1.0 Study Area and Background

The South Valley area of Bernallilo County encompasses the area from Central Avenue to the Isleta Pueblo and from Coors Blvd. to I-25 and comprises approximately 39 square miles. The Rio Grande, Bosque, and large agricultural tracts of the South Valley (Figure 1.1) create one of the most attractive physical settings in the metropolitan area. For centuries, agriculture has been a traditional way of life for people of the flood plain of the Rio Grande and the South Valley maintained itself as a nearly self-sufficient agricultural community until the early 1940's. Recently, the amount of agricultural acreage has declined due to the conversion of land from agriculture to residential, commercial and manufacturing uses.

Within the South Valley, the northern urbanized neighborhoods merge into the more semi-urban, and agricultural areas farther south. Within the South Valley 1,679 parcels of property receive irrigation water from the Middle Rio Grande Conservancy District (MRGCD) although less than 3% of landowners own parcels of agricultural land that are larger than 40 acres. Large, production-scale tracts of agricultural properties currently exist near the intersection of Coors Blvd. and Rio Bravo Blvd.; between 2nd Street and the Rio Grande south of Rio Bravo Blvd., and between Coors Blvd. and the Rio Grande south of Pajarito Rd. Production-scale agricultural uses in the South Valley have historically included dairies and feedlots. Crops have been largely alfalfa, intended as feed for the dairies. As the dairy industry has declined, the demand for feed has also declined.

Agriculture fields in the South Valley are sustained by irrigation water from the drains and canals of the MRGCD. The shallow hydrology of this area is complicated by the interaction of surface and groundwater along numerous irrigation and drainage channels and the Rio Grande. Ground water is the primary source of domestic water for all households in the South Valley and Southwest and Southeast Mesa whether they get water from their own wells, from shared wells or from municipal systems. The aquifer in the inner valley area is very susceptible to contamination because the water table is shallow. Depth to the seasonal high water table ranges from ten to thirty-five feet over much of the inner valley.

Recognizing this vulnerability, the City of Albuquerque (CABQ) and the Bernalillo County's resolution to protect their shared groundwater resources is documented in the *Groundwater Protection Policy and Action Plan* (GPPAP), with implementation occurring through the Joint Administrative Directive (JAD). With regard to agricultural practices, the GPPAP states the City and County are to "monitor groundwater and drains to assess potential impacts to groundwater". The JAD assigns responsibilities for identifying control programs and whether the programs are to be conducted jointly or individually by the City or County. The JAD assigns Bernalillo County with the responsibility of assessing the potential affects of agricultural practices on the groundwater resources of the county and for coordinating and developing a plan for the monitoring.

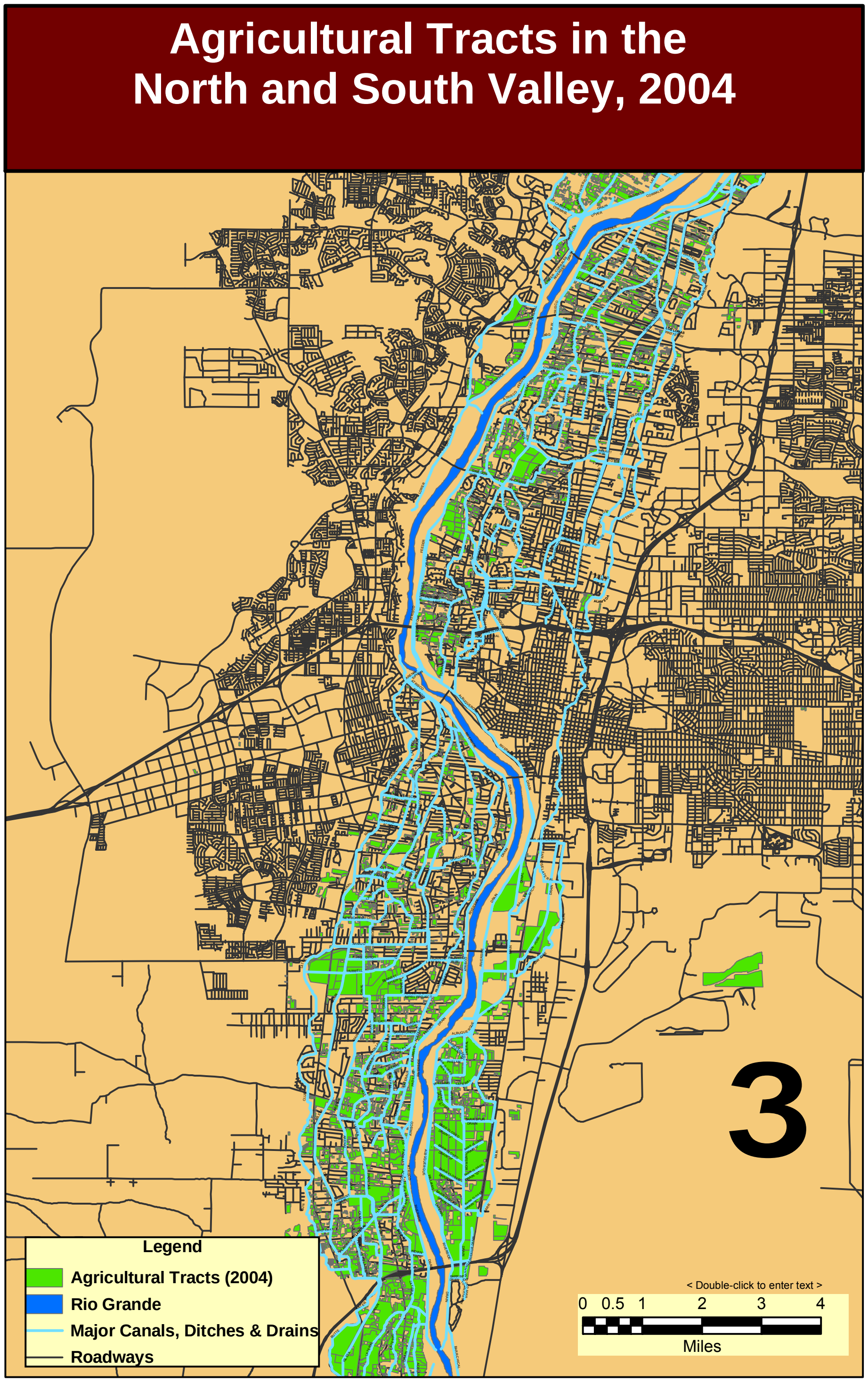

Figure 1.1 Agricultural Tracts in Bernalillo County

In April 2001, the Bernalillo County Environmental Health Department (BCEHD, and predecessor to Bernalillo County Office of Environmental Health), proposed development of an "agricultural waste impact monitoring program" along the Rio Grande. Accordingly, this study focuses on the potential shallow groundwater water-quality impacts of present-day agrichemical use.

1.1 *Initial Proposals and Programs*

Rick Shean with BCEHD prepared an initial proposal for a monitoring program in April of 2001 as a professional project within the University of New Mexico's (UNM) Water Resources Program. The initial stated purpose of the proposal was to:

> Develop an agricultural waste monitoring program for Bernalillo County along the Rio Grande that will conform with regional, local, and conservancy district planning using existing agricultural waste assessments, water quality data, surface and groundwater interaction estimates, and hydrological and geo hydrological data.

The proposal included a large scope of activities including gathering data on agricultural land and chemical use and practices, determination of diversion and return flow quantities, modeling of agricultural waste fate and transport, and developing a water budget and flow model for the valley area shallow aquifer, all within a one year time frame. There is no indication that the proposal came to fruition under the UNM program.

During FY01-02, however, BCEHD encumbered an initial $75,000 of GPPAP funding to implement a program closely paralleling the original proposal. The stated purpose of the program, as funded, was:

> Determination of both existing levels of agricultural waste products (pesticides, herbicides, fertilizers and fecal coliform) in shallow ground and surface water in the South Valley area of Bernalillo County, and assess shallow groundwater and surface water interaction.

1.2 *Related USGS Studies and Proposals*

The South Valley has been the focus of numerous reports and investigations by the New Mexico Environment Department (NMED), the United States Environmental Protection Agency (U.S. EPA) and the United States Geological Survey (USGS). Studies by the NMED and the U.S. EPA have typically been focused on hazardous waste releases and contamination issues and on specific locations or release area rather than on the impact of agricultural practices and surface water / shallow groundwater interaction. Three USGS studies are of particular relevance to this study

1.2.1 USGS Report: WRIR 97-4067

(Scott Anderholm, 1993. *Water Quality Assessment of the Rio Grande Valley, Colorado, New Mexico, and Texas – Shallow Ground-Water Quality and Land Use in the Albuquerque Area Central New Mexico*, U.S. Geological Survey Water-Resources Investigations Report 97-4069.)

As part of the National Water-Quality Assessment Program (NWQA), the USGS in 1993 conducted shallow groundwater sampling at 24 locations in the valley area, with locations covering an area just north of the Sandoval County line and extending southward to the I-25 / Rio Grande bridge, and between Coors Blvd. to the west and I-25 to the east. Site locations were selected using a computerized-stratified-random sampling technique. Well records within the selected locations were reviewed to ensure that 1) the well screened only the upper 10 to 15 feet of the zone of saturation, 2) well materials were either stainless steel or PVC, 3) the well was used only for monitoring, and 4) the well was not located in an area of known local contamination. Only five existing wells met those criteria. The USGS installed additional wells as needed. Sites 1 through 5 and 7 through 9 were located in the South Valley. In July through September 1993, the USGS sampled the wells for "selected common constituents, nutrients, dissolved organic carbon, trace elements, radionuclides, volatile organic compounds (VOCs) and pesticides." The wells were purged of three casing volumes, and samples were collected using a portable submersible pump.

The results of these analyses for samples collected in 1993 and reported by the USGS in 1997 indicated that volatile organic compounds were detected in 5 of 24 samples, with Cis-1,2-dichlorethene and 1,1 dichloroethane being detected in two samples each. Pesticides were detected in 8 of the 24 samples, with Prometon being the most common and detected in 8 of the 24 samples. Barium, iron, manganese, molybdenum, and uranium were the only trace elements analytes that had media concentrations greater than 5 micrograms per liter. Concentrations of nutrients were generally less than 1 milligram per liter, and the concentration of most of the trace elements were below or only slightly above 1 microgram per liter (ug/L)

The compounds Prometon and Atrazine are commonly used herbicides, Carbaryl is an insecticide used in multiple insecticide products and sold under the trade name of Sevin. P-isopropyltoluene is not an agricultural chemical. The reported concentrations were at least two orders of magnitude less than equivalent EPA limits or reference doses.

In samples from the South Valley sites, total nitrogen concentrations (as N) ranged from <0.05 to 2.8 mg/L and phosphorous ranged from <0.01 to 0.40 mg/L. The USGS (Water Supply Paper 2254, p. 128) cites references suggesting that total dissolved inorganic phosphate concentrations (as P) in river water should average about 0.01 mg/L (10 ug/L) and total dissolved phosphate about 0.025 mg/L (25 ug/L). The analysis results do not indicate any abnormally high concentrations of either of these two constituents, which are a primary component of agricultural fertilizers.

Organic compounds found in the samples from the South Valley wells included the following:

Table 1.1 South Valley Organic Compound Detections from the 1993 NWQA Study

Location Number	General Location	Detected Compound	Reported Conc. (ug/L)	Regulatory Standards*
2	Atrisco Drain south of Don Felipe Rd.	P-isopropyltoluene	0.4	No Data Available
4	Isleta Drain north of Harris Rd.	Atrazine	0.016	SDWA: 3 ug/L
3	Arenal Main Canal near Sunshine Rd.	Prometon	0.16	Oral RfD: 0.015 mg / kg $_{body}$/ day (≈ 17 ug/L)
5	Isleta Drain at the Pajarito Lateral	Prometon	0.005	Oral RfD: 0.015 mg / kg $_{body}$/ day (≈ 17 ug/L)
7	Atrisco Riverside Drain near Valle del Sol Rd..	Carbaryl	0.005	Oral RfD: 0.1 mg / kg $_{body}$/ day (≈113 ug/L)

* SDWA – Safe Drinking Water Act
RfD – Reference Dose taken from EPA IRIS database. Conversion to water concentration assuming body weight of 100 lbs (45.4 kg) and consumption of 4 liters of water per day.)

The USGS surmised that infiltration of surface water and the evaporation or transpiration of irrigation water was partially the result of past and present agricultural land use and seemed to affect the concentrations of common constituents in the shallow groundwater study area. The USGS also noted that infiltration of septic-system effluent from residential land use had affected the shallow groundwater compositions in parts of the study area. Although the presence of synthetic organic compounds was noted and indicates impact from human activities, determining the relationship between the type of land use and the presence of particular synthetic compounds was not possible.

The NWQA program is on-going and wells and additional sample locations in the South Valley were added to program as of November 2005.

1.2.2 USGS Report: WRIR 01-4069

(D.M. Roark, 2001, *Estimation of hydraulic characteristics in the Santa Fe Group aquifer system using computer simulations of river and drain pulses in the Rio Bravo study area, near Albuquerque, New Mexico*: U.S. Geological Survey Water-Resources Investigations Report 01-4069.)

In 1977, the USGS conducted a hydrologic investigation of the Rio Grande and the surrounding alluvium and the Santa Fe Group aquifer system in an area near the Rio Bravo Bridge. Wells were installed and equipped to monitor water levels in a transect perpendicular to the Rio Grande on the east side of the river. Equipment to measure stream stage was installed at two sites, on the Albuquerque Riverside Drain and on the Rio Grande. A short duration river pulse and a long-duration river pulse were used to stress the groundwater system. Computer modeling was used to simulated the hydrologic response. Simulated horizontal hydraulic conductivities varied from 0.03 to 100 feet per day, and vertical hydraulic conductivities varied from 1.5×10^{-6} to 0.01 feet per day. The specific yield from the upper most layer of the model was estimated to be 0.3, and lower layers were estimated to be approximately 1.0×10^{-6} (p.1).

1.2.3 USGS Investigation: Data Collection at Selected Locations on the Rio Grande River

In 2003, the USGS approached Bernalillo County with a proposal to install 20 monitoring wells in the South Valley area from Central Street south to the Pubelo of Isleta and within the historic Rio Grande Flood Plain. The wells were to be used to obtain shallow groundwater levels with the South Valley area. The data were to be used, primarily, by the Bureau of Reclamation and the U.S. Army Corp of Engineers to develop groundwater / surface water interaction data sets for input into the Upper Rio Grande Water Operations Model. No further action was taken on the proposal by the County.

Regardless, the USGS obtained funding to install a series of deep and shallow transects within the Rio Grande floodplain. In 2003, a cross section was established at the Rio Bravo Bridge and at other transect locations. Groundwater-levels from these sites are currently available and can be accessed on-line at http://nm.water.usgs.gov/bosque.html. The USGS transects at Rio Bravo Bridge and the I-25 bridges provide overlap in coverage with the transects installed and monitored as part of the agrichemical water-quality impact study. During 2004 and 2005, additional cross sections were established in the Albuquerque area. Cross-section locations now include the Alameda, Paseo del Norte, Montano, I-40, Central, Barelas, and I-25 Bridges. From 2005 to 2007, additional cross sections are to be established from Cochiti Dam to Bernalillo, I-25 to Bernardo, and Bernardo to San Acacia.

1.3 Surface Water Monitoring for Acequias Located Within Bernalillo County, 2005

Surface water monitoring for acequias located within Bernalillo County was done as a collaborative project between the Bernalillo County Office of Environmental Health, New Mexico Environment Department (NMED), Surface Water Quality Bureau, and the South Valley Partners for Environmental Justice (SVPEJ). Surface water monitoring was performed in response to the testimony provided by South Valley community residents on changing surface water quality standards from secondary to primary contact for the reach of the Rio Grande running through Bernalillo County. The Water Quality Control Board subsequently implemented the change from secondary to primary contact standards during the Triennial Review process.

Samples were collected from eight sites selected by community organizers living in the South Valley who were knowledgeable regarding the location of acequias that experienced the greatest amount of illegal dumping, and therefore represented a worst case scenario. The samples were collected according to EPA approved quality assurance/quality control protocols. Samples were analyzed by an EPA approved laboratory, the State Laboratory Division of the New Mexico Department of Health.

Of the eight sites sampled, the San Jose Drain site, the Los Padillas Drain site, and the Albuquerque Riverside Drain site exceeded the New Mexico Administrative Code surface water quality standards for *E. Coli* in the fall, while the San Jose Drain site also exceeded the *E. Coli* standard in the spring.

Based on the surface water quality standards for dissolved aluminum, antimony, arsenic, boron, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, thallium, vanadium, and zinc, the San Jose Drain site was also found to exceed the standard for dissolved mercury in the fall.

There were no exceedances of any of the semivolatile organics tested based on the surface water quality standards. Soil samples collected from San Jose Drain site did exceed the reference dose (RfD) levels set by the EPA Integrated Risk Information System for three of the semi-volatile organic compounds. These include Bis(2-Ethylhexyl)phthalate, Fluoranthene, and Pyrene. However, none of the soil samples collected exceeded the health based screening levels established by the NMED Hazardous Waste Bureau, the NMED Ground Water Quality Bureau Voluntary Remediation Program, and the NMED Superfund Section.

A more detailed description of this project and summary of results was prepared by the staff of the Bernalillo County of Environmental Health are provided in Appendix A of this report

1.4 Middle Rio Grande Microbial Source Tracking Assessment Report

The Middle Rio Grande Microbial Source Tracking Project was funded by the New Mexico Environmental Department, Albuquerque Metropolitan Arroyo Flood Control Authority, and Bernalillo County. The objective of the project was to identify specific sources of fecal coliform causing high levels of bacteria in the Middle Rio Grande area between Angostura Diversion Dam in southeastern Sandoval County to the Isleta Diversion Dam, at the northern border of the Isleta Pueblo.

A fecal coliform total maximum daily loads (TMDL) for the Middle Rio Grande was approved by the U.S. Environmental Protection Agency (U.S. EPA) Region 6 in May 2002. The TDML identified several potential sources of fecal bacteria in the Middle Rio Grande. The TMDL document indicates that septic systems and failures in sanitary sewer systems do not appear to be a large contributor to the elevated fecal coliform levels in the Middle Rio Grande. Nonpoint source runoff is identified as the likely major contributor to fecal coliform contamination. Of concern is nonpoint source runoff of storm water contaminated by livestock, wildlife, and other domestic animals, and discharged to the river through arroyos and drains.

Of interest to the agrichemical water-quality impact study is any contamination due to livestock evidenced at the subwatershed surface water sampling locations that correlate to the study

locations. For the entire study area, the relative percent of fecal coliform attributable to livestock does not change more than 1 percent between runoff and non-runoff conditions.
A summary of the findings is provided in Table 1.2 and indicates that fecal contamination from livestock (principally bovine and equine) is a notable contributor to the total fecal contamination load of the Middle Rio Grande.

Table 1.2 Summary of Microbial Source Tracking Assessment Report

Sample Location	Fecal Coliform Counts Runoff / *Non-Runoff* (Geo. Mean / Min / Max) cfu / 100 ml	# Samples Collected - Runoff / *Non- Runoff*	Percent of Isolates Attributable to Livestock - Combined (Total / Bovine / Equine)	Percent of Isolates Attributable to Livestock Runoff / *Non-Runoff* (Total / Bovine /Equine)
Entire MRG Study Area	4970 / 27 / 1,040,000 *28 / <10 / 712*	172 / *34*	13.7 / 7.2 / 4.3	13.7 / 7.2 / 4.4 *13.8 / 6.9 / 3.4*
Rio Grande at the Rio Bravo Bridge	2320 / 64 / 650,000 *22 / 9 /135*	7 / *3*	20.5 / 11.4 / 4.5	20.5 / 11.4 / 4.5 *Insufficient Data*
Rio Grande at the I-25 Bridge	4610 / 490 / 360,000 *412 / 189 / 684*	8 / *3*	17.4 / 9.4 / 4.7	12.2 / 8.1 / 2.7 *22.7 / 10.7 / 6..7*
Amole del Norte Channel	20,000 / 40,000 / 80,000 *Not Sampled*	2 / *0*	14.3 / 4.8 / 9.5	14.3 / 4.8 / 9.5 -- / -- / --
Los Padillas Drain upstream of Isleta Drain	253 / 36 / 2,600 *Not Sampled*	8 / *0*	16.7 / 16.7 / 0	16.7 / 0 / 16.7 -- / -- / --
Isleta Drain upstream of Las Padillas Drain	2,100 / 200 / 420,000 *Not Sampled*	9 / *0*	17.3 / 4.3 / 4.3	17.3 / 4.3 / 4.3 -- / -- / --

Location Notes:

Rio Grande at Rio Bravo Bridge – In addition to the watershed contributing from upstream, 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.

Rio Grande at Interstate 25 - This site is approximately 6 miles downstream of the Rio Bravo Bridge. 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 Wastewater Treatment Facility 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.

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.

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.

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.

1.5 Analogous Study at Las Nutria

(Bowman and Henrdickx, 1998. *Determination of Agricultural Chemical Impacts on Shallow Groundwater Quality in the Rio Grande Valley: Las Nutria Groundwater Project.* WRRI 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 Grand Valley. The study site was a highly instrumented 15-acres 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 purgeables. Intensive groundwater and tile drain sampling was also conducted for chloripyrifos (Lorsban) in 1995 and dimethoate (Dimate 4E) in 1996. A few groundwater samples contained trace amounts (0.1 to 1 ug/L) of chloripyrifos; no dimthoate was detected in any sample. Application rates were 1.5 pints per acre for chlropyrifos (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