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Ambient Groundwater Quality of the Gila Valley Sub-Basin of the Safford Basin

A 2004 Baseline Study

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Surface Water Section, Monitoring Unit

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Open File Report 2009 - OFR 09-12

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Photo Credits: Douglas Towne

Report Cover: Groundwater pumped by a shallow well empties into a ditch and eventually irrigates a field of cotton near the community of Geronimo just upstream of the tribal lands of the San Carlos Apache in the Gila Valley sub-basin. The farmland is located in the floodplain of the Gila River; in the background are the Gila Mountains.

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Other Publications of the ADEQ Ambient Groundwater Monitoring Program

ADEQ Ambient Groundwater Quality Open-File Reports (OFR):

Agua Fria Basin	OFR 08-02, July 2008, 59 p.
Pinal Active Management Area	OFR 08-01, June 2008, 97 p.
Hualapai Valley Basin	OFR 07-05, March 2007, 53 p.
Big Sandy Basin	OFR 06-09, October 2006, 66 p.
Lake Mohave Basin	OFR 05-08, October 2005, 66 p.
Meadview Basin	OFR 05-01, January 2005, 29 p.
San Simon Sub-Basin	OFR 04-02, October 2004, 78 p.
Detrital Valley Basin	OFR 03-03, November 2003, 65 p.
San Rafael Basin	OFR 03-01, February 2003, 42 p.
Lower San Pedro Basin	OFR 02-01, July 2002, 74 p.
Willcox Basin	OFR 01-09, November 2001, 55 p.
Sacramento Valley Basin	OFR 01-04, June 2001, 77 p.
Upper Santa Cruz Basin	OFR 00-06, Sept. 2000, 55 p. (With the U.S. Geological Survey)
Prescott Active Management Area	OFR 00-01, May 2000, 77 p.
Upper San Pedro Basin	OFR 99-12, July 1999, 50 p. (With the U.S. Geological Survey)
Douglas Basin	OFR 99-11, June 1999, 155 p.
Virgin River Basin	OFR 99-04, March 1999, 98 p.
Yuma Basin	OFR 98-07, September, 1997, 121 p.

ADEQ Ambient Groundwater Quality Fact sheets (FS):

Gila Valley Sub-basin	FS 09-28, November 2009, 7 p.
Agua Fria Basin	FS 08-15, June 2008, 4 p.
Pinal Active Management Area	FS 07-27, June 2008, 7 p.
Hualapai Valley Basin	FS 07-10, March 2007, 4 p.
Big Sandy Basin	FS 06-24, October, 2006, 4 p.
Lake Mohave Basin	FS 05-21, October 2005, 4 p.
Meadview Basin	FS 05-01, January 2005, 4 p.
San Simon Sub-basin	FS 04-06, October 2004, 4 p.
Detrital Valley Basin	FS 03-07, November 2003, 4 p.
San Rafael Basin	FS 03-03, February 2003, 4 p.
Lower San Pedro Basin	FS 02-09, August 2002, 4 p.
Willcox Basin	FS 01-13, October 2001, 4 p.
Sacramento Valley Basin	FS 01-10, June 2001, 4 p.
Yuma Basin	FS 01-03, April 2001, 4 p.
Virgin River Basin	FS 01-02, March 2001 4 p.
Prescott Active Management Area	FS 00-13, December 2000, 4 p.
Douglas Basin	FS 00-08, September 2000, 4 p.
Upper San Pedro Basin	FS 97-08, August 1997, 2 p. (With the U.S. Geological Survey)

These publications are available on-line.
Visit the ADEQ Ambient Groundwater Monitoring Program at:

www.azdeq.gov/environ/water/assessment/ambient.html

ADEQ Ambient Groundwater Monitoring Program Studies

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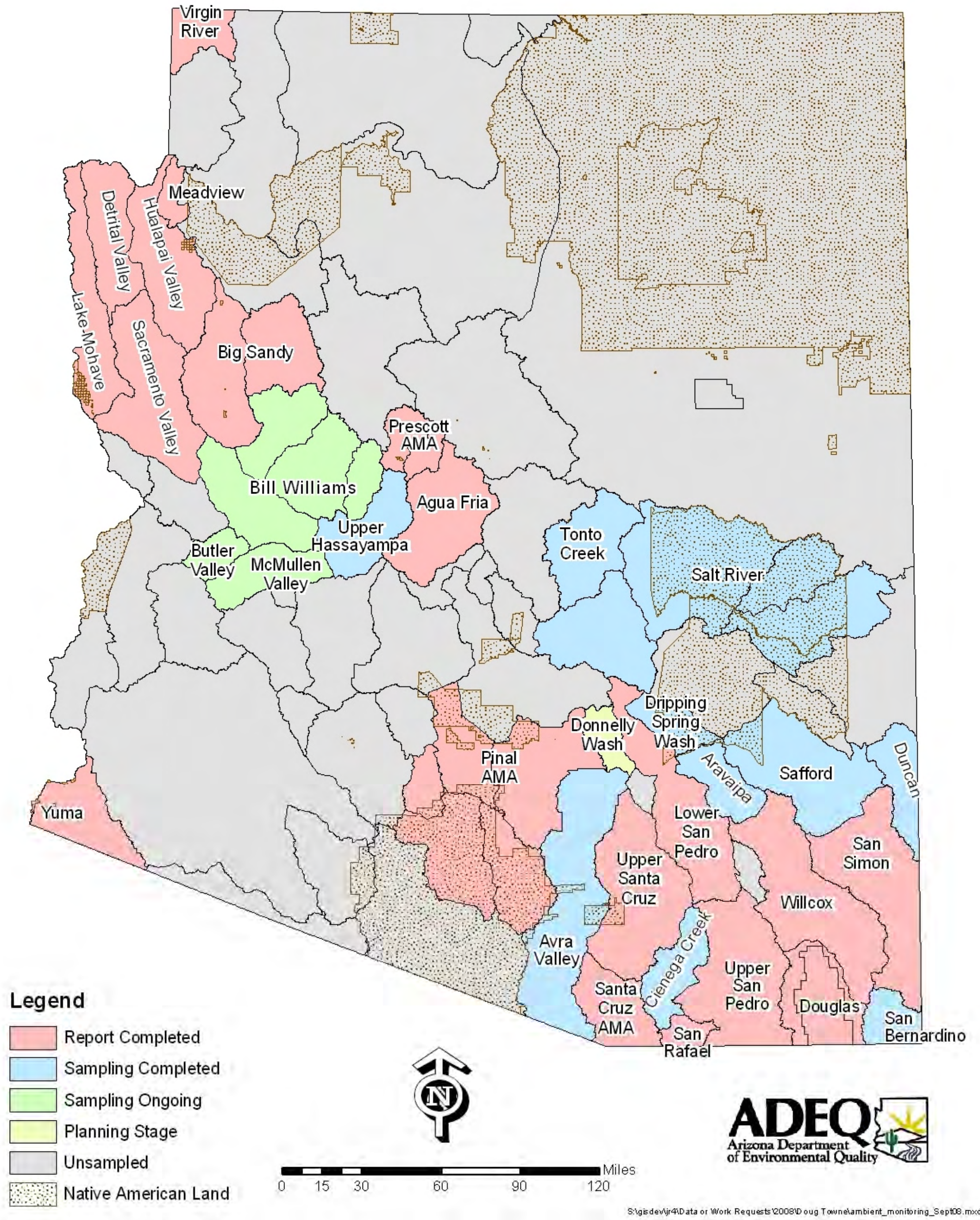

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Abbreviations

amsl	above mean sea level
ac-ft	acre-feet
AF/yr	acre-feet per year
ADEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
ADWR	Arizona Department of Water Resources
ARRA	Arizona Radiation Regulatory Agency
AZGS	Arizona Geological Survey
As	arsenic
bls	below land surface
BLM	U.S. Department of the Interior Bureau of Land Management
^{o}C	degrees Celsius
$CI_{0.95}$	95 percent Confidence Interval
Cl	chloride
EPA	U.S. Environmental Protection Agency
F	fluoride
Fe	iron
gpm	gallons per minute
GV	Gila Valley sub-basin
hard-cal	hardness concentration calculated from calcium and magnesium concentrations
HCl	hydrochloric acid
LLD	Lower Limit of Detection
MCL	Maximum Contaminant Level
ml	milliliter
msl	mean sea level
ug/L	micrograms per liter
um	micron
uS/cm	microSiemens per centimeter at 25° Celsius
mg/L	milligrams per liter
MRL	Minimum Reporting Level
MTBE	Methyl Tertiary-Butyl Ether
ns	not significant
ntu	nephelometric turbidity unit
pCi/L	picocuries per liter
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
SAF	Safford Groundwater Basin
SAR	Sodium Adsorption Ratio
SDW	Safe Drinking Water
SC	Specific Conductivity
su	standard pH units
SO_4	sulfate
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
USGS	U.S. Geological Survey
VOC	Volatile Organic Compound
*	significant at $p \leq 0.05$ or 95% confidence level
**	significant at $p \leq 0.01$ or 99% confidence level
***	for information only, statistical test for this constituent invalid because detections fewer than 50 percent

Ambient Groundwater Quality of the Gila Valley Sub-Basin: A 2004-2005 Baseline Study

Abstract - In 2004, the Arizona Department of Environmental Quality (ADEQ) conducted a baseline groundwater quality study of the Gila Valley sub-basin of the Safford groundwater basin located in eastern Arizona. The sub-basin includes the drainage of the Gila River from the Peloncillo Mountains down gradient to near the San Carlos Tribal Lands and the drainage of the San Simon River downstream from a ridge near the railroad siding of Tanque.[5] The sub-basin includes the communities of Safford, Thatcher, Pima and Fort Thomas and consists primarily of federal lands (U.S. Forest Service and Bureau of Land Management), State Trust and private land.[4]

To characterize regional groundwater quality, samples were collected from 67 wells and springs using a randomly stratified design. All sites were sampled for oxygen and deuterium isotopes. At selected sites, samples were collected for inorganic constituents (65 sites), radon (30 sites), radiochemistry (20 sites) and pesticides (4 sites). Nine isotope samples were collected from surface water sources to help determine groundwater recharge sources.

Analytical results indicate that of the 65 sites sampled for inorganics, only 11 sites (17 percent) met all health and aesthetics-based, federal and State water-quality standards. Health-based water quality standards, called Primary Maximum Contaminant Levels (MCLs), were exceeded at 30 of 65 sites (46 percent). These enforceable standards define the maximum concentrations of constituents allowed in water supplied for drinking water purposes by a public water system and are based on a lifetime (70 years) daily consumption of two liters.[3, 39] Constituents exceeding Primary MCLs include arsenic (21 sites), fluoride (20 sites), gross alpha (3 site), nitrate (4 sites), and uranium (2 sites). The proposed 300 picocuries per liter water quality standard for radon was also exceeded at 19 sites.[39] These water quality exceedances, with the exception of nitrate, appear to be the result of natural sources. Fluoride exceedances often occur at sites that are depleted in calcium allowing for large concentrations if a source for fluoride ions is available for dissolution.[28] Elevated arsenic concentrations may be related to an oxidizing environment, aquifer residence time, and clay mineralogy.[28, 29] Aesthetics-based water quality guidelines, called Secondary MCLs, were exceeded at 54 of 65 sites (83 percent).[39] Constituents above Secondary MCLs include chloride (29 sites), fluoride (35 sites), manganese (4 sites), pH (11 sites), sulfate (29 sites), and TDS (43 sites).

Groundwater is characterized as predominantly of either *sodium-bicarbonate* or *sodium-mixed* chemistry, varied from *fresh* to *moderately saline*, had *soft* to *very hard* water, and had few occurrences of trace elements other than arsenic, boron and fluoride.[13, 20] Analyses of oxygen and deuterium isotope samples revealed two general recharge groups: Gila River (18 sites) and local precipitation (47 sites). Local precipitation recharge was further subdivided into four categories: recent (2 sites), newer (12 sites), older (29 sites), and Mt. Graham springs (4 sites). These recharge sources roughly correlate to the following alluvial units: Gila River recharge (younger alluvium), local precipitation (older alluvium), recent local precipitation (summer monsoon recharge along tributaries to the Gila River), newer local precipitation (clay-silt sub-unit), older local precipitation (evaporate and/or basal conglomerate sub-unit), and Mt. Graham springs (winter precipitation recharge in the high altitude Pinaleno Mountains).

Statistically-significant patterns were found among the two main recharge sources (Kruskal-Wallis test, $p \leq 0.05$). TDS, major ions, nitrate and boron were higher in Gila River recharge than local recharge; the opposite pattern occurred with pH. Older local precipitation sites had significantly higher temperature, TDS, sodium, potassium, chloride, sulfate, arsenic, boron, and fluoride concentrations than newer local precipitation sites (Kruskal-Wallis test with Tukey test, $p \leq 0.05$). These patterns indicate the best strategy for developing public water supplies in the Gila Valley sub-basin from a water quality perspective appears to be drilling shallow wells in the older alluvium along the mountain front up from the Gila River.

In 1995, ADEQ conducted an extensive study of the Gila Valley sub-basin data sampling 81 targeted wells.[41] Despite different sampling strategies, the frequency of water quality exceedances for each study was remarkably similar. Examination of the 1995 data revealed deficiencies with sampling protocol and data validation, but the collected information was still considered suitable for making general groundwater quality comparisons between the studies. Using well characteristics and isotope data from the 2004 study, the 1995 sites were classified as either younger or older alluvium.[6] Using the data from the younger alluvium, 49 sites sampled in 1995 were compared with the 18 sites sampled in 2004. Concentrations of TDS, sodium, chloride, sulfate and pH-lab increased significantly in the decade between the studies (Mann-Whitney test, $p \leq 0.05$). Increases in concentrations of these constituents in the younger alluvium appears to be the result of saline water under artesian pressure entering from upward leakages along faults and abandoned wells and from saline irrigation recharge.[9, 19]

INTRODUCTION

Purpose and Scope

The Safford groundwater basin (SAF) covers approximately 4,854 square miles in southeastern Arizona. The basin is divided by the Arizona Department of Water Resources (ADWR) into three sub-basins: the San Simon, Gila Valley and San Carlos Valley. The Gila Valley sub-basin (GV), the focus of this report and the sub-basin exhibiting the greatest water development, encompasses approximately 1,642 square miles. [9]

The Gila Valley sub-basin is located in Graham County. The sub-basin's main drainage, the Gila River, flows east to west through the basin until debouching into San Carlos Lake. Groundwater is the primary source for municipal, domestic and stock uses in the basin. Most groundwater pumped in the sub-basin, however, is used for irrigation to supplement supplies from surface water diversions from the Gila River. Most of the cultivated lands are within the inner valley, a strip along the Gila River ranging from up to 3.5 miles in width. [9]

The sub-basin was selected for study by the Arizona Department of Environmental Quality (ADEQ) Ambient Groundwater Monitoring program to characterize the 2004 groundwater quality conditions and to investigate for any water quality changes since 1995 when the last study in the sub-basin was conducted. [41] The study will also continue the assessment of the groundwater quality of Upper Gila watershed that has culminated in the following ADEQ hydrology reports: Upper Gila Valley watershed (1998),[41] San Simon sub-basin (2004), [33] and Duncan basin (forthcoming).

Sampling by the ADEQ Ambient Groundwater Monitoring program is authorized by legislative mandate in the Arizona Revised Statutes §49-225, specifically: "*...ongoing monitoring of waters of the state, including...aquifers to detect the presence of new and existing pollutants, determine compliance with applicable water quality standards, determine the effectiveness of best management practices, evaluate the effects of pollutants on public health or the environment, and determine water quality trends.*" [3]

Benefits of ADEQ Study – This study, which utilizes accepted sampling techniques and quantitative analyses, is designed to provide the following benefits:

- A general characterization of regional groundwater quality conditions in the Gila Valley sub-basin identifying areas with impaired conditions. This statistically-based study is a valid and cost-effective alternative to testing all private wells in the basin for a wide variety of groundwater quality concerns. [21]

- A process for evaluating potential groundwater quality impacts arising from a variety of sources including mineralization, mining, agriculture, livestock, septic tanks, and poor well construction.

- An evaluation on whether the groundwater quality has significantly changed over the past decade.

- A guide for identifying future locations of public supply wells.

Physical Characteristics

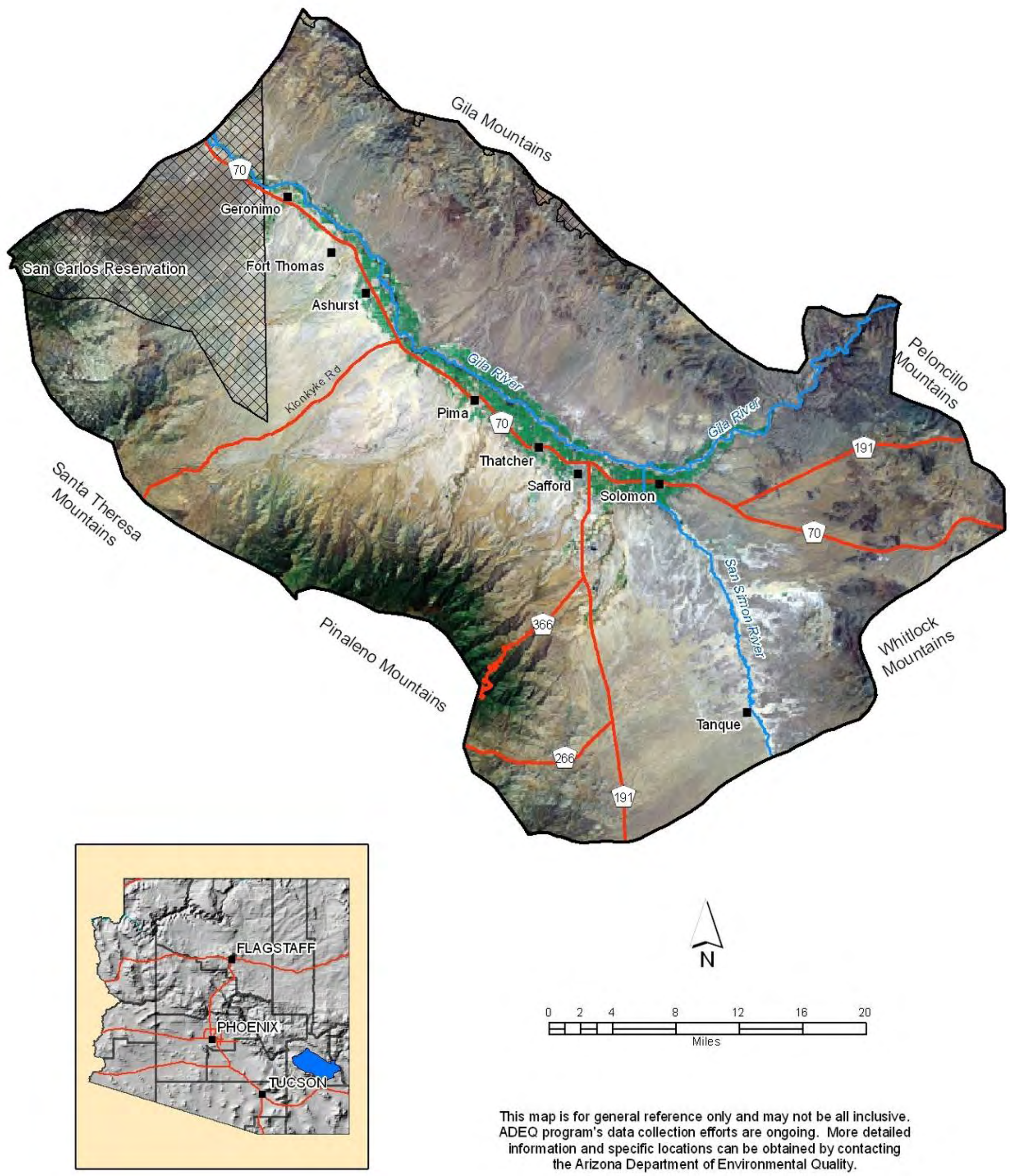
Geography –The Gila Valley sub-basin boundaries include the drainage divides formed by the Gila Mountains on the northeast, the Peloncillo and Whitlock Mountains on the east, and the Pinaleno and Santa Teresa Mountains on the southwest (Map 1). A ridge south of the railroad siding of Tanque marks the southeast boundary that separates it from the up-gradient San Simon sub-basin. An arbitrary line five miles downstream from the community of Geronimo forms the northwest boundary that separates it from the down gradient San Carlos Valley sub-basin. [9]

Land surface elevations in the Gila Valley sub-basin vary from 10,713 feet above mean sea level (amsl) at Mount Graham in the Pinaleno Mountains to about 2,600 feet amsl where the Gila River enters the San Carlos Valley sub-basin. [9]

Safford is the sub-basin's largest community with a 2007 population of 9,460. [1] Other towns located along Highway 70 include Solomon, Thatcher, Pima and Fort Thomas. The Gila Valley sub-basin consists of federal land managed by the U.S. Forest Service (USFS) or the Bureau of Land Management (BLM), State Trust land, and private land.[4]

Climate – The climate of the Gila Valley sub-basin is semiarid, characterized by hot summers and mild winters. Precipitation occurs predominantly as rain in during the late summer, localized monsoon thunderstorms and, to a lesser degree, as widespread,

Map 1: Gila Valley Sub Basin



low intensity winter rain that sometimes includes snow at higher elevations. Annual precipitation averages 9 inches per year in the inner valley and greater than 30 inches per year in the surrounding mountains. [9]

Economy – Safford serves as a government and retail center for the area. [1] Agriculture is the major industry in the area with about 40,000 acres of crops, mostly cotton and alfalfa, grown. [1] The Safford Mine operated by Freeport-McMoran Copper & Gold Company began production in 2007. This mine is a major employer in the area and is the first new, large-scale, copper mining project in Arizona in more than 30 years.

HYDROGEOLOGY

Surface Water

The basin's main drainage is the Gila River, which originates in the Mogollon Mountains in western New Mexico and flows easterly through Arizona—and the Gila Valley sub-basin—before debouching into San Carlos Lake, an impoundment formed by Coolidge Dam completed in 1928. [38] The San Simon River, an ephemeral watercourse, drains the southern part of the sub-basin and has its confluence with the Gila River east of Safford near the town of Solomon.

The Gila River is intermittent at the New Mexico border but has two perennial stretches approximately 43 miles in length in Arizona.[41] Perennial reaches of the Gila River include a stretch through the Gila River Riparian National Conservation Area and another just above the Gila Valley sub-basin and are largely the result of inflow from three major tributaries: the San Francisco, Bonita Creek and Eagle Creek. Through the Gila Valley sub-basin, the Gila River is intermittent because of stream diversions, heavy pumping of groundwater for irrigation use and water consumption by riparian vegetation. [6] First used for irrigation around 1872, several diversion dams along the Gila River continue to divert water for irrigation use, a practice that has been regulated by the Gila Decree since 1936.[6] Drought and an increase in cultivated land in the mid-1930s resulted in increased demands for water which prompted many irrigation wells to be drilled in the area.[9] The quantity of groundwater pumped is closely related to the quantity of surface water available for irrigation use as the total water used is fairly consistent.

Groundwater

The Gila Valley sub-basin is part of a large, sediment-filled, trough-like depression typical of the geological structures of the Mexican Highland section of the Basin and Range physiographic province. [9] The surrounding mountains are composed of gneiss, schist, granite, volcanic, and sedimentary rocks; their eroded remnants fill the Gila Valley. [26] The sediment in the Gila Valley, which may be as much as 11,200 feet thick, has been divided into two units, the younger alluvial fill and the older alluvial fill that together likely function as a single aquifer system. [9] These units are often separated by a thick, discontinuous blue clay layer though well logs sometimes reveal more complex interbedding with other clay, sand and gravel layers to form the demarcation. [18] Although the majority of retrievable groundwater is in the older alluvial fill, the younger alluvial fill is the unit of principal use. [9]

The younger alluvial fill of Holocene age is composed of Gila River sediments that occur in discontinuous lenticular beds consisting of clay and unconsolidated silt, sand, and gravel. The unit is rarely wider than four miles and is thickest near Safford where it averages 85 feet in depth and tapers to about 30 feet thick down gradient near Geronimo. [9]

Although the older alluvial fill is interfingered with numerous water bearing layers, it can be divided into, in descending order, three sub-units classified by lithologic and paleontologic characteristics: clay-silt, evaporite, and basal-conglomerate. [9] The clay-silt sub-unit is lacustrine in origin and can be as much as 610 feet thick. [9] The evaporite sub-unit is composed of salt beds, gypsum, limestone, gypsiferous clay, and shale and is thickest near the basin axis. The basal-conglomerate sub-unit is composed of sand and gravel and extends throughout the sub-basin. The clay-silt sub-unit, at the top of the older alluvial unit, restricts vertical movement of groundwater in the underlying sub-units causing artesian conditions that result in flowing wells at ground surface.[9] Hard rock found in the surrounding mountains (Map 1) also yields small amounts of water from local aquifers.

The primary source of recharge in the sub-basin is the Gila River; groundwater levels respond rapidly to increases in surface water flow. Significant amounts of mountain-front recharge from local precipitation occur in stream channels that have cut into caliche-capped gravel zones along the Pinaleno and Gila Mountains (Map 1). [9] Other sources of recharge are percolation from agricultural irrigation and seepage from canals. Groundwater moves from the sub-basin's margins toward, and then parallel, to the Gila River as it flows to the northwest. [9]

Figure 1 – Carrying a heavy silt load from summer rains, the Gila River flows from the Gila Box Riparian National Conservation area toward the town of Solomon. Mt Graham in the Pinaleno Mountains is in the distance.

Figure 2 - After flowing through the Gila Valley with part of the water diverted for irrigation purposes, the Gila River enters San Carlos Apache lands near the community of Geronimo. Groundwater pumping supplements flow from the Gila River for irrigation in the valley.

INVESTIGATION METHODS

ADEQ collected samples from 67 groundwater sites to characterize regional groundwater quality in the Gila Valley sub-basin (Map 2). Specifically, the following types of samples were collected:

- oxygen and deuterium isotopes at 67 sites
- inorganic suites at 65 sites
- radon at 30 sites
- radiochemistry at 20 sites
- pesticides at 4 sites
- In addition, 6 isotopes were collected and analyzed from surface water sources and 3 isotopes were collected from precipitation events to help determine groundwater recharge sources.

No bacteria sampling was conducted because microbiological contamination problems in groundwater are often transient and subject to a variety of changing environmental conditions including soil moisture content and temperature. [17]

Sampling Strategy

This study focused on regional groundwater quality conditions that are large in scale and persistent in time. The quantitative estimation of regional groundwater quality conditions requires the selection of sampling locations that follow scientific principles for probability sampling. [21]

Sampling followed a systematic, random selection approach with sites stratified between water units. This is an efficient method since it requires sampling relatively few sites to make valid statistical statements about the conditions of large areas. This systematic element requires that the selected wells be spatially distributed while the random element ensures that every well has an equal chance of being sampled. This strategy also reduces the possibility of biased well selection and assures adequate spatial coverage throughout the study area. [21]

Wells pumping groundwater for irrigation, stock and domestic purposes were sampled for this study, provided each well met ADEQ requirements. A well was considered suitable for sampling if the owner gave permission to sample, if a sampling point existed near the wellhead, and if the well casing and surface seal appeared to be intact and undamaged.[7] Other factors such as casing access to determine groundwater depth and construction information were preferred but not essential.

Many requests to sample wells were denied because of fears the data would influence water rights litigation associated with the Gila River adjudication; other wells were not sampled because they lack proper sampling ports.

For this study, ADEQ personnel sampled 67 groundwater sites that consisted of 14 springs and 53 wells with the following types of pumps: submersible pumps (23 wells), turbine pumps (18 wells), windmills (8 wells), and artesian flow (4 wells). Springs produce water for domestic, stock and/or wildlife use, submersible pumps produce water for municipal, domestic and/or stock use, turbine and artesian wells produce water for irrigation and windmills produce water for stock use. Additional information on groundwater sample sites is compiled from the ADWR well registry in Appendix A. [6]

Several factors were considered to determine sample size for this study. Aside from administrative limitations on funding and personnel, this decision was based on three factors related to the conditions in the area: amount of groundwater quality data already available; extent to which impacted groundwater is known or believed likely to occur; and hydrologic complexity and variability of the basin. [21]

Sample Collection

The sample collection methods for this study conformed to the *Quality Assurance Project Plan* (QAPP) [2] and the *Field Manual For Water Quality Sampling*. [7] While these sources should be consulted as references to specific sampling questions, a brief synopsis of the procedures involved in collecting a groundwater sample is provided.

After obtaining permission from the owner to sample the well, the volume of water needed to purge the well three bore-hole volumes was calculated from well log and on-site information. Physical parameters—temperature, pH, and specific conductivity—were monitored at least every five minutes using an YSI multi-parameter instrument.

To assure obtaining fresh water from the aquifer, after three bore volumes had been pumped and physical parameter measurements had stabilized within 10 percent, a sample representative of the aquifer was collected from a point as close to the wellhead as possible. In certain instances, it was not possible to purge three bore volumes. In these cases, at least one bore volume was evacuated and the physical parameters had stabilized within 10 percent.

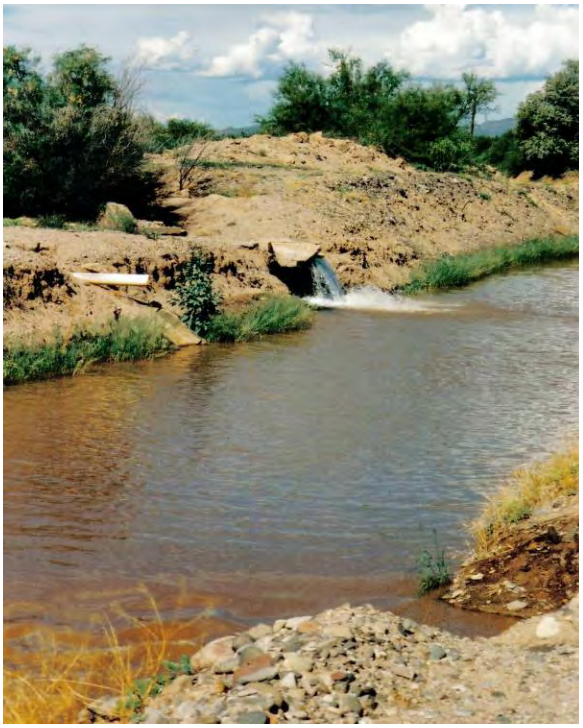


Figure 3 – A diversion dam on the Gila River diverts flow into the San Jose Canal for irrigation use; the 700-foot-deep Buena Vista Hot Well (GV-48) also supplies the canal.

Figure 4 – The windmill at Goat Well (GV-1) south of Safford near the San Simon River produces water for livestock.

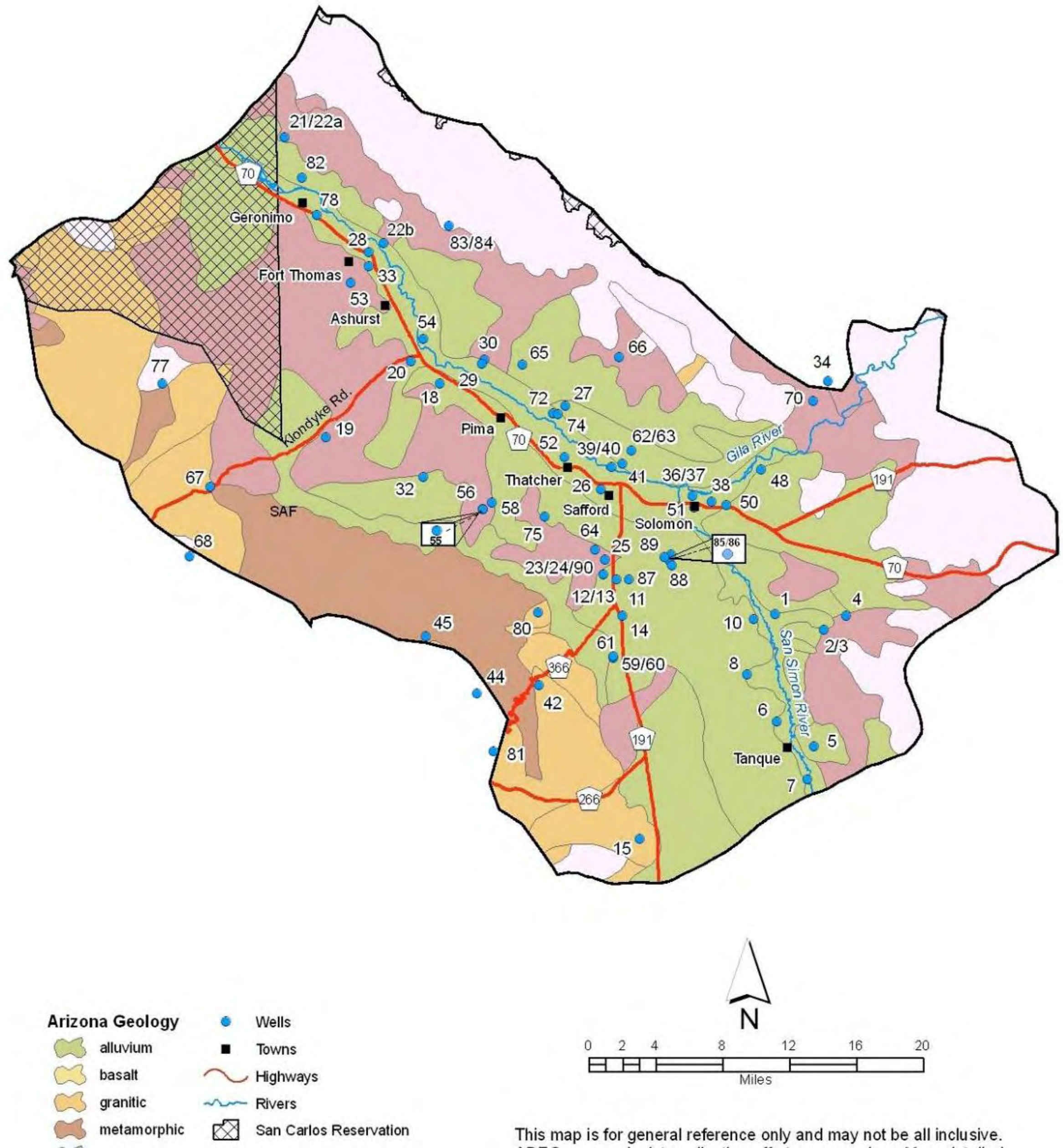
Figure 5 - A well (GV-90) equipped with a submersible pump used for domestic purposes near Cactus Flat is sampled by ADEQ's Elizabeth Boettcher.

Figure 6 – Dankworth Hot Well (GV-14) is an artesian well used for recreation purposes near Roper State Park.

Figure 7 – An un-sampled irrigation well equipped with a turbine pump supplies water to a field of cotton near the Town of Thatcher; Mt. Graham is in the background. While the Gila River is the main source of irrigation water for farms, groundwater supplements or is the only water source for some farms. [9]

Figure 8 – ADEQ intern Claire Metz samples Heliograph Spring (GV-44) near the summit of Mt. Graham. Springs are found throughout the Gila Valley sub-basin**.**

Map 2: Geology and Sample Sites



This map is for general reference only and may not be all inclusive. ADEQ program's data collection efforts are ongoing. More detailed information and specific locations can be obtained by contacting the Arizona Department of Environmental Quality.

Inset maps are used to show closely spaced sample sites; sub-basin boundaries are approximate; all sample sites are within sub-basin.

Sample bottles were filled in the following order:

1. Pesticides
2. Radon
3. Inorganic
4. Radiochemistry
5. Isotope

Pesticide samples were collected in unpreserved, 1 gallon amber glass containers. Radon samples were collected in two unpreserved, 40-ml clear glass vials. Radon samples were carefully filled to minimize volatilization and subsequently sealed so that no headspace remained. [14]

The inorganic constituents were collected in three, 1-liter polyethylene bottles: samples to be analyzed for dissolved metals were delivered to the laboratory unfiltered and unpreserved where they were subsequently filtered into bottles using a positive pressure filtering apparatus with a 0.45 micron (µm) pore size groundwater capsule filter and preserved with 5 ml nitric acid (70 percent). Samples to be analyzed for nutrients were preserved with 2 ml sulfuric acid (95.5 percent). Samples to be analyzed for other parameters were unpreserved. [27]

Radiochemistry samples were collected in two collapsible 4-liter plastic containers and preserved with 5 ml nitric acid to reduce the pH below 2.5 su. [15]

All samples were kept at 4^{o}C with ice in an insulated cooler, with the exception of the isotope and radiochemistry samples. Chain of custody procedures were followed in sample handling. Samples for this study were collected during seven field trips between April 2004 and August 2005.

Laboratory Methods

The inorganic and organic analyses for this study were conducted by the Arizona Department of Health Services (ADHS) Laboratory in Phoenix, Arizona. Inorganic sample splits analyses were conducted by Test America Laboratory in Phoenix, Arizona. A complete listing of inorganic parameters, including laboratory method, EPA water method and Minimum Reporting Level (MRL) for each laboratory is provided in Table 1. The analyte list for the organic samples is provided in Table 2 and Table 3.

Radon samples were analyzed by Radiation Safety Engineering, Inc. Laboratory in Chandler, Arizona.
Radiochemistry samples were analyzed by the Arizona Radiation Regulatory Agency Laboratory in Phoenix and radiochemistry splits by the Radiation Safety Engineering, Inc. Laboratory. The following EPA SDW protocols were used: Gross alpha was analyzed, and if levels exceeded 5 picocuries per liter (pCi/L), then radium-226 was measured. If radium-226 exceeded 3 pCi/L, radium-228 was measured. If gross alpha levels exceeded 15 pCi/L initially, then radium-226/228 and total uranium were measured. [15]

DATA EVALUATION

Quality Assurance

Quality-assurance (QA) procedures were followed and quality-control (QC) samples were collected to quantify data bias and variability for the Gila Valley sub-basin study. The design of the QA/QC plan was based on recommendations included in the *Quality Assurance Project Plan* (*QAPP*) and *the Field Manual For Water Quality Sampling.* [2, 7] Types and numbers of QC samples collected for this study are as follows:

Inorganic: (5 duplicates, 5 splits, and 6 blanks).

Radiochemical, Radon and Pesticide: (no QA/QC samples)

Isotope: (6 duplicates)

Based on the QA/QC results, sampling procedures and laboratory equipment did not significantly affect the groundwater quality samples of this study.

Blanks - Equipment blanks for inorganic analyses were collected to ensure adequate decontamination of sampling equipment, and that the filter apparatus and/or de-ionized water were not impacting the groundwater quality sampling. [7] Equipment blank samples for major ion and nutrient analyses were collected by filling unpreserved and sulfuric acid preserved bottles with de-ionized water. Equipment blank samples for trace element analyses were collected with de-ionized water that had been filtered into nitric acid preserved bottles.

Systematic contamination was judged to occur if more than 50 percent of the equipment blank samples contained measurable quantities of a particular groundwater quality constituent according to UGSG protocols. The equipment blanks contained SC-lab and turbidity contamination at levels expected due to impurities in the source water used for the samples. The blank results, however, did not indicate systematic contamination. SC was detected in 6 equipment blanks, turbidity in 5 equipment blanks, and chloride in 2 samples.

Table 1. Laboratory Water Methods and Minimum Reporting Levels Used in the Gila Valley Sub-Basin Study

Constituent	Instrumentation	ADHS / Test America Water Method	ADHS / Test America Minimum Reporting Level
Physical Parameters and General Mineral Characteristics			
Alkalinity	Electrometric Titration	SM2320B	2 / 5
SC (uS/cm)	Electrometric	EPA 120.1/ SM2510B	-- / 1
Hardness	Titrimetric, EDTA	EPA 130.2 / SM2340B	10 / 1
Hardness	Calculation	Calculation	--
pH (su)	Electrometric	EPA 150.1	0.1
TDS	Gravimetric	EPA 160.1 / SM2540C	10 / 20
Turbidity (NTU)	Nephelometric	EPA 180.1	0.01 / 1
Major Ions			
Calcium	ICP-AES	EPA 200.7	1 / 2
Magnesium	ICP-AES	EPA 200.7	1 / 0.5
Sodium	ICP-AES	EPA 200.7 / EPA 273.1	1 / 5
Potassium	Flame AA	EPA 200.7 / EPA 258.1	0.5 / 1
Bicarbonate	Calculation	Calculation	2
Carbonate	Calculation	Calculation	2
Chloride	Potentiometric Titration	SM 4500 CL D	5 / 0.5
Sulfate	Colorimetric	EPA 375.4	1 / 0.5
Nutrients			
Nitrate as N	Colorimetric	EPA 353.2	0.02 / 0.1
Nitrite as N	Colorimetric	EPA 353.2	0.02 / 0.1
Ammonia	Colorimetric	EPA 350.1/ EPA 350.3	0.02 / 0.5
TKN	Colorimetric	EPA 351.2 / SM4500	0.05 / 0.5
Total Phosphorus	Colorimetric	EPA 365.4 / EPA 365.3	0.02 / 0.05

All units are mg/L except as noted
Source [14, 27]

Table 1. Laboratory Water Methods and Minimum Reporting Levels Used in the Gila Valley Sub-Basin Study--Continued

Constituent	Instrumentation	ADHS / Test America Water Method	ADHS / Del Mar Minimum Reporting Level
		Trace Elements	
Antimony	Graphite Furnace AA	EPA 200.9	0.005 / 0.004
Arsenic	Graphite Furnace AA	EPA 200.9	0.01 / 0.003
Barium	ICP-AES	EPA 200.7	0.1 / 0.01
Beryllium	Graphite Furnace AA	EPA 200.9	0.0005
Boron	ICP-AES	EPA 200.7	0.1 / 0.5
Cadmium	Graphite Furnace AA	EPA 200.9	0.001 / 0.0005
Chromium	Graphite Furnace AA	EPA 200.7	0.01 / 0.004
Copper	Graphite Furnace AA	EPA 200.7 / EPA 200.9	0.01 / 0.004
Fluoride	Ion Selective Electrode	SM 4500 F-C	0.1 / 0.1
Iron	ICP-AES	EPA 200.7	0.1 / 0.2
Lead	Graphite Furnace AA	EPA 200.9	0.005 / 0.002
Manganese	ICP-AES	EPA 200.7	0.05 / 0.02
Mercury	Cold Vapor AA	SM 3112 B / EPA 245.1	0.0002 / 0.0002
Nickel	ICP-AES	EPA 200.7	0.1 / 0.05
Selenium	Graphite Furnace AA	EPA 200.9	0.005 / 0.004
Silver	Graphite Furnace AA	EPA 200.9 / EPA 200.7	0.001 / 0.005
Thallium	Graphite Furnace AA	EPA 200.9	0.002
Zinc	ICP-AES	EPA 200.7	0.05
		Radiochemicals	
Gross alpha beta	Gas flow proportional counter	EPA 900.0	varies
Co-Precipitation	Gas flow proportional counter	EPA 00.02	varies
Radium 226	Gas flow proportional counter	EPA 903.0	varies
Radium 228	Gas flow proportional counter	EPA 904.0	varies
Uranium	Kinetic phosphorimeter	EPA Laser Phosphorimetry	varies

All units are mg/L
Source [14, 15, 27]

For SC, equipment blanks had a mean (7 uS/cm) which was less than 1 percent of the SC mean concentration for the study. The SC detections may be explained in two ways: water passed through a de-ionizing exchange unit will normally have an SC value of at least 1 uS/cm, and carbon dioxide from the air can dissolve in de-ionized water with the resulting bicarbonate and hydrogen ions imparting the observed conductivity.[27]

For turbidity, equipment blanks had a mean level (0.0475 ntu) less than 1 percent of the turbidity median level for the study. Testing indicates turbidity is present at 0.01 ntu in the de-ionized water supplied by the ADHS laboratory, and levels increase with time due to storage in ADEQ carboys.[27] Chloride had a mean concentration of 0.81 mg/l while the single detection of nitrate (as nitrogen) occurred at a concentration of 0.02 mg/l.

Duplicate Samples - Duplicate samples are identical sets of samples collected from the same source at the same time and submitted to the same laboratory. Data from duplicate samples provide a measure of variability from the combined effects of field and laboratory procedures.[7] Duplicate samples were collected from sampling sites that were believed to have elevated constituent concentrations as judged by field SC values. Five duplicate samples were collected in this study.

Analytical results indicate that of the 36 constituents examined, 22 had concentrations above the MRL. The maximum variation between duplicates was less than 10 percent (Table 2). The only exceptions were turbidity (71 percent), TKN (44 percent), fluoride (18 percent), calcium and sulfate (14 percent), and magnesium (11 percent). The median variation between duplicates was less than 3 percent except with turbidity (43 percent), carbonate (13 percent), and TKN (10 percent). Isotope (6 duplicates) samples showed less than a 1 percent maximum variation between duplicates.

Split Samples - Split samples are identical sets of samples collected from the same source at the same time that are submitted to two different laboratories to check for laboratory differences.[7] Five inorganic split samples were collected and analytical results were evaluated by examining the variability in constituent concentrations in terms of absolute levels and as the percent difference.

Analytical results indicate that of the 36 constituents examined only 19 had concentrations above MRLs for both ADHS and Test America (formerly Del Mar) laboratories (Table 3). The maximum variation between splits was less than 10 percent. The only exceptions were TKN (60 percent), carbonate and turbidity (33 percent), copper (24 percent), hardness and fluoride (13 percent), and potassium (12 percent).

Split samples were also evaluated using the non-parametric sign test to determine if there were any significant ($p \leq 0.05$) differences between ADHS laboratory and Test America laboratory analytical results. Results of the sign test revealed no significant differences. Split results reported by ADHS laboratory detected phosphorus and zinc in one sample at concentrations above Test America laboratory MRLs that were reported as non-detections by the latter laboratory.

Despite some high variations in turbidity and TKN concentrations in QA/QC samples which have also occurred in other studies, based on the results of blanks, duplicates and the split sample collected for this study, no significant QA/QC problems were apparent with the groundwater quality collected for this study.

Data Validation

The analytical work for this study was subjected to the following five QA/QC correlations. [22] The analytical work conducted for this study was considered valid based on the quality control samples and the QA/QC correlations.

Cation/Anion Balances - In theory, water samples exhibit electrical neutrality. Therefore, the sum of milliequivalents per liter (meq/L) of cations must equal the sum of meq/L of anions. However, this neutrality rarely occurs due to unavoidable variation inherent in all water quality analyses. Still, if the cation/anion balance is found to be within acceptable limits, it can be assumed there are no gross errors in concentrations reported for major ions.[22]

Overall, cation/anion meq/L balances of Gila Valley sub-basin samples were significantly correlated (regression analysis, $p \leq 0.01$) and were within acceptable limits (90 - 110 percent) except for eight samples. Of these eight samples, six (GV-1, GV-6, GV-12/12, GV-14, GV-20 and GV-41) were almost within acceptable limits (85 – 115 percent). Of the two remaining samples, GV-33 had an 18 percent error while GV-58 had a 24 percent error. Although the ADHS lab could not locate any errors in these samples, GV-58 had a high TDS concentration of 3,400 mg/L along with a strong sodium-chloride chemistry that may have made constituent analyses more difficult.

Table 2. Summary Results of Gila Valley Sub-Basin Duplicate Samples from the ADHS Laboratory

Parameter	Number	Difference in Percent			Difference in Concentrations		
		Minimum	Maximum	Median	Minimum	Maximum	Median
Physical Parameters and General Mineral Characteristics							
Alk., Total	5	0 %	3 %	0 %	0	10	0
SC (uS/cm)	5	0 %	1 %	0 %	0	10	0
Hardness	5	0 %	2 %	0 %	0	10	0
pH (su)	5	0 %	2 %	0 %	0	0.3	0
TDS	5	0 %	1 %	0 %	0	10	0
Turb. (ntu)	5	5 %	71 %	43 %	0.03	0.7	0.2
Major Ions							
Bicarbonate	5	0 %	4 %	0 %	0	10	0
Carbonate	1	-	-	13 %	-	-	2.5
Calcium	5	0 %	14 %	1 %	0	8	1
Magnesium	5	0 %	11 %	1 %	0	1	0.2
Sodium	5	0 %	2 %	0 %	0	40	
Potassium	5	0 %	5 %	0 %	0	10	0
Chloride	5	0 %	3 %	3 %	0	40	1
Sulfate	5	0 %	14 %	1 %	0	50	0.1
Nutrients							
Nitrate (as N)	4	0 %	6 %	0 %	0	0.2	0
Phosphorus *	3	0 %	2 %	0 %	0	0.001	0
TKN	5	7 %	44 %	10 %	0.011	0.15	0.04
Trace Elements							
Arsenic	1	-	-	2 %	-	-	0.002
Boron	3	0 %	0 %	0 %	0	0	0
Chromium	1	-	-	3 %	-	-	0.001
Copper	1	-	-	3 %	-	-	0.001
Fluoride *	4	0 %	18 %	2 %	0	0.8	0.1

All concentration units are mg/L except as noted with certain physical parameters.

* Total phosphorus was detected near the MRL in one duplicate sample (0.034 mg/L) and not detected in the other sample (0.02 mg/L). Fluoride was detected near the MRL in one duplicate sample (0.33 mg/L) and not detected in the other sample (< 0.20 mg/L). Zinc was detected near the MRL in one duplicate sample (0.055 mg/L) and not detected in the other sample (0.05 mg/L).

SC/TDS - The SC and TDS concentrations measured by contract laboratories were significantly correlated as were field-SC and TDS concentrations (regression analysis, $r = 0.98$, $p \leq 0.01$). The TDS concentration in mg/L should be from 0.55 to 0.75 times the SC in µS/cm for groundwater up to several thousand TDS mg/L.[22] Groundwater high in bicarbonate and chloride will have a multiplication factor near the lower end of this range; groundwater high in sulfate may reach or even exceed the higher factor. The relationship of TDS to SC becomes undefined for groundwater with very high or low concentrations of dissolved solids.[22]

Hardness - Concentrations of laboratory-measured and calculated values of hardness were significantly correlated (regression analysis, $r = 0.99$, $p \leq 0.01$). Hardness concentrations were calculated using the following formula: [(Calcium x 2.497) + (Magnesium x 4.118)].[22, 23]

SC - The SC measured in the field at the time of sampling was significantly correlated with the SC measured by contract laboratories (regression analysis, $r = 0.99$, $p \leq 0.01$).

pH - The pH value is closely related to the environment of the water and is likely to be altered by sampling and storage.[22] Thus, the pH values measured in the field using a YSI meter at the time of sampling were not significantly correlated with laboratory pH values (regression analysis, $r = 0.68$, $p \leq 0.01$).

Temperature / GW Depth /Well Depth – Groundwater temperature measured in the field was compared to well depth and groundwater depth. Groundwater temperature should increase with depth, approximately 3 degrees Celsius with every 100 meters or 328 feet. [8] Well depth was significantly correlated with temperature (regression analysis, $r = 0.84$, $p \leq 0.01$); however temperature was not significantly correlated with groundwater depth (regression analysis, $r = 0.07$). The lack of a significant relationship between temperature and groundwater depth is due in part to the four deep artesian wells.

Statistical Considerations

Various methods were used to complete the statistical analyses for the groundwater quality data of this study. All statistical tests were conducted on a personal computer using SYSTAT software.[42]

Data Normality: Data associated with 29 constituents were tested for non-transformed normality using the Kolmogorov-Smirnov one-sample test with the Lilliefors option.[10] Results of this test revealed that none of the 29 constituents examined were normally distributed.

Spatial Relationships: The non-parametric Kruskal-Wallis test using untransformed data was applied to investigate the hypothesis that constituent concentrations from groundwater sites having different water sources were the same. The Kruskal-Wallis test uses the differences, but also incorporates information about the magnitude of each difference.[42] The null hypothesis of identical mean values for all data sets within each test was rejected if the probability of obtaining identical means by chance was less than or equal to 0.05. Comparisons conducted using the Kruskal Wallis test include sub-basins, land uses, irrigation districts, and water zones.

If the null hypothesis was rejected for any of the tests conducted, the Tukey method of multiple comparisons on the ranks of data was applied. The Tukey test identified significant differences between constituent concentrations when compared to each possibility with each of the tests. [21] Both the Kruskal-Wallis and Tukey tests are not valid for data sets with greater than 50 percent of the constituent concentrations below the MRL.[21] The Kruskal-Wallis tests were applied to arsenic and carbonate even though the result was not considered statistically valid in order to highlight possible significant differences.

Correlation Between Constituents: In order to assess the strength of association between constituents, their concentrations were compared to each other using the Pearson Correlation Coefficient test. The Pearson correlation coefficient varies between -1 and +1, with a value of +1 indicating that a variable can be predicted perfectly by a positive linear function of the other, and vice versa. A value of -1 indicates a perfect inverse or negative relationship. The results of the Pearson Correlation Coefficient test were then subjected to a probability test to determine which of the individual pair wise correlations were significant.[42] The Pearson test is not valid for data sets with greater than 50 percent of the constituent concentrations below the MRL.[21] Consequently, Pearson Correlation Coefficients were not calculated for the same constituents as in spatial relationships.

Table 3. Summary Results of Gila Valley Sub-Basin Split Samples From ADHS/Test America Labs

Constituents	Number	Difference in Percent		Difference in Levels		Significance
		Minimum	Maximum	Minimum	Maximum	
Physical Parameters and General Mineral Characteristics						
Alkalinity, total	5	0 %	4 %	0	10	ns
SC (uS/cm)	5	0 %	3 %	0	200	ns
Hardness	5	0 %	13 %	0	10	ns
pH (su)	5	0 %	3 %	0.01	0.45	ns
TDS	5	0 %	6 %	0	200	ns
Turbidity (ntu)	1	33 %	33 %	4.5	4.5	ns
Major Ions						
Calcium	5	0 %	5 %	0	10	ns
Magnesium	4	0 %	4 %	0	2	ns
Sodium	5	3 %	7 %	10	50	ns
Potassium	4	4 %	12 %	0.3	1.1	ns
Carbonate	1	33 %	33 %	11	11	ns
Chloride	5	1 %	10%	1	30	ns
Sulfate	5	0 %	6 %	0	70	ns
Nutrients						
Nitrate as N	2	7 %	9 %	0.15	0.2	ns
TKN	3	26 %	60 %	0.23	0.63	ns
Trace Elements						
Arsenic	1	1 %	1 %	0.002	0.002	ns
Copper	1	24 %	24 %	0.0043	0.0043	ns
Fluoride	5	3 %	13 %	0.1	1	ns
Manganese	1	6 %	6 %	0.03	0.03	ns

All units are mg/L except as noted

ns = No significant ($p \leq 0.05$) difference between labs

Phosphorus and zinc were detected near the MRL in ADHS samples and not detected in the associated Test America samples; thallium was detected near the MRL in two Test America samples and not detected in the associated ADHS samples.

GROUNDWATER SAMPLING RESULTS

Water Quality Standards/Guidelines

The ADEQ ambient groundwater program characterizes regional groundwater quality. An important determination ADEQ makes concerning the collected samples is how the analytical results compare to various drinking water quality standards. ADEQ used three sets of drinking water standards that reflect the best current scientific and technical judgment available to evaluate the suitability of groundwater in the basin for drinking water use:

- Federal Safe Drinking Water (SDW) Primary Maximum Contaminant Levels (MCLs). These enforceable health-based standards establish the maximum concentration of a constituent allowed in water supplied by public systems.[39]

- State of Arizona Aquifer Water Quality Standards. These apply to aquifers that are classified for drinking water protected use.[3] All aquifers within Arizona are currently classified and protected for drinking water use. These enforceable State standards are identical to the federal Primary MCLs. [3]

- Federal SDW Secondary MCLs. These non-enforceable aesthetics-based guidelines define the maximum concentration of a constituent that can be present without imparting unpleasant taste, color, odor, or other aesthetic effects on the water.[39]

Health-based drinking water quality standards (such as Primary MCLs) are based on the lifetime consumption (70 years) of two liters of water per day and, as such, are chronic not acute standards.[39] Exceedances of specific constituents for each groundwater site is found in Appendix B.

Gila Valley Sub-Basin Sites - Of the 65 sites sampled for inorganic constituents in the Gila Valley sub-basin study, 11 (17 percent) met all SDW Primary and Secondary MCLs.

Health-based Primary MCL water quality standards and State aquifer water quality standards were exceeded at 30 of 65 sites (46 percent; Map 3; Table 4). Constituents exceeding Primary MCLs include arsenic (21 sites), fluoride (20 sites), nitrate (4 sites), gross alpha (3 sites), and uranium (2 sites). Potential health effects of these chronic Primary MCL exceedances are provided in Table 4. [3, 39]

Aesthetics-based Secondary MCL water quality guidelines were exceeded at 54 of 65 sites (83 percent; Map 3; Table 5). Constituents above Secondary MCLs include TDS (43 sites), fluoride (35 sites), chloride and sulfate (29 sites each), fluoride (35 sites), pH (11 sites), and manganese (4 sites). Potential impacts of these Secondary MCL exceedances are provided in Table 5.[39]

Radon is a naturally occurring, intermediate breakdown product from the radioactive decay of uranium-238 to lead-206.[11] Of the 30 sites sampled for radon, none exceeded the proposed 4,000 picocuries per liter (pCi/L) standard that would apply if Arizona establishes an enhanced multimedia program to address the health risks from radon in indoor air. Nineteen (19) sites exceeded the proposed 300 pCi/L standard for states that would apply if Arizona doesn't develop a multimedia program. [39] There were no positive detections of any of the 20 organochlorine compounds analyzed in the four pesticides samples.

Suitability for Irrigation - The groundwater at each sample site was assessed as to its suitability for irrigation use based on salinity and sodium hazards. Excessive levels of sodium are known to cause physical deterioration of the soil and vegetation. [40] Irrigation water may be classified using specific conductivity (SC) and the Sodium Adsorption Ratio (SAR) in conjunction with one another. [40] Groundwater sites in the Gila Valley sub-basin display a wide range of irrigation water classifications. The 65 sample sites are divided into the following salinity hazards: low or C1 (6), medium or C2 (16), high or C3 (20), and very high or C4 (23). The 65 sample sites are divided into the following sodium or alkali hazards: low or S1 (24), medium or S2 (11), high or S3 (5), and very high or S4 (25).

Analytical Results

Analytical inorganic and radiochemistry results of the Gila Valley sub-basin sample sites are summarized (Table 6) using the following indices: minimum reporting levels (MRLs), number of sample sites over the MRL, upper and lower 95 percent confidence intervals ($CI_{95\%}$), median, and mean. Confidence intervals are a statistical tool which indicates that 95 percent of a constituent's population lies within the stated confidence interval.[42] Specific constituent information for each groundwater site is found in Appendix B.

Table 4. Gila Valley Sub-Basin Sites Exceeding Health-Based (Primary MCL) Water Quality Standards

Constituent	Primary MCL	Number of Sites Exceeding Primary MCL	Concentration Range of Exceedances	Potential Health Effects of MCL Exceedances *
		Nutrients		
Nitrite (NO_2-N)	1.0	0	-	-
Nitrate (NO_3-N)	10.0	**4**	10 - 25	Methemoglobinemia
		Trace Elements		
Antimony (Sb)	0.006	0	-	-
Arsenic (As)	0.01	**21**	0.011 – 0.11	Dermal and nervous system toxicity
Barium (Ba)	2.0	0	-	-
Beryllium (Be)	0.004	0	-	-
Cadmium (Cd)	0.005	0	-	-
Chromium (Cr)	0.1	0	-	-
Copper (Cu)	1.3	0	-	-
Fluoride (F)	4.0	**20**	4.0 – 14	Skeletal damage
Lead (Pb)	0.015	0	-	-
Mercury (Hg)	0.002	0	-	-
Nickel (Ni)	0.1	0	-	-
Selenium (Se)	0.05	0	-	-
Thallium (Tl)	0.002	0	-	-
		Radiochemistry Constituents		
Gross Alpha	15	**3**	16 - 67	Cancer
Ra-226+Ra-228	5	0	-	-
Radon **	300	**19**	310 – 3,249	Cancer
Radon **	4,000	0	-	-
Uranium	30	**2**	50 - 69	Cancer and kidney toxicity

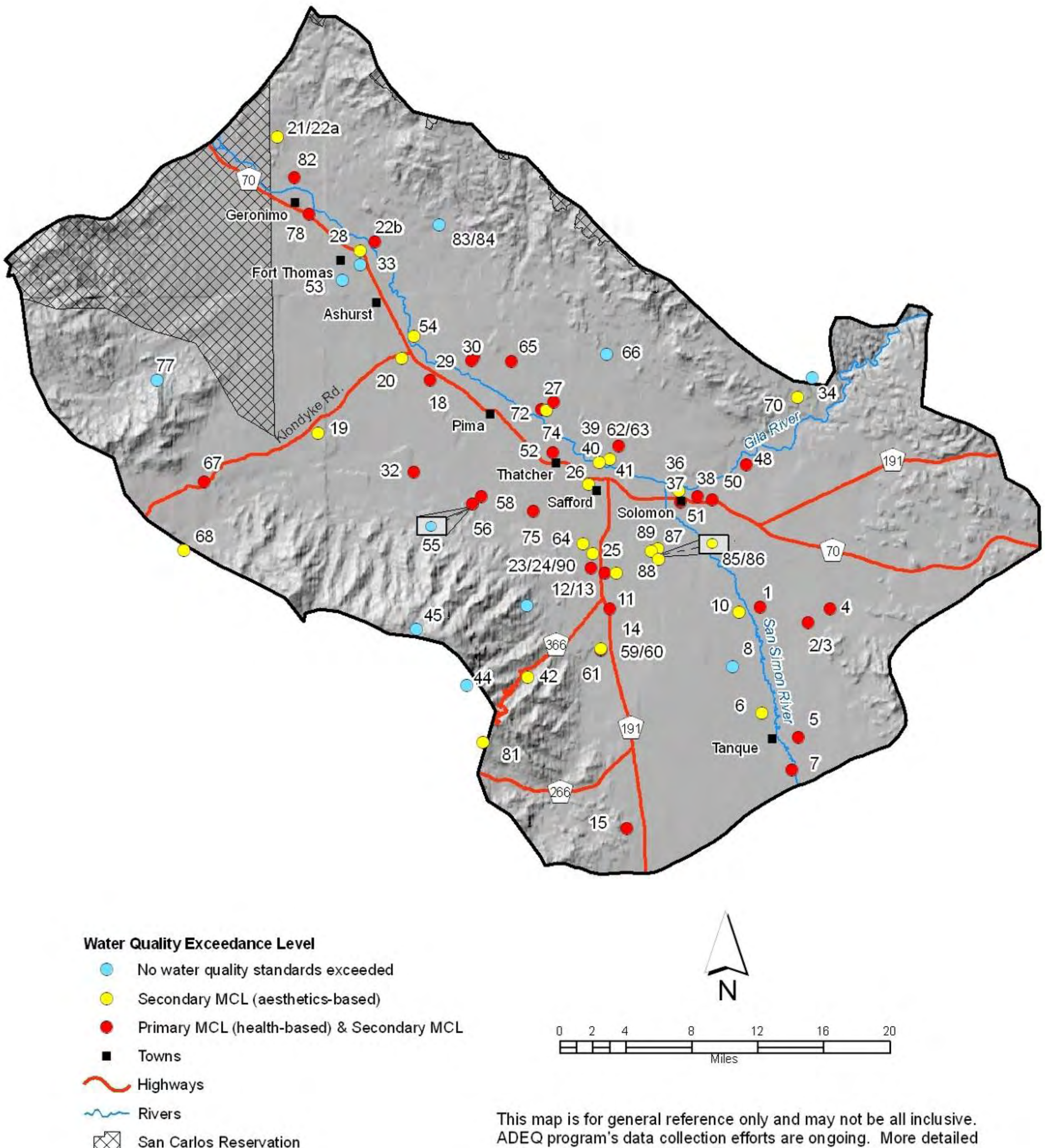
All units are mg/L except gross alpha, radium-226+228 and radon (pCi/L), and uranium (ug/L).
* Health-based drinking water quality standards are based on a lifetime consumption of two liters of water per day over a 70-year life span.[39]
** Proposed EPA Safe Drinking Water Act standards for radon in drinking water; 300 pCi/L for states without a multimedia program for radon, 4,000 pCi/L for states with an enhanced multimedia program for radon

Table 5. Gila Valley Sub-Basin Sites Exceeding Aesthetics-Based (Secondary MCL) Water Quality Standards

Constituents	Secondary MCL	Number of Sites Exceeding Secondary MCLs	Concentration Range of Exceedances	Aesthetic Effects of MCL Exceedances
		Physical Parameters		
pH - field	<6.5 ; >8.5	**11**	8.59 – 9.35	slippery feel; soda taste; deposits
		General Mineral Characteristics		
TDS	500	**43**	500 – 6,000	hardness; deposits; colored water; staining; salty taste
		Major Ions		
Chloride (Cl)	250	**29**	250 – 2,700	Salty taste
Sulfate (SO_4)	250	**29**	255 – 1,400	Rotten-egg odor, unpleasant taste and laxative effect
		Trace Elements		
Fluoride (F)	2.0	**35**	2.0 – 14	Mottling of teeth enamel
Iron (Fe)	0.3	0	-	-
Manganese (Mn)	0.05	**4**	0.235 – 0.50	black to brown color; black staining; bitter metallic taste
Silver (Ag)	0.1	0	-	-
Zinc (Zn)	5.0	0	-	-

All units mg/L except pH is in standard units (su). Source: [39]

Map 3: Water Quality Exceedances



This map is for general reference only and may not be all inclusive. ADEQ program's data collection efforts are ongoing. More detailed information and specific locations can be obtained by contacting the Arizona Department of Environmental Quality.

Table 6. Summary Statistics for Gila Valley Sub-Basin Groundwater Quality Data

Constituent	Minimum Reporting Limit (MRL)	# of Samples / # over MRL	Lower 95% Confidence Interval	Median	Mean	Upper 95% Confidence Interval
Physical Parameters						
Temperature (C)	0.1	64 / 64	21.7	22.5	23.3	24.9
pH-field (su)	0.01	65 / 65	7.74	7.70	7.57	8.06
pH-lab (su)	0.01	65 / 65	8.00	8.09	7.81	8.28
Turbidity (ntu)	0.01	65 / 65	0.61	0.26	1.26	1.90
General Mineral Characteristics						
T. Alkalinity	2.0	65 / 65	180	190	211	241
Phenol. Alk.	2.0	65 / 17	> 50% of data below MRL			
SC-field (uS/cm)	N/A	65 / 65	1514	1410	2000	2485
SC-lab (uS/cm)	N/A	65 / 65	1559	1500	2066	2573
Hardness-lab	10.0	65 / 64	143	140	191	239
TDS	10.0	65 / 65	977	880	1304	1630
Major Ions						
Calcium	5.0	65 / 65	38	35	52	66
Magnesium	1.0	65 / 65	11	12	15	18
Sodium	5.0	65 / 65	267	270	369	471
Potassium	0.5	65 / 65	3.1	2.9	5.0	6.9
Bicarbonate	2.0	65 / 65	201	200	237	273
Carbonate	2.0	65 / 17	> 50% of data below MRL			
Chloride	1.0	65 / 65	254	190	383	512
Sulfate	10.0	65 / 65	192	210	265	339
Nutrients						
Nitrate (as N)	0.02	65 / 65	1.3	0.4	2.3	3.3
Nitrite (as N)	0.02	65 / 1	> 50% of data below MRL			
TKN	0.05	65 / 52	0.13	0.12	0.20	0.28
T. Phosphorus	0.02	65 / 40	0.03	0.03	0.06	0.09

Table 6. Summary Statistics for Gila Valley Sub-Basin Groundwater Quality Data—Continued

Constituent	Minimum Reporting Limit (MRL)	# of Samples / # over MRL	Lower 95% Confidence Interval	Median	Mean	Upper 95% Confidence Interval
Trace Elements						
Antimony	0.005	65 / 0	> 50% of data below MRL			
Arsenic	0.01	65 / 21	> 50% of data below MRL			
Barium	0.1	65 / 4	> 50% of data below MRL			
Beryllium	0.0005	65 / 1	> 50% of data below MRL			
Boron	0.1	65 / 44	0.30	0.25	0.45	0.60
Cadmium	0.001	65 / 0	> 50% of data below MRL			
Chromium	0.01	65 / 3	> 50% of data below MRL			
Copper	0.01	65 / 6	> 50% of data below MRL			
Fluoride	0.20	65 / 65	2.5	2.2	3.3	4.2
Iron	0.1	65 / 5	> 50% of data below MRL			
Lead	0.005	65 / 0	> 50% of data below MRL			
Manganese	0.05	65 / 4	> 50% of data below MRL			
Mercury	0.0005	65 / 0	> 50% of data below MRL			
Nickel	0.1	65 / 0	> 50% of data below MRL			
Selenium	0.005	65 / 0	>50% of data below MRL			
Silver	0.001	65 / 0	> 50% of data below MRL			
Thallium	0.002	65 / 0	> 50% of data below MRL			
Zinc	0.05	65 / 7	> 50% of data below MRL			
Radiochemical Constituents						
Radon*	Varies	30 / 30	312	365	564	816
Gross Alpha*	Varies	20 / 17	> 50% of data below MRL			
Gross Beta*	Varies	20 / 17	> 50% of data below MRL			
Ra-226*	Varies	20 / 1	> 50% of data below MRL			
Uranium**	Varies	20 / 3	> 50% of data below MRL			
Isotopes						
Oxygen-18	Varies	67 / 67	- 10.2	- 10.3	- 9.9	- 9.6
Deuterium	Varies	67 / 67	- 74.9	- 72.0	- 72.7	- 70.5

All units mg/L except where noted or * = pCi/L, ** = ug/L, and *** = 0/00

GROUNDWATER COMPOSITION

General Summary

Groundwater in the Gila Valley sub-basin was predominantly of sodium-chloride or sodium-mixed chemistry (Map 4) (Diagram 1). The water chemistry at the 65 sample sites, in decreasing frequency, includes sodium-chloride (23 sites), sodium-mixed (20 sites), mixed-bicarbonate (10 sites), calcium-bicarbonate (6 sites), sodium-bicarbonate and sodium-sulfate (2 sites apiece) and mixed-sulfate and mixed-mixed (1 site apiece) (Diagram 2 – middle diagram).

Of the 65 sample sites in the Gila Valley sub-basin, the dominant cation was sodium at 47 sites and calcium at 6 sites; at 12 sites, the composition was mixed as there was no dominant cation (Diagram 2 – left diagram).

The dominant anion was chloride at 23 sites, bicarbonate at 18 sites and sulfate at 3 sites; at 21 sites the composition was mixed as there was no dominant anion (Diagram 2 – right diagram).

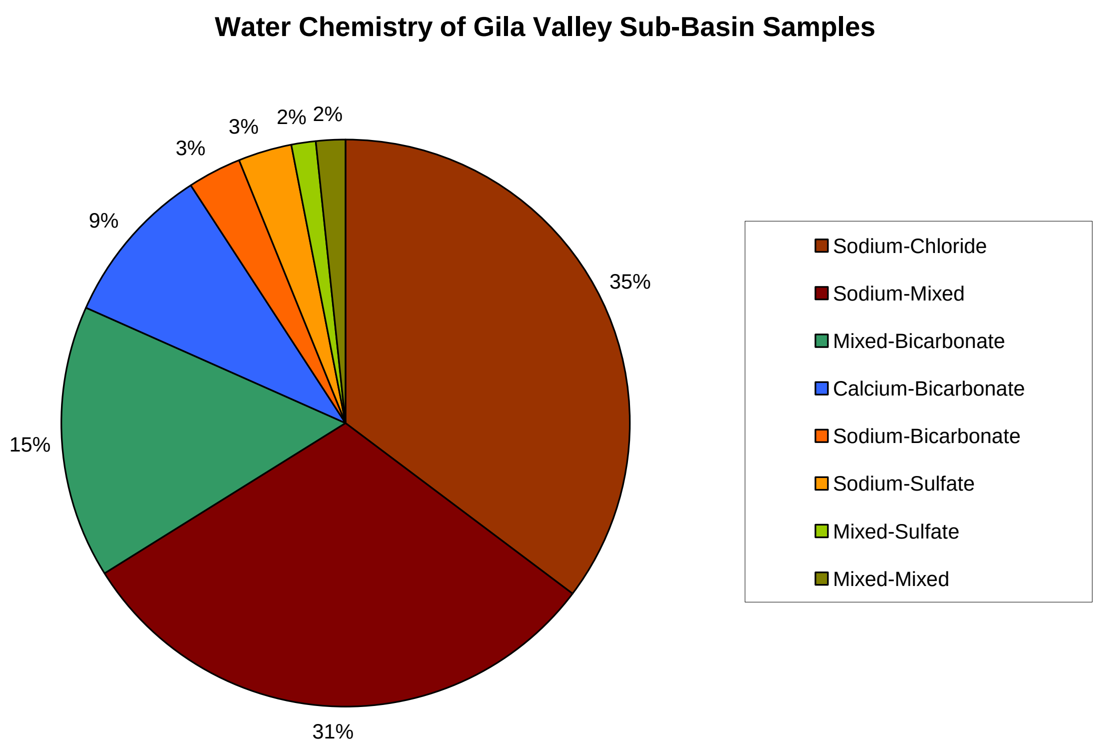
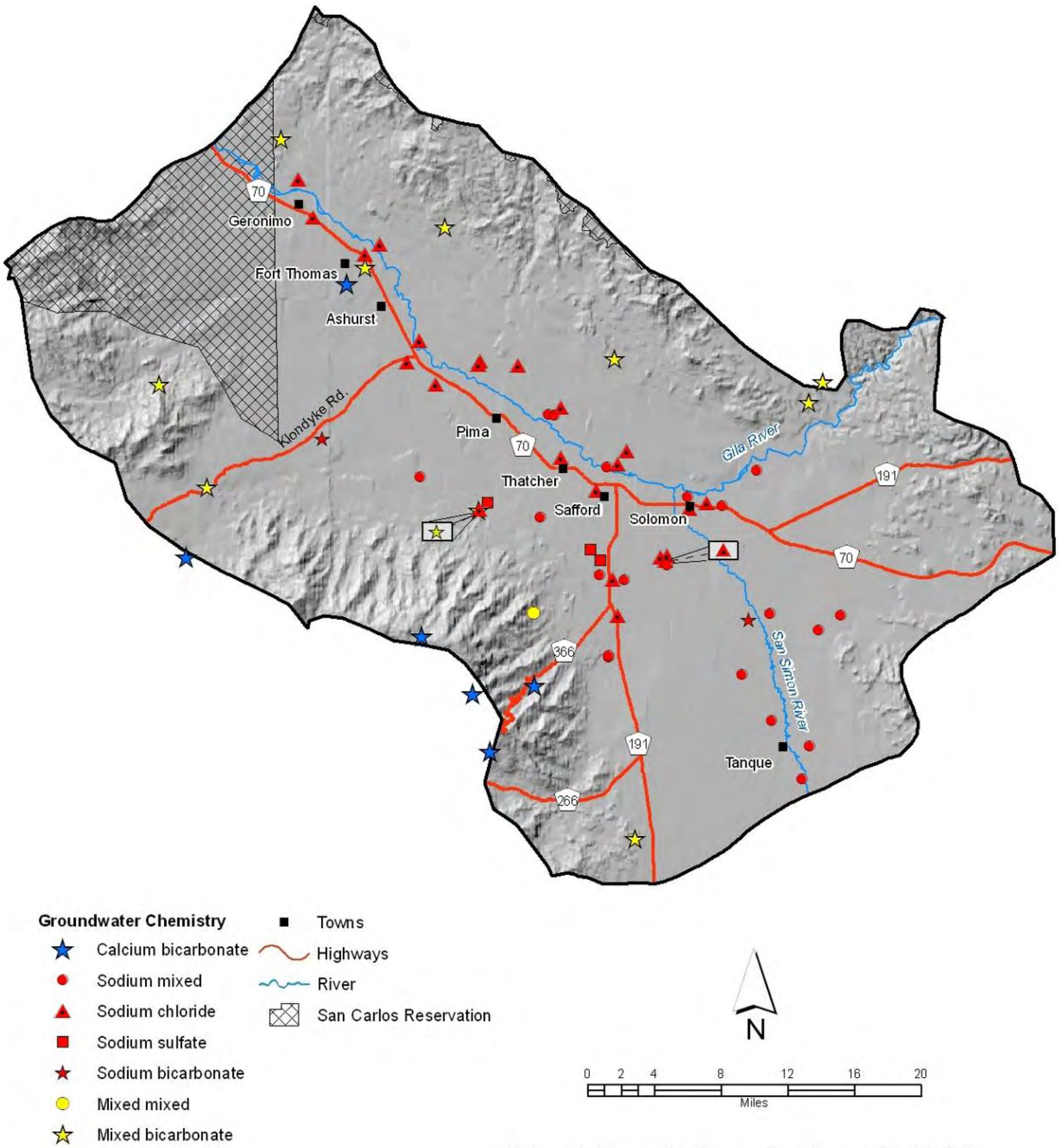


Diagram 1 – The 65 inorganic sample sites in the Gila Valley sub-basin comprise a wide variety of water chemistry types. Groundwater chemistry varied by elevation of the sample sites; the highest sites in the Pinaleno Mountains had a calcium-bicarbonate composition. Sites lower in the Pinaleno Mountains and in the Gila Mountains had a mixed-bicarbonate composition. Sites in the lower Gila Valley predominantly had a sodium-mixed or sodium-chloride composition.

Cations, or those major ions that are positively charged, are predominantly (72 percent) sodium. The others are of a mixed composition except for 9 percent of samples that are predominantly calcium, collected from sites located at high elevations in the Pinaleno Mountains.
Anions, of those major ions that are negatively charged, are almost equally divided among chloride, mixed and bicarbonate with just a few samples having sulfate water chemistry. Most of the bicarbonate samples were collected from sites on the margins of the sub-basin while the chloride samples were collected from sites close to the Gila River.

Map 4: Water Chemistry



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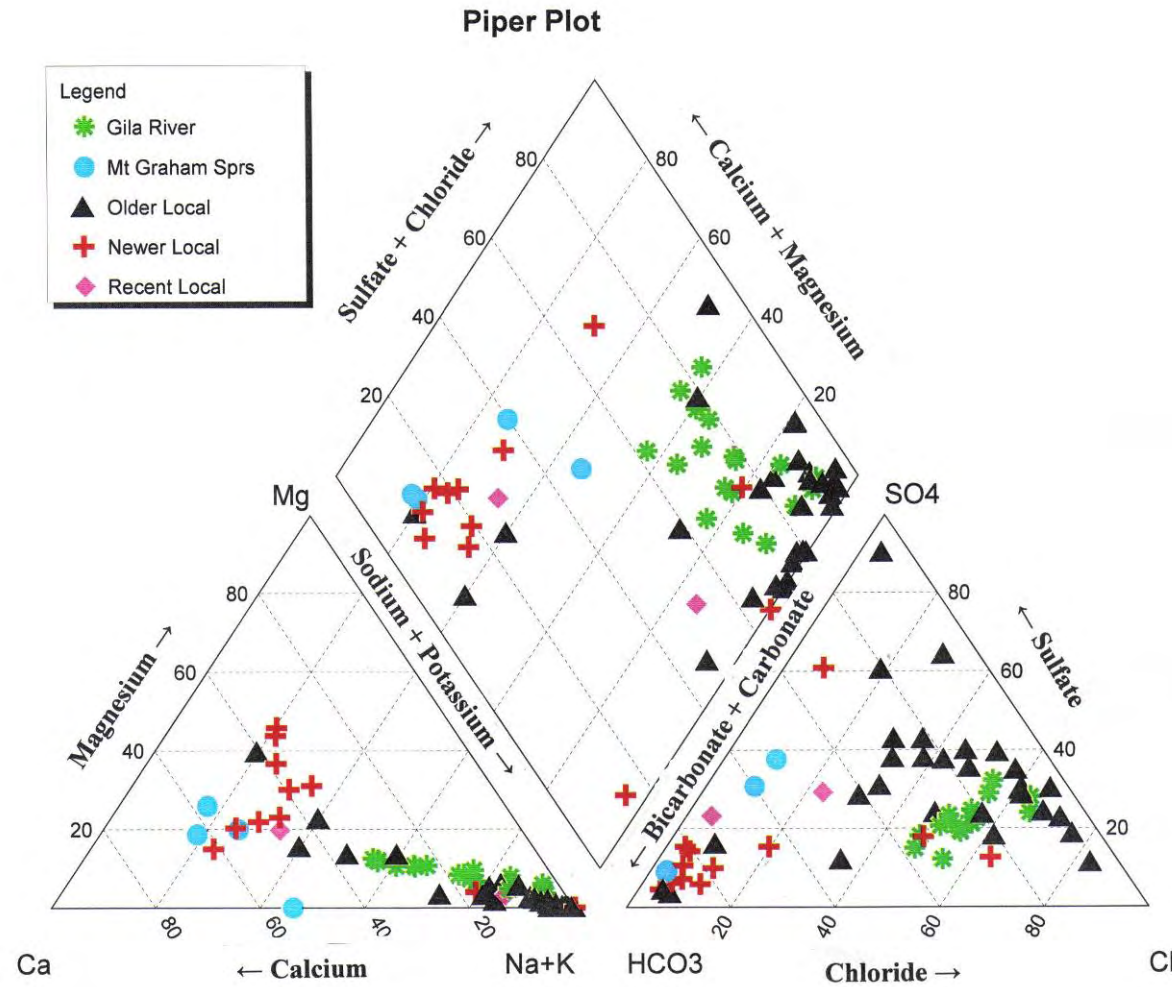


Diagram 2 – The Piper trilinear diagram shows that most of samples consisting of recharge from the Gila River and older local precipitation sources have sodium-type waters and chloride and/or sulfate as their dominant anion. Three samples that were classified as older local precipitation had a mixed-bicarbonate chemistry: GV-21/22A, GV-33, and GV-83/84.

In contrast, newer local precipitation sources and Mt. Graham springs tended to have calcium-bicarbonate chemistry. Two samples consisting of newer local precipitation had a sodium-mixed chemistry (GV-6 and GV-8) while two other newer local precipitation samples (GV-19 and GV-80) were outliers having a calcium-bicarbonate and mixed-mixed chemistry, respectively. GV-6 and GV-8 are located in the drainage of the San Simon River and show the strong sodium chemistry of samples from that area even though their recharge appears to be newer than that of the other sites.

The oxygen and hydrogen isotope analysis that created these recharge sub-groups are discussed in the next section.

Levels of pH-field were *slightly alkaline* (above 7 su) at 63 sites and slightly acidic (below 7 su) at 2 sites.[20] Of the 63 sites above 7 su, 25 sites had pH-field levels over 8 su.

TDS concentrations were considered *fresh* (below 1,000 mg/L) at 38 sites, *slightly saline* (1,000 to 3,000 mg/L) at 21 sites and *moderately saline* (3,000 to 10,000 mg/L) at 6 sites (Map 5).[20]

Hardness concentrations were *soft* (below 75 mg/L) at 20 sites, *moderately hard* (75 – 150 mg/L) at 13 sites, *hard* (150 – 300 mg/L) at 20 sites, and *very hard* (above 300 mg/L) at 12 sites (Diagram 3 and Map 6).[13]

Nitrate (as nitrogen) concentrations at 42 percent of the sample sites did not appear to be influenced by human activities, the majority of sample sites did appear to be influenced by anthropogenic activities. Nitrate concentrations were divided into natural background (27 sites at <0.2 mg/L), may or may not indicate human influence (23 sites at 0.2 – 3.0 mg/L), may result from human activities (11 sites at 3.0 – 10 mg/L), and probably result from human activities (4 sites >10 mg/L).[24]

Most trace elements such as antimony, barium, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, thallium and zinc were rarely–if ever—detected. Only arsenic, boron, and fluoride were detected at more than 20 percent of the sites.

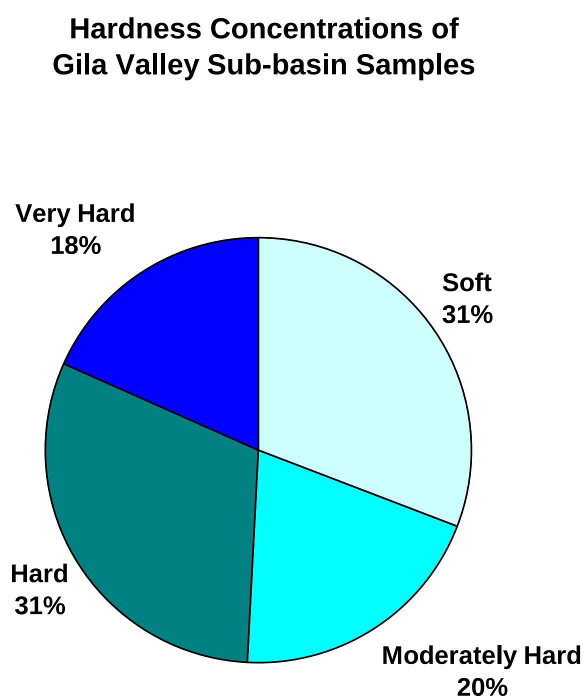
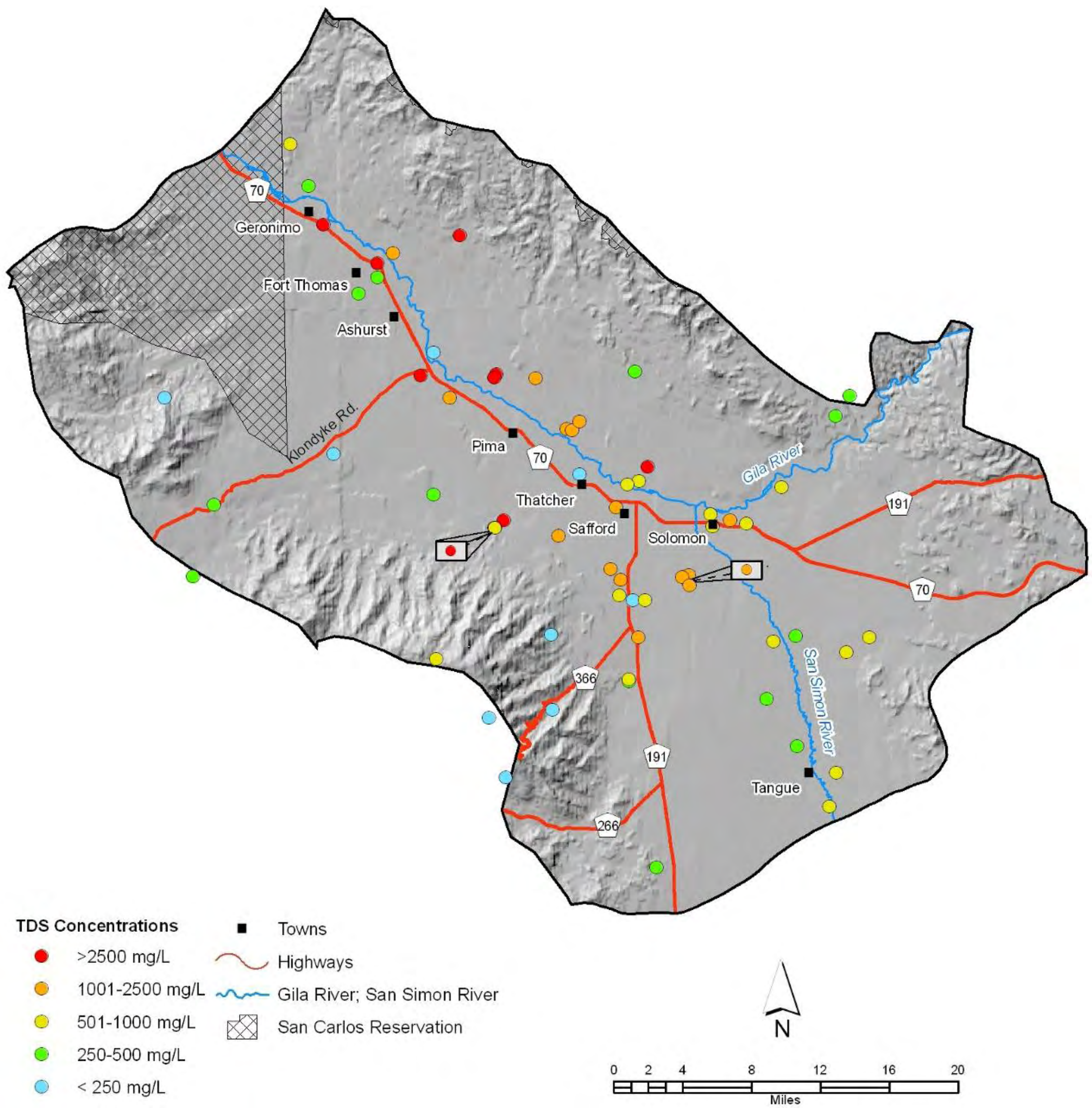


Diagram 3 – This pie chart illustrates that sample sites in the Gila Valley sub-basin were almost equally divided among *soft*, *moderately hard*, *hard* and *very hard* water.

Hardness concentrations tended to be largest at sites along the Gila River with the highest concentration of 970 mg/L collected at Salt Spring located just north of the Gila River a few miles before the waterway enters the San Carlos Apache Indian Reservation. The lowest hardness concentrations tended to be at sites along the San Simon River or along the flanks of the Pinaleno Mountains, many of which had an almost complete lack of any calcium or magnesium ions.

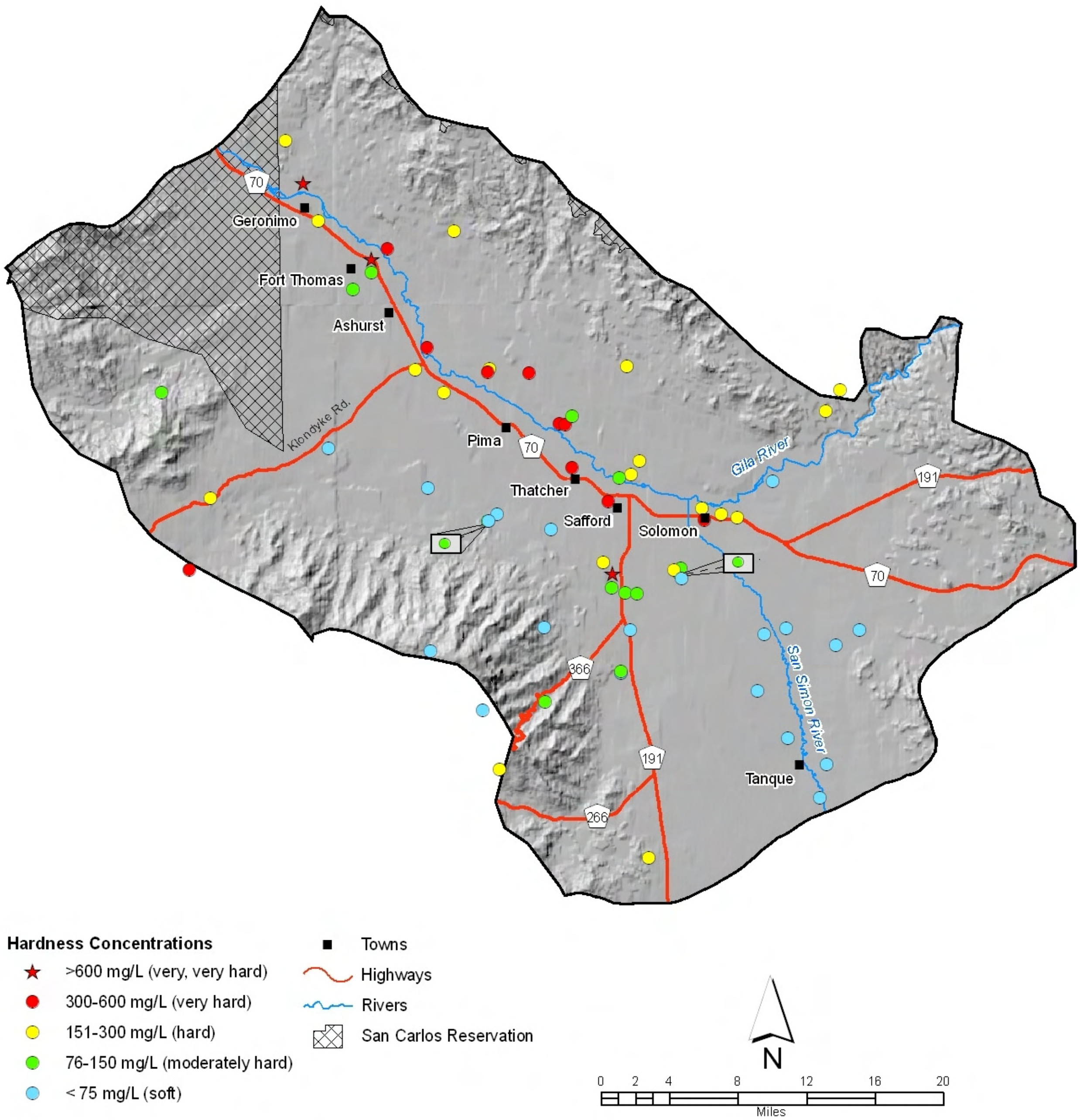
Map 5: Total Dissolved Solids (TDS)

Secondary MCL for TDS = 500 mg/L



This map is for general reference only and may not be all inclusive. ADEQ program's data collection efforts are ongoing. More detailed information and specific locations can be obtained by contacting the Arizona Department of Environmental Quality.

Map 6: Hardness (as CaCO3)



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Constituent Co-Variation

The co-variation of constituent concentrations was determined to scrutinize the strength of the association. The results of each combination of constituents were examined for statistically-significant positive or negative correlations. A ***positive correlation*** occurs when, as the level of a constituent increases or decreases, the concentration of another constituent also correspondingly increases or decreases. A ***negative correlation*** occurs when, as the concentration of a constituent increases, the concentration of another constituent decreases, and vice-versa. A positive correlation indicates a direct relationship between constituent concentrations; a negative correlation indicates an inverse relationship.[42]

Several significant correlations occurred among the 65 sample sites (Table 7, Pearson Correlation Coefficient test, $p \leq 0.05$). Several important correlations were identified:

- Positive correlations occurred between fluoride and three constituents: temperature, pH-field and arsenic.

- Positive correlations occurred between TDS and major ions including magnesium, sodium (Diagram 4), potassium, bicarbonate, chloride and sulfate; only the TDS-calcium relationship was not significant.

- Negative correlations occurred between oxygen-18 and deuterium and pH-field; positive correlations occurred between oxygen-18 and deuterium and bicarbonate and nitrate.

TDS concentrations are best predicted among major ions by chloride concentrations (standard coefficient = 0.41), among cations by sodium concentrations (standard coefficient = 0.96) (Diagram 4) and among anions, chloride (standard coefficient = 0.56) (multiple regression analysis, $p \leq 0.01$).

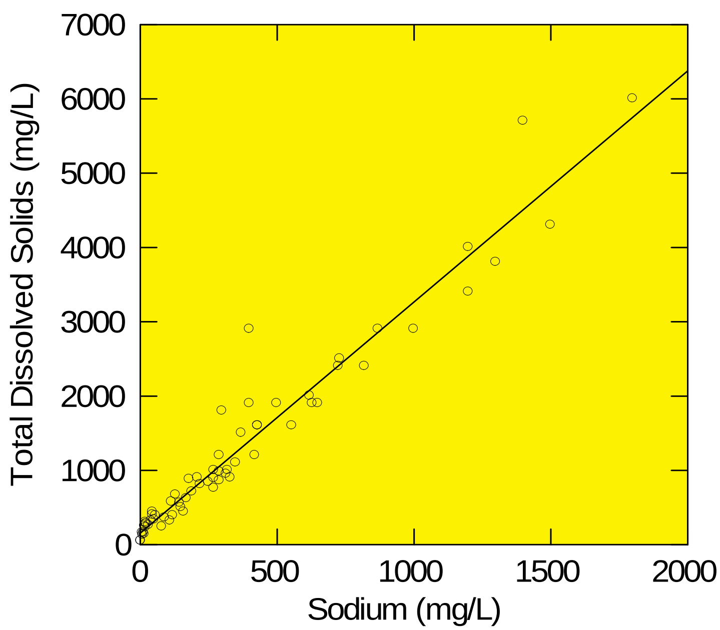


Diagram 4 – The graph illustrates a strong positive correlation between two constituents; as TDS concentrations increase so do sodium concentrations. The regression equation for this relationship is $y = 3.1x + 155$, $n = 65$, $r = 0.97$ (regression, $p \leq 0.01$). TDS concentrations are best predicted among cations by sodium concentrations with a standard coefficient of 0.96 (multiple regression analysis, $p \leq 0.01$).

Table 7. Correlation among Gila Valley Sub-Basin Groundwater Quality Constituent Concentrations Using Pearson Correlation Probabilities

Constituent	Temp	pH-f	SC-f	TDS	Hard	Ca	Mg	Na	K	Bic	Cl	SO_4	NO_3	As	B	F	O	D
Physical Parameters																		
Temperature																**		
pH-field																*	#	##
General Mineral Characteristics																		
SC-field				**	*		**	**	**	**	**	**	**				*	
TDS					*		**	**	**	**	**	**	**				*	
Hardness						**	**		*			**						
Major Ions																		
Calcium							**					**						
Magnesium								*		*	*	**	*				*	
Sodium									**	**	**	**	**		*		*	
Potassium											**	**					*	
Bicarbonate											**	*	**	**			**	**
Chloride												**	**		*		*	
Sulfate													*					
Nutrients																		
Nitrate																	**	**
Trace Elements																		
Arsenic																**		
Boron																		
Fluoride																		
Isotopes																		
Oxygen																		**
Deuterium																		

Blank cell = not a significant relationship between constituent concentrations
* = Significant positive relationship at $p \leq 0.05$
** = Significant positive relationship at $p \leq 0.01$
# = Significant negative relationship at $p \leq 0.05$
= Significant negative relationship at $p \leq 0.01$

Isotope Comparison

Groundwater characterizations using oxygen and hydrogen isotope data may be made with respect to the climate and/or elevation where the water originated, residence within the aquifer, and whether or not the water was exposed to extensive evaporation prior to collection.[12] This is accomplished by comparing oxygen-18 isotopes ($\delta^{18}O$) and deuterium (δD), an isotope of hydrogen, data to the Global Meteoric Water Line (GMWL). The GMWL is described by the linear equation:

$$\delta D = 8\delta^{18}O + 10$$

where δD is deuterium in parts per thousand (per mil, $^0/_{00}$), 8 is the slope of the line, $\delta^{18}O$ is oxygen-18 $^0/_{00}$, and 10 is the y-intercept.[12] The GMWL is the standard by which water samples are compared and represents the best fit isotopic analysis of numerous worldwide water samples.

Isotopic data from a region may be plotted to create a Local Meteoric Water Line (LMWL) which is affected by varying climatic and geographic factors. When the LMWL is compared to the GMWL, inferences may be made about the origin or history of the local water.[12] The LMWL created by $\delta^{18}O$ and δD values for samples collected at sites in the Gila Valley sub-basin were compared to the GMWL. The δD and $\delta^{18}O$ data lie to the right of the GMWL. Meteoric waters exposed to evaporation characteristically plot increasingly below and to the right of the GMWL. Evaporation tends to preferentially contain a higher percentage of lighter isotopes in the vapor phase and causes the water that remains behind to be isotopically heavier.[12]

Groundwater from arid environments is typically subject to evaporation, which enriches δD and $\delta^{18}O$, resulting in a lower slope value (usually between 3 and 6) as compared to the slope of 8 associated with the GMWL.[12] The data for the Gila Valley sub-basin conform to this theory, having a slope of 6.4, with the LMWL described by the linear equation:

$$\delta D = 6.4^{18}O - 9.4$$

The LMWL for the Gila Valley sub-basin (6.4) is similar to other arid basins in Arizona such as Detrital Valley (5.15), Agua Fria (5.3), Sacramento Valley (5.5), Big Sandy (6.1), Pinal Active Management Area (6.4) and San Simon (6.5).[32, 37, 30, 35, 36, 33]

Groundwater Recharge Sources - The isotopic data were examined for logical clusters using the oxygen and deuterium values as well as hydrologic factors. Along the Local Meteoric Water Line (LMWL) the plots highest on the precipitation trajectory were the three precipitation samples (P) collected from Safford and Mt. Graham during the summer and fall (Diagram 5).

Below the precipitation samples but above the Gila River recharge sites are two sites (#) that form a unique group. These two "recent" local recharge sites plot above the precipitation trajectory and are the most enriched groundwater sites sampled in the sub-basin. Both sites are shallow alluvial wells located near ephemeral washes far upgradient of the Gila River and appear to produce water predominantly recharged from summer monsoon precipitation.[16]

Below these recent local recharge sites are a large cluster of sites (*) that are thought to reflect recharge from the Gila River. The isotope values of surface water samples from the Gila River (G) and the San Simon River (S) near it's confluence with the Gila River) are within this cluster. The sample sites also consist of shallow wells near the Gila River.

Below the sites that consist of Gila River recharge are many samples along the LMWL that likely consist of local recharge. The transition between these two groups is fairly abrupt; the old local recharge sites closest in isotope values to the Gila River recharge sites are spatially remote from this water source making it an unlikely recharge contributor.

The local recharge sites below the Gila River recharge sites along the LMWL can be subdivided into three general groups (Map 7):

- 4 samples (^) from springs atop Mt. Graham that lie slightly above the LMWL and appear to produce water mainly from winter precipitation;[16]
- 29 older local recharge samples (+) from sites lowest on the precipitation trajectory that include all the artesian wells, and
- 12 newer local recharge samples (.) that lie along the LMWL closer to the Gila River recharge sites. The older and newer local precipitation recharge sites were divided using cluster analysis.

The number and frequency of water quality standard exceedances for each recharge group is provided in Table 8.

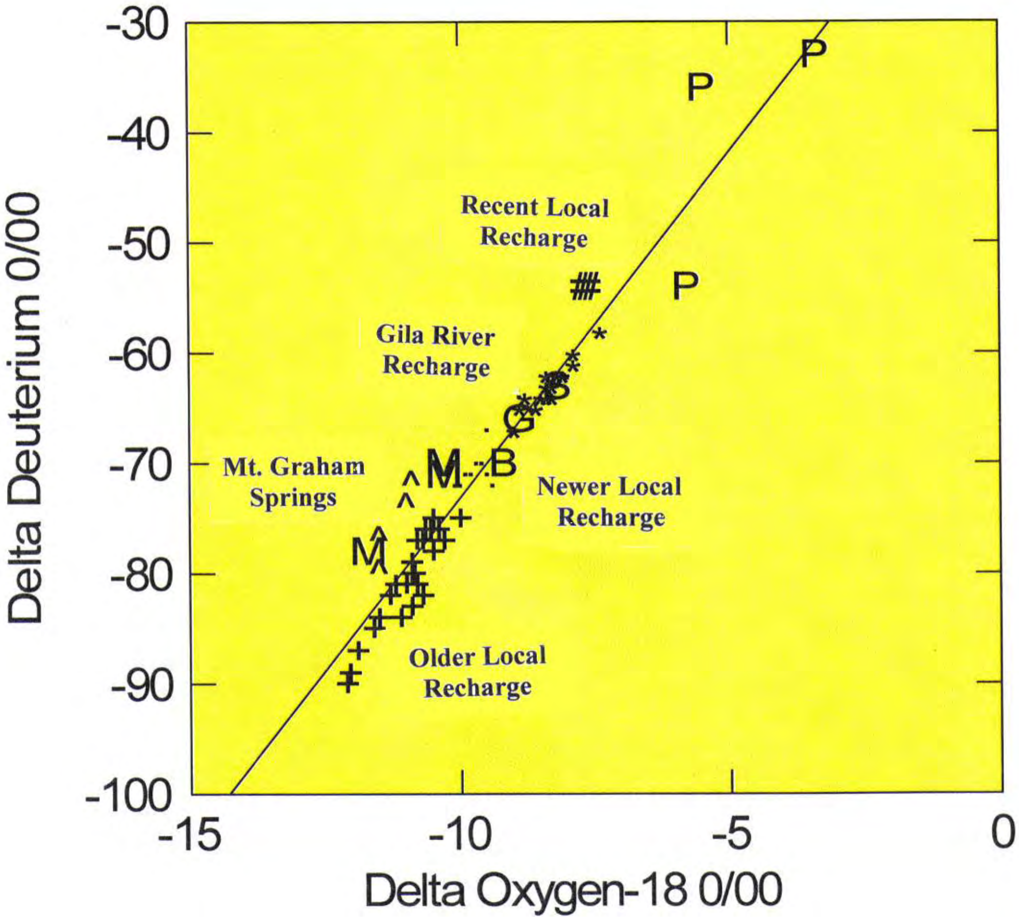


Diagram 5. The 67 groundwater sites, 6 surface water sites and 3 precipitation events collected for the Gila Valley sub-basin study were plotted according to their oxygen-18 and deuterium isotope values.

Along the Local Meteoric Water Line (LMWL) starting from highest on the precipitation trajectory (upper right of graph), the following types of samples plot: precipitation, recent local precipitation recharge, Gila River recharge (including samples from the Gila River and the San Simon River), newer local precipitation recharge (including a sample from Bonita Creek) and older local precipitation recharge samples including those from flowing artesian wells. Slightly above the LMWL and the older local precipitation recharge are four spring samples from atop Mt. Graham (along with three surface water samples from the same area).

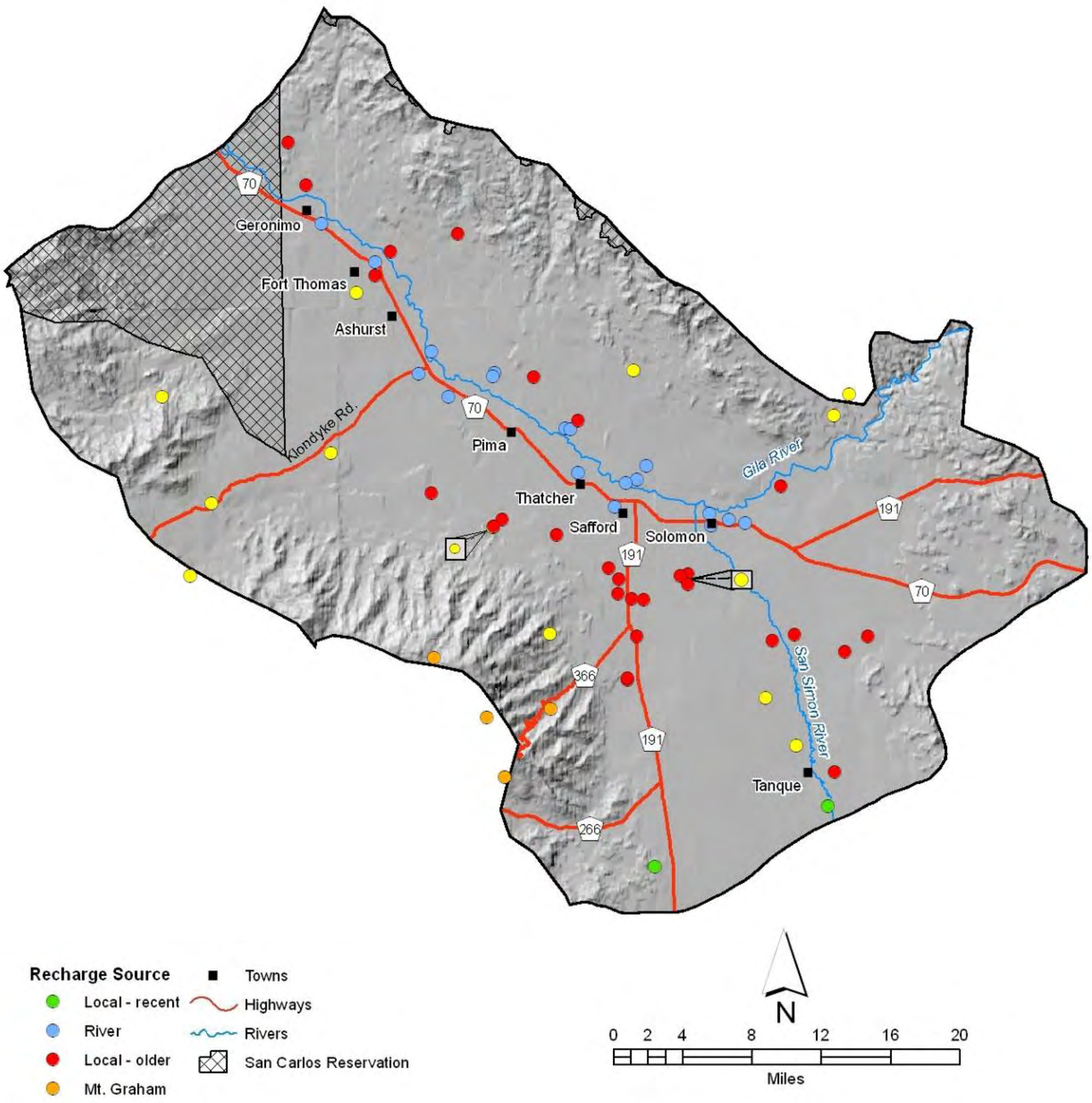
Isotope Diagram Legend

= Recent local precipitation recharge
***** = Gila River recharge
. = Newer local precipitation recharge
^ = Older local precipitation recharge - Mt. Graham springs
+ = Older local precipitation recharge
P = Precipitation event
S = San Simon River
G = Gila River
B = Bonita Creek
M = Creeks on Mt. Graham

Table 8. Comparison of Sample Results by Recharge Source for Selected Constituents with Water Quality Standards

Constituents	Newer Local Recharge			Older Local Recharge			Recent Local Recharge			Mt. Graham Springs			Gila River Recharge		
	# of Sites	# Over Standards	% Over Standards	# of Sites	# Over Standards	% Over Standards	# of Sites	# Over Standards	% Over Standards	# of Sites	# Over Standards	% Over Standards	# of Sites	# Over Standards	% Over Standards
Primary MCLs															
Arsenic	12	0	0%	29	13	44%	2	1	**50%**	4	0	0%	18	7	39%
Fluoride	12	0	0%	29	16	**55%**	2	0	0%	4	0	0%	18	4	22%
G. Alpha	5	1	20%	11	0	0%	2	2	**100%**	2	0	0%	0	0	-
Nitrate	12	0	0%	29	0	0%	2	0	0%	4	0	0%	18	4	22%
Uranium	5	1	20%	11	0	0%	2	1	**50%**	2	0	0%	0	0	-
Radon (proposed)	6	3	**50%**	13	7	**53%**	2	1	**50%**	3	2	0%	6	6	**100%**
Secondary MCLs															
Chloride	12	0	0%	29	13	45%	2	0	0%	4	0	0%	18	16	**89%**
Fluoride	12	3	25%	29	20	**69%**	2	1	**50%**	4	1	50%	18	10	**56%**
Manganese	12	1	8%	29	3	10%	2	0	0%	4	0	0%	18	0	0%
pH-field	12	1	8%	29	8	28%	2	0	0%	4	0	0%	18	1	6%
Sulfate	12	0	0%	29	17	**59%**	2	0	0%	4	0	0%	18	12	**67%**
TDS	12	1	8%	29	23	**79%**	2	1	**50%**	4	0	0%	18	18	**100%**

Map 7: Recharge Source



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Groundwater Quality Variation

Between Two Recharge Groups - Twenty-seven (27) groundwater quality constituent concentrations were compared between two recharge sources: Gila River (18 sites) and local precipitation recharge, including recent, newer and older local precipitation recharge and Mt. Graham springs, (47 sites) as revealed by oxygen and deuterium isotope values. Significant concentration differences (Table 9) were found with 21 constituents (Kruskal-Wallis test, $p \leq 0.05$).

Well depth, pH-field (Diagram 6), pH-lab, and carbonate were significantly higher in local precipitation recharge sites than Gila River recharge sites. SC-field, SC-lab, TDS (Diagram 7), hardness, calcium, magnesium, sodium, potassium, bicarbonate, chloride, sulfate, nitrate, TKN, total phosphorus, boron, oxygen-18, and deuterium were significantly higher in Gila River recharge than in local recharge. Summary statistics in the form of 95% confidence intervals are provided for those constituents with significant concentration differences between recharge groups in Table 10.

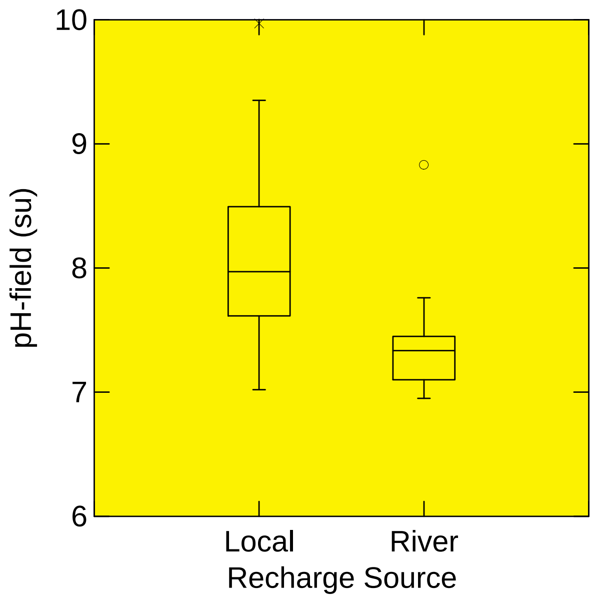


Diagram 6. Sample sites consisting of groundwater derived from local recharge have significantly higher pH-field values than sample sites derived from recharge from the Gila River (Kruskal-Wallis test, $p \leq 0.01$). Similar pH relationships have been found in other Arizona groundwater basins with perennial streams such as the Lower San Pedro basin. [31] Much of the recharge in the Gila Valley sub-basin occurs from the Gila River and water in such areas is usually near neutral (6.9 – 7.4 su) whereas in other areas, pH values in groundwater can increase up to 9.5 su. [28]

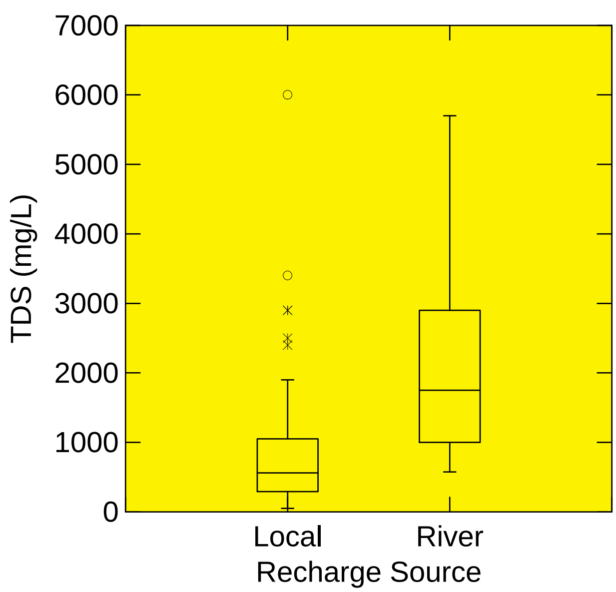


Diagram 7. Sample sites consisting of groundwater derived from Gila River recharge have significantly higher TDS concentrations than sample sites derived from recharge from local sources (Kruskal-Wallis test, $p \leq 0.01$). This pattern is likely impacted by highly saline irrigation recharge from irrigated fields percolating to the floodplain aquifer as well as by upwelling of highly saline water from the evaporate sub-unit of the older alluvium. [9, 19]

Table 9. Variation in Groundwater Quality Constituent Concentrations Between Two Recharge Sources Using Kruskal-Wallis Test

Constituent	Significance	Significant Differences Among Recharge Sources
Well Depth	**	Local > River
Groundwater Depth	ns	-
Temperature - field	ns	-
pH – field	**	Local > River
pH – lab	**	Local > River
SC - field	**	River > Local
SC - lab	**	River > Local
TDS	**	River > Local
Turbidity	ns	-
Hardness	**	River > Local
Calcium	**	River > Local
Magnesium	**	River > Local
Sodium	**	River > Local
Potassium	**	River > Local
Bicarbonate	**	River > Local
Carbonate ***	**	Local > River
Chloride	**	River > Local
Sulfate	**	River > Local
Nitrate (as N)	**	River > Local
TKN	**	River > Local
Phosphorus, T.	**	River > Local
Arsenic***	ns	-
Boron	**	River > Local
Fluoride	ns	-
Oxygen	**	River > Local
Deuterium	**	River > Local
Radon	ns	-

ns = not significant * = significant at $p \leq 0.05$ or 95% confidence level ** = significant at $p \leq 0.01$ or 99% confidence level
*** = for information only, statistical test not valid because of the large number of non-detects
All units mg/L except temperature (degrees Celsius) and SC (uS/cm).

Table 10. Summary Statistics (95% Confidence Intervals) for Gila Valley Sub-Basin Groundwater Quality Constituents With Significant Concentration Differences Among Two Recharge Sources

Constituent	Significant Differences	Local	River
Well Depth (feet)	**	182 to 461	70 - 106
Groundwater Depth (feet)	ns	-	-
Temperature – field (C)	ns	-	-
pH – field (su)	**	7.91 to 8.27	7.18 to 7.60
pH – lab (su)	**	8.05 to 8.41	7.72 to 8.10
SC – field (uS/cm)	**	1032 to 2102	2187 to 4074
SC – lab (uS/cm)	**	1063 to 2116	2223 to 4398
TDS	**	652 to 1309	1427 to 2868
Turbidity (ntu)	ns	-	-
Hardness	**	84 to 190	263 to 418
Calcium	**	23 to 55	63 to 108
Magnesium	**	7 to 13	21 to 33
Sodium	**	179 to 392	361 to 814
Potassium	**	2.1 to 6.5	2.7 to 10.5
Bicarbonate	**	149 to 204	326 to 462
Carbonate ***	**	4 to 9	-1 to 7
Chloride	**	132 to 421	414 to 909
Sulfate	**	136 to 298	236 to 549
Nitrate (as N)	**	0.3 to 0.9	3.9 to 9.6
TKN	**	0.10 to 0.22	0.11 to 0.55
Phosphorus, T.	**	0.02 to 0.08	0.02 to 0.17
Arsenic ***	ns	-	-
Boron	**	0.2 to 0.6	0.3 to 0.9
Fluoride	ns	-	-
Oxygen (0/00)	**	-10.8 to -10.2	-8.5 to -8.1
Deuterium (0/00)	**	-78.4to -73.7	-64.9 to 62.8
Radon (pCi/L)	ns	-	-

All units in milligrams per liter (mg/L) unless otherwise noted
ns = not significant * = significant at $p \leq 0.05$ or 95% confidence level ** = significant at $p \leq 0.01$ or 99% confidence level
*** = for information only, statistical test not valid because of the large number of non-detects

Figure 9 – Reed Well (GV-61) sampled by Shaunel Wytcherley produces water recharged by local precipitation for irrigation that is generally lower in salinity than is found in Gila River recharge water.

Figure 11 – The City of Safford's Morris Well #3 (GV-41) produces water that has much lower TDS concentrations than most well samples of recharged Gila River water.

Figure 10 – Kimball Well (GV-27) has artesian flow and high concentrations of arsenic and fluoride that is characteristic of water from the evaporite and/or basal conglomerate sub-units of the older alluvium.

Figure 12 – This irrigation well produces recharged Gila River water that typically has higher concentrations of major ions and nitrate than recharged water from local precipitation.

Between Two Local Precipitation Recharge Groups - Twenty-seven (27) groundwater quality constituent concentrations were compared among newer and older local precipitation recharge sources as revealed by oxygen and deuterium isotope values grouped according to cluster analysis. Significant concentration differences were found with 14 constituents (Kruskal-Wallis test, $p \leq 0.05$).

Well depth, temperature, SC-field, SC-lab, TDS (Diagram 8), sodium, potassium, chloride, sulfate, arsenic, boron and fluoride (Diagram 9) were significantly higher in samples from sites producing older local precipitation recharge than from sites with newer local (Table 11).

Summary statistics in the form of 95% confidence intervals are provided for those constituents with significant concentration differences between newer and older local precipitation recharge sources in Table 12.

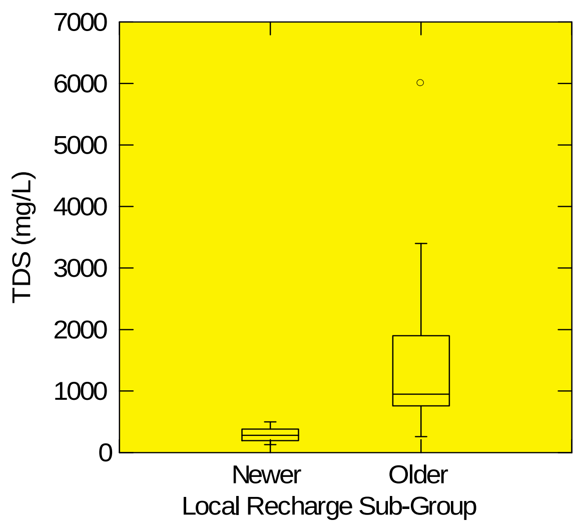


Diagram 8. Sample sites producing older local precipitation recharge (including wells with artesian flow) have significantly higher TDS concentrations than sample sites derived from newer local precipitation recharge (Kruskal-Wallis test, $p \leq 0.05$). Shallow wells in the older alluvium generally have lower TDS concentrations compared to wells drilled deeper into the older alluvium that penetrate the evaporite and/or basal conglomerate sub-units.

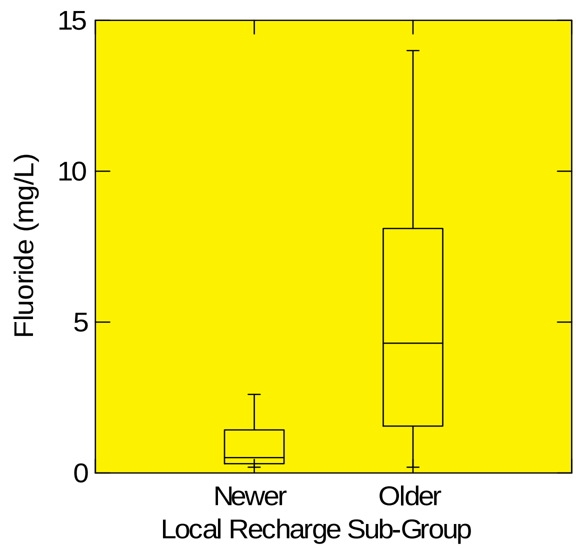


Diagram 9. Sample sites with older local precipitation recharge have significantly higher fluoride concentrations than sample sites derived from newer local precipitation recharge (Kruskal-Wallis test, $p \leq 0.05$). Older recharge sites were often depleted in calcium; if a source of fluoride ions is available for dissolution high concentrations of dissolved fluoride may occur in groundwater.[28] Similar fluoride patterns occur in other southwestern Arizona basins with confined aquifers such as the San Simon sub-basin and the Lower San Pedro basin.[31, 33]

Table 11. Variation in Groundwater Quality Constituent Concentrations Between Two Local Precipitation Recharge Sources Using Kruskal-Wallis Test

Constituent	Significance	Significant Differences Among Recharge Sources
Well Depth	*	Older > Newer
Groundwater Depth	ns	-
Temperature - field	**	Older > Newer
pH – field	ns	-
pH – lab	ns	-
SC - field	**	Older > Newer
SC - lab	**	Older > Newer
TDS	**	Older > Newer
Turbidity	ns	-
Hardness	ns	-
Calcium	ns	-
Magnesium	ns	-
Sodium	**	Older > Newer
Potassium	**	Older > Newer
Bicarbonate	ns	-
Carbonate ***	ns	-
Chloride	**	Older > Newer
Sulfate	**	Older > Newer
Nitrate (as N)	ns	-
TKN	ns	-
Phosphorus, T.	ns	-
Arsenic***	**	Older > Newer
Boron	**	Older > Newer
Fluoride	**	Older > Newer
Oxygen	**	Older > Newer
Deuterium	**	Older > Newer
Radon	ns	-

ns = not significant * = significant at $p \leq 0.05$ or 95% confidence level ** = significant at $p \leq 0.01$ or 99% confidence level
*** = for information only, statistical test not valid because of the large number of non-detects
All units mg/L except temperature (degrees Celsius) and SC (uS/cm).

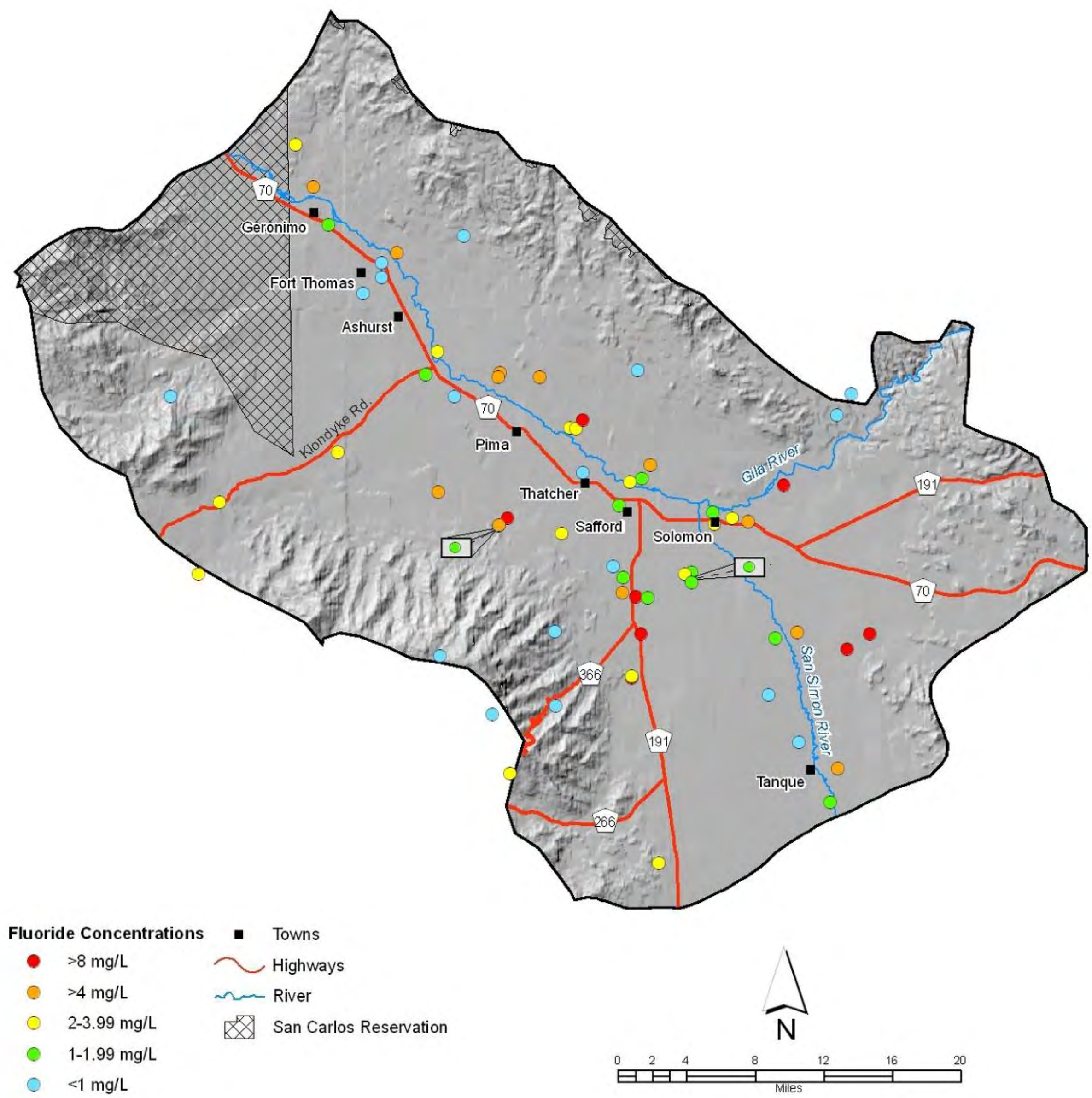
Table 12. Summary Statistics (95% Confidence Intervals) for Gila Valley Sub-Basin Groundwater Quality Constituents With Significant Concentration Differences Among Two Local Recharge Sources

Constituent	Significant Differences	Newer	Older
Well Depth (feet)	*	29 to 203	216 - 566
Groundwater Depth (feet)	ns	-	-
Temperature – field (C)	**	17.7 to 22.9	23.4 to 28.9
pH – field (su)	ns	-	-
pH – lab (su)	ns	-	-
SC – field (uS/cm)	**	324 to 575	1505 to 3039
SC – lab (uS/cm)	**	319 to 586	1562 to 3054
TDS	**	214 to 366	946 to 1887
Turbidity (ntu)	ns	-	-
Hardness	ns	-	-
Calcium	ns	-	-
Magnesium	ns	-	-
Sodium	**	20 to 73	284 to 585
Potassium	**	0.8 to 2.5	2.6 to 9.6
Bicarbonate	ns	-	-
Carbonate ***	ns	-	-
Chloride	**	1 to 62	212 to 651
Sulfate	**	15 to 38	218 to 445
Nitrate (as N)	ns	-	-
TKN	ns	-	-
Phosphorus, T.	ns	-	-
Arsenic ***	**	0.005 to 0.005	0.012 to 0.033
Boron	**	0.05 to 0.05	0.3 to 0.8
Fluoride	**	0.4 to 1.5	3.7 to 6.7
Oxygen (0/00)	**	-9.9 to -9.2	-11.2 to -10.8
Deuterium (0/00)	**	-70.6 to -66.6	-82.3 to 79.2
Radon (pCi/L)	ns	-	-

All units in milligrams per liter (mg/L) unless otherwise noted
ns = not significant * = significant at $p \leq 0.05$ or 95% confidence level ** = significant at $p \leq 0.01$ or 99% confidence level
*** = for information only, statistical test not valid because of the large number of non-detects

Map 8: Fluoride

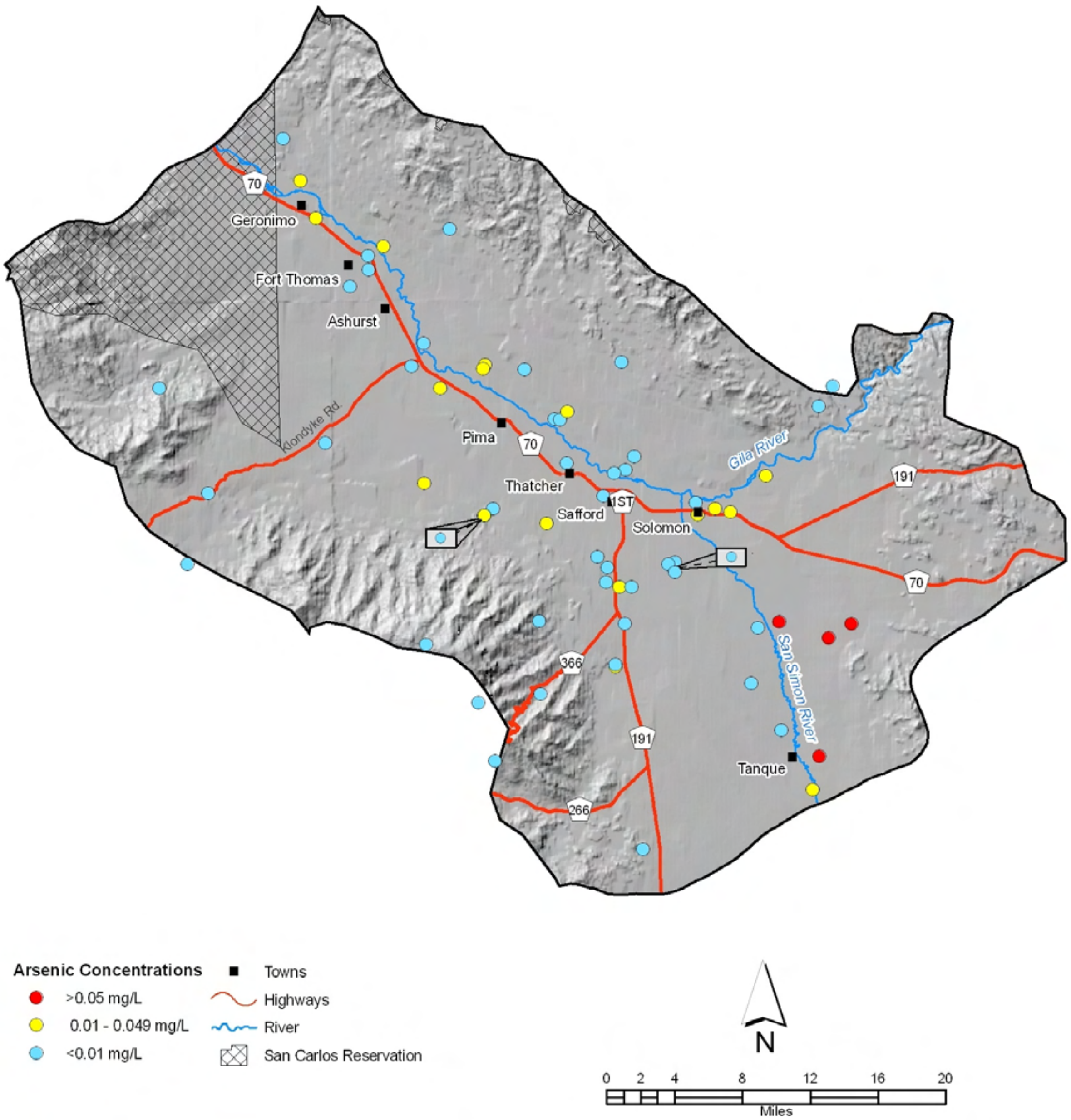
Primary MCL for Fluoride = 4.0 mg/L
Secondary MCL for Fluoride = 2.0 mg/L



This map is for general reference only and may not be all inclusive. ADEQ program's data collection efforts are ongoing. More detailed information and specific locations can be obtained by contacting the Arizona Department of Environmental Quality.

Map 9: Arsenic

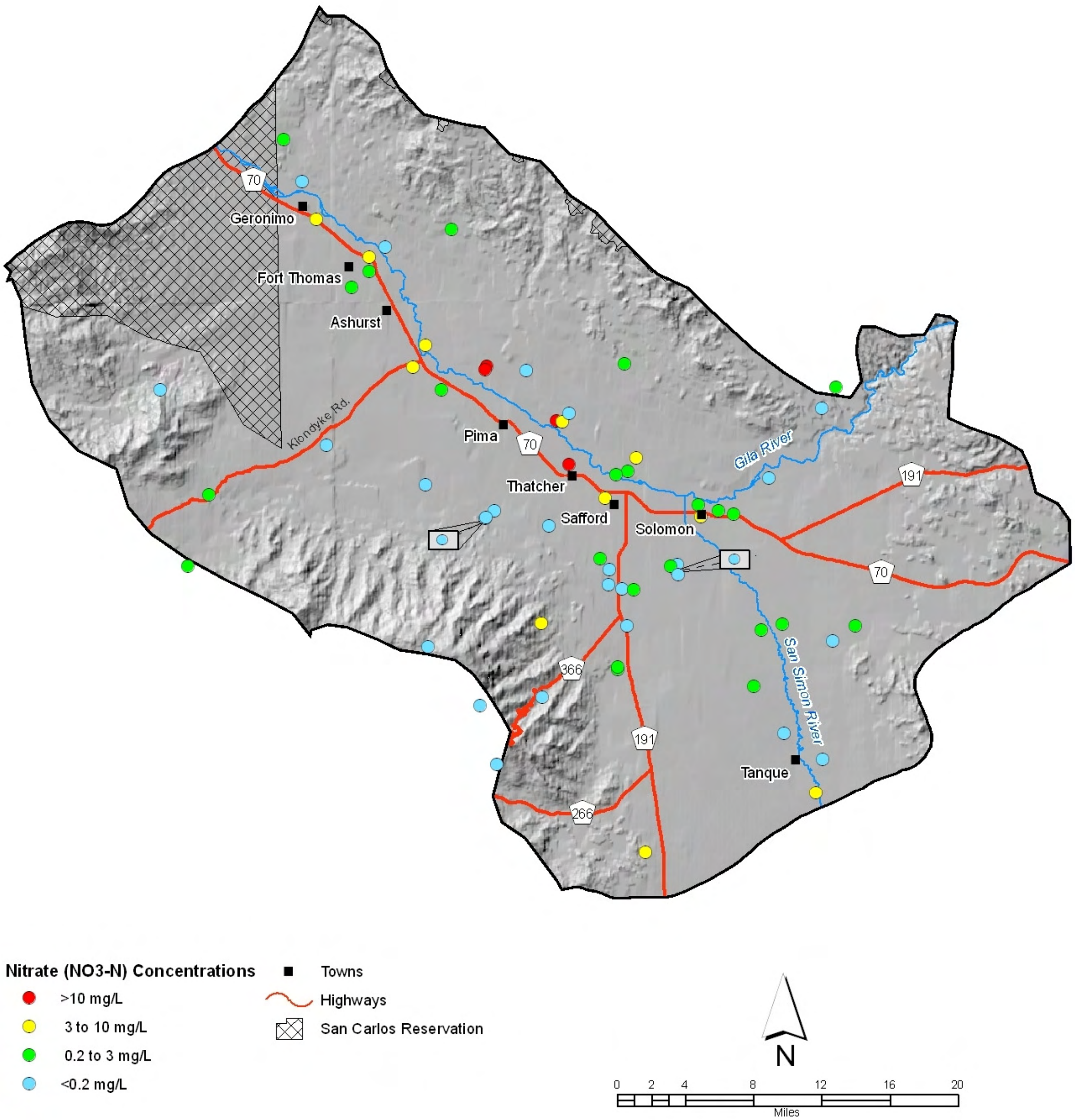
Primary MCL for Arsenic = 0.01 mg/L



This map is for general reference only and may not be all inclusive. ADEQ program's data collection efforts are ongoing. More detailed information and specific locations can be obtained by contacting the Arizona Department of Environmental Quality.

Map 10: Nitrate (as Nitrogen)

Primary MCL for Nitrate (as N) = 10 mg/L



This map is for general reference only and may not be all inclusive. ADEQ program's data collection efforts are ongoing. More detailed information and specific locations can be obtained by contacting the Arizona Department of Environmental Quality.

Time Trend Analysis

In 1995, ADEQ conducted a comprehensive groundwater quality study of the Upper Gila watershed that included 81 samples collected from within the Gila Valley sub-basin. [41] Groundwater quality changes were investigated between the 1995 and 2004 data.

1995 Study Data Validation

The analytical work for this study was scrutinized for adherence to ADEQ sampling protocol and to examine data validity. [2, 7, 22]

ADEQ sampling protocol requires that physical parameters—temperature, pH, and specific conductivity—are monitored at least every five minutes during the purging of a well. [2, 7] Of the 81 sites sampled in 1995, only 51 sites (62 percent) had field readings for all three of these physical parameters. The recorded frequencies of each field physical parameter were temperature: 74 readings (91 percent), pH: 53 readings (65 percent) and SC: 66 readings (82 percent).

The 1995 data was examined for the variability of quality control (QC) samples. Two sites at which duplicate samples were collected (G-63/63D and G-64/64D) had such extreme variation between constituent concentrations that both sites were excluded from further analysis. For G-63/63D, examples include total alkalinity (290/120 mg/L), TDS (1,000/470 mg/L), hardness (190/56 mg/L), sodium (280/140 mg/L), nitrate (8.8/1.1 mg/L) and arsenic (0.03/<0.005 mg/L). For G-64/64D, examples include total alkalinity (140/350 mg/L), fluoride (0.38/4.2 mg/L), hardness (510/220 mg/L), sodium (140/360 mg/L) and nitrate (1.8/9.0 mg/L). [41]

Further QC correlations involving SC-field, SC-lab and TDS, were conducted with data from the remaining 79 sites sampled in 1995. Typically, the TDS concentration in mg/L should be from 0.55 to 0.75 times the SC in µS/cm for groundwater.[22] Comparing SC-field values to TDS concentrations for the 79 sites: 13 sites (16 percent) had no SC-field data, 15 sites (19 percent) exceeded the 0.75 ratio, 13 sites (16 percent) were below the 0.55 ratio and 38 sites (48 percent) fell within the 0.55–0.75 ratio. Comparing SC-lab values to TDS concentrations for the 79 sites: 29 sites (37 percent) had no SC-lab data, 24 sites (30 percent) exceeded the 0.75 ratio, 13 sites (16 percent) were below the 0.55 ratio and 28 sites (35 percent) fell within the 0.55-0.75 ratio.

Out of the 79 sites sampled in 1995, only 13 sites (16 percent) met the 0.55-0.75 ratio between TDS and both SC-lab and SC-field. For comparison purposes, of the 65 sites sampled in 2004, 61 sites (94 percent) met the 0.55-0.75 ratio between TDS and both SC-lab and SC-field. Thus, based on the results of adhering to sampling protocol, data variability and data correlations, there appear to be major inadequacies concerning the reliability of the 1995 data. Despite the deficiencies with sampling protocol and data validation revealed, the data were still considered suitable for making some types of general groundwater quality comparisons between the studies.

1995 Groundwater Sampling Results

Of the 79 sites sampled for the within the Gila Valley sub-basin in 1995, 18 (23 percent) met all current SDW Primary and Secondary MCLs including the new arsenic standard. Health-based Primary MCL water quality standards and State aquifer water quality standards were exceeded at 39 of 79 sites or 49 percent. Constituents exceeding Primary MCLs include arsenic (25 sites), fluoride (12 sites), gross alpha (1 site), lead (1 site), nitrate (8 sites), selenium (1 site), and thallium (1 site). The numbers and frequencies of the 1995 exceedances are compared to those that occurred in 2004-2005 in Table 13. [41]

Aesthetics-based Secondary MCL water quality guidelines were exceeded at 59 of 79 sites or 75 percent (Table 14). Constituents above Secondary MCLs include chloride (28 sites), fluoride (35 sites), iron (3 sites), manganese (2 sites), pH (7 sites), sulfate (25 sites), and TDS (56 sites). The numbers and frequencies of the 1995 exceedances are compared to those that occurred in 2004-2005 in Table 14. [41]

Analytical inorganic and radiochemistry results of the 79 Gila Valley sub-basin sites sampled in 1995 are summarized (Table 15) using the following indices: minimum reporting levels (MRLs), number of sample sites over the MRL, upper and lower 95 percent confidence intervals ($CI_{95\%}$), median, and mean. Confidence intervals are a statistical tool which indicates that 95 percent of a constituent's population lies within the stated confidence interval.[21] Specific constituent information for each groundwater site are found in Appendix C and D.

Table 13. Comparison of ADEQ Gila Valley Sub-Basin 1995 and 2004 Sample Results for Constituents with Health-Based (Primary MCL) Water Quality Standards

Constituent	1995 ADEQ Data			2004 ADEQ Data		
	# of Sites Sampled	# of Site Exceedances	Percentage of Exceedances	# of Sites Sampled	# of Site Exceedances	Percentage of Exceedances
Nutrients						
Nitrite	79	0	0 %	65	0	0 %
Nitrate	79	8	10 %	65	4	6 %
Trace Elements						
Antimony	79	0	0 %	65	0	0 %
Arsenic	79	25	32 %	65	21	32 %
Barium	79	0	0 %	65	0	0 %
Beryllium	79	0	0 %	65	0	0 %
Cadmium	79	0	0 %	65	0	0 %
Chromium	79	0	0 %	65	0	0 %
Copper	79	0	0 %	65	0	0 %
Fluoride	79	12	15 %	65	20	31 %
Lead	79	1	1 %	65	0	0 %
Mercury	79	0	0 %	65	0	0 %
Nickel	-	-	-	65	0	0 %
Selenium	79	1	1 %	65	0	0 %
Thallium	79	1	1 %	65	0	0 %
Radiochemistry Constituents						
Gross Alpha	10	1	10 %	17	3	18 %
Ra-226+228	10	0	0 %	17	0	0 %
Radon	-	-	-	31	19	61 %
Uranium	10	0	0 %	17	2	12 %

The health-based water quality standard for radon is proposed only.

Table 14. Comparison of ADEQ Gila Valley Sub-Basin 1995 and 2004 Sample Results for Constituents with Aesthetics-Based (Secondary MCL) Water Quality Standards

Constituent	1995 ADEQ Data			2004 ADEQ Data		
	# of Sites Sampled	# of Site Exceedances	Percentage of Exceedances	# of Sites Sampled	# of Site Exceedances	Percentage of Exceedances
Physical Parameters						
pH - field	51	7	14 %	65	11	17 %
General Mineral Characteristics						
TDS	79	56	71 %	65	43	66 %
Major Ions						
Chloride	79	28	35 %	65	29	45 %
Sulfate	79	25	32 %	65	29	45 %
Trace Elements						
Fluoride	79	35	44 %	65	35	39 %
Iron	79	3	4 %	65	0	3 %
Manganese	79	2	3 %	65	4	3 %
Silver	79	0	0 %	65	0	0 %
Zinc	79	0	0 %	65	0	0 %

Table 15. Summary Statistics for Gila Valley Sub-Basin Groundwater Quality Data, 1995

Constituent	Minimum Reporting Limit (MRL)	# of Samples / # over MRL	Lower 95% Confidence Interval	Median	Mean	Upper 95% Confidence Interval
Physical Parameters						
Temperature (C)	0.1	72 / 72	22.2	22.6	23.2	24.2
pH-field (su)	0.01	51 / 51	7.19	7.21	7.04	7.60
pH-lab (su)	0.01	79 / 79	7.48	7.50	7.38	7.73
General Mineral Characteristics						
T. Alkalinity	2.0	79 / 79	235	240	262	288
SC-field (uS/cm)	N/A	66 / 66	1259	1398	1540	1820
SC-lab (uS/cm)	N/A	52 / 52	1085	1208	1364	1644
Hardness-lab	10.0	79 / 79	216	220	263	309
TDS	10.0	79 / 79	882	92	1051	1219
Major Ions						
Calcium	5.0	79 / 79	58	53	71	83
Magnesium	1.0	79 / 79	17	18	21	26
Sodium	5.0	79 / 79	214	240	263	313
Potassium	0.5	79 / 70	3.3	3.5	3.9	4.5
Chloride	1.0	79 / 79	185	180	240	295
Sulfate	10.0	79 / 79	163	150	205	248
Nutrients						
Nitrate (as N)	0.02	79 / 79	3.1	2.4	4.0	4.8
Trace Elements						
Boron	0.01	79 / 79	0.25	0.24	0.31	0.38
Fluoride	0.20	79 / 79	2.0	1.8	2.5	2.9

All units are mg/L except as noted

Groundwater Quality Variation

Between Two Recharge Groups – For the 1995 data, 19 groundwater quality constituent concentrations were compared between two recharge sources: Gila River (49 sites) and local precipitation recharge (30 sites) as revealed by well depths and locations.[6] Significant concentration differences were found with 15 constituents (Kruskal-Wallis test, $p \leq 0.05$).

Temperature, pH-field, and pH-lab were significantly higher in local precipitation recharge sites than Gila River recharge sites. SC-field, SC-lab, TDS, hardness (Diagram 10), calcium, magnesium, sodium (Diagram 11), potassium, total alkalinity, chloride, nitrate and boron, were significantly higher in Gila River recharge than in local recharge.

Significant differences found with the 1995 and 2004 data are compared in Table 16. Summary statistics in the form of 95% confidence intervals are provided for those constituents with significant concentration differences between recharge groups in Table 17 for both the 1995 and 2004 data.

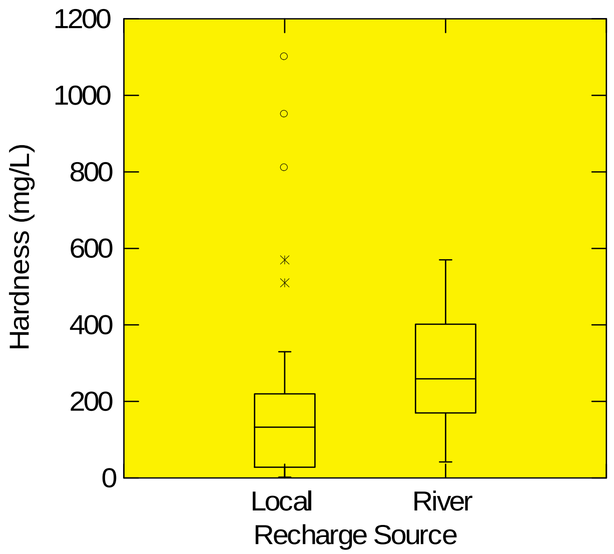


Diagram 10. Sites sampled in 1995 consisting of groundwater derived from Gila River recharge have significantly higher hardness concentrations than sample sites derived from recharge from the local precipitation (Kruskal-Wallis test, $p \leq 0.01$). Similar hardness relationships between have been found in other Arizona groundwater basins with perennial streams such the Lake Mohave basin where the floodplain aquifer recharged by the Colorado River had significantly higher hardness concentrations than recharge from local precipitation .[34]

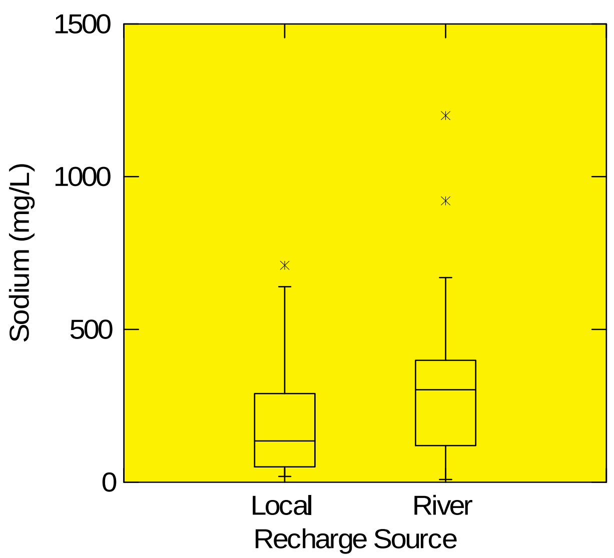


Diagram 11. Sites sampled in 1995 consisting of groundwater derived from Gila River recharge have significantly higher sodium concentrations than sample sites derived from recharge from local precipitation (Kruskal-Wallis test, $p \leq 0.01$). Similar sodium relationships were also observed in the Lake Mohave basin due to recharge from local precipitation.[34]

Table 16. Variation in Groundwater Quality Constituent Concentrations Between Two Recharge Sources Using Kruskal-Wallis Test for Two Different Studies

Constituent	1995 Data		2004 Data	
	Significance	Significant Differences Among Recharge Sources	Significance	Significant Differences Among Recharge Sources
Temperature - field	**	Local > River	ns	-
pH – field	**	Local > River	**	Local > River
pH – lab	**	Local > River	**	Local > River
SC - field	*	River > Local	**	River > Local
SC - lab	**	River > Local	**	River > Local
TDS	**	River > Local	**	River > Local
Hardness	**	River > Local	**	River > Local
Calcium	**	River > Local	**	River > Local
Magnesium	**	River > Local	**	River > Local
Sodium	**	River > Local	**	River > Local
Potassium	*	River > Local	**	River > Local
Bicarbonate	**	River > Local	**	River > Local
Chloride	**	River > Local	**	River > Local
Sulfate	ns	-	**	River > Local
Nitrate (as N)	**	River > Local	**	River > Local
TKN	ns	-	**	River > Local
Arsenic***	ns	-	ns	-
Boron	**	River > Local	**	River > Local
Fluoride	ns	-	ns	-

ns = not significant * = significant at $p \leq 0.05$ or 95% confidence level ** = significant at $p \leq 0.01$ or 99% confidence level
*** = for information only, statistical test not valid because of the large number of non-detects
All units mg/L except temperature (degrees Celsius) and SC (uS/cm).

Table 17. Summary Statistics for Gila Valley Sub-Basin Groundwater Quality Constituents With Significant Concentration Differences Between Two Local Recharge Sources and Two Different Studies

Constituent	1995 Data		2004 Data	
	Local	River	Local	River
Temperature - field	23.8 to 27.7	20.7 to 22.3	-	-
pH – field	7.31 to 8.06	6.96 to 7.41	7.91 to 8.27	7.18 to 7.60
pH – lab	7.58 to 8.15	7.36 to 7.53	8.05 to 8.41	7.72 to 8.10
SC - field	834 to 1672	1371 to 2130	1032 to 2102	2187 to 4074
SC - lab	700 to 1346	1290 to 2175	1063 to 2116	2223 to 4398
TDS	514 to 1042	1005 to 1430	652 to 1309	1427 to 2868
Hardness	118 to 331	246 to 327	84 to 190	263 to 418
Calcium	32 to 89	66 to 88	23 to 55	63 to 108
Magnesium	8 to 26	20 to 28	7 to 13	21 to 33
Sodium	120 to 250	245 to 378	179 to 392	361 to 814
Potassium	2.3 to 4.3	3.7 to .5.1	2.1 to 6.5	2.7 to 10.5
Total Alkalinity	164 to 235	267 to 332	138 to 189	276 to 393
Chloride	58 to 213	233 to 375	132 to 421	414 to 909
Sulfate	-	-	136 to 298	236 to 549
Nitrate (as N)	0.6 to 1.6	4.6 to 6.8	0.3 to 0.9	3.9 to 9.6
TKN	-	-	0.10 to 0.22	0.11 to 0.55
Arsenic***	-	-	-	-
Boron	0.1 to 0.3	0.3 to 0.4	0.2 to 0.6	0.3 to 0.9
Fluoride	-	-	-	-

ns = not significant * = significant at $p \leq 0.05$ or 95% confidence level ** = significant at $p \leq 0.01$ or 99% confidence level
*** = for information only, statistical test not valid because of the large number of non-detects
All units mg/L except temperature (degrees Celsius) and SC (uS/cm).

Time Trend Analysis

Site Comparison – Thirteen groundwater sites sampled during the 1995 ADEQ Upper Gila watershed study were resampled during the 2004 ADEQ study. However data from only 11 sites could be compared between the time periods as two sites were excluded from further analysis because of data quality issues. These sites (G-63/63D and G-64/64D) sampled for the 1995 study had duplicate samples collected whose extreme variation excluded these sites from further analysis. Statistical analysis of the data found in Table 18 indicated that three constituents: pH-lab, chloride and arsenic increased significantly between 1995 and 2004 (Wilcoxon test, $p \leq 0.05$).

Study Comparison – Another time trend comparison was made by classifying the 1995 sample sites by alluvial unit using well characteristics.[6] Further sub-classifying older alluvium without actual isotope data was not possible and no time trend analyses were done with data from this alluvial unit. Using the data from the younger alluvium, 49 sites sampled in 1995 were compared with 18 sites sampled in 2004. Nineteen constituents were examined for groundwater quality changes over time. Statistical analysis of the data (Table 19) indicated that pH-lab, SC-field, SC-lab, TDS (Diagram 12), sodium, chloride (Diagram 13) and sulfate increased significantly between 1995 and 2004 (Mann-Whitney test, $p \leq 0.05$).

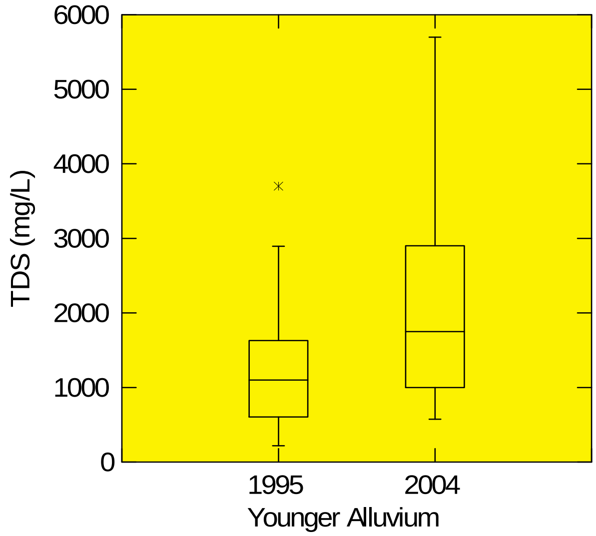


Diagram 12. Sites sampled in 1995 consisting of groundwater pumped from the younger alluvium recharged by the Gila River have significantly higher TDS concentrations than such sites sampled in 2004 (Mann-Whitney test, $p \leq 0.01$). Likely contributors to the TDS increase is excess irrigation water that recharges groundwater carrying a large salt load and upward leakages of saline groundwater along faults and through abandoned irrigation and oil exploration wells drilled prior to the 1930s.[19]

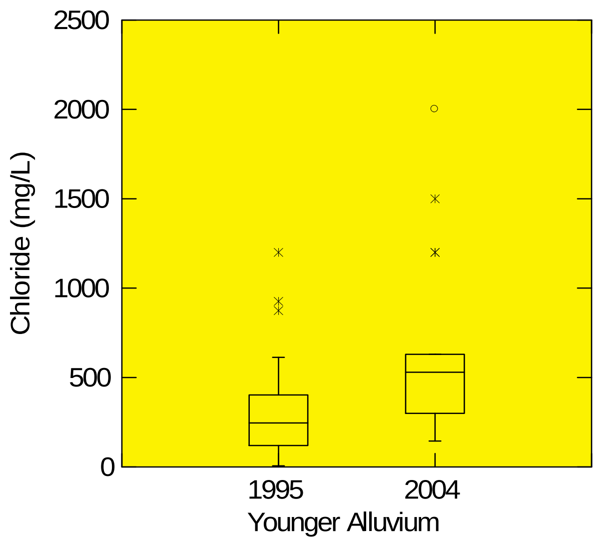


Diagram 13. Sites sampled in 1995 consisting of groundwater pumped from the younger alluvium recharged by the Gila River have significantly higher chloride concentrations than such sites sampled in 2004 (Mann-Whitney test, $p \leq 0.01$). Chloride, along with sodium and sulfate, are the most important contributors to the significant TDS increases that also occurred in the time between the two studies.

Table 18. Summary Results of Gila Valley Sub-Basin Time Trend Analysis from Sites Sampled both in 1995 and 2004 including Wilcoxon Test Significance

Constituents	Number of Sites	Difference in Percent		Difference in Levels		Wilcoxon Test Significance
		Minimum	Maximum	Minimum	Maximum	
Physical Parameters and General Mineral Characteristics						
Temperature (C)	9	0 %	24 %	0	15	ns
pH – field (su)	7	0 %	6 %	0.05	0.99	ns
pH – lab (su)	10	0 %	6 %	0	0.89	*
SC–fld (uS/cm)	8	2 %	21 %	14	514	ns
SC–lab (uS/cm)	10	3 %	23 %	36	728	ns
TDS	11	0 %	15 %	0	300	ns
Hardness	11	0 %	75 %	0	140	ns
Alkalinity, total	11	0 %	23 %	0	70	ns
Major Ions						
Calcium	11	2 %	70 %	0	10	ns
Magnesium	11	0 %	14 %	0	11	ns
Sodium	11	0 %	24 %	0	110	ns
Potassium	11	2 %	36 %	0.15	1.6	ns
Chloride	11	1 %	30 %	1	190	**
Sulfate	11	0 %	30 %	0	185	ns
Nutrients						
Nitrate as N	11	0 %	36 %	0	1.2	ns
TKN	11	0 %	84 %	0	0.52	ns
Trace Elements						
Arsenic	6	0 %	39 %	0	0.039	*
Boron	11	0 %	11 %	0	0.04	ns
Fluoride	11	0 %	37 %	0	4.4	ns

All units are mg/L except as noted
ns = No significant ($p \leq 0.05$) difference between time periods
* = Significant difference at the $p \leq 0.05$ or 95 % confidence level
** = Significant difference at the $p \leq 0.01$ or 99 % confidence level
At 11 sites, pH-lab, chloride and arsenic had significantly higher concentrations in 2004 compared with 1995.

Table 19. Variation in Groundwater Quality Constituent Concentrations of Younger Alluvium Samples Between 1995 and 2004 Using the Mann-Whitney Test

Constituent	Significance	Significant Differences Over Time
Physical Parameters and General Mineral Characteristics		
Temperature – field (C)	ns	-
pH – field (su)	ns	-
pH – lab (su)	**	2004 > 1995
SC – field (uS/cm)	**	2004 > 1995
SC – lab (uS/cm)	**	2004 > 1995
TDS	**	2004 > 1995
Hardness	ns	-
Total Alkalinity	ns	-
Major Ions		
Calcium	ns	-
Magnesium	ns	-
Sodium	**	2004 > 1995
Potassium	ns	-
Chloride	**	2004 > 1995
Sulfate	*	2004 > 1995
Nutrients		
Nitrate	ns	-
TKN	ns	-
Trace Elements		
Arsenic	ns	-
Boron	ns	-
Fluoride	ns	-

All units are mg/L except as noted
ns = No significant ($p \leq 0.05$) difference between time periods
* = Significant difference at the $p \leq 0.05$ or 95 % confidence level
** = Significant difference at the $p \leq 0.01$ or 99 % confidence level

DISCUSSION

The Gila River is an important influence on groundwater quality in the Gila Valley sub-basin. Salinity in the Gila River seasonally fluctuates, varying in an inverse, nearly linear fashion versus flow rate. [18] In 2002, the river's average TDS concentration increased from 594 mg/L at Solomon located at the head of the Gila Valley to 2,150 mg/L at Calva located 62.6 river miles away just down gradient from the sub-basin.[25] While TDS concentrations at Solomon aren't highly variable, those at Calva can fluctuate from several hundred mg/L when flood events dilute the salinity during high flows of the Gila River to many thousand mg/L during low flows of the Gila River. [25]

River flow, especially during flood stages, recharges the younger alluvium with fresh water that usually has no detectable amounts of nitrate.[25] However much of the Gila River is diverted for irrigation use above Solomon (Figure 9). The excess water applied for irrigation that is unused by the crops recharges the groundwater carrying a large salt load as well as nitrogen from fertilizer applications. The irrigation recharge contributes to the elevated TDS and nitrate concentrations found in the younger alluvium. Nitrate concentrations in irrigation recharge can be reduced by utilizing best management practices while salt loading can be decreased by changing irrigation methods to reduce the volume of water—and the associated salt—applied to farmland.

While the salinity from irrigation recharge contributes to the significant increase in TDS concentrations found in the younger alluvium between the two ADEQ studies, recent research suggests it's not the most important factor. Another major natural source, determined using isotope analysis, is upward leakages of saline groundwater along faults and through abandoned irrigation and oil exploration wells drilled prior to the 1930s. [19] This highly mineralized groundwater produced from great depths is probably impacted by evaporite deposits and under artesian pressure, is particularly prevalent in the lower portion of the sub-basin. [19] Water quality in the older alluvial fill is poor in the central part of the basin but appears to improve along the mountain front near Artesia possibly due to the absence of the evaporite deposits there. [9]

Effluent from faulty septic systems and waste associated with livestock in corrals adjacent to sample sites such as windmills are likely responsible for the occasionally elevated nitrate concentrations not associated with farming. These sources have been found to impact nitrate concentrations in isolated wells in other Arizona groundwater basins.[32]

Other water quality exceedances in the Gila Valley sub-basin appear to be the result of natural sources. Elevated gross alpha and uranium concentrations were usually located in or near areas of granite, or alluvial areas of eroded granite, a common pattern for these constituents. [23] Elevated fluoride and arsenic concentrations are generally associated with an oxidizing environment, an abundance of trace elements in the sediments, and the long residence time characteristic of waters in chemically closed systems such as the evaporate and basal conglomerate sub-units. [28]

Fluoride water quality exceedances occur both in the older and younger alluvium. Fluoride concentrations above 5 mg/L are controlled by calcium through precipitation or dissolution of the mineral fluorite. In a chemically closed hydrologic system, such as can be found in the older alluvium, calcium is removed from solution by precipitation of calcium carbonate and the formation of smectite clays. High concentrations of dissolved fluoride may occur in groundwater depleted in calcium if a source of fluoride ions is available for dissolution. [28]

Exchange of sorption-desorption reactions are an important control for lower (< 5 mg/L) fluoride concentrations. In recharge areas, weathering of rocks releases fluoride ions into solution. As pH levels increase down gradient, more hydroxyl ions may exchange for fluoride ions, thereby increasing the fluoride in solution. [28] Elevated fluoride concentrations in the younger alluvium may result from both upward leakages from the older alluvium and from the high average fluoride concentration (1.2 mg/L) found in the Gila River. [19, 25]

Arsenic was the constituent that most frequently exceeded health-based water quality standards. Although the exceedances were generally interspersed throughout the Gila Valley sub-basin, the highest concentrations however, were located east of the San Simon River. Arsenic concentrations may be influenced by similar reactions as fluoride, including exchange on clays or with hydroxyl ions. Other factors such as aquifer residence time, an oxidizing environment, and lithology likely effect arsenic concentrations. [28, 29]

The suitability of groundwater for domestic use in the Gila Valley sub-basin is variable; approximately half the sites sampled exceeded a health-based water quality standard. ADEQ recommends that private owners sample any well and/or spring used for domestic purposes for SDW constituents. Particular emphasis however, should be placed on sampling shallow wells located in the Gila River floodplain and deep wells producing older local recharge especially those having artesian flow. An effective strategy for developing public water supplies in the Gila Valley sub-basin, from a water quality perspective, appears to be drilling shallow wells in the older alluvium along the mountain front up from the Gila River and minimizing the chance of intersecting deep evaporite deposits. Such wells generally have lower TDS, arsenic, and fluoride concentrations compared to wells drilled deeper into the older alluvium that penetrate the evaporite and/or basal conglomerate sub-units. Wells in the older alluvium also generally have lower TDS and nitrate concentrations than are commonly found in the younger alluvium.

The suitability of groundwater for irrigation use in the Gila Valley sub-basin is also variable; approximately 70 percent of sample sites had irrigation water classifications deemed high or very high for either salinity or sodium hazards.[40] Even more revealing were the 12 sample sites that consisted of irrigation wells producing large volumes of groundwater for commercial agricultural activities; all had high or very high hazards for either salinity or sodium. Fortunately, in many farming areas, water diverted from the Gila River is able to be blended with groundwater to provide a more suitable resource for growing irrigated crops.

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Appendix A. Data for Sample Sites, Gila Valley Sub-Basin, 2004

Site #	Cadastral / Pump Type	Latitude - Longitude	ADWR #	ADEQ #	Site Name	Samples Collected	Well Depth	Water Depth	Recharge Group
1st Field Trip, April 19-21, 2004 - Towne & Horsley (Equipment Blank, GV-17)									
GV-1	D(8-27)23dbb windmill	32°43'11.69" 109°32'58.71"	615568	33410	Goat Well	Inorganic, Radon, O, H Isotopes	150'	60'	Local-older
GV-2/3 Split	D(8-28)29dbd submersible	32°42'19.62" 109°29'59.13"	608751	33413	Constructn Well	Inorganic, Radiochem Radon, O, H isotopes	600'	6'	Local-older
GV-4	D(8-28)22ccb submersible	32°43'03.56" 109°28'35.87"	615569	33412	111 Ranch Well	Inorganic O, H isotopes	700'	80'	Local-older
GV-5	D(9-28)31dad windmill	32°36'15.27" 109°30'40.92"	615670	34051	LL Well	Inorganic, Radiochem Radon, O, H isotopes	200'	110'	Local-older
GV-6	D(9-27)26abd windmill	32°37'36.90" 109°32'58.38"	615669	34046	Spike C Well	Inorganic, Radon, O, H isotopes	-	-	Local-newer
GV-7	D(10-28)7dbc windmill	32°34'33.54" 109°31'08.19"	-	34435	Bailey Well	Inorganic, Radiochem Radon, O, H isotopes	-	-	Local-recent
GV-8	D(9-27)9aca windmill	32°40'02.80" 109°34'45.42"	807397	34045	RockHouse Well	Inorganic O, H isotopes	220'	90'	Local-newer
GV-9	San Simon River at 32nd St. Bridge	--	--	--	San Simon River	O, H isotopes	--	--	-
GV-10	D(8-27)22cdd submersible	32°42'55.23" 109°34'17.80"	622645	33409	Solar Well #1	Inorganic, Radon O, H isotopes	125'	100'	Local-older
GV-11	D(8-26)8dcc submersible	32°45'04.59" 109°41'57.33"	616544	58886	Roper Well	Inorganic, Radiochem Radon, O, H isotopes	222’	180’	Local-older
GV-12/13 Duplicate	D(8-26)8bdc artesian	32°45'06.46" 109°42'40.59"	628222	33308	Roper Hot Well	Inorganic, Radiochem Radon, O, H isotopes	1450'	flowing	Local-older
GV-14	D(8-26)20dbc artesian	32°43'13.04" 109°42'22.91"	803625	33349	Dankworth Hot Well	Inorganic O, H isotopes	1260’	flowing	Local-older
GV-15	D(10-26)33abb submersible	32°31'35.47" 109°41'28.31"	644133	34428	Solar #2 Well	Inorganic, Radiochem Radon, O, H isotopes	30'	20'	Local-recent
GV-16	Gila River at 8th Ave Bridge	--	--	--	Gila River	O, H isotopes	-	-	-
2nd Field Trip, July 7-9, 2004 - Towne & Horsley (Equipment Blank, GV-31)									
GV-18	D(6-24)09d spring	32°55'23.825" 109°53'28.741"	--	63655	Opp Spring	Inorganic, Radon O, H isotopes	-	-	Gila River
GV-19	D(6-23)29ddc windmill	32°52'37.903" 110°00'30.286"	624922	45005	Brimhall Well	Inorganic, Radiochem Radon, O, H isotopes	120’	100’	Local-newer
GV-20	D(6-24)06ada pumpjack	32°56'33.613" 109°55'12.465"	512311	63656	Winter Well	Inorganic O, H isotopes	165’	67'	Gila River
GV-21/22a Duplicate	D(3-22)25cc windmill	33°08'17.385" 110°02'54.937"	--	27191	Samson Windmill	Inorganic, Radiochem Radon, O, H isotopes	-	-	Local-older
GV-22b	D(4-23)36bbc spring	33°02'43.932" 109°56'49.526"	--	27967	Charlie Thompson	Inorganic O, H isotopes	-	-	Local-older
GV-23/24/90 Split	D(8-26)25acb submersible	32°46'06.826" 109°43'24.411"	532191	51515	Sanders Well	Inorganic, Radiochem Radon, O, H isotopes	208'	69'	Local-older
GV-25	D(8-26)07bad submersible	32°45'21.522" 109°43'29.273"	611213	63657	Sanders Well	Inorganic, Radiochem O, H isotopes	200'	8'	Local-older
GV-26	D(7-26)18baa turbine	32°49'46.466" 109°43'36.392"	-	71420	Safford HS Well	Inorganic, Radon O, H isotopes			Gila River
GV-27	D(6-25)23bba artesian	32°54'07.806" 109°45'44.035"	643412	30876	Kimball Well	Inorganic, Radiochem Radon, O, H isotopes	1000’	artesian	Local-older
GV-28	D(4-23)35cca turbine	33°02'14.202" 109°57'46.027"	630946	71421	Ft. Thomas HS Well	Inorganic O, H isotopes	60’	30’	Gila River
GV-29	D(6-24)01bdb turbine	32°56'35.351" 109°50'42.408"	560105	63658	Tatum Well #2	Inorganic, Radon O, H isotopes	80’	20’	Gila River
GV-30	D(6-24)01cab windmill	32°56'23.460" 109°50'49.440"	560340	63659	Tatum Well #1	Inorganic O, H isotopes	65'	25’’	Gila River

Well depth and water depth are from ADWR database as reported by well drillers

Appendix A. Data for Sample Sites, Gila Valley Sub-Basin, 2004

Site #	Cadastral / Pump Type	Latitude - Longitude	ADWR #	ADEQ #	Site Name	Samples Collected	Well Depth	Water Depth	Recharge Source
3rd Field Trip, August 2-4, 2004 - Towne & Metz (Equipment Blank, GV-46)									
GV-32	D(7-24)08aca submersible	32°50'32.601" 109°54'30.978"	565865	63677	Well #7	Inorganic, Radiochem Radon, O, H isotopes	300'	42'	Local-older
GV-33	D(5-23)02cbd turbine	33°01'31.174" 109°57'46.295"	606087	59971	Cope Well	Inorganic, Radiochem Radon, O, H isotopes	80'	30'	Local-older
GV-34	D(6-28)5dcc turbine	32°55'15.727" 109°29'31.559"	607100	51284	Bonita Well #15	Inorganic, Radiochem Radon, O, H isotopes	212'	25'	Local-newer
GV-35	D(6-28)5	-	-	-	Bonita Creek	O, H isotopes	-	-	-
GV-36/37 Split	D(7-26)13dab turbine	32°49'22.264" 109°37'58.857"	607107	57079	Kempton A Well	Inorganic, Radon, O, H isotopes	89’	-	Gila River
GV-38	D(7-27)18ddd turbine	32°49'03.632" 109°36'47.563"	629193	32560	Carrasco Well	Inorganic O, H isotopes	-	-	Gila River
GV-39/40 Duplicate	D(7-26) 6dda turbine	32°50’56.638" 109°42'56.024"	805753	51283	Smith Well	Inorganic O, H isotopes	50'	12'	Gila River
GV-41	D(7-26)5dba turbine	32°51'06.764" 109°42'14.819"	607105	32157	Morris Well #3	Inorganic O, H isotopes	104’	50’	Gila River
GV-42	D(9-25)9dcb spring	32°39'37.87" 109°47'34.24"	-	34021	Angle Spring	Inorganic, Radon O, H isotopes	--	--	Mt. Graham
GV-43	Wet Canyon at Hwy 366	-	-	-	Wet Canyon	O, H isotopes	-	-	-
GV-44	D(9-24)14adc spring	32°39'13.87" 109°51'21.67"	-	34017	Heliograph Spring	Inorganic, Radiochem Radon, O, H isotopes	-	-	Mt. Graham
GV-45	D(8-24)29dcd spring	32°42'14.52" 109°54'28.58"	-	33234	Columbine Spring	Inorganic, Radon O, H isotopes	-	-	Mt. Graham
GV-47	Precipitation on Mt. Graham	-	-	-	-	O, H isotopes	-	-	-
GV-48	D(7-27)10abc turbine	32°50'41.602" 109°33'41.463"	620676	32506	BuenaVista Hot Well	Inorganic O, H isotopes	700’	20’	Local-older
GV-49	Precipitation in Solomon	--	--	--	--	O, H isotopes	-	-	-
GV-50	D(7-27)20ada turbine	32°48'52.58" 109°35'51.45"	619069	63678	Irri Well	Inorganic O, H isotopes	125’	60'	Gila River
GV-51	D(7-26)24ada turbine	32°48'45.704" 109°37'51.660"	607283	32384	Well #3	Inorganic O, H isotopes	102’	50’	Gila River
GV-52	D(7-25)2bbd turbine	32°51'29.425" 109°45'47.688"	607287	32016	Irri. Well	Inorganic O, H isotopes	81’	27’	Gila River
4th Field Trip, October 20-22, 2004 - Towne & Aguilar (Equipment Blank, GV-76)									
GV-53	D(5-23)10ccb submersible	33°00'41.62" 109°58'53.92"	619439	28991	Rhodes Well	Inorganic O, H isotopes	60'	30'	Local-newer
GV-54	D(5-24)29cdd turbine	32°57'42.23" 109°54'26.91"	603049	29129	Turf Well	Inorganic, Pesticides O, H isotopes	48'	12'	Gila River
GV-55	D(7-24)24bbd submersible	32°48'49.43" 109°50'54.08"	628228	31989	Shallow Well	Inorganic, Radon O, H isotopes	50'	20'	Local-newer
GV-56	D(7-24)24bbb submersible	32°48'50.26" 109°50'52.25"	530098	63952	Deep Well	Inorganic, Radiochem Radon , O, H isotopes	197’	29’	Local-older
GV-57	D(6-24)01bdb	-	-	-	Ash Creek Diversion	O, H isotopes	-	-	-
GV-58	D(7-24)13dcb spring	32°49'11.15" 109°50'20.46"	-	31975	Smith Spring	Inorganic O, H isotopes	-	-	Local-older
GV-59/60 Split	D(9-26)5bbc submersible	32°41'06.09" 109°42'58.25"	647251	34031	Hamblin Well	Inorganic, Radon O, H isotopes	122'	67'	Local-older
GV-61	D(9-26)5bbc turbine	32°41'01.19" 109°42'58.87"	608711	34030	Reed Well	Inorganic O, H isotopes	350’	100’	Local-older

Well depth and water depth are from ADWR database as reported by well drillers

Appendix A. Data for Sample Sites, Gila Valley Sub-Basin, 2004

Site #	Cadastral / Pump Type	Latitude - Longitude	ADWR #	ADEQ #	Site Name	Samples Collected	Well Depth	Water Depth	Recharge Source
GV-62/63 Duplicate	D(6-26)32ddd submersible	32°51'48.08" 109°41'42.43"	580318	63953	Birdno Well	Inorganic, Radon, O, H isotopes	125’	98’	Gila River
GV-64	D(7-25)36dad submersible	32°46'39.9" 109°44'00"	509916	32403	Lemon Well	Inorganic, Radon O, H isotopes	160’	65’	Local-older
GV-65	D(6-25) 5dab spring	32°53'57.1" 109°46'56"	-	30684	Lower Big Spring	Inorganic O, H isotopes	-	-	Local-older
GV-66	D(7-26)5dba spring	32°56'38" 109°42'23"	-	64000	Upper Big Spring	Inorganic, Radon O, H isotopes	-	-	Local-newer
GV-67	D(7-22)8cbc submersible	32°50'08.17" 110°07'40.06"	756177	63954	Ctnwd Cyn RanchWell	Inorganic, Radiochem O, H isotopes	--	--	Local-newer
GV-68	D(7-21)36ddc submersible	32°46'30" 110°08'58"	805025	63955	Cedar Spgs Windmill	Inorganic O, H isotopes	33’	25’	Local-newer
GV-69	Precipitation in Safford	-	-	-	-	O, H isotopes	-	-	-
GV-70	D(6-28)17ccd spring	32°54'14" 109°30'26"	-	63957	Spring Cyn Spring	Inorganic O, H isotopes	-	-	Local-newer
GV-71	D(6-28)17ccd submersible	32°54'17.109" 109°30'29.097"	583507	63956	Spring Cyn Well	O, H isotopes	80’	32’	Local-newer
GV-72	D(6-25)22caa turbine	32°53'45.811" 109°46'30.586"	619537	30869	Irrigation Well	Inorganic, Pesticides O, H isotopes	60’	45’	Gila River
GV-73	D(6-25)22caa submersible	32°53'45.037" 109°46'31.585"	619538	30868	Domestic Well	Pesticides O, H isotopes	60’	45’	Gila River
GV-74	D(6-25)22dab turbine	32°53'42.898" 109°46'10.641"	616863	30871	Shop Well	Inorganic, Pesticides O, H isotopes	82’	47'	Gila River
GV-75	D(7-25)21dad artesian	32°48'23.8" 109°47'05"	611091	32109	Artesian Well	Inorganic O, H isotopes	-	flowing	Local-older
GV-77	D(6-21)11cac spring	32°55'32" 110°10'34"	-	63958	Preacher Spring	Inorganic, Radiochem Radon, O, H isotopes	-	-	Local-newer
5th Field Trip, November 16-17, 2004 - Towne & Aguilar (Equipment Blank, GV-85)									
GV-78	D(4-23)20c submersible	33°04'11.789" 110°00'.57.772"	641099	27859	Kriley Well	Inorganic O, H isotopes	87’	30’	Gila River
GV-79	D(8-25)27caa surface water	-	-	-	Marijilda Canyon	O, H isotopes	-	-	-
GV-80	D(8-25)21bdd spring	32°43'24.625" 109°4737.077"	-	64266	Rincon Spring	Inorganic O, H isotopes	-	-	Local-newer
GV-81	D(9-24)36ddc spring	32°36'13.4" 109°5022.4"	-	64321	Trapp Spring	Inorganic, Radiochem O, H isotopes	-	-	Mt. Graham
GV-82	D(4-23)7bdb spring	33°06'08.796" 110°01'50.900"	-	27789	Salt Spring	Inorganic O, H isotopes	-	-	Local-older
GV-83/84 Duplicate	D(4-24)27bbd spring	33°03'35.210" 109°52'46.969"	-	27970	Teague Spring	Inorganic, Radiochem O, H isotopes	-	-	Local-older
6th Field Trip, April 28, 2005 - Towne (Equipment Blank, GV-90a)									
GV-85/86 Split	D(8-26)2ddb submersible	32°46'03.065" 109°39'.24.472"	517403	64749	Smith Well	Inorganic O, H isotopes	155’	98’	Local-older
GV-87	D(8-26)2abb submersible	32°46'20.343" 109°39'.18.460"	579664	64751	Jurado Well	Inorganic O, H isotopes	205’	75’	Local-older
GV-88	D(8-26)2dbc submersible	32°45'48.329" 109°39’16.894"	651087	64753	Lundguth Well	Inorganic O, H isotopes	96’	60’	Local-older
GV-89	D(8-26)2bdd submersible	32°46'14.291" 109°39’43.186"	645143	64752	Bryce Well	Inorganic O, H isotopes	120’	-	Local-older
7th Field Trip, August 10, 2005 – Boettcher & Rodine (resampling of GV-23/24)									
GV-90 (GV-23/24)	D(8-26)25acb submersible	32°46'06.826" 109°43'24.411"	532191	51515	Sanders Well	Inorganic	208'	69'	Local-older

* - Well depth and water depth are from ADWR database as reported by well drillers

Appendix B. Groundwater Quality Data, Gila Valley Sub-Basin, 2004

Site #	Site MCL Exceedances	Temp (°C)	pH-field (su)	pH-lab (su)	SC-field (uS/cm)	SC-lab (uS/cm)	TDS (mg/L)	Hard (mg/L)	Hard - cal (mg/L)	Turb (ntu)
GV-1	TDS, As, **F**	24.14	8.47	***8.6***	1362	1200	**840**	10	10	*0.31*
GV-2/3	pH, TDS, SO_4, As **F**, Radon	35.1	**8.65**	***8.8***	1557	1550	**950**	11.5	12	*0.15*
GV-4	pH, TDS, SO_4, As **F**	31.8	**8.59**	***8.6***	1599	1600	**980**	12	14	*0.10*
GV-5	pH, TDS, SO_4, As **F**, Radon	24.1	**8.90**	***9.0***	1668	1700	**1000**	ND	ND	*0.55*
GV-6	pH, TDS, Radon	24.6	**8.97**	***9.0***	834	850	**500**	ND	ND	*0.61*
GV-7	TDS, As, gross ά U	23.0	7.95	*7.8*	986	990	**620**	48	66	*5.2*
GV-8	-	23.4	8.25	*8.2*	633	630	360	47	52	*0.60*
GV-9	-	16.7	7.74	-	660	-	-	-	-	-
GV-10	pH	23.4	**8.66**	***8.6***	631	630	390	13	16	0.61
GV-11	TDS	25.8	8.05	*8.0*	1371	1400	**810**	85	91	0.23
GV-12/13	pH, TDS, As, Cl, **F**, SO_4, Radon	37.1	**8.63**	***8.8***	4216	4100	**2400**	76	87	0.14
GV-14	pH, TDS, Cl, **F**	37.6	**8.82**	***8.9***	1583	1600	**890**	16	19	0.18
GV-15	F, gross ά, Radon	26.2	7.55	*7.3*	640	640	390	240	250	0.06
GV-16	-	22.9	8.06	-	641	-	-	-	-	-
GV-18	pH, TDS, Cl, SO_4 As, Radon	30.3	**8.83**	*8.8*	4027	4000	**2400**	200	190	*4.8*
GV-19	F	26.3	7.51	*9.4*	351	350	240	11	ND	*0.98*
GV-20	TDS, Cl, SO_4	25.4	7.76	*7.7*	6588	8900	**5700**	*	250	*5.4*
GV-21/22a	F	23.6	7.69	*7.85*	447	455	300	205	215	*0.43*
GV-22b	TDS, Cl, SO_4, **F** As, Mn	27.4	7.62	*7.5*	4921	5100	**2900**	450	450	*16*
GV-23/24/90	TDS, Cl, SO_4, Mn, Radon	25.2	7.58	*8.02*	2435	2500	**1800**	660	675	*0.09*
GV-25	TDS, Cl, SO_4, **F**	26.93	8.37	*8.3*	1458	1500	**860**	79	69	*0.54*
GV-26	TDS, Cl, SO_4, Radon	23.1	7.06	*7.3*	2443	2500	**1500**	450	460	*0.02*
GV-27	TDS, Cl, SO_4, **F** As, Radon	39.3	7.85	*8.0*	4922	4900	**2900**	98	87	*0.06*
GV-28	TDS, Cl, SO_4	25.7	6.95	*7.0*	3044	3000	**2900**	680	690	*0.28*
GV-29	TDS, Cl, SO_4 NO_3, **F**, As, Radon	22.5	7.53	*7.7*	5695	5900	**3800**	270	270	*0.03*
GV-30	TDS, Cl, SO_4 NO_3, **F**, As	21.1	7.24	*7.5*	5961	6100	**4000**	520	520	*0.29*

bold = constituent level exceeds Primary or Secondary MCL
italics = constituent exceeded holding time
F = fluoride concentrations exceeding Primary MCL; F = fluoride concentrations exceeding Secondary MCL

Appendix B. Groundwater Quality Data, Gila Valley Sub-Basin, 2004

Site #	Site MCL Exceedances	Temp (°C)	pH-field (su)	pH-lab (su)	SC-field (uS/cm)	SC-lab (uS/cm)	TDS (mg/L)	Hard (mg/L)	Hard - cal (mg/L)	Turb (ntu)
GV-32	pH, **F**, As	24.3	**9.97**	***9.8***	541	550	320	ND	ND	2.1
GV-33	Radon	22.3	7.42	*7.9*	339	360	260	110	110	2.8
GV-34	Radon	24.1	7.61	*8.2*	400	410	280	170	170	0.70
GV-36/37	TDS, Radon	22.3	7.32	*8.09*	934	985	**575**	205	200	6.75
GV-38	TDS, Cl, F, As, Radon	21.8	7.06	*7.9*	1410	1500	**900**	280	270	0.21
GV-39/40	TDS, F	21.0	7.41	*8.1*	1098	1200	**710**	140	130	7.35
GV-41	TDS, Cl	22.2	7.26	*8.1*	1059	1100	**670**	250	240	0.30
GV-42	-	-	7.97	*8.5*	221	220	160	100	97	6.6
GV-44	Radon	10.6	8.58	*7.0*	46	46	51	ND	ND	0.12
GV-45	Radon	10.6	8.13	*6.9*	45	46	49	19	15	ND
GV-48	TDS, SO_4, **F**, As	46.1	8.49	*8.7*	1706	1700	**1100**	10	ND	0.04
GV-50	TDS, Cl, **F**, As	23.3	7.28	*8.1*	1573	1600	**1000**	190	170	0.04
GV-51	TDS, Cl, F, As	21.7	7.10	*8.0*	1914	2000	**1200**	350	330	0.08
GV-52	TDS, Cl, SO_4 NO_3	21.9	6.97	*8.0*	2945	3100	**1900**	610	580	0.04
GV-53	-	20.0	8.10	*7.9*	319	340	230	140	150	0.02
GV-54	TDS, Cl, SO_4, F	19.6	7.45	*8.0*	2859	2900	**1900**	400	400	0.12
GV-55	Radon	21.1	7.02	*7.3*	187	200	140	69	76	0.16
GV-56	pH, TDS, **F**, As	21.3	**9.35**	*9.4*	1260	1300	**760**	ND	ND	1.5
GV-58	TDS, SO_4, **F**	22.4	7.67	*7.5*	5410	5600	**3400**	70	64	1.7
GV-59/60	TDS, F, Radon	26.3	7.32	*7.88*	855	900	**560**	120	120	0.06
GV-61	**F**, As	30.3	8.42	*8.6*	707	730	440	17	17	0.60
GV-62/63	TDS, Cl, SO_4, **F**, Radon	26.0	7.64	*8.1*	6633	6500	**4300**	340	295	0.66
GV-64	TDS, SO_4	22.3	7.73	*8.1*	1213	1300	**880**	270	270	0.04
GV-65	TDS, Cl, SO_4, **F** Mn	21.7	7.38	*8.0*	3782	3900	**2500**	360	330	4.6
GV-66	-	20.3	7.80	*8.1*	389	390	280	170	180	0.10

bold = constituent level exceeds Primary or Secondary MCL
italics = constituent exceeded holding time
F = fluoride concentrations exceeding Primary MCL; F = fluoride concentrations exceeding Secondary MCL

Appendix B. Groundwater Quality Data, Gila Valley Sub-Basin, 2004

Site #	Site MCL Exceedances	Temp (°C)	pH-field (su)	pH-lab (su)	SC-field (uS/cm)	SC-lab (uS/cm)	TDS (mg/L)	Hard (mg/L)	Hard - cal (mg/L)	Turb (ntu)
GV-67	F, gross ά, U	18.2	7.48	*8.1*	618	640	400	250	260	0.10
GV-68	F	19.1	7.57	*8.0*	666	700	440	300	300	0.07
GV-70	Mn	18.6	7.55	*8.0*	462	480	320	180	180	1.6
GV-71	-	-	7.52	-	343	-	-	-	-	-
GV-72	TDS, Cl, SO_4 NO_3, F	20.3	7.41	*8.0*	2453	2500	**1600**	340	330	0.15
GV-73	-	21.2	7.41	-	2392	-	-	-	-	-
GV-74	TDS, Cl, SO_4, F	21.2	7.35	*8.0*	2453	2500	**1600**	310	300	0.10
GV-75	pH, TDS, Cl, F, As	20.0	**9.35**	*9.3*	1489	1500	**900**	ND	ND	0.41
GV-77	-	17.2	8.50	*8.3*	310	210	120	92	94	0.27
GV-78	TDS, Cl, SO_4, As	17.5	7.37	*8.0*	3259	3300	**2000**	250	240	*0.65*
GV-80	-	10.9	8.24	*7.5*	221	230	160	69	75	*0.26*
GV-81	F	10.6	7.66	*8.2*	423	420	250	190	200	*0.02*
GV-82	TDS, Cl, SO_4, **F** As	9.6	7.25	*7.9*	9709	9100	**6000**	970	930	*3.2*
GV-83/84	-	20.4	7.51	*8.05*	525	550	335	170	180	*0.035*
GV-85/86	TDS, Cl, SO_4	23.6	7.93	*8.20*	2627	3000	**1600**	120	120	0.02
GV-87	TDS, Cl, SO_4	22.0	8.08	*8.3*	2940	3200	**1900**	100	97	ND
GV-88	TDS, Cl, SO_4	23.0	8.18	*8.3*	1758	2000	**1200**	68	69	0.02
GV-89	TDS, Cl, SO_4, F	21.6	7.83	*8.1*	2887	3100	**1900**	220	211	0.53
GV-90b					see GV-23/24					

bold = constituent level exceeds Primary or Secondary MCL
italics = constituent exceeded holding time
F = fluoride concentrations exceeding Primary MCL; F = fluoride concentrations exceeding Secondary MCL

Appendix B. Groundwater Quality Data, Gila Valley Sub-Basin, 2004--Continued

Sample #	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	T. Alk (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
GV-1	4.1	ND	250	2.2	210	240	10	150	240
GV-2/3	4.7	ND	315	4.6	170	200	11	185	**250**
GV-4	5.6	ND	290	5.2	180	200	7.7	190	**310**
GV-5	1.2	ND	320	1.8	250	250	25	160	**310**
GV-6	ND	ND	150	ND	160	160	16	130	66
GV-7	21	3.5	170	2.3	240	290	ND	80	140
GV-8	17	2.4	90	1.2	71	87	ND	133	36
GV-10	4.5	1.1	120	0.71	170	200	5.8	77	36
GV-11	33	2.3	220	2.1	110	130	ND	220	220
GV-12/13	29	3.7	725	4.15	91	92.5	9.75	**980**	**605**
GV-14	7.5	ND	270	1.2	70	69	8.2	**290**	240
GV-15	70	18	57	0.72	230	280	ND	10	71
GV-18	28	28	820	3.3	510	540	38	**630**	**300**
GV-19	3.3	ND	80	0.61	180	130	24	6.1	8.5
GV-20	55	27	1400	3.1	490	600	ND	**2000**	**1000**
GV-21/22a	42.5	25	20	6.0	195	235	ND	*10*	*7.25*
GV-22b	130	30	870	32	130	160	ND	**1400**	**260**
GV-23/24	197.5	42.5	305	6.53	103	120	ND	**267.5**	**787.5**
GV-25	20	4.5	290	2.9	70	79	3.0	**260**	**270**
GV-26	130	32	370	2.6	290	350	ND	**510**	**290**
GV-27	28	4.0	1000	9.9	140	170	ND	**1300**	**560**
GV-28	200	46	400	3.6	270	330	ND	**630**	**450**
GV-29	49	36	1300	10	520	630	ND	**1200**	**860**
GV-30	110	59	1200	9.0	440	540	ND	**1200**	**970**
GV-32	ND	ND	110	ND	120	61	42	*58*	*40*
GV-33	32	6.7	32	0.80	190	230	ND	16	39

bold = constituent level exceeds Primary or Secondary MCL

Appendix B. Groundwater Quality Data, Gila Valley Sub-Basin, 2004--Continued

Site #	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	T. Alk (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
GV-34	35	20	24	2.5	190	230	ND	6	9
GV-36/37	59	13	115	4.65	165	200	ND	*145*	*62*
GV-38	75	19	210	4.6	220	270	ND	**250**	*76*
GV-39/40	37	9.7	190	4.3	200	240	ND	*185*	*97*
GV-41	69	16	130	4.9	160	200	ND	**270**	*140*
GV-42	30	5.4	8.5	2.3	100	110	3.7	2	9.2
GV-44	3.7	ND	3.2	0.66	11	13	ND	1.4	7.3
GV-45	4.5	1.0	2.4	ND	12	15	ND	1.3	6.0
GV-48	3.4	ND	350	3.1	190	200	13	*240*	**290**
GV-50	49	12	270	4.6	230	280	ND	**300**	*190*
GV-51	90	25	290	4.5	300	370	ND	**430**	*210*
GV-52	170	37	400	2.8	360	440	ND	**600**	**340**
GV-53	47	6.9	20	0.73	149	180	ND	4.5	27
GV-54	110	30	500	6.7	340	410	ND	**600**	**330**
GV-55	20	6.2	16	0.64	84	100	ND	3.5	14
GV-56	2.9	ND	270	0.95	90	61	24	240	160
GV-58	23	1.6	1200	3.6	87	110	ND	47	**1400**
GV-59/60	42.5	3.55	145	2.9	180	220	ND	94.5	120
GV-61	7	ND	160	1.4	120	140	5.5	75	95
GV-62/63	78.5	24.5	1500	37	300	370	ND	**1500**	**900**
GV-64	73	22	180	5.1	140	170	ND	89	**390**
GV-65	86	28	730	19	410	500	ND	**870**	**350**
GV-66	32	24	21	1.3	240	200	ND	7.3	11
GV-67	71	19	46	1.6	290	240	ND	42	45
GV-68	89	20	46	0.88	400	330	ND	28	33
GV-70	39	21	41	4.9	290	240	ND	8.9	24
GV-72	88	26	430	6.2	390	320	ND	**450**	**280**

bold = constituent level exceeds Primary or Secondary MCL

Appendix B. Groundwater Quality Data, Gila Valley Sub-Basin, 2004--Continued

Site #	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	T. Alk (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
GV-74	74	29	430	5.4	350	430	ND	**460**	**260**
GV-75	1.4	ND	330	1.1	210	170	42	**280**	160
GV-77	16	13	9.7	2	98	120	ND	9.3	6.7
GV-78	67	18	620	1.7	480	576	ND	**550**	**310**
GV-80	17	7.8	13	3.3	28	27	ND	3.7	41
GV-81	55	15	17	1.7	200	240	ND	4.4	19
GV-82	310	37	1800	41	270	324	ND	**2700**	**900**
GV-83/84	44	16	52	2.25	260	312	ND	9.6	12
GV-85/86	34.5	7	555	3.75	140	170	ND	**610**	**385**
GV-87	28	6.5	650	4.2	120	150	ND	**740**	**360**
GV-88	22	3.4	420	2.4	140	170	ND	**300**	**360**
GV-89	50	21	630	4.4	150	180	ND	**660**	**440**
GV-90b					see GV-23/24				

bold = constituent level exceeds Primary or Secondary MCL

Appendix B. Groundwater Quality Data, Gila Valley Sub-Basin, 2004--Continued

Site #	Nitrate-Nitrite-N (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)	TKN (mg/L)	Ammonia (mg/L)	T. Phos (mg/L)	SAR (value)	Irrigation Quality	Pesticide
GV-1	0.35	0.35	*ND*	0.060	ND	0.026	34	C3 – S4	-
GV-2/3	ND	ND	*ND*	0.060	ND	ND	37	C3 – S4	-
GV-4	0.28	0.28	*ND*	0.054	ND	ND	34	C3 – S4	-
GV-5	ND	ND	*ND*	0.056	ND	0.052	80	C3 – S4	-
GV-6	ND	ND	*ND*	0.054	ND	0.20	278	C3 – S4	-
GV-7	3.2	3.2	*ND*	0.12	ND	0.032	9	C3 – S2	-
GV-8	0.85	0.85	*ND*	0.080	ND	ND	5.4	C2 – S1	-
GV-10	1.1	1.1	ND	ND	ND	0.050	13	C2 – S2	-
GV-11	0.31	0.31	ND	ND	ND	0.035	10	C3 – S2	-
GV-12/13	ND	ND	ND	0.55	0.425	0.034	36	C4 – S4	-
GV-14	ND	ND	ND	0.10	0.033	ND	27	C3 – S4	-
GV-15	3.7	3.7	ND	0.14	ND	ND	1.6	C2 – S1	-
GV-18	1.5	1.4	*0.063*	2.1	0.041	0.68	26	C4 – S4	-
GV-19	0.081	0.081	*ND*	0.075	ND	0.030	12	C2 – S2	-
GV-20	7.5	7.5	*ND*	0.30	ND	0.060	39	C4 – S4	-
GV-21/22a	1.3	1.3	*ND*	0.041	ND	ND	0.6	C2 – S1	-
GV-22b	0.051	0.051	*ND*	0.80	0.024	0.71	18	C4 – S4	-
GV-23/24	ND	ND	*ND*	0.395	0.175	0.026	5.3	C4 – S2	-
GV-25	ND	ND	*ND*	0.60	0.55	ND	15	C3 – S3	-
GV-26	6.4	6.4	*ND*	0.13	ND	ND	7.5	C4 – S2	-
GV-27	ND	ND	*ND*	0.051	ND	ND	47	C4 – S4	-
GV-28	8.8	8.8	*ND*	0.27	ND	0.045	6.6	C4 – S2	-
GV-29	**11**	**11**	*ND*	0.25	ND	0.056	34	C4 – S4	-
GV-30	**25**	**25**	*ND*	0.39	ND	0.060	23	C4 – S4	-
GV-32	ND	ND	*ND*	0.16	0.23	0.028	204	C2 – S4	-
GV-33	0.86	0.86	*ND*	0.12	0.083	0.046	1.3	C2 – S1	-

bold = constituent level exceeds Primary or Secondary MCL
italics = constituent exceeded holding time

Appendix B. Groundwater Quality Data, Gila Valley Sub-Basin, 2004--Continued

Site #	Nitrate-Nitrite-N (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)	TKN (mg/L)	Ammonia (mg/L)	T. Phos (mg/L)	SAR (value)	Irrigation Quality	Pesticide
GV-34	0.49	0.49	*ND*	0.11	0.15	ND	0.8	C2 – S1	-
GV-36/37	0.80	0.80	*ND*	0.38	0.13	0.11	3.7	C3 – S1	-
GV-38	2.9	2.9	*ND*	0.19	0.094	ND	5.6	C3 – S1	-
GV-39/40	1.7	1.7	*ND*	0.21	ND	0.11	7.2	C3 – S2	-
GV-41	0.58	0.58	*ND*	0.16	ND	0.056	3.7	C3 – S1	-
GV-42	0.054	0.054	*ND*	0.063	ND	0.16	0.4	C1 – S1	-
GV-44	0.040	0.040	*ND*	0.11	ND	ND	0.5	C1 – S1	-
GV-45	0.051	0.051	*ND*	0.17	ND	ND	0.3	C1 - S1	-
GV-48	0.029	0.029	*ND*	ND	ND	ND	52	C3 – S1	-
GV-50	2.7	2.7	*ND*	0.13	ND	0.026	9.0	C3 – S2	-
GV-51	5.8	5.8	*ND*	0.19	ND	0.026	7.0	C4 – S2	-
GV-52	**10**	**10**	*ND*	0.22	ND	0.025	7.2	C4 – S2	-
GV-53	0.41	0.41	ND	ND	ND	0.070	0.7	C2 – S1	-
GV-54	5.5	5.5	ND	0.22	ND	0.071	11	C4 – S3	ND
GV-55	0.035	0.035	ND	ND	ND	ND	0.8	C1 – S1	-
GV-56	ND	ND	ND	ND	0.055	ND	44	C3 – S4	-
GV-58	ND	ND	ND	0.12	ND	ND	65	C4 – S4	-
GV-59/60	1.4	1.4	ND	ND	ND	0.018	5.8	C3 – S1	-
GV-61	0.97	0.97	ND	ND	ND	0.020	17	C2 – S3	-
GV-62/63	3.1	3.1	ND	0.056	ND	0.026	38	C4 – S4	-
GV-64	0.36	0.36	ND	0.16	ND	ND	4.7	C3 – S1	-
GV-65	ND	ND	ND	0.33	ND	0.13	18	C4 – S4	-
GV-66	0.71	0.71	ND	ND	ND	0.033	0.7	C2 – S1	-
GV-67	0.71	0.71	ND	ND	ND	ND	1.3	C2 – S1	-
GV-68	1.6	1.6	ND	ND	ND	0.017	1.1	C2 – S1	-
GV-70	ND	ND	ND	0.12	ND	0.055	1.3	C2 – S1	-
GV-72	**11**	**11**	ND	0.19	ND	0.074	10	C4 – S3	ND

bold = constituent level exceeds Primary or Secondary MCL
italics = constituent exceeded holding time

Appendix B. Groundwater Quality Data, Gila Valley Sub-Basin, 2004--Continued

Site #	Nitrate-Nitrite-N (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)	TKN (mg/L)	Ammonia (mg/L)	T Phos (mg/L)	SAR (value)	Irrigation Quality	Pesticide
GV-73	-	-	-	-	-	-	-	-	ND
GV-74	9.9	9.9	ND	0.19	ND	0.11	11	C4 – S3	ND
GV-75	0.20	0.20	ND	ND	ND	0.069	77	C3 – S4	-
GV-77	0.028	0.028	ND	ND	ND	0.073	0.4	C1 – S1	-
GV-78	7.4	7.4	*ND*	0.35	ND	0.061	17	C4 – S4	-
GV-80	6.6	6.6	*ND*	0.66	ND	0.043	0.7	C1 – S1	-
GV-81	0.062	0.062	*ND*	0.078	ND	ND	0.5	C2 – S1	-
GV-82	ND	ND	*ND*	0.37	ND	0.051	26	C4 – S4	-
GV-83/84	1.2	1.2	*ND*	0.14	ND	0.030	1.7	C2 – S1	-
GV-85/86	ND	ND	ND	0.47	0.19	ND	24	C4 – S4	-
GV-87	ND	ND	ND	0.53	0.46	ND	29	C4 – S4	-
GV-88	0.11	0.11	ND	0.06	ND	ND	22	C3 – S4	-
GV-89	0.26	0.26	ND	0.059	ND	ND	19	C4 – S4	-
GV-90b				see GV-23/24					

bold = constituent level exceeds Primary or Secondary MCL
italics = constituent exceeded holding time

Appendix B. Groundwater Quality Data, Gila Valley Sub-Basin, 2004--Continued

Site #	Antimony (mg/L)	Arsenic (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Boron (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Fluoride (mg/L)
GV-1	ND	**0.054**	ND	ND	0.33	ND	ND	ND	**5.6**
GV-2/3	ND	**0.076**	ND	ND	0.36	ND	ND	ND	**8.9**
GV-4	ND	**0.060**	ND	ND	0.37	ND	ND	ND	**9.0**
GV-5	ND	**0.069**	ND	ND	0.40	ND	ND	ND	**6.7**
GV-6	ND	ND	ND	ND	ND	ND	ND	ND	0.85
GV-7	ND	**0.019**	ND	ND	0.13	ND	ND	ND	1.6
GV-8	ND	ND	ND	ND	ND	ND	0.013	ND	0.32
GV-10	ND	ND	ND	ND	0.14	ND	0.014	ND	1.1
GV-11	ND	ND	ND	ND	0.17	ND	ND	ND	1.4
GV-12/13	ND	**0.041**	ND	ND	1.5	ND	ND	ND	**12**
GV-14	ND	ND	ND	ND	0.55	ND	ND	ND	**14**
GV-15	ND	ND	ND	ND	ND	ND	ND	ND	**3.9**
GV-18	ND	**0.014**	ND	ND	0.55	ND	ND	ND	0.12
GV-19	ND	ND	ND	ND	ND	ND	ND	ND	**2.0**
GV-20	ND	ND	ND	ND	1.3	ND	ND	0.14	*1.5*
GV-21/22a	ND	ND	ND	ND	ND	ND	0.0165	0.0155	**2.05**
GV-22b	ND	**0.012**	0.11	ND	0.54	ND	ND	ND	**4.3**
GV-23/24	ND	ND	0.032	ND	0.21	ND	ND	ND	1.525
GV-25	ND	ND	ND	ND	0.33	ND	ND	ND	**4.5**
GV-26	ND	ND	ND	ND	0.33	ND	ND	ND	*1.6*
GV-27	ND	**0.047**	ND	ND	1.0	ND	ND	ND	**9.0**
GV-28	ND	ND	ND	ND	0.46	ND	ND	ND	*0.71*
GV-29	ND	**0.10**	ND	ND	1.9	ND	ND	ND	**4.5**
GV-30	ND	**0.023**	ND	ND	1.5	ND	ND	ND	**5.2**
GV-32	ND	**0.044**	ND	ND	3.5	ND	ND	ND	**4.9**
GV-33	ND	ND	ND	ND	ND	ND	ND	ND	0.72

bold = constituent level exceeds Primary or Secondary MCL

Appendix B. Groundwater Quality Data, Gila Valley Sub-Basin, 2004--Continued

Site #	Antimony (mg/L)	Arsenic (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Boron (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Fluoride (mg/L)
GV-34	ND	ND	ND	ND	ND	ND	ND	ND	0.55
GV-36/37	ND	ND	ND	ND	0.11	ND	ND	ND	1.6
GV-38	ND	**0.011**	ND	ND	0.18	ND	ND	ND	**2.5**
GV-39/40	ND	ND	ND	ND	0.21	ND	ND	ND	**3.5**
GV-41	ND	ND	ND	ND	0.12	ND	ND	ND	1.5
GV-42	ND	ND	ND	ND	ND	ND	ND	ND	0.36
GV-44	ND	ND	ND	ND	ND	ND	ND	ND	0.093
GV-45	ND	ND	ND	ND	ND	ND	ND	ND	0.12
GV-48	ND	**0.11**	ND	ND	0.47	ND	ND	ND	**13**
GV-50	ND	**0.034**	ND	ND	ND	ND	ND	ND	**4.8**
GV-51	ND	**0.019**	ND	ND	0.29	ND	ND	ND	**3.3**
GV-52	ND	ND	ND	ND	0.46	ND	ND	ND	0.63
GV-53	ND	ND	ND	ND	ND	ND	ND	ND	0.68
GV-54	ND	ND	ND	ND	0.50	ND	ND	ND	**2.5**
GV-55	ND	ND	ND	ND	ND	ND	ND	ND	0.42
GV-56	ND	**0.022**	ND	ND	0.57	ND	ND	ND	**4.0**
GV-58	ND	ND	ND	ND	1.8	ND	ND	ND	**9.5**
GV-59/60	ND	ND	0.047	ND	0.17	ND	ND	ND	**3.9**
GV-61	ND	**0.012**	ND	ND	0.21	ND	ND	ND	**8.1**
GV-62/63	ND	ND	ND	ND	1.7	ND	ND	ND	**4.45**
GV-64	ND	ND	ND	ND	0.30	ND	ND	ND	0.64
GV-65	ND	ND	ND	ND	0.99	ND	ND	ND	**7.4**
GV-66	ND	ND	ND	ND	ND	ND	ND	ND	0.29
GV-67	ND	ND	0.24	ND	ND	ND	ND	ND	**2.6**
GV-68	ND	ND	0.16	ND	ND	ND	ND	0.017	**2.2**
GV-70	ND	ND	ND	ND	ND	ND	ND	ND	0.46
GV-72	ND	ND	ND	ND	0.47	ND	ND	ND	**3.8**

bold = constituent level exceeds Primary or Secondary MCL
***** = concentration exceeds the revised arsenic SDW Primary MCL of 0.01 mg/l which becomes effective in 2006

Appendix B. Groundwater Quality Data, Gila Valley Sub-Basin, 2004--Continued

Site #	Antimony (mg/L)	Arsenic (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Boron (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Fluoride (mg/L)
GV-74	ND	ND	ND	ND	0.45	ND	ND	ND	**3.6**
GV-75	ND	**0.016**	ND	ND	0.66	ND	ND	ND	**3.9**
GV-77	ND	ND	ND	ND	ND	ND	ND	0.096	0.29
GV-78	ND	**0.017**	ND	ND	0.72	ND	ND	0.020	1.6
GV-80	ND	ND	ND	ND	ND	ND	ND	ND	0.19
GV-81	ND	ND	ND	ND	ND	ND	ND	ND	**2.3**
GV-82	ND	**0.019**	ND	ND	0.95	ND	ND	ND	**5.7**
GV-83/84	ND	ND	ND	ND	ND	ND	ND	ND	0.19
GV-85/86	ND	ND	ND	ND	0.29	ND	ND	0.0122	1.3
GV-87	ND	ND	ND	ND	0.25	ND	ND	ND	1.6
GV-88	ND	ND	ND	ND	0.26	ND	ND	ND	1.4
GV-89	ND	ND	ND	ND	0.28	ND	ND	ND	**3.6**
GV-90b					see GV-23/24				

bold = constituent level exceeds Primary or Secondary MCL
***** = concentration exceeds the revised arsenic SDW Primary MCL of 0.01 mg/l which becomes effective in 2006

Appendix B. Groundwater Quality Data, Gila Valley Sub-Basin, 2004--Continued

Site #	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Nickel (mg/L)	Selenium (mg/L)	Silver (mg/L)	Thallium (mg/L)	Zinc (mg/L)
GV-1	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-2/3	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-4	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-5	0.13	ND	ND	ND	ND	ND	ND	ND	ND
GV-6	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-7	0.14	ND	ND	ND	ND	ND	ND	ND	0.11
GV-8	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-10	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-11	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-12/13	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-14	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-15	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-18	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-19	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-20	ND	ND	ND	ND	ND	ND	ND	ND	0.12
GV-21/22a	ND	ND	ND	ND	ND	ND	ND	ND	0.0525
GV-22b	ND	ND	**0.35**	ND	ND	ND	ND	ND	ND
GV-23/24	ND	ND	**0.22**	ND	ND	ND	ND	ND	ND
GV-25	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-26	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-27	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-28	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-29	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-30	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-32	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-33	ND	ND	ND	ND	ND	ND	ND	ND	ND

bold = constituent level exceeds Primary or Secondary MCL

Appendix B. Groundwater Quality Data, Gila Valley Sub-Basin, 2004--Continued

Site #	**Iron** (mg/L)	**Lead** (mg/L)	**Manganese** (mg/L)	**Mercury** (mg/L)	**Nickel** (mg/L)	**Selenium** (mg/L)	**Silver** (mg/L)	**Thallium** (mg/L)	**Zinc** (mg/L)
GV-34	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-36/37	ND	ND	ND	ND	ND	ND	ND	ND	0.064
GV-38	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-39/40	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-41	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-42	0.22	ND	ND	ND	ND	ND	ND	ND	ND
GV-44	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-45	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-48	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-50	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-51	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-52	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-53	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-54	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-55	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-56	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-58	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-59/60	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-61	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-62/63	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-64	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-65	0.20	ND	**0.50**	ND	ND	ND	ND	ND	ND
GV-66	ND	ND	ND	ND	ND	ND	ND	ND	0.45
GV-67	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-68	ND	ND	ND	ND	ND	ND	ND	ND	0.051
GV-70	0.17	ND	**0.47**	ND	ND	ND	ND	ND	ND
GV-72	ND	ND	ND	ND	ND	ND	ND	ND	ND

bold = constituent level exceeds Primary or Secondary MCL

Appendix B. Groundwater Quality Data, Gila Valley Sub-Basin, 2004--Continued

Site #	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Nickel (mg/L)	Selenium (mg/L)	Silver (mg/L)	Thallium (mg/L)	Zinc (mg/L)
GV-74	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-75	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-77	ND	ND	ND	ND	ND	ND	ND	ND	0.078
GV-78	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-80	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-81	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-82	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-83/84	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-85/86	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-87	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-88	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-89	ND	ND	ND	ND	ND	ND	ND	ND	ND
GV-90b					see GV-23/24				

bold = constituent level exceeds Primary or Secondary MCL

Appendix B. Groundwater Quality Data, Gila Valley Sub-Basin, 2004--Continued

Site #	Radon-222 (pCi/L)	Alpha (pCi/L)	Beta (pCi/L)	Ra-226 (pCi/L)	Uranium (µg/L)	δ^{18} O ($^0/_{00}$)	δ D ($^0/_{00}$)	Type of Chemistry
GV-1	289	-	-	-	-	-10.5	-78	sodium-mixed
GV-2/3	**805**	1.3	6.9	-	-	-10.9	-80	sodium-mixed
GV-4	-	-	-	-	-	-10.9	80	sodium-mixed
GV-5	**768**	< LLD	< LLD	-	-	-10.3	-77	sodium-mixed
GV-6	**364**	-	-	-	-	-9.7	-69	sodium-mixed
GV-7	273	**40**	32	< LLD	**69**	-7.6	-54	sodium-mixed
GV-8	-	-	-	-	-	-9.8	-70	sodium-mixed
GV-9	-	-	-	-	-	-8.2	-63	--
GV-10	188	-	-	-	-	-10.4	-76	sodium-bicarbonate
GV-11	265	1.4	< LLD	-	-	-10.7	-77	sodium-mixed
GV-12/13	**381**	0.4	7.6	-	-	-12.05	-89	sodium-chloride
GV-14	-	-	-	-	-	-12.1	-90	sodium-chloride
GV-15	**1581**	**16**	13	< LLD	25	-7.7	-54	mixed-bicarbonate
GV-16	-	-	-	-	-	-8.9	-66	--
GV-18	**519**	-	-	-	-	- 7.4	-59	sodium-chloride
GV-19	114	1.0	0.93	-	-	- 10.1	- 71	sodium-bicarbonate
GV-20	-	-	-	-	-	- 8.3	- 64	sodium-chloride
GV-21/22a	197	3.3	6.4	-	-	- 10.55	- 76	mixed-bicarbonate
GV-22b	-	-	-	-	-	- 10.9	- 83	sodium-chloride
GV-23/24	**344**	2.5	7.6	-	-	- 10.9	- 79	mixed-sulfate
GV-25	-	3.0	5.1	-	-	- 11.9	- 87	sodium-mixed
GV-26	**421**	-	-	-	-	- 8.5	- 65	sodium-chloride
GV-27	**492**	3.1	16	-	-	- 11.1	- 84	sodium-chloride
GV-28	-	-	-	-	-	- 8.9	- 66	sodium-chloride
GV-29	**446**	-	-	-	-	- 8.1	- 63	sodium-chloride
GV-30	-	-	-	-	-	- 7.9	- 62	sodium-chloride
GV-32	295	< LLD	1.6	-	-	- 11.5	- 84	sodium-mixed
GV-33	**415**	1.1	1.9	-	-	- 10.8	- 77	mixed-bicarbonate

bold = Primary MCL Exceedance
LLD = Lower Limit of Detection
italics = constituent exceeded holding time

Appendix B. Groundwater Quality Data, Gila Valley Sub-Basin, 2004—Continued

Site #	Radon-222 (pCi/L)	Alpha (pCi/L)	Beta (pCi/L)	Ra-226 (pCi/L)	Uranium (µg/L)	δ^{18} O ($^0/_{00}$)	δ D ($^0/_{00}$)	Type of Chemistry
GV-34	**365**	0.51	8.7	-	-	- 9.4	- 71	mixed-bicarbonate
GV-35	-	-	-	-	-	- 9.2	- 70	-
GV-36/37	**310**	-	-	-	-	- 8.6	- 66	sodium-mixed
GV-38	**383**	-	-	-	-	- 8.4	- 63	sodium-chloride
GV-39/40	-	-	-	-	-	- 8.8	- 65	sodium-mixed
GV-41	-	-	-	-	-	- 8.4	- 64	sodium-chloride
GV-42	< 28	-	-	-	-	- 11.5	- 77	calcium-bicarbonate
GV-43	-	-	-	-	-	- 11.7	- 78	-
GV-44	**3249**	0.76	1.9	-	-	- 11.0	- 74	calcium-bicarbonate
GV-45	**2399**	-	-	-	-	- 10.9	- 72	calcium-bicarbonate
GV-47	-	-	-	-	-	- 3.4	- 33	-
GV-48	-	-	-	-	-	- 11.3	- 82	sodium-mixed
GV-49	-	-	-	-	-	- 5.8	- 54	-
GV-50	-	-	-	-	-	- 9.0	- 68	sodium-mixed
GV-51	-	-	-	-	-	- 8.3	- 64	sodium-chloride
GV-52	-	-	-	-	-	- 8.4	- 65	sodium-chloride
GV-53	-	-	-	-	-	- 9.9	- 70	calcium-bicarbonate
GV-54	-	-	-	-	-	- 7.9	- 61	sodium-chloride
GV-55	**869**	-	-	-	-	- 10.3	- 71	mixed-bicarbonate
GV-56	60	< LLD	< LLD	-	-	- 11.6	- 85	sodium-chloride
GV-57	-	-	-	-	-	- 10.3	- 70	-
GV-58	-	-	-	-	-	- 10.8	- 81	sodium-sulfate
GV-59/60	**865**	-	-	-	-	- 10.65	- 76	sodium-mixed
GV-61	-	-	-	-	-	- 11.2	- 81	sodium-mixed
GV-62/63	**427**	-	-	-	-	- 8.2	- 63	sodium-chloride
GV-64	271	-	-	-	-	- 10.5	- 75	sodium-sulfate
GV-65	-	-	-	-	-	- 10.5	- 78	sodium-chloride
GV-66	70	-	-	-	-	- 9.5	- 66	mixed-bicarbonate

bold = Primary MCL Exceedance
LLD = Lower Limit of Detection
italics = constituent exceeded holding time

Appendix B. Groundwater Quality Data, Gila Valley Sub-Basin, 2004--Continued

Site #	**Radon-222** (pCi/L)	**Alpha** (pCi/L)	**Beta** (pCi/L)	**Ra-226** (pCi/L)	**Uranium** (µg/L)	**δ18 O** (‰)	**δ D** (‰)	**Type of Chemistry**
GV-67	-	**67**	22	0.78	**50**	- 9.6	- 69	mixed-bicarbonate
GV-68	-	-	-	-	-	- 8.3	- 62	calcium-bicarbonate
GV-69	-	-	-	-	-	- 5.5	- 36	-
GV-70	-	-	-	-	-	- 9.5	- 70	mixed-bicarbonate
GV-71	-	-	-	-	-	- 9.6	- 71	-
GV-72	-	-	-	-	-	- 8.2	- 63	sodium-mixed
GV-73	-	-	-	-	-	- 8.2	- 63	-
GV-74	-	-	-	-	-	- 8.2	- 63	sodium-mixed
GV-75	-	-	-	-	-	- 11.9	- 87	sodium-mixed
GV-77	< 25	0.35	2.4	-	-	- 10.0	- 71	mixed-bicarbonate
GV-78	-	-	-	-	-	- 8.3	- 65	sodium-chloride
GV-79	-	-	-	-	-	- 10.3	-71	-
GV-80	-	-	-	-	-	- 8.9	- 63	mixed-mixed
GV-81	-	4.8	3.0	-	-	- 11.5	- 80	calcium-bicarbonate
GV-82	-	-	-	-	-	- 10.7	- 82	sodium-chloride
GV-83/84	-	1.9	0.7	-	-	- 10.0	- 75	mixed-bicarbonate
GV-85/86	-	-	-	-	-	- 10.85	- 80	sodium-chloride
GV-87	-	-	-	-	-	- 11.0	- 81	sodium-chloride
GV-88	-	-	-	-	-	- 10.9	- 80	sodium-mixed
GV-89	-	-	-	-	-	- 11.0	- 81	sodium-chloride
GV-90b					see GV-23/24			

bold = Primary MCL Exceedance
LLD = Lower Limit of Detection
italics = constituent exceeded holding time

Appendix C. Data for Sample Sites, Gila Valley Sub-Basin, 1995

Site #	Cadastral / Pump Type	Latitude - Longitude	ADWR #	ADEQ #	Site Name	Samples Collected	Well Depth	Water Depth	Recharge Source
G-1	D(3-23)25cad	33°08'27.811" 109°56'26.187"	612597	27201	BLM #1	Inorganic	30'	20'	Local
G-2	D(4-22)13acd	33°05'06.000" 110°02'29.000"	651348	27747	C. Claridge #1	Inorganic	68'	14'	Gila River
G-3	D(4-22)22acd	33°04'16.910" 109°02'22.307"	623008	27762	S. Bryce #1	Inorganic	70'	19'	Gila River
G-4	D(4-22)26daa	33°03'19.579" 110°03'10.831"	623004	51635	S. Bryce #2	Inorganic	90'	-	Gila River
G-5	D(4-23)18aca	33°05'12.000" 110°01'20.000"	651352	27810	C. Claridge #2	Inorganic	50'	-	Gila River
G-6	D(4-23)18cdc	33°04'40.000" 110°01'44.000"	651350	27825	C. Claridge #3	Inorganic	70'	19'	Gila River
G-7/7D	D(4-23)18dcc	33°04'40.000" 110°01'32.000"	609288	27829	Black	Inorganic	76'	19'	Gila River
G-8	D(4-23)18ddc	33°04'42.000" 110°01'20.000"	618956	27833	L. Garcia	Inorganic	67'	-	Gila River
G-9	D(4-23)29acd	33°03'21.279" 110°01'23.333"	623050	49020	S. Bryce #3	Inorganic	90'	48'	Gila River
G-10	D(4-23)29dac	33°03'09.852" 110°00'13.323"	621386	49021	S. Bryce #4	Inorganic	95'	50'	Gila River
G-11	D(4-25)26cad	33°03'06.563" 109°45'01.952"	803566	51641	BLM #2	Inorganic	340'	23'	Local
G-12	D(5-23)02cba	33°01'31.862" 109°57'44.134"	606086	51507	GCU #1	Inorganic, Radiochem Banned Pesticides	76'	27'	Gila River
G-13	D(5-23)03aba	33°01'59.279" 109°58'18.347"	-	51622	Thomas	Inorganic	120'	70'	Gila River
G-14	D(5-23)10bab	33°01'11.038" 109°58'38.173"	613833	28989	T. Saunders	Inorganic	95'	48'	Gila River
G-15	D(5-24)27bba	32°58'33.000" 109°52'36.000"	606849	29103	Eden Water Co.	Inorganic	-	-	?
G-16	D(5-24)29add	32°58'09.796" 109°53'49.500"	602511	29119	Colvin #1	Inorganic	55'	-	Gila River
G-17	D(5-24)29dcd	32°57'42.314" 109°54'09.408"	606980	29130	Colvin #2	Inorganic	43'	9'	Gila River
G-18	D(5-24)31aaa	32°57'43.000" 109°54'60.000"	607326	29154	Ft. Thomas	Inorganic	58'	16'	Gila River
G-19/19D	D(5-24)31acc	32°57'16.020" 109°55'21.315"	607474	29162	M. Palmer #1	Inorganic	80'	55'	Gila River
G-20	D(5-24)31bdb	32°57'24.158" 109°55'37.594"	602507	51624	Colvin #3	Inorganic	70'	-	Gila River
G-21	D(5-24)33cbc	32°57'09.202" 109°53'43.028"	602512	29209	Colvin #4	Inorganic	50'	14'	Gila River
G-22	D(5-25)01baa	33°01'57.000" 109°44'12.000"	803505	57257	BLM #3	Inorganic	340'	-	Local
G-23	D(6-23)03cca	32°56'11.720" 109°59'08.795"	643420	51627	BLM #4	Inorganic	-	127'	Local
G-24	D(6-24)04aad	32°56'39.657" 109°53'13.249"	606845	30537	Colvin #5	Inorganic	61'	20'	Gila River
G-25	D(6-24)05abd	32°56'38.985" 109°54'24.937"	624786	30557	M. Palmer #2	Inorganic	65'	32'	Gila River
G-26	D(6-24)23bda	32°54'02.000" 109°51'40.000"	-	57258	R. McBride	Inorganic	60'	40'	Gila River
G-27	D(6-24)24bcd	32°53'52.000" 109°50'54.000"	603060	30664	Skinner	Inorganic	66'	45'	Gila River
G-28	D(6-25)19cbd	32°53'38.329" 109°49'52.266"	639724	51369	Drobka	Inorganic, Radiochem GWPL Pesticides	43'	12'	Gila River

Well depth and water depth are from ADWR database as reported by well drillers
Recharge source is interpreted from well records except when in **bold** from 2004 isotope data

Appendix C. Data for Sample Sites, Gila Valley Sub-Basin, 1995

Site #	Cadastral / Pump Type	Latitude - Longitude	ADWR #	ADEQ #	Site Name	Samples Collected	Well Depth	Water Depth	Recharge Source
G-29	D(6-25)26aca	32°53'04.652" 109°45'26.915"	534553	51379	Tolby	Inorganic Banned Pesticides	76'	39'	Gila River
G-30	D(6-25)30bbc	32°53'10.539" 109°50'03.145"	621142	30944	Weech	Inorganic Banned Pesticides	60'	35’	Gila River
G-31	D(6-25)33aaa	32°52'26.000" 109°47'05.000"	621075	30965	Smithville CC #1	Inorganic	72’	30’	Gila River
G-32	D(6-25)34aca	32°52'12.000" 109°46'17.000"	624744	30991	Smithville CC #2	Inorganic	82’	10’	Gila River
G-33	D(6-25)35dbd	32°51'55.000" 109°45'18.000"	607317	31022	Smithville CC #3	Inorganic	80'	30'	Gila River
G-34/34D	D(6-27)34ddc	32°51'35.436" 109°33'50.086"	-	51631	Brandau #1	Inorganic	300'	39’	Gila River
G-35	D(6-27)34ddd	32°51'38.583" 109°33'42.156"	603765	31081	Brandau #2	Inorganic GWPL Pesticides	120'	20'	Gila River
G-36/36D	D(6-27)36dbd	32°51'53.314" 109°31'54.689"	611957	31094	T. Clounts #1	Inorganic	260’	65’	Gila River
G-37	D(6-2736dda	32°51'47.569" 109°31'37.906"	611959	51640	T. Clounts #2	Inorganic	256’	150’	Gila River
G-38	D(6-28)31dba	32°52'01.000" 109°30'56.000"	611962	31115	T. Clounts #3	Inorganic	400’	30’	Gila River
G-39	D(7-23)05cbd	32°51'05.000" 110°01'08.000"	523365	57259	BLM #5	Inorganic	301'	276'	Local
G-40	D(7-24)08acb	32°50'30.997" 109°54'39.099"	540458	51508	GCU #2	Inorganic	210'	39'	Local
G-41	D(7-24)08bdb	32°50'31.900" 109°54'51.628"	545487	51509	GCU #3	Inorganic Radiochem	225'	40'	Local
G-42	D(7-25)02acc	32°42'46.694" 109°41'38.162"	617141	51376	A. Palmer #1	Inorganic	86'	28'	Gila River
G-43	D(7-25)02add	32°51'10.832" 109°45'04.813"	617140	32014	A. Palmer #2	Inorganic, Banned / GWPL Pesticides	92'	30’	Gila River
G-44	D(7-25)02bca	32°51'17.834" 109°45'43.351"	613799	51639	Platt #1	Inorganic	97'	75’	Gila River
G-45	D(7-25)02bdc	32°51'11.337" 109°45'36.249"	613798	51636	Platt #2	Inorganic	84'	75’	Gila River
G-46	D(7-25)11aab	32°50'39.219" 109°45'05.708"	617157	32066	Carpenter	Inorganic	120'	71’	Gila River
G-47/47D	D(7-26)05dba	32°51'03.696" 109°42'09.551"	538356	32156	City of Safford #1	Inorganic, Radiochem GWPL Pesticides	101'	51’	Gila River
G-48	D(7-26)06dda	32°50'56.957" 109°42'55.959"	805753	51283	City of Safford #2	Inorganic GWPL Pesticides	79'	32’	**Gila River**
G-49	D(7-26)13dab	32°49'22.546" 109°37'58.641"	607107	57079	City of Safford #3	Inorganic GWPL Pesticides	89’	24’	**Gila River**
G-50	D(7-26)23aaa	32°48'52.904" 109°38'50.710"	-	32371	Barney #1	Inorganic Banned / GWPL Pesticides	86’	-	Gila River
G-51	D(7-26)24abd	32°48'46.043" 109°38'03.459"	607284	32383	Layton #1	Inorganic	102’	40’	Gila River
G-52	D(7-26)24ada	32°48'45.939" 109°37'51.497"	607283	32384	Layton #2	Inorganic	102’	40’	**Gila River**
G-53	D(7-26)24bbb	32°48'57.761" 109°38'49.168"	623259	32386	Kempton	Inorganic	97'	80'	Gila River
G-54	D(7-26)31acd	32°46'50.341" 109°43'16.308"	512317	51374	Benskin	Inorganic	100'	30'	Local
G-55	D(7-26)31bbc	32°47'04.149" 109°43'42.305"	518879	51373	Effner	Inorganic Radiochem	99'	22'	Local

Well depth and water depth are from ADWR database as reported by well drillers
Recharge source is interpreted from well records except when in **bold** from 2004 isotope data

Appendix C. Data for Sample Sites, Gila Valley Sub-Basin, 1995

Site #	Cadastral / Pump Type	Latitude - Longitude	ADWR #	ADEQ #	Site Name	Samples Collected	Well Depth	Water Depth	Recharge Source
G-56	D(7-27)02aab	32°51'32.000" 109°32'55.000"	-	32425	T. Clouts #4	Inorganic	65'	15’	Gila River
G-57	D(7-27)02acd	32°51'10.000" 109°33'06.000"	-	32429	T. Clouts #5	Inorganic	400’	10’	Gila River
G-58/58D	D(7-27)03bac	32°51'26.262" 109°34'23.370"	-	51629	D. Clouts #1	Inorganic	250’	22’	Gila River
G-59	D(7-27)03cbb	32°51'07.243" 109°34'39.637"	617164	51628	D. Clouts #2	Inorganic	75'	15'	Gila River
G-60	D(7-27)08add	32°50'25.000" 109°35'47.000"	87268	57260	Michelena	Inorganic	62'	15’	Gila River
G-61	D(7-27)09abb	32°50'40.825" 109°35'06.228"	624750	32482	City of Safford #4	Inorganic, Radiochem GWPL Pesticides	79'	-	Gila River
G-62	D(7-27)20aab	32°48'56.109" 109°35'55.411"	616580	32576	Herrington	Inorganic	105’	50’	Gila River
G-63/63D	D(6-27)20aac	32°48'52.302" 109°35'55.786"	611954	51510	Barney #2	Inorganic Radiochem GWPL/Banned Pesticides	110’	-	Gila River
G-64/64D	D(8-26)06bdb	32°46'33.088" 109°43'35.687"	509493	51514	Walters	Inorganic	140’	48’	Local
G-65	D(8-26)06dcb	32°46'06.894" 109°43'24.735"	532191	51515	E. Saunders	Inorganic	208'	69'	**Local (old)**
G-66	D(8-26)06ddd1	32°45'36.547" 109°43'03.473"	519845	51371	Scott #1	Inorganic Radiochem	200'	29'	Local
G-67	D(8-26)06ddd2	32°45'36.940" 109°42'58.161"	543881	51372	Scott #2	Inorganic Radiochem	54'	15'	Local
G-68	D(8-26)28bad	32°42'46.580" 109°41'38.252"	532226	51513	Lawler	Inorganic Radiochem	225'	51'	Local
G-69	D(8-26)32abd	32°41'51.704" 109°41'17.841"	643328	51511	Sansom	Inorganic	90'	-	Local
G-70	D(8-26)32bbb	32°41'59.097" 109°42'21.216"	520813	51512	Nelson	Inorganic	225'	40’	Local
G-71	D(8-27)16bbd	32°44'28.536" 109°35'34.213"	-	51630	BLM #6	Inorganic	-	-	Local
G-72	D(8-27)23bdb	32°43'11.932" 109°32'58.662"	615568	33410	BLM #7	Inorganic	150'	60’	**Local (old)**
G-73	D(8-28)29dbd	32°42'19.677" 109°29'59.123"	608751	33413	BLM #8	Inorganic	600'	320’	**Local (old)**
G-74	D(9-26)05bbc1	32°41'06.125" 109°42'58.281"	647251	34031	Hamblin	Inorganic, Radiochem Banned Pesticides	122'	41’	**Local (old)**
G-75	D(9-26)05bbc2	32°41'00.908" 109°42'58.710"	608711	34030	Reed	Inorganic	350’	28’	**Local (old)**
G-76	D(9-26)06ddd	32°40'21.695" 109°43'10.610"	-	51378	Neff	Inorganic	-	60’	Local
G-77	D(9-28)31dad	32°36'15.593" 109°30'41.054"	615670	34051	BLM #9	Inorganic	200’	110’	**Local (old)**
G-78	D(10-28)07cad	32°34'33.684" 109°31'07.339"	-	34435	BLM #10	Inorganic	90’	87’	**Local (recent)**
B-1	D(6-28)05bdb	32°56'28.970" 109°30'23.511"	607090	31100	City of Safford #5	Inorganic Radiochem	175’	-	Local
B-2	D(6-28)05bdc	32°56'27.414" 109°30'19.130"	-	57080	City of Safford #6	Inorganic	158’	-	Local
B-3	D(6-28)09ccb	32°55'16.307" 109°29'31.896"	607100	51284	City of Safford #7	Inorganic	212’	25’	**Local (old)**

Well depth and water depth are from ADWR database as reported by well drillers
Recharge source is interpreted from well records except when in **bold** from 2004 isotope data

Appendix D. Groundwater Quality Data, Gila Valley Sub-Basin, 1995

Site #	Site MCL Exceedances	Temp (^oC)	pH-field (su)	pH-lab (su)	SC-field (uS/cm)	SC-lab (uS/cm)	TDS (mg/L)	Hard (mg/L)	Hard - cal (mg/L)	Turb (ntu)
G-1	TDS, SO_4, Fe, Mn	27.9	6.53	***6.8***	2050	1838	**1700**	1100	-	-
G-2	TDS	20.6	-	*7.58*	-	-	**556**	182	-	*0.12*
G-3	-	22.9	6.52	***6.88***	500	-	333	123	-	*0.21*
G-4	-	22.6	6.54	***6.66***	323	-	261	89	-	*0.09*
G-5	-	19.4	6.90	***7.65***	625	-	432	125	-	*0.27*
G-6	-	19.3	7.01	*7.93*	542	-	365	118	-	*0.21*
G-7/7D	-	17.8	7.04	*7.68*	603	-	395	135	-	*0.04*
G-8	As	19.3	7.14	***7.80***	671	-	442	135	-	0.30
G-9	pH, TDS, Cl, SO_4, Tl	23.4	**6.46**	*7.42*	2480	-	**1910**	398	-	0.16
G-10	pH, TDS	23.7	**6.35**	***6.95***	1381	-	**1050**	246	-	0.11
G-11	-	26.6	7.16	***7.1***	540	492	350	330	-	-
G-12	-	20.3	6.69	*7.0*	321	291	220	120	-	-
G-13	-	23.2	-	*6.7*	299	349	260	130	-	-
G-14	-	24.6	-	*6.8*	306	361	270	170	-	-
G-15	-	22.4	-	*7.8*	479	-	291	136	-	*0.18*
G-16	TDS, SO_4, NO_3, F	24.6	-	*7.4*	-	3290	**2300**	500	-	-
G-17	TDS, Cl, SO_4, NO_3, F	22.9	-	*7.4*	3050	3130	**2100**	420	-	-
G-18	TDS, Cl, Mn	19.6	7.64	*7.66*	-	-	**1630**	392	-	*0.22*
G-19/19D	TDS, Cl, SO_4, As, F	20.5	-	*7.55*	-	-	**2895**	402	-	*1.48*
G-20	TDS, Cl, SO_4	27.0	-	*7.4*	5660	5410	**3700**	530	-	*0.70*
G-21	TDS, Cl, SO_4	22.8	-	*7.4*	2228	2680	**1800**	380	-	-
G-22		27.5	7.43	*7.4*	519	448	330	220	-	-
G-23	TDS, As, **F**	30.3	-	*9.3*	1120	1066	**690**	16	-	-
G-24	TDS, Cl, SO_4, F	23.2	-	*7.6*	1640	1861	**1200**	280	-	-
G-25	TDS, Cl, SO_4, F, Pb	20.0	-	*7.44*	-	-	**2740**	455	-	*0.30*
G-26	TDS, Cl	19.2	9.07	*7.81*	2240	-	**1090**	256	-	*0.18*
G-27	TDS, F	17.7	6.96	*7.74*	1671		**934**	271	-	*0.13*

bold = constituent level exceeds Primary or Secondary MCL
italics = constituent exceeded holding time
F = fluoride concentrations exceeding Primary MCL; F = fluoride concentrations exceeding Secondary MCL

Appendix D. Groundwater Quality Data, Gila Valley Sub-Basin, 1995

Site #	Site MCL Exceedances	Temp (^{o}C)	pH-field (su)	pH-lab (su)	SC-field (uS/cm)	SC-lab (uS/cm)	TDS (mg/L)	Hard (mg/L)	Hard - cal (mg/L)	Turb (ntu)
G-28	TDS, As, **F**	-	-	***7.4***	-	1013	**850**	110	-	-
G-29	TDS, Cl, As, **F**	20.4	7.21	*7.5*	2010	1556	**1300**	230	-	-
G-30	TDS, Cl, As, F	20.5	7.41	***7.6***	2050	1596	**1300**	160	-	-
G-31	TDS, Cl, SO_4, NO_3,	19.7	8.24	***7.91***	3420	-	**1840**	455	-	*0.32*
G-32	TDS, Cl, SO_4, NO_3, F	18.7	7.51	***7.7***	3350	-	**1780**	512	-	*0.27*
G-33	TDS, Cl, SO_4, NO_3, F	20.4	8.38	*7.91*	4190	-	**2125**	416	-	*0.65*
G-34/34D	TDS, As, F	24.2	6.92	*7.20*	1133	-	**889**	246.5	-	*0.195*
G-35	TDS, As, F	22.6	7.53	***7.1***	1900	1185	**920**	250	-	-
G-36/36D	TDS	20.1	7.16	*7.4*	880	909	**590**	250	-	-
G-37	TDS	20.7	7.22	***7.5***	883	981	**630**	260	-	-
G-38	TDS	21.7	-	***7.46***	2150	-	**604**	245	-	0.35
G-39	TDS, Cl, SO_4, As F	25.7	-	*7.9*	1510	1661	**1000**	190	-	-
G-40	pH, As	21.0	9.49	*9.4*	298	254	190	23	-	-
G-41	pH, As	21.5	9.44	*9.6*	264	222	180	28	-	-
G-42	TDS, Cl, SO_4,	20.4	6.82	*7.1*	2840	2140	**1900**	570	-	-
G-43	TDS, Cl, SO_4, As, F	20.6	6.99	*7.5*	2980	2320	**1900**	480	-	-
G-44	TDS, Cl, NO_3,	24.8	6.78	*7.28*	784	-	**1420**	466	-	*0.02*
G-45	TDS, Cl, NO_3,	22.5	6.66	*7.20*	528	-	**1440**	494	-	*0.10*
G-46	TDS, Cl, SO_4, NO_3	26.9	-	*7.3*	2130	2230	**1500**	500	-	-
G-47/47D	-	18.2	7.4	*7.3*	1070	694.5	480	170	-	-
G-48	TDS	17.9	7.58	*7.3*	1050	746	**530**	150	-	-
G-49	TDS, F	21.0	7.51	*7.2*	1140	721	**560**	180	-	-
G-50	TDS, Cl, As, F	19.2	7.06	*7.5*	2040	1599	**1300**	170	-	-
G-51	TDS, Cl, SO_4 As, F	25.3	-	*7.5*	1517	1784	**1200**	320	-	-
G-52	TDS, SO_4, As, F	-	-	*7.3*	-	1712	**1200**	300	-	-
G-53	TDS, Cl, As, F	21.4	7.10	*7.33*	1489	-	**1280**	259	-	*0.10*
G-54	TDS, Cl, SO_4	23.2	7.18	*7.4*	2370	1833	**1600**	570	-	-

bold = constituent level exceeds Primary or Secondary MCL
italics = constituent exceeded holding time
F = fluoride concentrations exceeding Primary MCL; F = fluoride concentrations exceeding Secondary MCL

Appendix D. Groundwater Quality Data, Gila Valley Sub-Basin, 1995

Site #	Site MCL Exceedances	Temp (°C)	pH-field (su)	pH-lab (su)	SC-field (uS/cm)	SC-lab (uS/cm)	TDS (mg/L)	Hard (mg/L)	Hard - cal (mg/L)	Turb (ntu)
G-55	-	22.6	7.44	***7.84***	389	-	300	91	-	-
G-56	TDS, As, **F**	-	-	*8.27*	-	-	**763**	144	-	*0.50*
G-57	TDS, As, **F**	-	-	***7.5***	-	1604	**1040**	42	-	*0.59*
G-58/58D	TDS, As, **F**	26.6	-	***7.6***	1415	1599	**1100**	215	-	-
G-59	TDS, F	24.2	-	***7.3***	1440	1177	**770**	300	-	-
G-60	TDS, Cl, As, F	-	-	*7.47*	-	-	**1170**	321	-	*0.25*
G-61	TDS	-	-	*7.1*	-	1084	**810**	260	-	-
G-62	TDS, As, F	24.0	6.71	***7.45***	1338	-	**1010**	239	-	0.10
G-63/63D	Data did not meet QA/QC requirements									
G-64/64D	Data did not meet QA/QC requirements									
G-65	TDS, Cl, SO_4	24.4	7.65	***7.9***	2320	1672	**1500**	510	-	-
G-66	TDS, Cl, SO_4 Gross ά	22.4	6.84	*7.2*	3990	2950	**2700**	810	-	-
G-67	TDS, Cl, SO_4	20.3	6.92	*7.2*	4380	3330	**3000**	950	-	-
G-68	-	24.7	7.94	*8.1*	689	616	480	91	-	-
G-69	TDS, **F**	23.8	7.20	*7.5*	1428	1231	**930**	210	-	-
G-70	TDS, F	25.6	7.49	*7.7*	1015	822	**640**	130	-	-
G-71	-	28.4	-	*8.3*	477	471	330	4.9	-	-
G-72	TDS, As, **F**	37.7	7.48	*8.6*	1716	1299	**850**	16	-	-
G-73	TDS, SO_4, As, **F**	37.1	-	*8.5*	2060	1364	**930**	12	-	-
G-74	**F**	26.3	7.27	*8.0*	841	600	480	59	-	-
G-75	F	-	-	*7.6*	-	694	**550**	120	-	-
G-76	pH, As, **F**	23.5	**8.57**	*8.6*	317	274	220	2.1	-	-
G-77	pH, TDS, SO_4, As, **F,** Fe	39.1	**9.01**	*9.0*	2140	1564	**1000**	4.0	-	-
G-78	TDS, SO_4, Se	31.7	7.55	*7.6*	1500	1251	**840**	76	-	-
B-1	-	19.4	8.00	*7.6*	460	313	280	160	-	-
B-2	-	20.5	7.93	*7.6*	470	338	280	160	-	-
B-3	-	21.7	-	*7.6*	-	315	280	170	-	-

bold = constituent level exceeds Primary or Secondary MCL
italics = constituent exceeded holding time
F = fluoride concentrations exceeding Primary MCL; F = fluoride concentrations exceeding Secondary MCL

Appendix D. Groundwater Quality Data, Gila Valley Sub-Basin, 1995--Continued

Sample #	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	T. Alk (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
G-1	260	110	91	2.9	270	-	-	18	**970**
G-2	50.5	14.7	140	1.23	235	-	-	91	83
G-3	40.1	6.6	70	-	146	-	-	43	50
G-4	28.6	4.5	56	-	96	-	-	45	42
G-5	41.7	7.8	88	1.19	179	-	-	50	56
G-6	39.6	6.8	73	1.45	152	-	-	44	47
G-7/7D	44.2	7.0	80	1.08	172.5	-	-	49	51
G-8	46.6	8.2	96	1.30	196	-	-	57	57
G-9	95.4	38.2	548	-	277	-	-	**613**	**401**
G-10	59.9	23.3	307	-	221	-	-	249	231
G-11	53	29	25	3.6	240	-	-	10	34
G-12	38	7.2	22	ND	120	-	-	6	38
G-13	40	7.4	32	ND	100	-	-	12	87
G-14	56	8.1	19	ND	150	-	-	5	50
G-15	36	14.8	50	3.31	144	-	-	7	37
G-16	130	42	670	8.3	370	-	-	*62*	**430**
G-17	110	36	660	6.8	400	-	-	**610**	**380**
G-18	108	30.2	399	8.22	371	-	-	**480**	240
G-19/19D	101	40.6	921	7.06	567	-	-	**926**	**419**
G-20	130	49	1200	5.8	610	-	-	**1200**	**980**
G-21	100	31	540	7.2	360	-	-	**510**	**380**
G-22	46	25	27	3.7	220	-	-	14	25
G-23	4.5	1.2	280	2.4	460	-	-	58	68
G-24	73	23	350	5.1	300	-	-	**350**	**280**
G-25	111	49.9	852	7.32	586	-	-	**874**	**404**
G-26	42.6	34	303	1.67	327	-	-	**281**	156
G-27	27.8	62.1	224	0.86	271	-	-	246	111

bold = constituent level exceeds Primary or Secondary MCL

Appendix D. Groundwater Quality Data, Gila Valley Sub-Basin, 1995--Continued

Sample #	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	T. Alk (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
G-28	26	12	240	1.4	260	-	-	180	150
G-29	61	19	370	5.6	350	-	-	**260**	220
G-30	32	20	420	1.7	370	-	-	**300**	180
G-31	106	44.8	473	2.92	405	-	-	**527**	**282**
G-32	138	38	410	3.36	405	-	-	**499**	**265**
G-33	116	34.2	569	6.66	407	-	-	**604**	**337**
G-34/34D	61.75	22.3	228.5	-	356	-	-	185.5	99.8
G-35	64	22	220	5.2	320	-	-	210	130
G-36/36D	71	18	110	5.65	195	-	-	120	75
G-37	76	17	130	5.8	230	-	-	110	75
G-38	77.7	17.6	114	4.86	151	-	-	199	66.6
G-39	48	16	290	13	72	-	-	**320**	**260**
G-40	7.4	1.0	62	ND	130	-	-	10	15
G-41	9.4	1.2	57	1.4	140	-	-	ND	ND
G-42	160	41	430	2.8	400	-	-	**440**	**320**
G-43	130	39	540	3.7	390	-	-	**460**	**310**
G-44	140	29.2	332	-	356	-	-	**381**	221
G-45	143	32.9	323	-	352	-	-	**403**	225
G-46	140	36	360	2.5	350	-	-	**380**	**330**
G-47/47D	49.5	11	100	4.25	195	-	-	97	76.5
G-48	44	10	120	4.3	200	-	-	100	86
G-49	53	11	120	4.8	200	-	-	120	86
G-50	45	13	390	4.6	330	-	-	**330**	210
G-51	85	26	320	5.6	310	-	-	**280**	**290**
G-52	83	23	300	5.3	320	-	-	240	**250**
G-53	73	18	363	-	314	-	-	**325**	234
G-54	170	36	300	6.8	110	-	-	**410**	**390**

bold = constituent level exceeds Primary or Secondary MCL

Appendix D. Groundwater Quality Data, Gila Valley Sub-Basin, 1995--Continued

Sample #	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	T. Alk (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
G-55	25	7.0	57	2.7	130	-	-	21	59
G-56	44.8	10.8	216	4.33	205	-	-	207	86
G-57	12.6	2.4	344	4.17	206	-	-	225	235
G-58/58D	55	19.5	315	5.9	340	-	-	220	220
G-59	85	22	170	7.0	260	-	-	150	130
G-60	87.4	25	293	6.60	370	-	-	**294**	141
G-61	74	19	160	5.2	250	-	-	190	120
G-62	69.7	16	255	-	272	-	-	246	166
G-63/63D				Data did not meet QA/QC requirements					
G-64/64D				Data did not meet QA/QC requirements					
G-65	150	33	300	5.7	120	-	-	**260**	**620**
G-66	240	52	640	6.4	290	-	-	**790**	**520**
G-67	270	66	710	6.4	300	-	-	**810**	**620**
G-68	28	5.1	130	2.0	100	-	-	110	110
G-69	69	8.1	250	3.4	220	-	-	180	240
G-70	40	6.8	170	3.1	120	-	-	110	140
G-71	1.5	0.29	130	1.2	210	-	-	25	30
G-72	5.2	0.70	300	3.4	220	-	-	120	230
G-73	4.2	0.24	320	4.1	180	-	-	140	**370**
G-74	21	1.5	140	1.8	130	-	-	84	110
G-75	41	3.7	150	3.0	190	-	-	94	130
G-76	0.83	ND	74	ND	88	-	-	5.6	44
G-77	1.6	ND	370	2.7	260	-	-	130	**310**
G-78	24	4.0	280	3.3	420	-	-	110	**260**
B-1	35	17	21	3.2	200	-	-	6.2	16
B-2	35	17	22	3.4	200	-	-	ND	15
B-3	34	20	23	2.9	220	-	-	ND	13

bold = constituent level exceeds Primary or Secondary MCL

Appendix D. Groundwater Quality Data, Gila Valley Sub-Basin, 1995--Continued

Site #	Nitrate-Nitrite-N (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)	TKN (mg/L)	Ammonia (mg/L)	T. Phos (mg/L)	SAR (value)	Irrigation Quality	Pesticide
G-1	ND	-	ND	0.38	ND	ND	-	-	-
G-2	2.45	ND	2.45	ND	ND	ND	-	-	-
G-3	2.23	-	2.23	ND	ND	ND	-	-	-
G-4	0.67	-	0.67	ND	ND	ND	-	-	-
G-5	1.86	ND	1.86	ND	ND	ND	-	-	-
G-6	2.10	ND	2.10	ND	ND	ND	-	-	-
G-7/7D	1.725	ND	1.725	0.115	ND	ND	-	-	-
G-8	1.58	ND	1.58	ND	ND	ND	-	-	-
G-9	8.22	-	8.22	0.34	ND	ND	-	-	-
G-10	5.55	-	5.55	0.28	ND	0.22	-	-	-
G-11	0.79	-	0.79	0.31	ND	0.09	-	-	-
G-12	1.7	-	1.7	ND	ND	0.07	-	-	ND
G-13	2.0	-	2.0	0.35	0.17	ND	-	-	-
G-14	0.73	-	0.73	0.35	ND	ND	-	-	-
G-15	1.05	ND	1.05	ND	ND	ND	-	-	-
G-16	**16**	-	**16**	0.42	0.07	ND	-	-	-
G-17	**10**	-	**10**	0.31	0.10	0.07	-	-	-
G-18	4.27	ND	4.27	0.21	ND	ND	-	-	-
G-19/19D	4.69	ND	4.69	0.23	ND	ND	-	-	-
G-20	6.1	-	6.1	0.24	ND	0.08	-	-	-
G-21	6.5	-	6.5	0.35	0.33	0.09	-	-	-
G-22	1.3	-	1.3	0.25	ND	ND	-	-	-
G-23	0.72	-	0.72	0.36	ND	0.20	-	-	-
G-24	4.2	-	4.2	0.40	0.05	0.16	-	-	-
G-25	7.02	ND	7.02	0.41	ND	ND	-	-	-
G-26	5.41	ND	5.41	0.28	ND	0.18	-	-	-
G-27	4.47	ND	4.47	0.22	ND	ND	-	-	-

bold = constituent level exceeds Primary or Secondary MCL
italics = constituent exceeded holding time

Appendix D. Groundwater Quality Data, Gila Valley Sub-Basin, 1995--Continued

Site #	Nitrate-Nitrite-N (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)	TKN (mg/L)	Ammonia (mg/L)	T. Phos (mg/L)	SAR (value)	Irrigation Quality	Pesticide
G-28	3.8	-	3.8	0.33	ND	0.11	-	-	ND
G-29	8.8	-	8.8	ND	ND	0.14	-	-	ND
G-30	8.3	-	8.3	ND	ND	0.13	-	-	ND
G-31	**11.3**	ND	11.3	0.30	ND	ND	-	-	-
G-32	**10.8**	ND	10.8	0.34	ND	ND	-	-	-
G-33	**11.5**	ND	11.5	0.46	ND	ND	-	-	-
G-34/34D	3.395	-	3.395	0.335	ND	ND	-	-	-
G-35	4.2	-	4.2	0.27	ND	0.12	-	-	ND
G-36/36D	3.0	-	3.0	0.37	ND	ND	-	-	-
G-37	5.3	-	5.3	0.20	ND	ND	-	-	-
G-38	1.06	-	1.06	ND	ND	ND	-	-	-
G-39	ND	-	ND	0.34	ND	0.10	-	-	-
G-40	ND	-	ND	ND	ND	0.07	-	-	-
G-41	ND	-	ND	ND	ND	0.13	-	-	-
G-42	8.9	-	8.9	ND	ND	0.06	-	-	-
G-43	8.8	-	8.8	0.16	ND	0.08	-	-	ND
G-44	**14..2**	-	**14..2**	0.37	ND	ND	-	-	-
G-45	**12.2**	-	**12.2**	0.28	ND	ND	-	-	-
G-46	**11**	-	**11**	0.28	0.07	ND	-	-	-
G-47/47D	0.88	-	0.88	0.32	ND	0.115	-	-	ND
G-48	1.8	-	1.8	0.26	ND	0.16	-	-	ND
G-49	1.7	-	1.7	0.26	ND	0.12	-	-	ND
G-50	7.4	-	7.4	ND	ND	0.10	-	-	ND
G-51	6.5	-	6.5	0.53	ND	0.16	-	-	-
G-52	7.0	-	7.0	0.42	ND	ND	-	-	-
G-53	6.1	-	6.1	0.78	ND	ND	-	-	-
G-54	1.1	-	1.1	ND	0.08	ND	-	-	-

bold = constituent level exceeds Primary or Secondary MCL
italics = constituent exceeded holding time

Appendix D. Groundwater Quality Data, Gila Valley Sub-Basin, 1995--Continued

Site #	Nitrate-Nitrite-N (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)	TKN (mg/L)	Ammonia (mg/L)	T. Phos (mg/L)	SAR (value)	Irrigation Quality	Pesticide
G-55	0.23	-	0.23	ND	ND	ND	-	-	-
G-56	1.51	ND	1.51	ND	ND	ND	-	-	-
G-57	0.37	ND	0.37	ND	ND	ND	-	-	-
G-58/58D	7.5	-	7.5	0.46	ND	0.055	-	-	-
G-59	4.0	-	4.0	0.45	ND	ND	-	-	-
G-60	5.42	-	5.42	0.28	ND	ND	-	-	-
G-61	2.4	-	2.4	0.30	ND	0.07	-	-	ND
G-62	6.17	-	6.17	0.24	ND	ND	-	-	-
G-63/63D	Data did not meet QA/QC requirements								
G-64/64D	Data did not meet QA/QC requirements								
G-65	0.33	-	0.33	0.14	ND	ND	-	-	-
G-66	3.0	-	3.0	ND	ND	ND	-	-	-
G-67	5.7	-	5.7	0.27	ND	ND	-	-	-
G-68	0.16	-	0.16	ND	ND	ND	-	-	-
G-69	0.19	-	0.19	ND	ND	ND	-	-	-
G-70	0.27	-	0.27	ND	ND	ND	-	-	-
G-71	1.1	-	1.1	0.35	ND	0.11	-	-	-
G-72	0.23	-	0.23	0.68	ND	0.06	-	-	-
G-73	0.16	-	0.16	0.40	0.11	0.05	-	-	-
G-74	1.1	-	1.1	ND	ND	ND	-	-	ND
G-75	1.2	-	1.2	ND	ND	ND	-	-	-
G-76	1.6	-	1.6	ND	ND	0.06	-	-	-
G-77	ND	-	ND	0.57	ND	0.06	-	-	-
G-78	4.4	-	4.4	0.21	ND	0.07	-	-	-
B-1	0.37	-	0.37	0.33	ND	0.10	-	-	-
B-2	0.48	-	0.48	0.30	ND	0.10	-	-	-
B-3	0.59	-	0.59	0.29	ND	0.009	-	-	-

bold = constituent level exceeds Primary or Secondary MCL
italics = constituent exceeded holding time

Appendix D. Groundwater Quality Data, Gila Valley Sub-Basin, 1995--Continued

Site #	Antimony (mg/L)	Arsenic (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Boron (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Fluoride (mg/L)
G-1	ND	ND	ND	ND	ND	ND	ND	ND	1.1
G-2	ND	ND	ND	ND	0.17	ND	ND	ND	1.67
G-3	ND	ND	ND	ND	ND	ND	ND	0.012	1.41
G-4	ND	ND	ND	ND	ND	ND	ND	ND	1.08
G-5	ND	ND	ND	ND	ND	ND	ND	ND	1.63
G-6	ND	ND	ND	ND	ND	ND	ND	ND	1.53
G-7/7D	ND	ND	ND	ND	ND	ND	ND	ND	1.625
G-8	ND	**0.015**	ND	ND	ND	ND	ND	ND	1.69
G-9	ND	ND	ND	ND	0.70	ND	ND	ND	1.42
G-10	ND	ND	ND	ND	0.36	ND	ND	ND	0.95
G-11	ND	ND	ND	ND	ND	ND	ND	ND	0.31
G-12	ND	ND	ND	ND	ND	ND	ND	ND	0.64
G-13	ND	ND	ND	ND	ND	ND	ND	ND	0.60
G-14	ND	ND	0.07	ND	ND	0.0006	ND	ND	0.65
G-15	ND	ND	ND	ND	ND	ND	ND	ND	0.28
G-16	ND	ND	ND	ND	0.72	0.0012	ND	ND	**2.4**
G-17	ND	ND	ND	ND	0.71	ND	ND	ND	**3.1**
G-18	ND	ND	ND	ND	0.44	ND	ND	ND	1.93
G-19/19D	ND	**0.0145**	ND	ND	1.06	ND	ND	ND	**2.425**
G-20	ND	0.007	ND	ND	1.5	ND	ND	ND	1.6
G-21	ND	ND	ND	ND	0.52	ND	ND	ND	2.1
G-22	ND	ND	ND	ND	ND	ND	ND	ND	0.33
G-23	ND	**0.37**	ND	ND	0.84	ND	ND	ND	**8.4**
G-24	ND	0.006	ND	ND	0.42	ND	ND	ND	**2.3**
G-25	ND	ND	ND	ND	0.78	ND	ND	ND	**2.12**
G-26	ND	ND	ND	ND	0.34	ND	ND	ND	1.8
G-27	ND	ND	ND	ND	0.25	ND	ND	ND	**2.66**

bold = constituent level exceeds Primary or Secondary MCL
***** = concentration exceeds the revised arsenic SDW Primary MCL of 0.01 mg/l which becomes effective in 2006

Appendix D. Groundwater Quality Data, Gila Valley Sub-Basin, 1995--Continued

Site #	Antimony (mg/L)	Arsenic (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Boron (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Fluoride (mg/L)
G-28	ND	**0.020**	ND	ND	0.42	ND	ND	ND	**4.6**
G-29	ND	**0.039**	ND	ND	0.53	ND	0.022	ND	**4.4**
G-30	ND	**0.084**	ND	ND	0.56	ND	ND	ND	**2.8**
G-31	ND	ND	ND	ND	0.61	ND	ND	ND	1.65
G-32	ND	ND	ND	ND	0.50	ND	ND	ND	**2.01**
G-33	ND	ND	ND	ND	0.57	ND	ND	ND	**3.20**
G-34/34D	ND	**0.015**	ND	ND	0.17	ND	ND	ND	**2.785**
G-35	ND	**0.011**	ND	ND	0.24	ND	ND	ND	**2.3**
G-36/36D	ND	ND	ND	ND	0.115	ND	ND	ND	1.25
G-37	ND	ND	ND	ND	0.14	ND	ND	ND	1.4
G-38	ND	ND	ND	ND	0.10	ND	ND	ND	1.05
G-39	ND	**0.015**	ND	ND	0.20	ND	ND	ND	**3.2**
G-40	ND	**0.022**	ND	ND	0.17	ND	ND	ND	1.8
G-41	ND	**0.020**	ND	ND	0.12	ND	ND	ND	1.3
G-42	ND	0.006	ND	ND	0.42	ND	ND	ND	1.5
G-43	ND	**0.011**	ND	ND	0.47	ND	ND	ND	**2.1**
G-44	ND	ND	ND	ND	0.30	ND	ND	ND	0.68
G-45	ND	ND	ND	ND	0.34	ND	ND	ND	0.87
G-46	ND	ND	0.006	ND	0.45	ND	ND	ND	0.86
G-47/47D	ND	0.0085	ND	ND	ND	ND	ND	ND	1.4
G-48	ND	0.008	ND	ND	0.14	ND	ND	ND	1.6
G-49	ND	0.009	ND	ND	0.11	ND	ND	ND	**2.1**
G-50	ND	**0.020**	ND	ND	0.33	0.0011	ND	ND	**3.3**
G-51	ND	**0.015**	ND	ND	0.31	ND	ND	ND	**3.2**
G-52	ND	**0.020**	ND	ND	0.31	ND	ND	ND	**3.5**
G-53	ND	**0.014**	ND	ND	0.35	ND	ND	ND	**3.02**
G-54	ND	ND	ND	ND	0.34	ND	ND	ND	0.44

bold = constituent level exceeds Primary or Secondary MCL
***** = concentration exceeds the revised arsenic SDW Primary MCL of 0.01 mg/l which becomes effective in 2006

Appendix D. Groundwater Quality Data, Gila Valley Sub-Basin, 1995--Continued

Site #	Antimony (mg/L)	Arsenic (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Boron (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Fluoride (mg/L)
G-55	ND	ND	ND	ND	ND	ND	ND	ND	0.70
G-56	ND	**0.056**	ND	ND	0.24	ND	ND	ND	**6.13**
G-57	ND	**0.072**	ND	ND	0.50	ND	ND	ND	**9.93**
G-58/58D	ND	**0.016**	ND	ND	0.375	ND	ND	ND	**4.3**
G-59	ND	0.009	ND	ND	0.16	ND	ND	ND	**2.1**
G-60	ND	**0.011**	ND	ND	0.33	ND	ND	ND	**3.11**
G-61	ND	0.009	ND	ND	0.18	ND	ND	ND	1.9
G-62	ND	**0.018**	ND	ND	0.27	ND	ND	ND	**3.7**
G-63/63D	Data did not meet QA/QC requirements								
G-64/64D	Data did not meet QA/QC requirements								
G-65	ND	ND	ND	ND	0.22	ND	ND	ND	1.5
G-66	ND	ND	ND	ND	0.90	ND	ND	ND	1.0
G-67	ND	ND	ND	ND	1.3	ND	ND	ND	1.7
G-68	ND	ND	ND	ND	0.10	ND	ND	ND	1.4
G-69	ND	ND	ND	ND	0.23	ND	ND	ND	**4.6**
G-70	ND	ND	ND	ND	0.16	ND	ND	ND	**3.2**
G-71	ND	0.006	ND	ND	0.12	ND	ND	ND	0.84
G-72	ND	**0.027**	ND	ND	0.35	ND	ND	ND	**5.6**
G-73	ND	**0.040**	ND	ND	0.37	ND	ND	ND	**9.8**
G-74	ND	ND	ND	ND	0.18	ND	ND	ND	**6.8**
G-75	ND	ND	ND	ND	0.17	ND	ND	ND	**3.7**
G-76	ND	**0.032**	ND	ND	ND	ND	ND	ND	**5.4**
G-77	ND	**0.030**	ND	ND	0.42	ND	ND	ND	**7.2**
G-78	ND	0.008	ND	ND	0.14	ND	ND	ND	1.2
B-1	ND	ND	ND	ND	ND	ND	ND	ND	0.46
B-2	ND	ND	ND	ND	ND	ND	ND	ND	0.46
B-3	ND	ND	ND	ND	ND	ND	ND	ND	0.40

bold = constituent level exceeds Primary or Secondary MCL
***** = concentration exceeds the revised arsenic SDW Primary MCL of 0.01 mg/l which becomes effective in 2006

Appendix D. Groundwater Quality Data, Gila Valley Sub-Basin, 1995--Continued

Site #	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Nickel (mg/L)	Selenium (mg/L)	Silver (mg/L)	Thallium (mg/L)	Zinc (mg/L)
G-1	**1.7**	ND	**1.4**	ND	-	ND	ND	ND	ND
G-2	ND	ND	ND	ND	-	ND	ND	ND	ND
G-3	ND	ND	ND	ND	-	ND	ND	ND	ND
G-4	ND	ND	ND	ND	-	ND	ND	ND	ND
G-5	ND	ND	ND	ND	-	ND	ND	ND	ND
G-6	ND	ND	ND	ND	-	ND	ND	ND	ND
G-7/7D	ND	ND	ND	ND	-	ND	ND	ND	ND
G-8	ND	ND	ND	ND	-	ND	ND	ND	ND
G-9	ND	ND	ND	ND	-	ND	ND	**0.007**	ND
G-10	ND	ND	ND	ND	-	ND	ND	ND	ND
G-11	ND	ND	ND	ND	-	ND	ND	ND	0.52
G-12	ND	ND	ND	ND	-	ND	ND	ND	ND
G-13	ND	ND	ND	ND	-	ND	ND	ND	ND
G-14	ND	ND	ND	ND	-	ND	ND	ND	ND
G-15	ND	ND	ND	ND	-	ND	ND	ND	ND
G-16	ND	ND	ND	ND	-	ND	ND	ND	ND
G-17	ND	ND	ND	ND	-	ND	ND	ND	ND
G-18	ND	ND	**0.09**	ND	-	ND	ND	ND	ND
G-19/19D	ND	ND	ND	ND	-	ND	ND	ND	ND
G-20	ND	ND	ND	ND	-	ND	ND	ND	ND
G-21	ND	ND	ND	ND	-	ND	ND	ND	ND
G-22	ND	ND	ND	ND	-	ND	ND	ND	0.58
G-23	0.14	ND	ND	ND	-	0.012	ND	ND	0.08
G-24	ND	ND	ND	ND	-	ND	ND	ND	ND
G-25	ND	**0.194**	ND	ND	-	ND	ND	ND	ND
G-26	ND	ND	ND	ND	-	ND	ND	ND	ND
G-27	ND	ND	ND	ND	-	ND	ND	ND	ND

bold = constituent level exceeds Primary or Secondary MCL

Appendix D. Groundwater Quality Data, Gila Valley Sub-Basin, 1995—Continued

Site #	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Nickel (mg/L)	Selenium (mg/L)	Silver (mg/L)	Thallium (mg/L)	Zinc (mg/L)
G-28	ND	ND	ND	ND	-	ND	ND	ND	ND
G-29	ND	ND	ND	ND	-	ND	ND	ND	ND
G-30	ND	ND	ND	ND	-	ND	ND	ND	ND
G-31	ND	ND	ND	ND	-	ND	ND	ND	ND
G-32	ND	ND	ND	ND	-	ND	ND	ND	ND
G-33	ND	ND	ND	ND	-	ND	ND	ND	ND
G-34/34D	ND	ND	ND	ND	-	ND	ND	ND	ND
G-35	ND	ND	ND	ND	-	ND	ND	ND	ND
G-36/36D	ND	ND	ND	ND	-	ND	ND	ND	ND
G-37	ND	ND	ND	ND	-	ND	ND	ND	ND
G-38	ND	ND	ND	ND	-	ND	ND	ND	ND
G-39	ND	ND	ND	ND	-	ND	ND	ND	0.29
G-40	ND	ND	ND	ND	-	ND	ND	ND	ND
G-41	ND	ND	ND	ND	-	ND	ND	ND	ND
G-42	ND	ND	ND	ND	-	ND	ND	ND	ND
G-43	ND	ND	ND	ND	-	ND	ND	ND	ND
G-44	ND	ND	ND	ND	-	ND	ND	ND	ND
G-45	ND	ND	ND	ND	-	ND	ND	ND	ND
G-46	ND	ND	ND	ND	-	ND	ND	ND	ND
G-47/47D	ND	ND	ND	ND	-	ND	ND	ND	ND
G-48	ND	ND	ND	ND	-	ND	ND	ND	ND
G-49	ND	ND	ND	ND	-	ND	ND	ND	ND
G-50	ND	ND	ND	ND	-	ND	ND	ND	ND
G-51	ND	ND	ND	ND	-	ND	ND	ND	ND
G-52	ND	ND	ND	ND	-	ND	ND	ND	ND
G-53	ND	ND	ND	ND	-	ND	ND	ND	ND
G-54	ND	ND	ND	ND	-	ND	ND	ND	ND

bold = constituent level exceeds Primary or Secondary MCL

Appendix D. Groundwater Quality Data, Gila Valley Sub-Basin, 1995--Continued

Site #	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Nickel (mg/L)	Selenium (mg/L)	Silver (mg/L)	Thallium (mg/L)	Zinc (mg/L)
G-55	ND	ND	ND	ND	-	ND	ND	ND	ND
G-56	ND	ND	ND	ND	-	ND	ND	ND	ND
G-57	ND	ND	ND	ND	-	ND	ND	ND	ND
G-58/58D	ND	ND	ND	ND	-	ND	ND	ND	ND
G-59	ND	ND	ND	ND	-	ND	ND	ND	0.25
G-60	ND	ND	ND	ND	-	ND	ND	ND	ND
G-61	ND	ND	ND	ND	-	ND	ND	ND	ND
G-62	ND	ND	ND	ND	-	ND	ND	ND	ND
G-63/63D	Data did not meet QA/QC requirements								
G-64/64D	Data did not meet QA/QC requirements								
G-65	ND	ND	ND	ND	-	ND	ND	ND	ND
G-66	ND	ND	ND	ND	-	ND	ND	ND	0.07
G-67	ND	ND	ND	ND	-	ND	ND	ND	ND
G-68	ND	ND	ND	ND	-	ND	ND	ND	ND
G-69	ND	ND	ND	ND	-	ND	ND	ND	ND
G-70	ND	ND	ND	ND	-	ND	ND	ND	ND
G-71	0.10	ND	ND	ND	-	ND	ND	ND	ND
G-72	**0.61**	ND	ND	ND	-	ND	ND	ND	ND
G-73	ND	ND	ND	ND	-	ND	ND	ND	ND
G-74	ND	ND	ND	ND	-	ND	ND	ND	ND
G-75	ND	ND	ND	ND	-	ND	ND	ND	ND
G-76	ND	ND	ND	ND	-	ND	ND	ND	ND
G-77	**0.47**	ND	ND	ND	-	ND	ND	ND	0.10
G-78	0.22	ND	ND	ND	-	**0.17**	ND	ND	0.62
B-1	ND	ND	ND	ND	-	ND	ND	ND	ND
B-2	ND	ND	ND	ND	-	ND	ND	ND	ND
B-3	ND	ND	ND	ND	-	ND	ND	ND	ND

bold = constituent level exceeds Primary or Secondary MCL

Appendix D. Groundwater Quality Data, Gila Valley Sub-Basin, 1995--Continued

Site #	Radon-222 (pCi/L)	Alpha (pCi/L)	Beta (pCi/L)	Ra-226+228 (pCi/L)	Uranium (µg/L)	$\delta^{18}O$ ($^0/_{00}$)	δD ($^0/_{00}$)	Type of Chemistry
G-1	-	-	-	-	-	-	-	-
G-2	-	-	-	-	-	-	-	-
G-3	-	-	-	-	-	-	-	-
G-4	-	-	-	-	-	-	-	-
G-5	-	-	-	-	-	-	-	-
G-6	-	-	-	-	-	-	-	-
G-7/7D	-	-	-	-	-	-	-	-
G-8	-	-	-	-	-	-	-	-
G-9	-	-	-	-	-	-	-	-
G-10	-	-	-	-	-	-	-	-
G-11	-	-	-	-	-	-	-	-
G-12	-	< LLD	< LLD	-	-	-	-	-
G-13	-	-	-	-	-	-	-	-
G-14	-	-	-	-	-	-	-	-
G-15	-	-	-	-	-	-	-	-
G-16	-	-	-	-	-	-	-	-
G-17	-	-	-	-	-	-	-	-
G-18	-	-	-	-	-	-	-	-
G-19/19D	-	-	-	-	-	-	-	-
G-20	-	-	-	-	-	-	-	-
G-21	-	-	-	-	-	-	-	-
G-22	-	-	-	-	-	-	-	-
G-23	-	-	-	-	-	-	-	-
G-24	-	-	-	-	-	-	-	-
G-25	-	-	-	-	-	-	-	-
G-26	-	-	-	-	-	-	-	-
G-27	-	-	-	-	-	-	-	-

bold = Primary MCL Exceedance
LLD = Lower Limit of Detection
italics = constituent exceeded holding time

Appendix D. Groundwater Quality Data, Gila Valley Sub-Basin, 1995--Continued

Site #	Radon-222 (pCi/L)	Alpha (pCi/L)	Beta (pCi/L)	Ra-226+228 (pCi/L)	Uranium (μg/L)	δ^{18} O ($^0/_{00}$)	δ D ($^0/_{00}$)	Type of Chemistry
G-28	-	2.6	< LLD	-	-	-	-	-
G-29	-	-	-	-	-	-	-	-
G-30	-	-	-	-	-	-	-	-
G-31	-	-	-	-	-	-	-	-
G-32	-	-	-	-	-	-	-	-
G-33	-	-	-	-	-	-	-	-
G-34/34D	-	-	-	-	-	-	-	-
G-35	-	-	-	-	-	-	-	-
G-36/36D	-	-	-	-	-	-	-	-
G-37	-	-	-	-	-	-	-	-
G-38	-	-	-	-	-	-	-	-
G-39	-	-	-	-	-	-	-	-
G-40	-	-	-	-	-	-	-	-
G-41	-	1.7	2.3	-	-	-	-	-
G-42	-	-	-	-	-	-	-	-
G-43	-	-	-	-	-	-	-	-
G-44	-	-	-	-	-	-	-	-
G-45	-	-	-	-	-	-	-	-
G-46	-	-	-	-	-	-	-	-
G-47/47D	-	2.1	< LLD	-	-	-	-	-
G-48	-	-	-	-	-	-	-	-
G-49	-	-	-	-	-	-	-	-
G-50	-	-	-	-	-	-	-	-
G-51	-	-	-	-	-	-	-	-
G-52	-	-	-	-	-	-	-	-
G-53	-	-	-	-	-	-	-	-
G-54	-	-	-	-	-	-	-	-

bold = Primary MCL Exceedance
LLD = Lower Limit of Detection
italics = constituent exceeded holding time

Appendix D. Groundwater Quality Data, Gila Valley Sub-Basin, 1995--Continued

Site #	Radon-222 (pCi/L)	Alpha (pCi/L)	Beta (pCi/L)	Ra-226+228 (pCi/L)	Uranium (µg/L)	δ^{18} O ($^0/_{00}$)	δ D ($^0/_{00}$)	Type of Chemistry
G-55	-	< LLD	< LLD	-	-	-	-	-
G-56	-	-	-	-	-	-	-	-
G-57	-	-	-	-	-	-	-	-
G-58/58D	-	-	-	-	-	-	-	-
G-59	-	-	-	-	-	-	-	-
G-60	-	-	-	-	-	-	-	-
G-61	-	5.4	3.5	2.8	-	-	-	-
G-62	-	-	-	-	-	-	-	-
G-63/63D	Data did not meet QA/QC requirements							
G-64/64D	Data did not meet QA/QC requirements							
G-65	-	-	-	-	-	-	-	-
G-66	-	**24**	10.7	1.3	18.9	-	-	-
G-67	-	3.6	4.0	-	-	-	-	-
G-68	-	2.5	1.8	-	-	-	-	-
G-69	-	-	-	-	-	-	-	-
G-70	-	-	-	-	-	-	-	-
G-71	-	-	-	-	-	-	-	-
G-72	-	-	-	-	-	-	-	-
G-73	-	-	-	-	-	-	-	-
G-74	-	6.2	2.0	< LLD	-	-	-	-
G-75	-	-	-	-	-	-	-	-
G-76	-	-	-	-	-	-	-	-
G-77	-	-	-	-	-	-	-	-
G-78	-	-	-	-	-	-	-	-
B-1	-	1.8	< LLD	-	-	-	-	-
B-2	-	-	-	-	-	-	-	-
B-3	-	-	-	-	-	-	-	-

bold = Primary MCL Exceedance
LLD = Lower Limit of Detection
italics = constituent exceeded holding time