Arroyo	800000	Y
0208083-01A	8/4/2002	Rio Grande @ Angostura Diversion Dam	550	Y
0208115-01A	8/3/2002	Calabacillas Arroyo @ Coors Rd.	34000	Y
0208142-01A	8/3/2002	Paseo del Norte Pump Station	900	Y
0208143-01A	8/3/2002	Alameda Drain @ Ranchitos Rd.	23000	Y
0208143-02A	8/3/2002	Alameda Drain @ El Caminito Crossing	36000	Y
0208143-03A	8/3/2002	Rio Grande @ Alameda Bridge	38000	Y
0208460-01A	8/20/2002	Rio Grande above Rio Rancho Utility #2	1532	Y
0208460-02A	8/20/2002	FIELD BLANK	370	
0208460-03A	8/20/2002	Rio Grande above Rio Rancho Utility #3	34000	Y
0208469-01A	8/21/2002	North Diversion Channel @ Roy	560000	Y
0208469-02A	8/21/2002	Rio Grande @ HW 44 (US 550)	189	Y

TAGID	DATE	WATER SAMPLE COLLECTION STATION	FECAL COLIFORM (cfu/100 ml)	STORM WATER RUNOFF
0208469-03A	8/21/2002	Rio Grande above Rio Rancho Utility #3	108	Y
0208469-04A	8/21/2002	Rio Grande above Rio Rancho Utility #2	99	Y
0208469-05A	8/21/2002	Cabezon Channel	1170	Y
0208469-06A	8/21/2002	Rio Grande @ Alameda Bridge	45	Y
0208469-07A	8/21/2002	Rio Grande @ I-25 Crossing	1170	Y
0208469-08A	8/21/2002	Rio Grande @ Isleta Diversion Dam	360	Y
0208469-09A	8/21/2002	Rio Grande @ Isleta Diversion Dam (Duplicate)	340	Y
0208469-10A	8/21/2002	Rio Grande @ Rio Bravo Bridge	811	Y
0208474-01A	8/20/2002	Rio Grande @ Angostura Diversion Dam	81	Y
0209188-01A	9/10/2002	San Antonio Arroyo @ Rio Grande (Montano) Oxbow	100000	Y
0209189-01A	9/10/2002	Calabacillas Arroyo @ Swinburne Dam	60000	Y
0209189-03A	9/10/2002	South Diversion Channel @ Tijeras Arroyo	17300	Y
0209189-05A	9/10/2002	Amole del Norte Channel above Amole Dam	20000	Y
0209189-07A	9/10/2002	FIELD BLANK	<10	
0209189-08A	9/10/2002	North Domingo Baca Arroyo Dam @primary spillway (Duplicate)	88200	Y
0209189-10A	9/10/2002	Rio Grande @ HW 44 (US 550)	450	Y
0209206-01A	9/10/2002	Hahn Arroyo above N. Diversion Channel at Carlisle	530000	Y
0209210-01A	9/10/2002	Sandia Pueblo Natural Arroyo @I-25 Crossing	15400	Y
0209210-02A	9/10/2002	North Domingo Baca Arroyo Dam @primary spillway	78200	Y
0209210-03A	9/10/2002	North Diversion Channel @ Roy	260000	Y
0209210-04A	9/10/2002	North Pino Arroyo above North Diversion Channel	20000	Y
0209225-01A	9/10/2002	Embudo Channel above confluence with North Diversion Channel	150000	Y
0209353-01A	9/18/2002	Alameda Drain @ Ranchitos Rd.	3100	Y
0209353-02A	9/18/2002	Alameda Drain @ El Caminito Crossing	29000	Y
0209353-03A	9/18/2002	Rio Grande @ HW 44 (US 550)	99	Y
0212052-01A	12/3/2002	South Diversion Channel @ Tijeras Arroyo	189	Y
0212052-02A	12/3/2002	Rio Grande @ I-25 Crossing	1440	Y
0302315-01A	2/13/2003	North Diversion Channel @ Roy	2800	Y
0302315-02A	2/13/2003	North Pino Arroyo above North Diversion Channel	2000	Y
0302315-03A	2/13/2003	South Diversion Channel @ Tijeras Arroyo	240	Y
0302391-01A	2/20/2003	Rio Grande @ Alameda Bridge	54	Y
0302391-02A	2/20/2003	Rio Grande @ Rio Bravo Bridge	64	Y

TAGID	DATE	WATER SAMPLE COLLECTION STATION	FECAL COLIFORM (cfu/100 ml)	STORM WATER RUNOFF
0302391-03A	2/20/2003	Calabacillas Arroyo @ Coors Rd.	200	Y
0302391-04A	2/20/2003	Calabacillas Arroyo @ Swinburne Dam	270	Y
0302391-05A	2/20/2003	Rio Grande @ I-25 Crossing	1620	Y
0302391-06A	2/20/2003	Rio Grande @ Isleta Diversion Dam	1710	Y
0302391-07A	2/20/2003	Vita Romero Pump Station	2600	Y
0302396-01A	2/20/2003	Embudo Channel above confluence with North Diversion Channel	2900	Y
0302396-02A	2/20/2003	North Pino Arroyo above North Diversion Channel	991	Y
0302396-03A	2/20/2003	Hahn Arroyo above N. Diversion Channel at Carlisle	1080	Y
0302401-01A	2/20/2003	North Pino Arroyo above North Diversion Channel	721	Y
0303349-01A	3/19/2003	Los Padillas Drain just upstream of the confluence with the Isleta Drain	36	Y
0303349-02A	3/19/2003	Isleta Drain just upstream of the confluence with Los Padillas Drain	200	Y
0308027-01A	8/1/2003	Rio Grande @ Angostura Diversion Dam	72	Y
0308027-02A	8/1/2003	Los Padillas Drain just upstream of the confluence with the Isleta Drain	81	Y
0308027-03A	8/1/2003	Isleta Drain just upstream of the confluence with Los Padillas Drain	2000	Y
0308027-04A	8/1/2003	FIELD BLANK	<10	
0308027-05A	8/1/2003	FIELD BLANK	<10	
0308027-06A	8/1/2003	Rio Grande @ Isleta Diversion Dam	721	Y
0308337-01A	8/14/2003	Rio Grande @ Isleta Diversion Dam	631	Y
0308337-02A	8/14/2003	Ranchitos de Albuquerque Storm Drain	13600	Y
0308522-01A	8/25/2003	Rio Grande @ Angostura Diversion Dam	27	Y
0308522-02A	8/25/2003	FIELD BLANK	<10	
0308573-01A	8/28/2003	San Antonio Arroyo @ Rio Grande (Montano) Oxbow	200000	Y
0308609-01A	8/28/2003	Los Padillas Drain just upstream of the confluence with the Isleta Drain	81	Y
0308609-02A	8/28/2003	Isleta Drain just upstream of the confluence with Los Padillas Drain	1350	Y
0308609-03A	8/28/2003	Rio Grande @ Isleta Diversion Dam	648	Y
0309203-01A	9/9/2003	Ranchitos de Albuquerque Storm Drain	80000	Y
0310155-01A	10/8/2003	Rio Grande @ Angostura Diversion Dam	36000	Y
0310161-01A	10/7/2003	Amole del Norte Channel above Amole Dam	80000	Y
0310161-02A	10/7/2003	Los Padillas Drain just upstream of the confluence with the Isleta Drain	320	Y
0310161-03A	10/7/2003	Isleta Drain just upstream of the confluence with Los Padillas Drain	1350	Y
0310161-04A	10/7/2003	Rio Grande @ Isleta Diversion Dam	774	Y
0310161-05A	10/7/2003	Ranchitos de Albuquerque Storm Drain	56000	Y

TAGID	DATE	WATER SAMPLE COLLECTION STATION	FECAL COLIFORM (cfu/100 ml)	STORM WATER RUNOFF
0310210-01A	10/8/2003	Los Padillas Drain just upstream of the confluence with the Isleta Drain	721	Y
0310210-02A	10/8/2003	Los Padillas Drain just upstream of the confluence with the Isleta Drain (Duplicate)	390	Y
0310210-03A	10/8/2003	Isleta Drain just upstream of the confluence with Los Padillas Drain	420000	Y
0402341-01A	2/17/2004	Rio Grande @ Angostura Diversion Dam	<10	N
0402341-02A	2/17/2004	Rio Grande @ HW 44 (US 550)	<10	N
0402341-03A	2/17/2004	Rio Grande above Rio Rancho Utility #3	18	N
0402341-04A	2/17/2004	Rio Grande above Rio Rancho Utility #2	27	N
0402341-05A	2/17/2004	Rio Grande @ Alameda Bridge	27	N
0402430-01A	2/22/2004	Rio Grande above Rio Rancho Utility #2	9	N
0402430-02A	2/22/2004	Rio Grande above Rio Rancho Utility #3	<10	N
0402430-03A	2/22/2004	Rio Grande @ Alameda Bridge	9	N
0402430-04A	2/22/2004	Rio Grande @ HW 44 (US 550)	<10	N
0402430-05A	2/22/2004	South Diversion Channel @ Tijeras Arroyo	18	N
0402430-06A	2/22/2004	Rio Grande @ Angostura Diversion Dam	<10	N
0402430-07A	2/22/2004	Rio Grande @ Rio Bravo Bridge	9	N
0402430-08A	2/22/2004	North Diversion Channel @ Roy	580	N
0402430-09A	2/22/2004	Rio Grande @ Isleta Diversion Dam	135	N
0402430-10A	2/22/2004	Rio Grande @ I-25 Crossing	684	N
0403036-01A	2/29/2004	South Diversion Channel @ Tijeras Arroyo	90	N
0403036-02A	2/29/2004	Rio Grande @ Rio Bravo Bridge	9	N
0403036-03A	2/29/2004	Rio Grande @ Isleta Diversion Dam	36	N
0403036-04A	2/29/2004	Rio Grande @ I-25 Crossing	189	N
0403036-05A	2/29/2004	North Diversion Channel @ Roy	63	N
0403036-06A	2/29/2004	Rio Grande @ Alameda Bridge	18	N
0403036-07A	2/29/2004	Rio Grande above Rio Rancho Utility #2	<10	N
0403036-08A	2/29/2004	Rio Grande above Rio Rancho Utility #3	9	N
0403036-09A	2/29/2004	Rio Grande @ HW 44 (US 550)	<10	N
0403036-10A	2/29/2004	Rio Grande @ Angostura Diversion Dam	9	N
0403137-01A	3/5/2004	Rio Grande @ Angostura Diversion Dam	36	Y
0403137-02A	3/5/2004	Rio Grande @ HW 44 (US 550)	240	Y
0403137-03A	3/5/2004	Rio Grande above Rio Rancho Utility #3	63	Y
0403137-04A	3/5/2004	Rio Grande above Rio Rancho Utility #2	63	Y

TAGID	DATE	WATER SAMPLE COLLECTION STATION	FECAL COLIFORM (cfu/100 ml)	STORM WATER RUNOFF
0403137-05A	3/5/2004	Rio Grande @ Alameda Bridge	1090	Y
0403137-06A	3/5/2004	North Diversion Channel @ Roy	11000	Y
0403137-07A	3/5/2004	Rio Grande @ Rio Bravo Bridge	1090	Y
0403137-08A	3/5/2004	South Diversion Channel @ Tijeras Arroyo	1730	Y
0403137-09A	3/5/2004	Rio Grande @ I-25 Crossing	490	Y
0403137-10A	3/5/2004	Rio Grande @ Isleta Diversion Dam	570	Y
0403255-01A	3/12/2004	Rio Grande @ Angostura Diversion Dam	18	N
0403255-02A	3/12/2004	Rio Grande @ HW 44 (US 550)	63	N
0403255-03A	3/12/2004	Rio Grande above Rio Rancho Utility #3	54	N
0403255-04A	3/12/2004	Rio Grande above Rio Rancho Utility #2	27	N
0403255-05A	3/12/2004	Rio Grande @ Alameda Bridge	36	N
0403255-06A	3/12/2004	North Diversion Channel @ Roy	712	N
0403255-07A	3/12/2004	Rio Grande @ Rio Bravo Bridge	135	N
0403255-09A	3/12/2004	Rio Grande @ I-25 Crossing	540	N
0403255-10A	3/12/2004	Rio Grande @ Isleta Diversion Dam	350	N
0407351-01A	7/18/2004	Rio Grande @ HW 44 (US 550)	45	Y
0407351-02A	7/18/2004	Rio Grande above Rio Rancho Utility #3	808	Y
0407351-03A	7/18/2004	Rio Grande above Rio Rancho Utility #2	460	Y
0407351-04A	7/18/2004	Cabezon Channel	742	Y
0407351-05A	7/18/2004	Rio Grande @ Alameda Bridge	450	Y
0407351-06A	7/18/2004	Alameda Drain @ Ranchitos Rd.	851	Y
0407351-07A	7/18/2004	Alameda Drain @ El Caminito Crossing	712	Y
0407351-08A	7/18/2004	Hahn Arroyo above N. Diversion Channel at Carlisle	157000	Y
0407351-09A	7/18/2004	Embudo Channel above confluence with North Diversion Channel	1610	Y
0407351-10A	7/18/2004	FIELD BLANK	<1	
0407370-01A	7/19/2004	Rio Grande @ Isleta Diversion Dam	38000	Y
0407370-02A	7/19/2004	Rio Grande @ Isleta Diversion Dam	31000	Y
0407370-03A	7/19/2004	Isleta Drain just upstream of the confluence with Los Padillas Drain	340	Y
0407370-04A	7/19/2004	Los Padillas Drain just upstream of the confluence with the Isleta Drain	2600	Y
0407370-05A	7/19/2004	Rio Grande @ I-25 Crossing	1820	Y
0407370-06A	7/19/2004	South Diversion Channel @ Tijeras Arroyo	11800	Y
0407370-07A	7/19/2004	Rio Grande @ Rio Bravo Bridge	4100	Y

TAGID	DATE	WATER SAMPLE COLLECTION STATION	FECAL COLIFORM (cfu/100 ml)	STORM WATER RUNOFF
0407412-01A	7/21/2004	Rio Grande @ Angostura Diversion Dam	117	Y
0407412-02A	7/21/2004	Rio Grande @ HW 44 (US 550)	260	Y
0407412-03A	7/21/2004	Rio Grande above Rio Rancho Utility #3	250	Y
0407412-04A	7/21/2004	Rio Grande above Rio Rancho Utility #2	280	Y
0407412-05A	7/21/2004	Cabezon Channel	2000	Y
0407412-06A	7/21/2004	Rio Grande @ Alameda Bridge	727	Y
0407412-07A	7/21/2004	Alameda Drain @ Ranchitos Rd.	2300	Y
0407412-08A	7/21/2004	Hahn Arroyo above N. Diversion Channel at Carlisle	310000	Y
0407412-09A	7/21/2004	Hahn Arroyo above N. Diversion Channel at Carlisle	330000	Y
0407516-01A	7/23/2004	North Pino Arroyo above North Diversion Channel	>600000	Y
0407516-02A	7/23/2004	Embudo Channel above confluence with North Diversion Channel	>600000	Y
0407544-01A	7/25/2004	Embudo Channel above confluence with North Diversion Channel	60000	Y
0407544-02A	7/25/2004	Hahn Arroyo above N. Diversion Channel at Carlisle	209000	Y
0407544-03A	7/25/2004	North Domingo Baca Arroyo Dam @primary spillway	55000	Y
0407544-04A	7/25/2004	North Diversion Channel @ Roy	210000	Y
0407544-05A	7/25/2004	Sandia Pueblo Natural Arroyo @ I-25 Crossing	200000	Y
0407544-06A	7/25/2004	Rio Grande @ Angostura Diversion Dam	3500	Y
0407544-07A	7/25/2004	Rio Grande @ HW 44 (US 550)	29000	Y
0407544-08A	7/25/2004	Rio Grande above Rio Rancho Utility #3	21000	Y
0407544-09A	7/25/2004	Rio Grande above Rio Rancho Utility #2	1820	Y
0407544-10A	7/25/2004	Cabezon Channel	2500	Y
0407544-11A	7/25/2004	Rio Grande @ Alameda Bridge	22000	Y
0407544-12A	7/25/2004	Alameda Drain @ Ranchitos Rd.	3200	Y
0407544-13A	7/25/2004	Alameda Drain @ El Caminito Crossing	9090	Y
0407544-14A	7/25/2004	Rio Grande @ Rio Bravo Bridge	22000	Y
0407544-15A	7/25/2004	South Diversion Channel @ Tijeras Arroyo	70000	Y
0407544-16A	7/25/2004	Los Padillas Drain just upstream of the confluence with the Isleta Drain	220	Y
0407544-17A	7/25/2004	Isleta Drain just upstream of the confluence with Los Padillas Drain	17000	Y
0407544-18A	7/25/2004	Rio Grande @ Isleta Diversion Dam	30000	Y
0407544-19A	7/25/2004	Rio Grande @ Isleta Diversion Dam	32000	Y
0407544-20A	7/25/2004	Rio Grande @ I-25 Crossing	70000	Y
0407544-21A	7/25/2004	FIELD BLANK	<1	

TAGID	DATE	WATER SAMPLE COLLECTION STATION	FECAL COLIFORM (cfu/100 ml)	STORM WATER RUNOFF
0407618-01A	7/27/2004	North Pino Arroyo above North Diversion Channel	134000	Y
0407618-02A	7/27/2004	Alameda Drain @ El Caminito Crossing	25000	Y
0407618-03A	7/27/2004	Alameda Drain @ Ranchitos Rd.	51000	Y
0407618-04A	7/27/2004	Calabacillas Arroyo @ Coors Rd.	800000	Y
0407618-05A	7/27/2004	FIELD BLANK	<1	

APPENDIX G
RESPONSE TO COMMENTS ON DRAFT REPORT

Comment Response Matrix
Middle Rio Grande Microbial Source Tracking Assessment Report
October 2005

Location			***Reviewer***	***Comment***	***Response***
Section	***Page***	***Line***			
General	--	--	LM	As a general comment, the report should include an appendix of all the samples and fecal bacteria concentrations that were taken as a part of the study at the various sampling points. A table by sampling point indicating sample data and the bacteria concentration should be included.	New Appendix G contains the fecal coliform concentration data.
General	--	--	AJF	Why did Parsons collect samples to build a local library, when MEI had a large library? Did Parsons or MEI determine that the additions of MRG strains to the MEI library improved the ability to type unknown isolates from MRG? How useful or necessary would it be to expand the library with local isolates again for another BST study in New Mexico?	Because the abundance of particular *E. coli* strains in animals is expected to vary with space and time, reliance on the MEI library alone would likely result in an unacceptably large percentage of E. coli with ribotypes for which sources could not be identified. In numerous studies, Dr. Samadpour has found that sources can be identified for approximately 60-70% of E. coli isolates based on his nationwide library alone, but that with a local library the identified percentage can be increased by 15 to 25%.
General	--	--	AJF	The challenges distinguishing categories within the avian supercategory suggest that some isolates which were not successfully typed (unknowns) could be strains which have been observed in very different animal taxa. To what extent are the unknowns strains which have been observed in very different taxa, versus strains for which no similar strains existed in the library?	Resolution of the avian source to the species level does not appear practical with ribotyping at this time. The E. coli strains of the avian gut have been commonly found in many different bird species. However, some strains of *E. coli* are only seen in waterfowl. Thus, avian strains may be categorized as the more specific "waterfowl" or the less specific "avian," but no identification to species level can be made with confidence. As the size of the known source library grows, it is possible that more species-specific strains will be identified.
General	--	--	AJF	Some effort at identifying watersheds contributing significant loading (utilizing bacteria concentrations and flow estimates) would further assist in prioritizing areas for source reduction actions.	Hydraulic modeling to estimate flow rates for storm events is beyond the scope of this study.

Location			***Reviewer***	***Comment***	***Response***
Section	***Page***	***Line***			
General	--	--	AJF	The Adobe Acrobat version of the final report would benefit from the use of bookmarks to aid navigation.	Agree.
General	--	--	AJF	The raw data should be delivered with the report, preferably in Excel format. These will allow additional interpretation by stakeholders and individuals.	New Appendix G contains the fecal coliform concentration data. Excel spreadsheet will be provided.
General	--	--	DWH	Refer to the study as "MST" rather than "BST" – the report is correct in this regard – what was tracked was the "microbe" population, not the "bacterial" population.	Agree
General	--	--	DWH	The figure naming convention in the report is odd. Usually a figure is labeled or named below the figure, not above it. The report has the numerous photographs labeled above them.	Disagree
General	--	--	DWH	The normalized results are "surprising", as the report points out. However, no explanation is offered for this "surprise" – and it draws into question the appropriateness of the "normalization" approach. If the math was done correctly, it seems the "normalized" numbers should be different than the "raw" numbers – in any case, an explanation is needed.	The large number of samples collected and isolates characterized is one reason that the weighting scheme does not affect the results greatly. Thus, even though some sites or samples are weighted very heavily relative to others, those samples still represent only a fraction of the total sample count. Another reason is that the sources were somewhat consistent among sites and dates.
1	4	--	LM	The narrative indicates that load capacities are exceeded for fecal coliform for the TMDL, while the table indicates that load capacities are identical to the total maximum daily load values. To our knowledge, there is no data that shows that load capacities shown in the TMDL are exceeded.	The last sentence of first paragraph on page 1-4 was deleted.

Location			Reviewer	Comment	Response
Section	**Page**	**Line**			
2	1	--	LM	The narrative needs further clarification on the main source of fecal coliform bacteria in the middle Rio Grande. For instance, for total annual loading in the river at any given point, is the major source of coliform bacteria loading contributed from total river flow or from stormwater contribution to the river?	The overall top *E. coli* contributors are wildlife (primarily avian) at 46 percent and pets at 24 percent. The two groups account for 70 percent of the *E. coli* detected in all the water samples. Humans and livestock contributed 16 and 14 percent, respectively. Parsons does not have any flow data that corresponds to fecal coliform data. Therefore, magnitude of fecal coliform loading is unknown for both dry and wet weather flow. The fecal coliform concentration in storm water runoff is 100 to 1,000 times higher than dry weather flow, but it does not rain very often. The fecal coliform concentration in dry-weather flow is much lower than storm water, but it is continuous. Reducing fecal coliform concentrations in dry-weather flow to below the water quality standard would make the biggest impact.
2	1	--	LM	Narrative indicates that impoundments effectively serve as settling basins for fecal bacteria. If appropriate data for this fact is available, it may be appropriate to include some data or the source for a reader of this report for acquiring the data to confirm.	No data was available. The paragraph was rewritten to not include the reference to settling basins.
2	--	Figure 2.1	LM	Figure 2.1 needs further clarification. Some of the mapping shown as "county line" may be confusing to someone who does not know the area. Also, the different colorations on the map need to be further identified for clarification.	Parsons did not create the GIS map. Parsons was provided an Adobe Acrobat (pdf) file of this map, which cannot be revised.
2	6	Figure 2.2	MKM	This Figure is difficult to interpret because it lacks any identifying markers as to the area being shown. We think that it would be beneficial to include details such as city limits, beginnings and endings of the reach, etc. to more clearly identify the area discussed. Also, what is the source and the date of this coverage?	The figure was revised.
2	7	--	LM	Is there year 2000 census data available that would give more recent data for household sewage disposal data?	No, household sewage disposal methods have not been addressed in the 2000 U.S. Census.

Location			Reviewer	Comment	Response
Section	**Page**	**Line**			
2	7	First Paragraph	MKM	I am very concerned that the consultants utilized 1990 Census data to determine density, sewer hookups and so forth. This should be 2000 data and it should be cross referenced against know sewer connections, which both the City and the County have, and aerial photographs, which are also available. A great deal of the conclusions of this study may be inaccurate if they are based on 1990 data, due to the extensive growth in the North and South Valley, North Albuquerque Acres, the foothills and the Westside, and do to the 3,000 or so sewer connections that have been made available since 1990 in Bernalillo County. This failure to utilize current information will most adversely affect Bernalillo County, as this is where the most change has occurred, but will also impact the Westside results.	It is unfortunate that the wastewater disposal methods have not been published for the 2000 U.S. Census. Sewer connection data was obtained from Bernalillo County but was not compatible with the average census track density method used to determine population and sewer connections within each watershed. Nevertheless, Bernalillo County and the City of Albuquerque have expended considerable effort to extend new sewers into unsewered areas and reduce sewer system overflows. The conclusion of the MST report is 70% of the E. coli bacteria identified in water samples are from wildlife and pets.
2		Figures 2.4, 2.6	LM	Figure 2.4 and Figure 2.6 are identical. Is this an error in printing of the photographs, since the narrative indicates two different locations for the same photograph?	Figure 2.6 was not the correct picture. The correct picture is in the final document.
2	10	--	LM	The South Diversion Channel discharges into the Tijeras Arroyo, and the combination channel discharges directly to the river. The South Diversion Channel and the Tijeras Arroyo do not drain into the Riverside Drain.	The text has been corrected.
2	15	Map	MKM	The labels identifying the outfalls and the predominant color of the map are both yellow, making it difficult to read. The map should be edited for greater clarity and readability	Parsons did not create the GIS map. Parsons was provided an Adobe Acrobat (pdf) file of this map, which cannot be revised.
2	16	Table 2.2	MKM	What is the source and the citation (including age) of this data?	The citation and date have been added to the bottom of the table.
2	19	Table 2.3	MKM	What is the source and the citation (including age) of this data?	The reference to US Census data can be found at the bottom of the table.
2	23	--	LM	The listing of bird species in the middle Rio Grande area does not list some of the bird species that are very common to the middle Rio Grande area. Some of these birds that are not listed are Curved-Bill Thrasher, Ladder-Back Woodpecker, Hummingbirds, Fly-Catchers (various species), Oriels.	Agree.

Location			*Reviewer*	*Comment*	*Response*
Section	***Page***	***Line***			
3	6	Table 3.1	LM	This table shows a summary of the fecal source sampling for development of the source library. The samples for "sewage" are all samples collected from wastewater sources. The question arises as to whether wastewater is an appropriate source bacteria for tracking human sources of bacteria, and whether or not interference may be generated by the types of bacteria variance that may be present in the wastewater stream. The introduction of interference from other sources of bacteria may be warping the proper identification of the true human source for bacteria concentrations, and could impact the results of actual human concentration in the bacteria population.	While sewage is believed to primarily consist of human waste, it is true that sewage may also contain fecal matter from a variety of non-human sources. In addition to sewage and septage, the MEI library also contains samples directly from human feces. This allowed identification of human generated *E. coli*. In cases where isolates matched a sewage source, it was reported as such, and not attributed to "human".
3	7	Large Carnivores	LM	They don't show any bears, nor any samples collected. Wondering what happened to bear, maybe, and also coyote.	The table identifies objectives established early in the project. Bear and coyote scat were collected for the local library. One E. coli strain attributed by a bear was detected in the water at Isleta Diversion Dam. Coyote E. coli were detected in five watersheds.
3	9	--	AJF	At least so far, the major weakness or criticism of the project would be the sample design – specifically, the placement of the sample stations and the frequency of sampling. On page 3-9, the statement is made that the location of the sample stations was determined by the stakeholders based on their information needs – this begs the question of sample station distribution – random versus specifically identified.	The eight sampling stations on the MRG are routine NMED water quality stations. The other 22 stations were picked because they are major tributaries of storm water runoff. The objective was to determine the mammalian sources of fecal coliform to the MRG, which required sampling at the selected locations.
3	13	Microbial Source Tracking Objectives and Methods	MKM	"Quantification of Accuracy and Precision in Ribotyping and ARA Source Determinations" Where is a discussion of the results of this Quantification. It would be better to include it here after a discussion of the process.	The Quantification of Accuracy and Precision in Ribotyping and ARA Source Determinations results are shown in Section 4.1.

Location			Reviewer	Comment	Response
Section	Page	Line			
3	13		AJF	The report (p. 3-13) indicates that isolates from within the MEI library were typed to determine the accuracy and repeatability of the ribotyping method. The resulting high accuracy and repeatability may have resulted partly from the use of isolates that were still found within the library. The accuracy and precision of typing isolates from unknown sources would be better estimated by typing isolates from known sources NOT within the MEI library. This could be conservatively approximated with existing data by omitting known isolates, one at a time, from the library, and testing to see whether those isolates (preferably those from the Middle Rio Grande) are typed correctly based on the remaining isolates in the library.	The MST methodology relies on exact matches of ribotypes from unknown and known-source E. coli. If a particular ribotype is not present in the library, its source cannot be identified. Thus, we limited the QC study to isolates already within the library to test the method for routine precision and accuracy of identification. In two more intensive method comparison studies, the procedure has been tested with unknowns not from the library (see Griffith et al. 2003. J. Water Health 1:141-151, or Stoeckel et al. 2004. Environ. Sci. Technol.38: 6109-6117.) However, both of these studies were plagued with several confounding problems of their own which tended to complicate the interpretation and bias the results. These studies highlighted the difficulties of doing that kind of QC study, which is why we chose to limit the objectives of our study to test whether the method could reproducibly differentiate between ribotypes.
3	14		LM	The display of isolate numbers and duplicate samples, I'm assuming is representative of the correct correlation that was accomplished in the source determination techniques.	More explanation is provided.
4	3	Table 4.1	AJF	Table 4.1 indicates that 4 duplicates were collected, all at one site (Rio Grande at Isleta Diversion Dam). With so few data, the data themselves should be presented.	The data is in Appendix F.
4.2	5	3rd paragraph	MKM	"Although they drain *[sic]* adjacent watersheds, the levels of fecal coliform in the Isleta Drain were on average an order of magnitude higher than those in *[sic]* Los Padillas Drain after rainfall. The factors responsible for this difference are difficult to discern." One possible explanation is that the return flow from a lateral irrigation ditch enters the Isleta Drain just above the sampling point.	Modified text to mention this

Location			Reviewer	Comment	Response
Section	Page	Line			
4.2	5	--	AJF	Regarding the differences in bacteria levels observed in Isleta and Padillas drains, because the sites were sampled on the same dates, and because they drain adjacent watersheds, differences in antecedent hydrology (e.g., period of time passed since the last precipitation event) probably had an insignificant effect on the results, making comparisons of the two sites more meaningful than they might otherwise be. Does the Isleta Drain watershed contain more of particular types of agriculture, such as dairies or poultry farms, than the Los Padillas Drain watershed?	Just the opposite. There are three permitted CAFOs (dairies) in the Isleta Drain watershed. There are no permitted CAFOs in the Los Padillas Drain watershed.
4.3.1	8		AJF	Section 4.3.1 starting on p. 4-8 describes categories of bacteria sources. This section should be expanded to discuss the rationale behind selection of categories. Of particular relevance is the use of one category for all birds. Why is waterfowl not listed as a category in sections 4.3.2.1 through 4.3.2.27? In Appendix B, waterfowl is provided as a category, but only "avian" is provided elsewhere. Were chickens part of the library, and if so, were they grouped with avian, or livestock? Knowing more about sources within the avian supercategory is very relevant for making management decisions to reduce bacteria loading. Appropriate approaches to address bacteria loading from pigeons, for example, would be quite different than approaches to address loading from waterfowl. A statement is made near the top of page 4-9 (Sec. 4.3.1) that some E. coli strains have been observed in both waterfowl and other bird species. What are the prospects of typing the strains in greater detail to allow greater differentiation? Discussion of this challenge may assist development of future studies. Also related to categories of sources, Appendix B includes separate categories for "bovine" and "cow". It may be that no bison occur in the watersheds of some sample sites, and therefore the analyst felt confident assigning these isolates to the category "cow". If so, this should be stated in Section 4.3.1. Similarly, the categories "dog" and "canine" both appear in Appendix B. Are these really one category?	Segregation of the avian source categories to the species level does not appear practical with ribotyping at this time. The *E. coli* strains of the avian gut have been commonly found in many different bird species. However, some strains of *E. coli* are only seen in waterfowl. Thus, avian strains may be categorized as the more specific "waterfowl" or the less specific "avian," but no identification to species level can be made with confidence. As the size of the known source library grows, it is possible that more species-specific E. coli strains will be identified. Identifications as cow were changed to bovine, and from dog to canine.
4	6	Table 4.2	LM	Table 4-2 needs additional legends to identify the columns.	Added legend and units
4	6-7	Table 4.2 Table 4.3	MKM	A legend for these tables, which includes units, should be provided.	Added legend and units

Location			Reviewer	Comment	Response
Section	Page	Line			
4		Table 4.6 Table 4.7	DWH	Tables 4.6 and 4.7 (and perhaps others) should have sample sizes (number of samples analyzed, or something like that) along with the confidence intervals – a small number of samples with a given confidence interval is very different from a large number of samples with the same confidence interval – the interval is a surrogate for a more direct measure of the variance of the data.	Added sample sizes
4	21		LM	When reviewing the data and pie charts for the sources in the Rio Grande sampling stations, it would appear that canine percentage seems to decrease as you proceed downstream in the Rio Grande. What would be the explanation for that result; population of dogs decreasing and/or possible die-off of bacteria as one proceeds downstream?	The reduction in the relative importance of canine and feline sources of fecal coliform with the increasingly developed nature of the watershed runs counter to expectations. Parsons assumed that the sheer number of dogs in urban areas would cause an increase in canine fecal loading to water, in both absolute and relative terms, with increasing urbanization of the watershed. This was not observed. In addition, several of the relatively undeveloped small watersheds indicated a major canine source. It may be that a large population of canines in less developed portions of the watershed, and/or efficient dog waste cleanup in urban areas, may be responsible for the observations. It seems unlikely that coyotes are present in sufficient numbers in rural areas to overwhelm the urban dog influence.
4	29		LM	In general, some of the data shown in the pie charts and in the data tables for percentage of various sources seems to be confusing. A particular example is the data shown for the Hahn Arroyo just above the North Diversion Channel. The Hahn Arroyo is the highest percentage of developed land, and yet bovine shows as a significant percentage as a source of bacteria in that basin. What would be the explanation for the bovine concentration?	The presence of bovine sources was somewhat surprising in this urban watershed. It may be due to manure spread in gardens. It should be noted that four of the eight samples matched to bovine feces originated in a single water sample.
4.3.2.13	29	First Paragraph	MKM	What is the hypothesis for bovine sources?	See previous response

Location			Reviewer	Comment	Response
Section	Page	Line			
4.3.2.26	37	First Paragraph	MKM	What is the hypothesis as to why birds and canines are the major sources at this site?	Many small farms with row crops are located adjacent to the Los Padillos Drain. More than one dog located on each farm is typical. Birds like the seeds.
5		Figure 5.1	LM	Figure 5.1 is a bar chart showing fecal coliform sources for the 8 monitoring sites on the Rio Grande. It is difficult to decipher on the chart what the left-hand scale is representing. Please clarify.	The y-axis has been labeled.
			AJF	Figure 5.1 early in section 5 needs its vertical axis labeled. The last sentence in the second paragraph in Section 5.1.1 (p. 5-1) should be expanded to read, "The number of unknown isolates are not included in the totals shown in Figure 5.1, or in the text below."	The y-axis has been labeled. The suggested sentence was added.
5	1		AJF	There are three page 5-1's	Corrected.
5.1.1.		Second Paragraph	AJF	The statement in the second paragraph of section 5.1.1 that "the fecal contribution of avian and non-avian wildlife [is] considered the background or natural concentration" is arguable. Bird feces running off of impervious surfaces may be significant, and as such urban stormwater management may have an effect on loading.	Parsons is regards background or natural fecal coliform contributions as non-anthropogenic.
5	4		LM	What information indicates overpopulation of dogs & cats?	The City of Albuquerque website located at: http://www.cabq.gov/pets/index.html. See "Affordable Spay Neuter". Additionally, the CABQ and Bernalillo County have past ordinances limiting the number of dogs at each residence.

Location			Reviewer	Comment	Response
Section	Page	Line			
5.1.2	4	Second Paragraph	MKM	How is Parsons defining the "overpopulation of dogs and cats"? It would be appropriate to say there are many strays (number etc.), especially when compared to other communities, but what is the net impact of this on storm water quality? Also, the section indicates that both dogs and cats are a source yet only mentions the detrimental effects of dog waste (dogs being carriers of parasites). What are the hazards from cat waste?	The City of Albuquerque website located at: http://www.cabq.gov/pets/index.html. See "Affordable Spay Neuter". Additionally, the CABQ and Bernalillo County have past ordinances limiting the number of dogs at each residence. Hemolytic *E. coli* such as strain O157:H7, can cause serious illness in humans. The ribotypes of these hemolytic bacteria indicated that twenty-one and eight of the forty-seven hemolytic bacteria identified in water samples were from dogs and cats, respectively (Section 4.2).
5	5		LM	Indicate location and type of CAFOs that are in MRG.	Three CAFOs (dairies) are located in the Isleta Drain watershed. One CAFO (dairy) is located in the Rio Grande at I-25 watershed.
5.1.2	5	Seventh Paragraph	MKM	Livestock: Where is this CAFO located? What impact has it had on water quality in that drainage area?	Three CAFOs (dairies) are located in the Isleta Drain watershed. One CAFO (dairy) is located in the Rio Grande at I-25 watershed. The percent of *E. coli* associated with bovine were less than the overall average in the Isleta Drain watershed. This is most likely the result of these facilities capturing wastewater and storm water and storing it in ponds. The bovine contribution in the Rio Grande at I-25 watershed was slightly above the overall average, 9.4 percent verses 7.2 percent. Nevertheless, the E. coli associated with bovine upstream of the I-25 Bridge at the Rio Bravo Bridge was 11.4 percent.
5.1.2	6	Last Paragraph	MKM	Livestock: Contents of the proposed general permit for discharges from CAFOs were available on December 7, 2004, when the public notice was issued. This information can be found at http://www.epa.gov/region6/6wq/npdes/genpermt/cafoguidance.pdf	Thank you.

Location			Reviewer	Comment	Response
Section	Page	Line			
5.1.2	6	First Paragraph	MKM	Untreated or Inadequately Treated Sewage: What is the basis for saying that contaminated groundwater should be investigated as a source. What justifies this statement?	The intent of the statement was to suggest groundwater be tested for fecal coliform to determine if it is contaminated. The paragraph has been revised.
5	6	--	LM	The discussion of untreated or inadequately treated sewage indicates that septic systems could be a contributor to fecal coliform bacteria in the Rio Grande. The report should indicate any available data from either the County or State sources that may address contaminated ground water associated with septic systems. Bernalillo County has been active in monitoring wells for various contamination sources, however, the use of that data in relation to actual septic waste may not be possible. Any available data should be researched and discussion contained within the final report.	The intent of the statement was to suggest groundwater be tested for fecal coliform to determine if it is contaminated. The paragraph has been revised.
5	6	--	AJF	On page 5-6 is a statement that includes the number "19.8 quadrillion." Perhaps more readers would understand the scientific notation ("19.8 x 10^15").	Agree
App D	2	--	DWH	Change "possum turd" to "opossum scat."	Agree

Reviewers:
(MKM) Mary K. Murnane, Water Resources Program Manager, Bernalillo County
(DWH) David W. Hogge, New Mexico Environment Department
(AJF) Abraham Franklin, New Mexico Environment Department
(LM) Loren Meinz, AMAFCA