

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.

1.5 Analogous Study at Las Nutria

(Bowman and Hendrickx, 1998. *Determination of Agricultural Chemical Impacts on Shallow Groundwater Quality in the Rio Grande Valley: Las Nutria Groundwater Project*. WRI Technical Completion Report No. 308)

A brief literature review for this report uncovered a similar study published in 1998 by Bowman and Hendrickx. The study involved a comprehensive assessment of water and chemical relationships at a commercial farm in the central Rio Grande Valley. The study site was a highly instrumented 15-acre tile-drained field and the study focused on determining averaged data on recharge rates and nitrate and pesticide leaching to shallow groundwater.

Conclusions of the study state that nitrate leaching did not appear to create a major or persistent problem with regard to shallow groundwater quality. Nitrate concentrations in excess of 10 mg/L persisted for only a short period immediately following a flood irrigation event during the 1994 irrigation season. Samples collected at the outfall never exceeded the nitrate standard.

With respect to pesticides, the conclusions state that no pesticides were detected in the tile drain water at any time over a two-year sampling period. Analysis included 1,2-dibromoethane (EDB), 1,2-dibromo-3-chloropropane (DBCP); acid herbicides, synthetic organics, carbamate pesticides, and aromatic and halogenated pesticides. Intensive groundwater and tile drain sampling was also conducted for chlorpyrifos (Lorsban) in 1995 and dimethoate (Dimate 4E) in 1996. A few groundwater samples contained trace amounts (0.1 to 1 ug/L) of chlorpyrifos; no dimethoate was detected in any sample. Application rates were 1.5 pints per acre for chlorpyrifos (40.7% by weight) in 1995 and 0.75 pints per acre for dimethoate (4 lbs dimethoate per gallon) in 1996, with applications made in mid-April.

The conclusions clearly state that “based on the information collected during Las Nutrias Groundwater Project, typical agricultural cropping, water, nutrient, and pesticide management practices do not appear to pose a broad threat to shallow groundwater in the Rio Grande Valley. Due to large dilution by ambient groundwater ... temporary spikes in field drainage chemical concentrations are rapidly diluted below regulatory levels.”

2.0 Scope of the South Valley Agrichemical Water-Quality Impact Study

In April 2001, the BCEHD proposed development an “agricultural waste impact monitoring program” along the Rio Grande. The purpose of the program was to develop a plan to conform with regional, local, and conservancy district planning using existing agricultural waste assessments, water quality data, surface and groundwater interaction estimates, and hydrological

and geohydrological data. Continuation of the program was transferred to Bernalillo County Public Works at the time of the County's structural reorganization.

The associated Scope of Work for the project included developing a network of sampling points within the groundwater drains in the South Valley, collection of samples along three transects with sampling occurring twice during irrigation season and three subsequent sampling events during the fall, spring, and early summer. The scope was also to include developing a catalog of agricultural activities with the county, including inventories of water diversion rights, crop production, and estimated herbicide and pesticide use, with the stated intention of creating a model of agricultural waste migration for the South Valley. The planned report was to address the creation of the sampling network, data analysis and presentation, a network analysis, monitoring network recommendations, best management practice recommendations, and evaluation and recommendations of the sampling program. The focus of the project was a regional, rather than site specific, assessment of the impact of agricultural practices. The South Valley was selected for the initial pilot project due to historical contamination problems, high density of residents dependent on individual wells, and density of agricultural land use.

2.1 Sampling Location

The agricultural waste monitoring network consists of a total of forty-five surface water and shallow groundwater sampling locations located in the South Valley. The sampling locations are located in three transects, with sampling locations in or adjacent to irrigation canals and drains on MRGCD property. These three transects include surface water sites at the inlets to canals and drains near the Rio Grande in the north part of the South Valley, and surface water and adjacent monitoring well locations in transects along Rio Bravo Blvd., and along Malpais Rd. The sampling locations were selected to capture background concentrations of Rio Grande water supplied for irrigation and for determining contaminant concentrations in waters draining from agricultural fields and in groundwater.

Figures 2-1 through 2-4 plot the location of the various sampling points used for this sampling program. The location naming convention uses the prefix to denote the transect: "B" indicating baseline stations near the Rio Grande, "RB" denoting the transect parallel to Rio Bravo Blvd., and "M" denoting locations along Malpais Rd. Location names ending in "S" or "SURF" denote a surface water collection sites regardless of whether they be canals or drains, and those ending in "G" denote a shallow groundwater monitoring well. The numeric designator indicates order of installation and generally increases from west to east. Samples have also been collected from dewatering activities at the intersection of the Isleta Drain and Rio Bravo, and along Pajarito Rd. approximately ½ mile east of Coors Blvd..

Surface water sampling points were chosen at the diversion points into the canal system, in proximity to agricultural fields, and from drains. A license agreement was obtained from the MRGCD in 2002 and wells were subsequently installed along canals and ditches within the MRGCD right-of-way. Rodgers and Co., Inc. was contracted in September, 2003 to install twenty (20) drive-point type shallow groundwater monitoring wells. The wells were constructed during the period of September – December 2003. Wells were pushed/driven to a depth of

approximately fifteen (15) feet below ground surface using 10-feet of blank galvanized casing and 5 feet of slotted galvanized screen. The wells were completed below grade and provided with locking caps and flush-mounted bolted monitoring well covers and concrete pads. In most cases, wells were paired, with one well on the upstream side of the surface water sampling point, and one on the downstream side. No wells or sampling points were placed within the boundaries of privately-owned agricultural plots or in areas of known contamination from other sources.

2.2 Sample Collection and Analysis

Water samples were collected during the period of 2001 to 2005 and analyzed for a constituent list useful for detecting and characterizing agrichemicals. The composite list included pesticides, and herbicides, nutrients (nitrates, ammonia, total Kjeldahl nitrogen (TKN), chloride, sulfate and total dissolved solids, and selected metals (chromium, arsenic, iron and manganese).

Sampling events were chosen to capture seasonal water table fluctuations, agricultural chemical application seasons, and pre- and post- irrigation seasons. Initial surface water samples were taken in October 2001 and September of 2003, and both surface water and groundwater samples were taken in December-January 2004, July 2004, March 2005, June 2005, and September 2005. Due to laboratory scheduling constraints, samples were typically collected over a two to three week interval. Samples were collected, field preserved, cooled, and typically delivered by hand on the day of collection.

2.2.1 Analyte List

Production-scale agriculture often utilizes a variety of agrichemicals to boost productivity and increase yield and quality. Agrichemical (or agrochemical), a contraction of *agricultural chemical*, is a generic term for the various chemical products used in agriculture. In most cases, agrichemical refers to the broad range of pesticides, herbicides, and fungicides, but it may also include synthetic fertilizers, hormones and other chemical growth agents, and concentrated stores of raw animal manure. The misuse or mishandling of these chemicals and synthetics has the potential to adversely impact surface and groundwater quality.

For the Scope of Work funded in 2003, the analyte list consisted of the following:

- Base/Neutrals and Acids (BNAs)
- Fecal Coliform
- Nitrates + Nitrite
- Total Kjeldahl Nitrogen (TKN)
- Chloride
- Total Dissolved Solids (TDS)
- Sulfate
- Chromium
- Iron
- Lead

As sampling progressed, the analyte list was modified to ensure that all appropriate compounds (e.g. surfactants and volatile organic compounds) were analyzed.

Agricultural Waste Impact Study Sample Locations

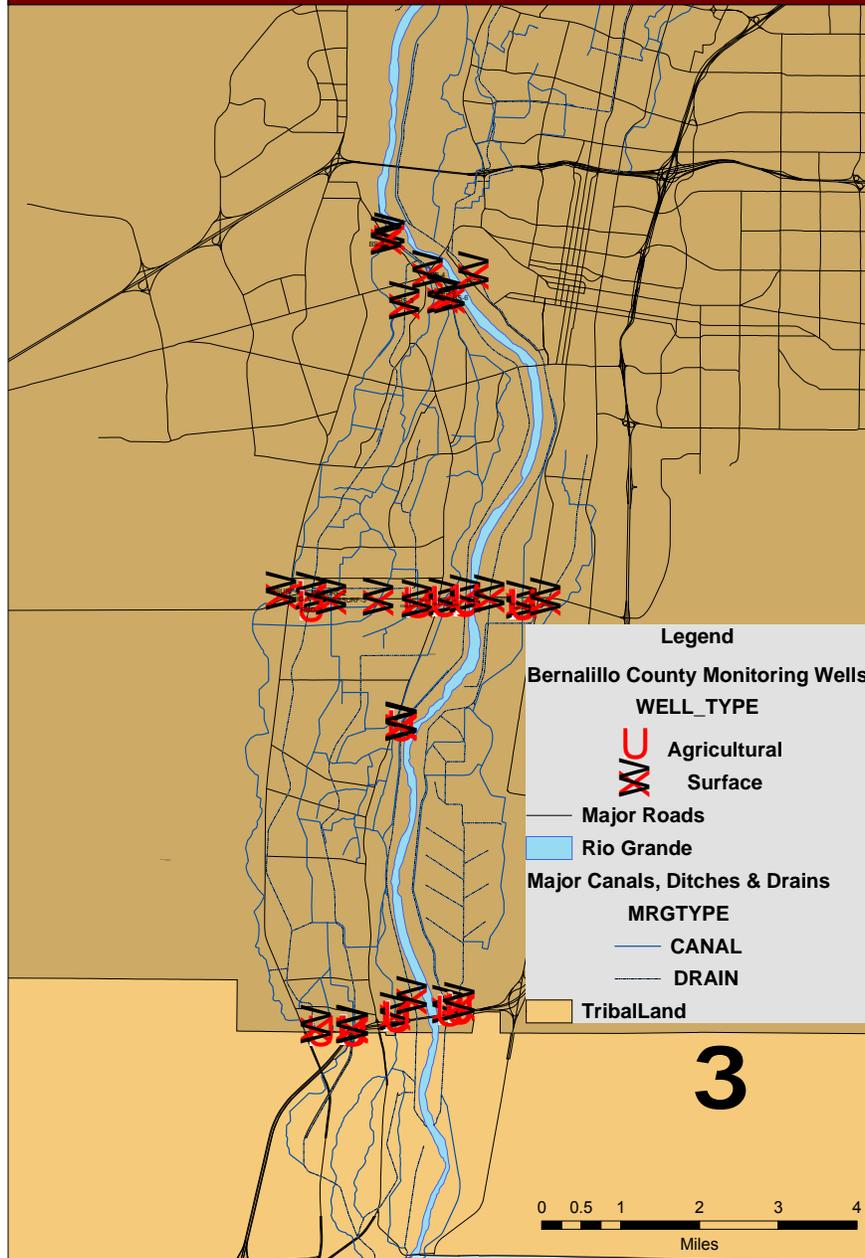


Figure 2.1 Overview of Sampling Locations

Agricultural Waste Impact Study Baseline Surface Sample Locations

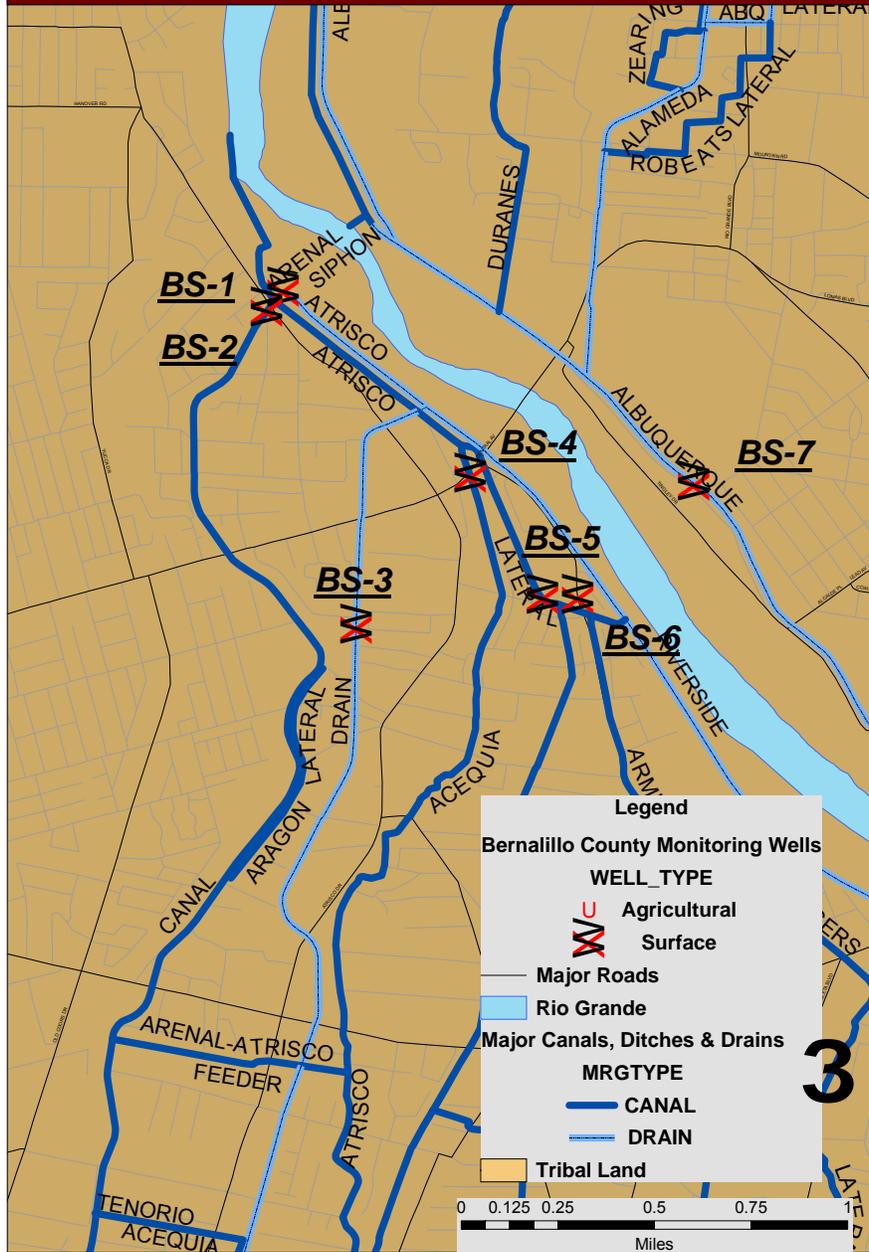


Figure 2.2 Headwater Transect Sampling Locations

Agricultural Waste Impact Study Rio Bravo Transect Locations

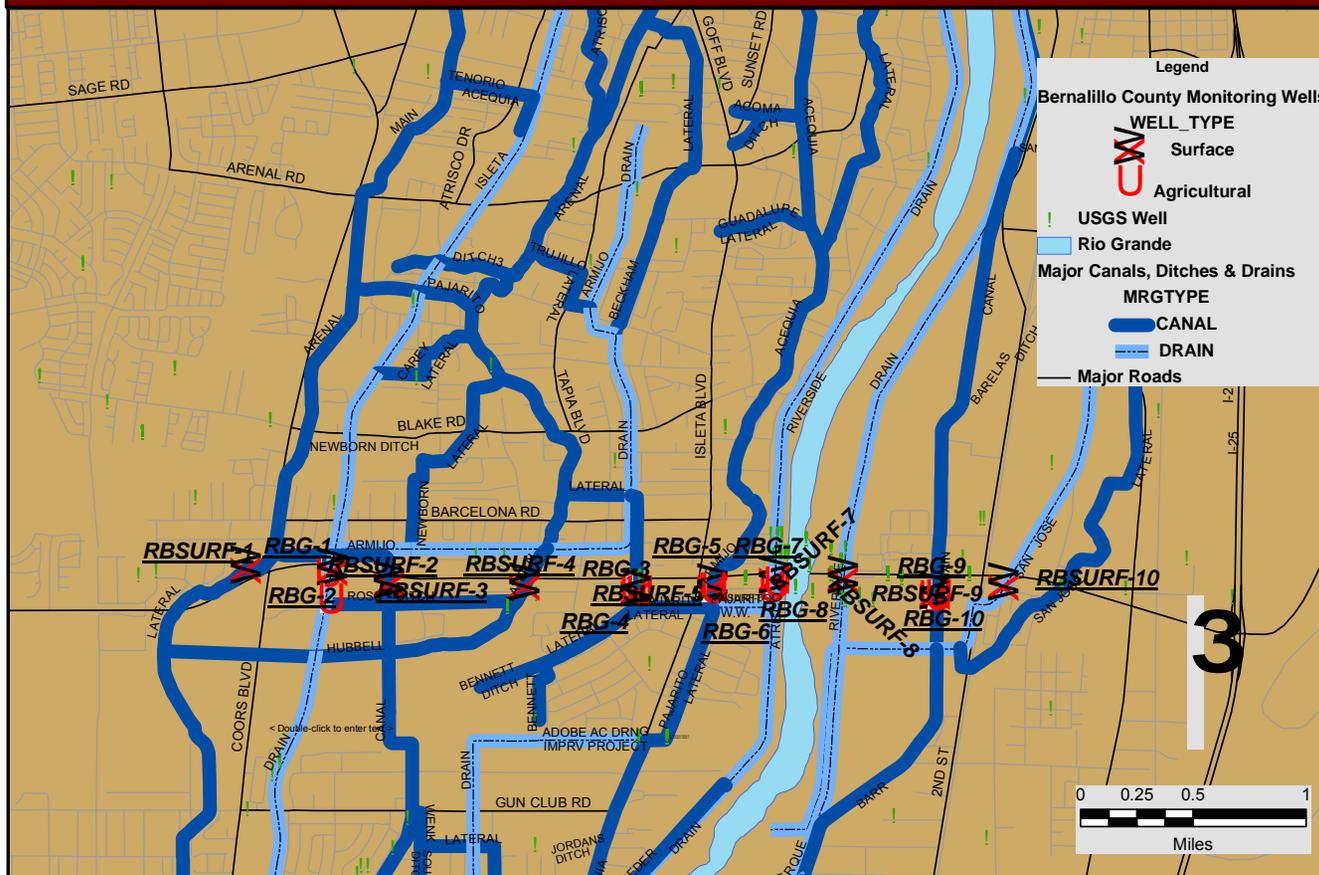


Figure 2.3 Rio Bravo Transect Locations

Agricultural Waste Impact Study Malpais Transect Locations

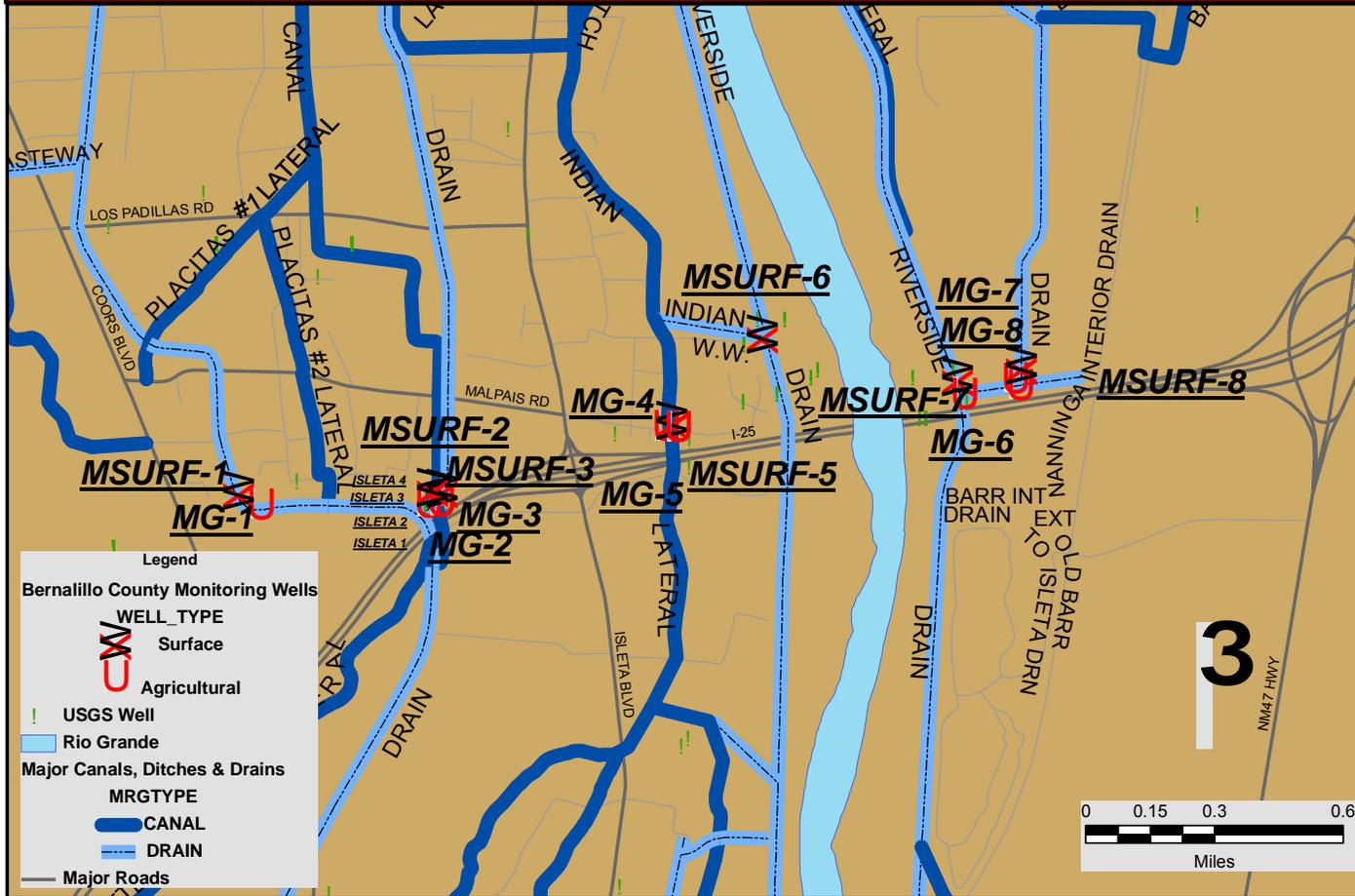


Figure 2.4 Malpais Transect Sample Locations

2.2.2 *Sampling Events and Methods*

Initial sampling of surface water locations occurred in October 2001 and again in September 2003. Groundwater monitoring wells were first sampled in December 2003 - January 2004. Starting in 2004, each sampling event retrieved samples from all accessible groundwater monitoring wells, with the exception of MPG-8 which was destroyed during MRGCD maintenance activities. Each surface water location was checked, and if water was present a sample was collected. In many instances, the drains were dry and samples could not be obtained.

Surface water samples were collected using grab sampling techniques. The samples were collected by BCEHD personnel for the October 2001 and September 2003 sampling events. Existing records do not explain the two year delay in sampling events.

The first groundwater samples were collected during the winter of 2003-2004 by BCEHD personnel. No surface water samples were collected during this sampling event. Existing records do not explain the lack of surface water sampling at that time. There are no records indicating what method was used to collect the samples. Presumably, they were hand-bailed. This sampling event represents a post-irrigation season sample of the groundwater.

Only groundwater samples were collected during July 2004. The samples were collected by a County contractor. The wells were purged and subsequently sampled using disposable bailers. Contract requirements and field notes indicate that the wells were purged of only one casing volume prior to sampling and that the pH, temperature and conductivity were measured. A review of the field notes indicates that pH had not stabilized after one volume, though temperature and conductivity had stabilized. The pH readings indicated a continuing decrease in pH with successive measurements. The total change from the initial measurement was at least 0.3 units in most cases and as great as 0.5 units in one case. The difference in successive pH measurements immediately prior to sampling was in some cases larger than 0.1 units. Typical well sampling practice is to purge three casing volumes and/or demonstrate three successive pH measurements within 0.1 units. These samples, if representative, reflect mid-season irrigation conditions.

Starting in March 2005, the County elected to resume sampling utilizing County personnel. The field protocol was changed to ensure that at least three well volumes were purged prior to sampling. However, field parameters were not measured. Samples were collected from all serviceable groundwater wells and from all surface water locations containing sufficient water. Samples were collected in March 2005 to represent pre- irrigation season conditions. Additional samples were collected in June-July 2005 and again in August-September 2005. The timing of these events was intended to capture the range of conditions occurring during the early and late irrigation seasons.

Subsequent groundwater samples were taken at two construction dewatering locations. The amount of time and volume of pumping preceding pumping is unknown, but the systems were in operation for at least three days prior to sampling. These samples were taken due to proximity to large agricultural acreages near the intersection of Rio Bravo and Coors Blvd. and near Pajarito

and Coors Blvd.. Additional dewatering samples are currently planned during sewer and water line installation throughout the South Valley.

2.2.3 *Field Documentation / Quality Control*

A brief review of field documentation and quality control documentation has been conducted for each sampling event to ensure representativeness of the samples and to ensure comparability of samples over the period of record. After the 2004 sampling events, the level of field documentation was increased. Though not a regulatory or program requirement, chain-of-custody forms were completed and preservation of samples was noted.

2.2.3.1 Initial Sampling Events

The first round of surface water samples was collected in October 2001 and September 2003 and during Winter 2003-2004 for groundwater samples. Field documentation of the sampling events was not found during the file review. Analytical results and the analysis request form are available.

The analytical request form includes information relevant to chain-of-custody issues such as sample date and time, personnel, and sample preservation methods. These analysis requests sheets indicate that samples were delivered to the contract laboratory (State Laboratory Division –SLD) either on the day of collection or on the following day.

The semivolatile organic compound (SVOC) analyses reports indicate that extractions and analysis were conducted within hold times and the only notations of “flags” for the analyses were for the detection of various phthalate compounds. Phthalates are a known laboratory contaminant. Some analyses also noted that surrogate recoveries were low, suggesting potential for negative reporting errors for the related compounds. However, most recoveries were within normal ranges. The analysis requests sheets either lack indication of any preservation methods (in this case, chilling) or indicate chilling. However, documentation for SVOC analysis indicate all samples were received at temperatures below 10C, indicating at least chilled storage of the samples prior to delivery to the laboratory.

Trace metal analysis are available for only a very few of the samples from the initial events. The analysis requests sheet indicate that the samples were not filtered, nor were they field acidified. The analytical sheets however indicate that the samples were acidified in the laboratory. In most cases, matrix spike recoveries were within normal bounds (80 percent to 100 percent). If outside those bounds, the data was flagged and it was noted that matrix interference was suspected. In one instance (RBS-6 on 9/29/2003) multiple trace metals were flagged as having relative percent differences of greater than 10 percent for aluminum, boron, iron, and manganese. All trace metal analyses were conducted within the 6 month hold time.

The analysis requests sheet for the nutrient-series analysis generally indicate that the samples were field preserved with H₂SO₄ and chilled per appropriate sampling protocols for the samples collected in 2001. Analysis request sheets for samples collected in 2003 indicate that no field

preservation occurred. The analysis request sheets however indicated that the samples were acidified in the laboratory, generally within one hour of laboratory receipt of the sample. Exceptions to this do exist including the samples for MS-7 and MS-8, which do not indicate any preservation. Analysis results sheets indicate that all holding times were met.

Analysis requests sheets indicated that samples for other inorganic analysis (major anion and cation, alkalinity, total dissolved solids (TDS), and pH) were cooled and that corresponding hold times were met. However, for the cations there is no indication whether the analyses was performed on an acidified split. This is of concern because the analyses were performed some 43 days after sample collection. Comparison of results for cations that were also analyzed for the trace metals on a known acidified split generally yielded higher concentrations. Consequently, where duplication of the analysis exists (i.e. for iron and manganese), the value with the higher concentration is presumed correct. Generally this corresponds to the values reported for the trace metal analysis rather than the cation/anion analyses.

2.2.3.2 Samples from July 2004

Only groundwater samples were collected during July 2004. The samples were collected by Intera, Inc. under a negotiated County contract. Contract requirements and field notes indicate that the wells were purged of only one well volume prior to sampling and that the pH, temperature and conductivity were measured. Typical well sampling practice is to purge three casing volumes and/or demonstrate pH stabilization by measurement of three successive pH measurements, all within 0.1 units. A review of the available field notes indicate that in some cases, pH had not stabilized after purging of one volume.

A review of the Chain-of-Custodies for these samples indicated no handling abnormalities. However, neither field notes nor the chain of custodies document field preservation or filtering of metals or nutrient samples. Laboratory reports for the metals analysis however indicate that the metals samples were acidified prior to receipt by the analyzing laboratory. All bottles used for sampling were field prepped by Pinnacle laboratories. It is routine practice for this laboratory to add the appropriate preservatives as part of the bottle preparation. For evaluation purposes, it is assumed that all samples were properly preserved.

A review of the laboratory QC data indicated that all analyses were performed within control limits and that surrogate recoveries were adequate. For this sampling event, the reported minimal concentrations of total phosphorous (i.e. <1 mg/L) are flagged to indicate that the analyte was found in the method control blank. However, other samples collected from these wells at different dates do indicate the presence of minimal concentrations of total phosphorous.

2.2.3.3 Samples from March 2005 and More Recent Sampling Events

Samples collected during March 2005 and subsequent events were collected by BCPW personnel. The field protocol was changed to include bailing of a minimum of five gallons (or slightly in excess of three well volumes) prior to sampling. Field parameters were not monitored during purging. Field documentation does not indicate the preservation methods used.

However, one-to-one discussions and one round of field observations by the author indicates appropriate documentation and custody of samples were maintained, that prepared bottles contain the appropriate preservatives, and that the samples were chilled upon collection until daily delivered to the analytical laboratory. All bottles used for sampling were field prepped by Pinnacle laboratories. It is routine practice for this laboratory to add the appropriate preservatives as part of the bottle preparation. For evaluation purposes, it is assumed that all samples were properly preserved.

For the March 2005 event, laboratory certificates could only be located for a subset of the analysis including only the samples for RBG-1, RBG-2, and RBS-2. The available documentation indicates that these analyses were performed within control limits and that surrogate recoveries were adequate.

For the June 2005 sampling event, multiple samples were qualified for total phosphorous, potassium and sodium which were found in the method blank. There is one incidence of an SVOC compound (3,3'-Dichlorobenzidine, 2-fluorophenyl) and of potassium being outside of matrix spike or method blank surrogate control limits.

For the October 2005 sampling event, analyses were performed by two separate laboratories due to the impacts of Hurricane Katrina on the laboratory normally used for analysis. All quality control problems are associated with analysis from the alternate laboratory. These issues include: low matrix spike recovery for sulfate for samples from RBG series of wells, instances of both high and low matrix spike recovery for potassium, sample matrix interference on chromium for MG-3, MS-1, and MS-2, and excess recoveries for calcium. Problems with precision and accuracy were also flagged for magnesium. The analyses also note low recovery for foaming agents. Although the problems were flagged, results do not appear anomalous from other samples at these locations. These problems do, however, impose a limitation on determining significant statistical differences involving the October 2005 sampling event.

3.0 Results of Water Quality Analyses

The scope of the water quality analysis was previously discussed in Section 2.0. Analysis included organic compounds (herbicides, semivolatiles, volatiles, and surfactants), fecal coliform, metals, and other inorganic parameters.

3.1 Organic Compounds

3.1.1 *Herbicides and Pesticides*

Based on personal communications with the local New Mexico State University Agricultural Extension Agent for Bernalillo County, the commonly used pesticides/herbicides for pastures are Banvel and 2-4-D. Other pesticides that may be used include Poast, Pursuit, Sinbar, Treflan, Baylan, Bucril, Granoxon, Lorsban, and Sevine. On streambanks, the primary herbicide of