


Tracing Groundwater Flowpaths in Kinney County, Texas

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Abbreviations and Acronyms

BEG........................Bureau of Economic Geology, The University of Texas at Austin
BFZ..Balcones Fault Zone of the Edwards Aquifer
cm... centimeter
cfs... cubic feet per second
d.. day
EAA.. Edwards Aquifer Authority
EUWD..Edwards Underground Water District
ft.. foot
ft^2 .... square foot
g.. gram
g/m^3 .... grams per cubic meter
gal.. gallons
gpm... gallons per minute
h.. hour
IBWC..International Boundary and Water Commission
in.. inches
KCGCD...Kinney County Groundwater Conservation District
km.. kilometer
L.. liter
L/sec... liters per second
LOD .... limit of detection
LOQ .... limit of quantitation
m.. meter
ma...Mega-annum; millions of years before present
m^3/s.. cubic meters per second
mg/L... milligrams per liter
mi.. mile
mm.. millimeter
msl.. mean sea level
MUD .... municipal utility district
µg/L .... micrograms per liter
ND .... not detected
nm.. nanometer
PCA .... principal components analysis
ppb.. parts per billion
ppm.. parts per million
PVC .... polyvinyl chloride
PWS .... public water supply well
QC/QA.. quality control/quality assurance
RPD .... relative percent difference
RR .... ranch road
SA.. San Antonio
SRB .... Sulforhodamine B
T .... tentative
TCEQ...Texas Commission on Environmental Quality
TCMA... Texas Cave Management Association
TDS .... total dissolved solids
USGS .... U.S. Geological Survey
ZARA .... ZARA Environmental, LLC

EXECUTIVE SUMMARY

This report presents the findings of a groundwater flowpath investigation in Kinney County, Texas, performed by the Edwards Aquifer Authority between 2007 and 2012.

Purpose

The purpose of this study was to characterize groundwater flowpaths and time of travel in Kinney County, Texas, and to better refine the boundary between the Kinney County pool and the Uvalde County pool of the Edwards Aquifer.

Scope of Investigation

The scope of this investigation consisted of 12 tracer tests (dye injections) completed between 2007 and 2012 at various locations in Kinney County using one or more injection points and tracers by the EAA. The tests consisted of injections of nontoxic organic dyes into the Edwards Aquifer to trace groundwater flowpaths and measure groundwater flow velocities. More than 100 sites were monitored during the tests, including Las Moras and Pinto springs, major discharge points for groundwater in the Kinney County pool, and public and private wells. Water and activated charcoal samples were collected from wells and springs for analysis.

Findings of Investigations

Results of the investigation revealed discrete groundwater flowpaths and relatively slow to rapid groundwater velocities connecting the injection points to wells and springs. Apparent velocities from the injection point to each detection site ranged from two ft/d (one m/d) to 4,458 ft/d (1,367 m/d). These are straight-line distances between dye injection and recovery points divided by travel time until the first detection of dye. Because the actual groundwater flowpaths are certainly longer than straight lines, the apparent velocities underestimate the actual velocities. Injection points were Alamo Village Cave, HF&F Cave, Grass Valley PW-1, Whitney Cave, and Pratt's Sink in the north part of the study area; Dooley Irrigation Well in Pinto Valley; and Boerschig Well located approximately two mi northwest of Brackettville. Dyes from Grass Valley PW-1, Whitney Cave, and Pratt's Sink traveled radially to the south, east, and west, influenced by a structural embayment in the Edwards Aquifer that maintained relatively flat groundwater gradients. Deep flowpaths probably influenced by geologic structures resembling anticlines carried dyes southward to Las Moras Springs, a City of Brackettville well, and Fort Clark Municipal Utility District (MUD) wells. Groundwater chemical compositions vary at these locations, suggesting that there are discrete flowpaths to each one. Dye from Alamo Village Cave traveled to Pinto Springs. Dye from HF&F Cave was detected in few locations. Dyes from the Boerschig Well were detected at Las Moras Springs, a City of Brackettville well, and Fort Clark MUD wells, although the detections seemed to change with groundwater head, Las Moras Springs discharge, or other factors. Igneous intrusions near Las Moras Mountain created a barrier to groundwater flow and diverted dyes westward toward Pinto Valley.

The tracer tests confirmed the general hydrologic conditions in Kinney County. Recharge from the West Nueces River in the north central part of the county infiltrates into an embayment. Groundwater flows south toward Las Moras Springs, east toward Uvalde County, and west toward Pinto Valley. Tracer tests revealed the three-dimensional groundwater flow system in the Edwards Aquifer and highlighted the heterogeneity that exists in karst aquifers, which is often underrated or even ignored when groundwater systems are characterized.

INTRODUCTION

The Edwards Aquifer Authority (EAA) conducts a variety of studies to investigate the hydraulic characteristics of the Edwards Aquifer in order to establish the technical basis for effective management and protection of the aquifer. The water balance for the aquifer is particularly important for quantifying recharge sources and volumes and identifying discharge points. A study performed for the Edwards Underground Water District by LBG-Guyton Associates (1994) placed the groundwater divide between the Uvalde Pool and the Kinney County pool near Los Moras Springs in Brackettville. However, a more recent study by Green (2004) indicates a groundwater divide near the Uvalde/Kinney county line. Little is known regarding the volume of recharge that originates from Kinney County and the West Nueces River. This study is designed to characterize groundwater flow in Kinney County and to determine its relationship to Uvalde County.

PURPOSE AND SCOPE

This report presents results of tracer-test investigations of groundwater flowpaths in the Edwards Aquifer in Kinney County, Texas. Tracer tests consist of injecting nontoxic fluorescent dyes into the groundwater system and then tracking their movements through samples collected from wells and springs. Groundwater velocities and flowpaths may be calculated from rates and directions of dye movement.

The purpose of this study was to better refine the presence and location of a groundwater divide between the Kinney County Pool and the Uvalde Pool. Groundwater is thought to flow from areas of higher elevation in the recharge zone to areas of lower elevation to discharge points such as wells and Las Moras or Pinto springs, then eastward toward Uvalde County. Tracer tests and other subsurface information were used to investigate the principal groundwater flowpaths in Kinney County.

The scope of this investigation consists of 12 tracer tests (dye injections) completed between 2007 and 2012 at various locations in Kinney County using one or more injection points and tracers (fluorescent dyes) by the EAA.

Geologic Setting of the Edwards Aquifer

Kinney County is located in the Maverick Basin, which is a Cretaceous-age depositional environment that contains formations stratigraphically equivalent to the Edwards Group elsewhere in the Balcones Fault Zone Edwards Aquifer. Figure 1 from Maclay and Small (1986) shows the Edwards Group, as well as overlying confining units and underlying Cretaceous-age formations. For the purposes of this study, the important formations within the Maverick Basin are the Salmon Peak Formation, the McKnight Formation, and the West Nueces Formation, which compose the Edwards Aquifer in descending order. The Del Rio Clay and other, younger rocks are the upper confining unit, and the Glen Rose Formation is the lower confining unit for the Edwards Aquifer.

Table 1 lists a lithologic log from Snyder (2008) for the Edwards Aquifer for well RP-70-37-704, which is located in Pinto Valley, approximately 5.5 mi (8.8 km) northwest of Brackettville in Kinney County.

The geologic structure of Kinney County is characterized by the Balcones Fault Zone and igneous intrusions that have displaced and deformed the Cretaceous sediments. According to Barker and Ardis (1996), the normal (down to the coast) faulting of the Balcones Fault Zone occurred during the late Oligocene (23–28 ma) through early Miocene (23–seven ma), subsequent to the igneous intrusions in the Late Cretaceous. Faults are displaced from a few feet (one m) to about 75 ft (25 m), generally toward the southeast, although a few faults are down-dropped to the northwest (Bennett and Sayre, 1962). Of interest to this study is the Salmon

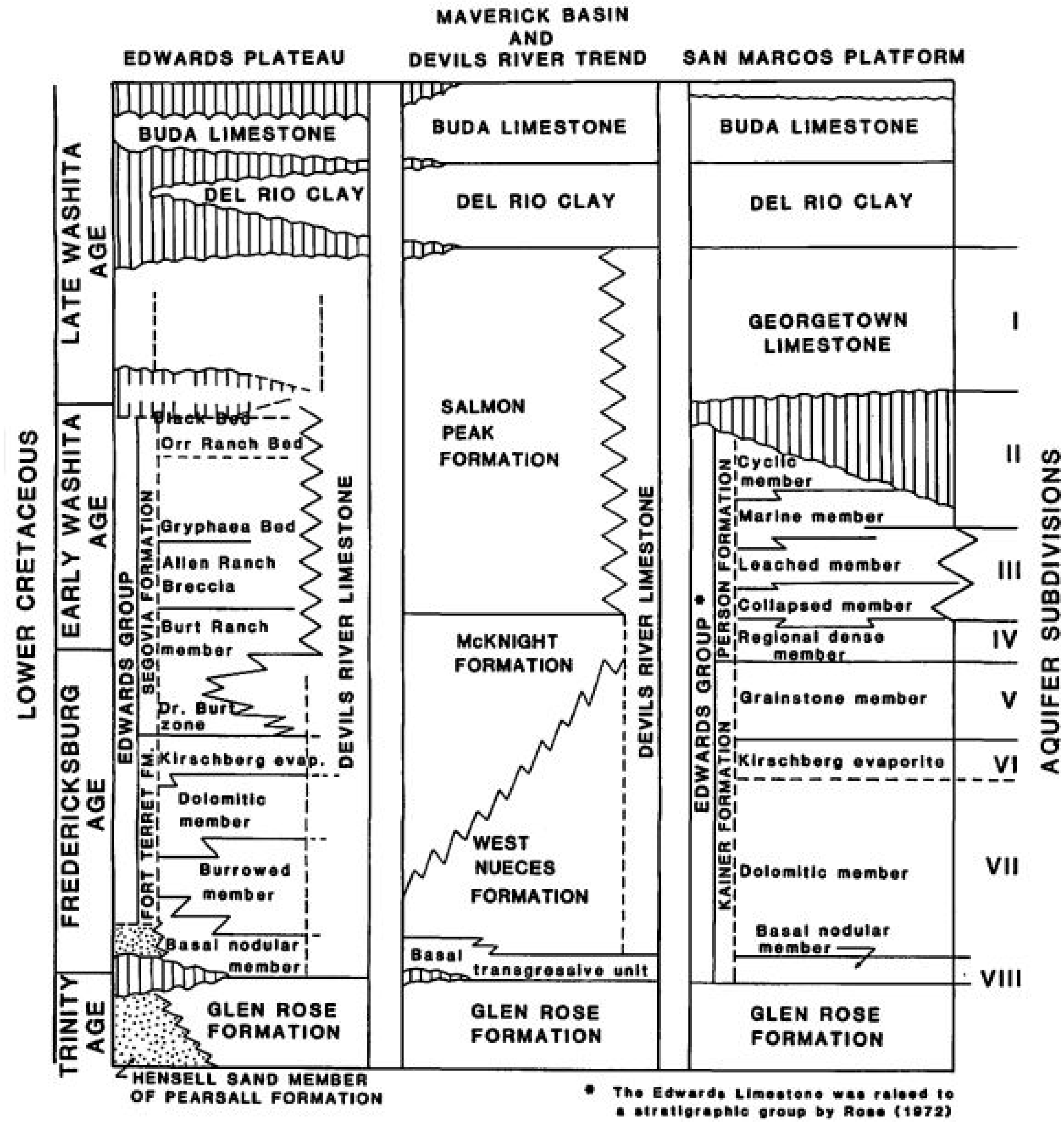

Figure 1. Correlation of Stratigraphic Units of the Lower Cretaceous Series in South Texas (Maclay and Small, 1986)

Peak Formation, which was exposed in the north part of the county by normal faulting and erosion. This is the recharge zone for the Edwards Aquifer in the study area. South of the recharge zone, the Salmon Peak Formation occurs at depth in the down-dropped fault blocks, overlain by the Del Rio Clay, Buda Limestone, Eagle Ford Shale, and the Austin Chalk.

Moore (2010) and LBG-Guyton Associates (1994) interpreted anticlines associated with igneous intrusions. Figure 2 is a schematic cross section by LBG-Guyton Associates (1994) that shows the relationship between anticlines, igneous intrusions, and overlying sediments. The axes of the anticlines trend approximately N50°E and plunge toward the southwest. Anticlines may have formed as the intrusions pushed up the rock formations from below. Figure 3 is a geologic map of the study area showing the relationship between the Cretaceous sediments and the anticlines. Axes for the anticlines are taken from Moore (2010). Outlines of the anticlines may be seen in the rounded outcrop pattern of the Del Rio Clay. The hydraulic effect of the anticlines is creation

(continued on p. 5)

Table 1. Lithologic Log for RP-70-37-704

Depth below ground (ft)	Thickness (ft)	Unit	Description
Surface–28	28	Caliche and Uvalde Gravel	Rounded chert cobbles with pieces of limestone, quartz, and chert pebbles; weathers to black soil.
28–60	32	Austin Group	Massive, chalky, locally marly, generally fossiliferous mudstone.
60–160	100	Eagle Ford Group	Black to dark-gray, interbedded shale, sandy shale, and calcareous clay.
160–244	84	Buda Limestone	Light-gray, porcellaneous carbonate with pelagic foraminifera.
244–353	109	Del Rio Clay	Bluish-gray calcareous clay and gypsiferous silt and shale with abundant marine megafossils and pyrite, fragile mollusk fragments, and microspherulites.
353–780	427	Salmon Peak Limestone	Dense, thick-bedded, deep-water mudstone that grades upward into a cross-bedded, rudist-shell grainstone.
780–922	142	McKnight Formation	Thin-bedded carbonate mudstone grading upward to petroliferous shales and evaporates, with pelleted grainstones in the uppermost layers deposited under euxinic conditions; evaporites dissolved by groundwater created high secondary permeability.
922–1083	161	West Nueces Formation	Nodular, shaly limestone grading upward to pelleted, shell-fragment wackestone and some grainstones with beds of dolomitized, burrowed wackestones
1083–1112	29	Glen Rose Formation (Upper Member)	Alternating beds of hard limestone, marls, and dolomites, with some zones of evaporites (Maclay and Small, 1986); karstification similar to that of the Edwards Aquifer.
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*Source: Snyder (2008).

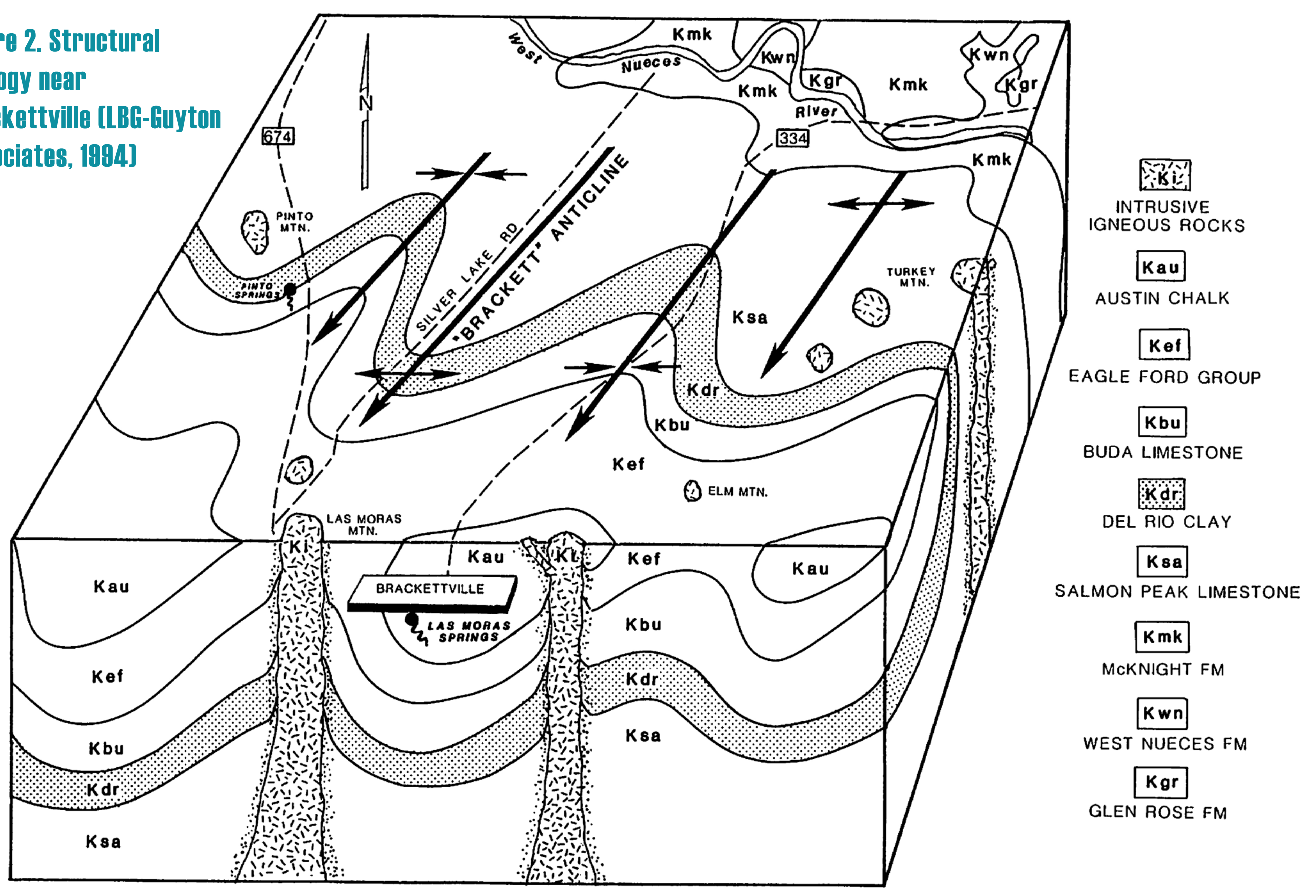

Figure 2. Structural Geology near Brackettville (LBG-Guyton Associates, 1994)

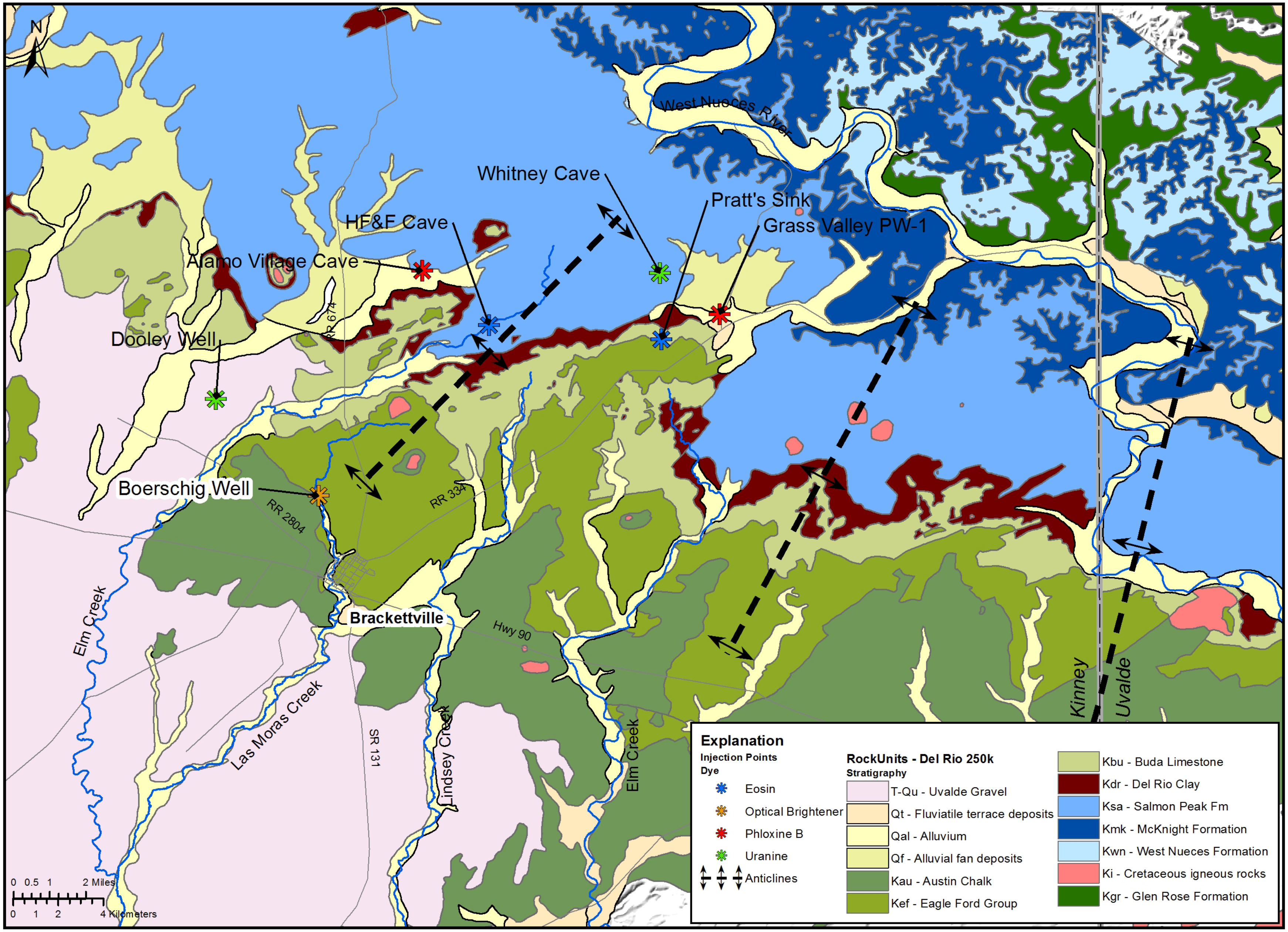

Figure 3. Geologic Map of Project Area

(continued from p. 2)

of potential preferential flowpaths for groundwater along the bottoms of the folds. The parallel anticlines create a series of troughs and arches that may channel water, resembling a corrugated metal roof (LBG-Guyton Associates, 1994). Pinto Valley may have formed in a structural depression related to an anticline.

Hydrogeology

Groundwater conditions in Kinney County are influenced by rock units, geologic structure, igneous intrusions, and the karstic nature of the Edwards Aquifer. For the purposes of this study, the principal hydrogeologic features of Kinney County are Las Moras Springs, the West Nueces River, Pinto Springs, Pinto Valley, Grass Valley, and the groundwater divide in the Edwards Aquifer. LBG-Guyton Associates (1994) placed the groundwater divide west of Las Moras Springs and extended it northward toward Pinto Mountain. Consequently, all of the tracer tests were completed on the Edwards Aquifer (east) side of the divide.

Green et al. (2006) proposed a conceptual model for the regional groundwater system that consists of separate pools in Kinney and Uvalde counties (Figure 4). A groundwater divide was proposed west of Pinto Creek and another near the Kinney/Uvalde County line. In this conceptualization, groundwater generally flows southwestward with minimal eastward flow. Green et al. (2006) indicated low-permeability sediments and no evidence of karst conditions between Kinney and Uvalde counties. Therefore, groundwater flow was restricted, creating separate pools. Although the hydraulic gradient toward the east is significant, Green et al. (2006) found little groundwater flow. Evidence of the limited groundwater flow is the large number of unsuccessful attempts to drill high-yielding wells near the county line. However, groundwater may be flowing primarily in conduits where it is difficult to locate by drilling without a high density of wells. Although currently no evidence exists of significant conduit flow having developed in the area, the conceptual model would change if any were found. Groundwater that bypasses the springs may discharge into streams, such as Elm Creek, Lindsey Creek, Las Moras Creek, or Pinto Creek, or into overlying sediments, rather than continuing east.

The Edwards Aquifer, which is composed of largely the Salmon Peak Formation, is recharged by infiltration from the West Nueces River and precipitation, and it discharges to wells and Las Moras and Pinto springs. Like other rock units that compose the Edwards Aquifer, the Salmon Peak Formation has been karstified, greatly enhancing groundwater flow. The underlying McKnight and West Nueces formations yield smaller volumes of groundwater except where karstified. Bennett and Sayre (1962) described the Salmon Peak Formation as "eastward-trending zones of solution channels" that parallel the dominant strike of the Balcones Fault Zone and observed that groundwater does not necessarily flow at right angles to "generalized contours on the water surface." Additional water level measurements would be needed to show actual groundwater flow directions. In the recharge zone, the Salmon Peak Limestone is unconfined, but it becomes confined by the juxtaposition of the overlying Del Rio Clay and Buda Limestone (Figure 5).

Pinto Springs issues from the Buda Limestone through dissolution channels when groundwater levels are high enough and feeds Pinto Creek. Uliana et al. (2006) found that Pinto Creek loses much of its flow within three mi of the springs and then regains it as it flows toward RR 2804 and Hwy 90.

Las Moras Springs is an important discharge point for the Edwards Aquifer in Kinney County, although the source of the water is not well known. Bennett and Sayre (1962) described it as groundwater rising in a channel (conduit) caused by a fault or fracture (Figure 6). Water discharges from the Edwards Limestone, passing through the overlying rocks, to discharge from the Austin Chalk. They observed that discharge responds more quickly to rainfall in the northeast part of the county than in the north central and northwest parts of the county.

Other water levels are available to test their correlation to Las Moras Springs discharge to help define the recharge area. Figure 7 was created using discharges from Las Moras and Pinto springs measured on similar days by Bennett and Sayre (1962) between 1939 and 1953 and IBWC measured between 1965 and 1996 acquired by LBG-Guyton Associates (2010). It shows low to moderate correlation between the two springs' discharges. LBG-Guyton Associates (2010) prepared charts of monthly discharge volumes from Pinto and Las Moras springs that also showed low to moderate correlation, which is consistent with the conclusions

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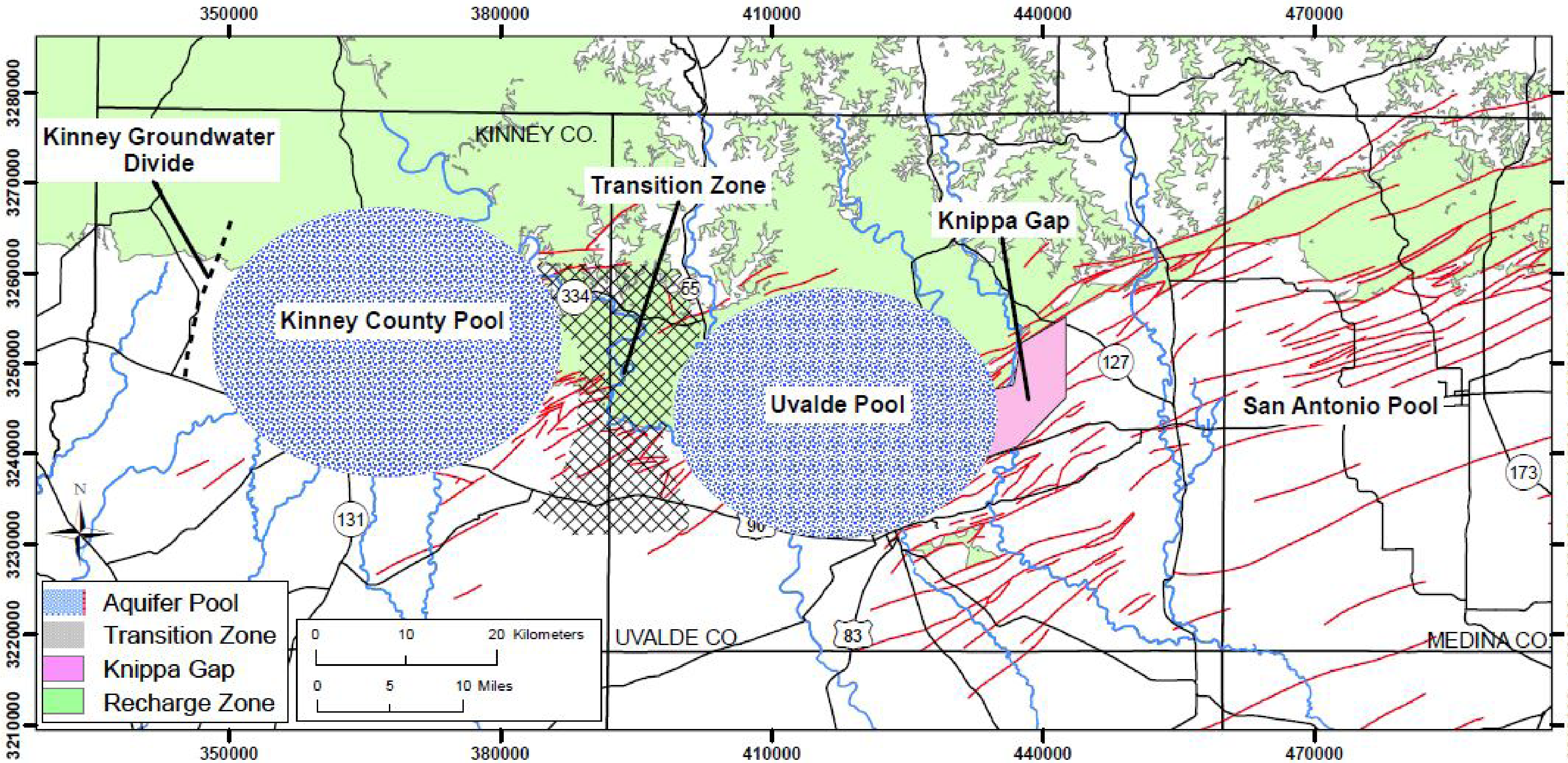

Figure 4. Kinney County and Uvalde County Pools as Proposed by SWRI (2006)

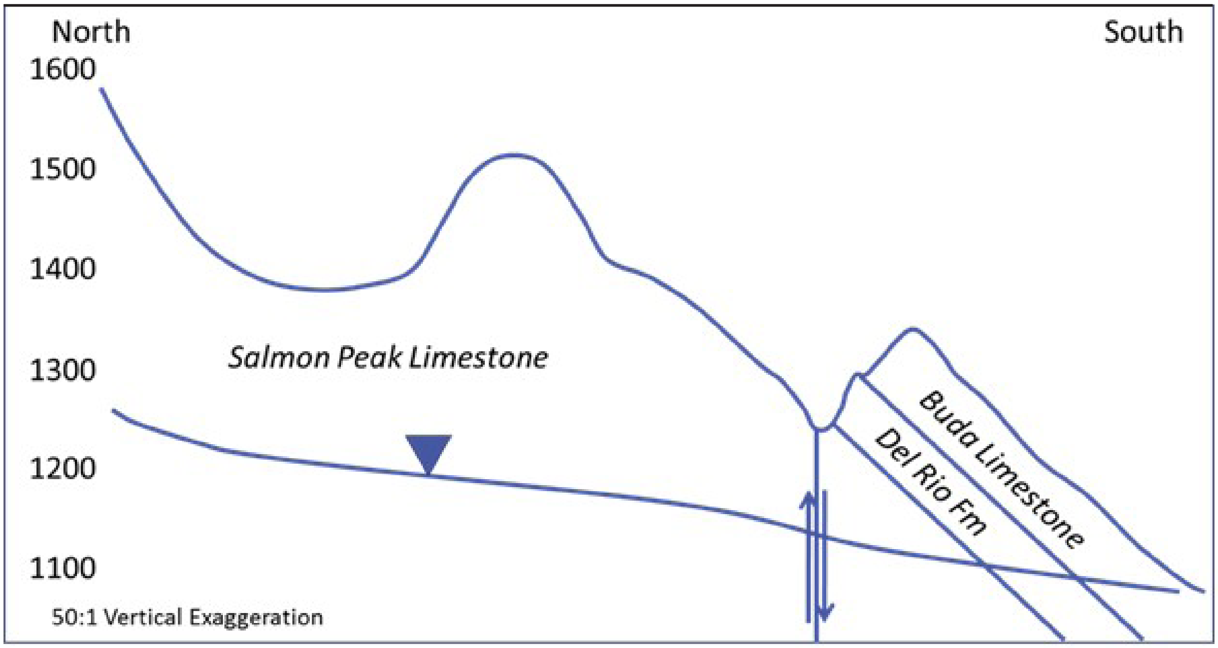

Figure 5. North-South Schematic Cross Section in Northern Kinney County

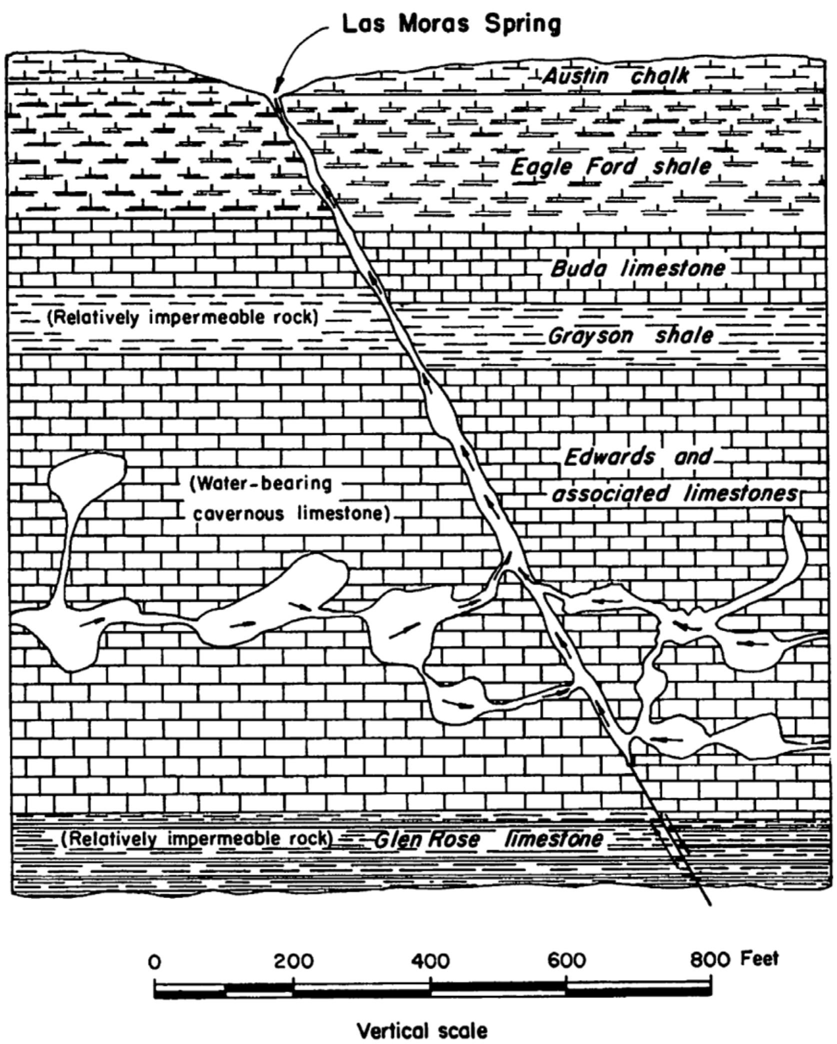

Figure 6. Schematic Cross Section at Las Moras Springs (Bennett and Sayre, 1962)

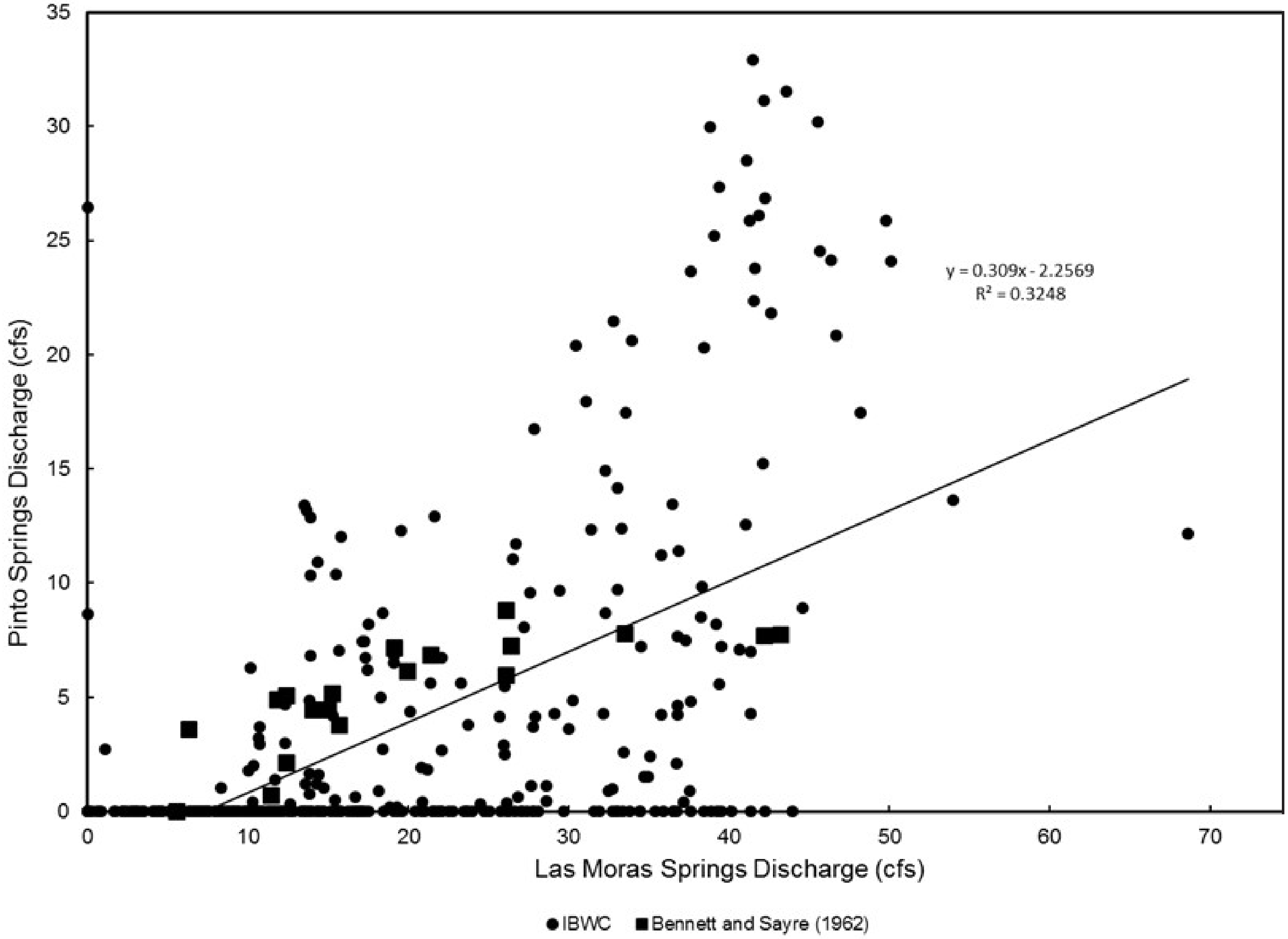

Figure 7. Correlation of Pinto Springs and Las Moras Springs Discharge

(continued from p. 5)

of Bennett and Sayre (1962). However, the hydraulic connection appears to be weak because Pinto Springs stops flowing even when Las Moras Springs discharge is relatively high.

Figure 8 compares water levels in the City of Brackettville Well #2 (7045601) measured by the TWDB, Las Moras Springs discharges measured by the USGS, and precipitation at Brackettville for the period 2004 through 2009. Although the water level measurements are widely spaced, they show a high degree of correlation with springflow (Figure 9), especially after 2007. Both the well and Las Moras Springs responded to precipitation events in early August 2007 and early September 2008 and then declined in parallel. The well was completed at a depth of 1,481 ft (451.5 m), with open hole below 424 ft (129.3 m), which is just below the top of the Georgetown Formation, according to TWDB documents, and it penetrates almost 500 ft (150 m) of the Edwards Aquifer. Other TWDB records show that the well produced 685 gpm (43 lit/sec) in a pumping test, indicating that it is completed in a highly permeable part of the aquifer.

Since 1993 EAA has measured water levels at the Tularosa Well (RP-70-38-902) on RR 334, approximately 11 mi (18 km) northeast of Brackettville. Data were collected either manually (tape-downs) or using electronic data loggers. Figure 10 compares water levels in the Tularosa Well measured by EAA with Las Moras Springs discharges measured by the USGS for the period beginning in 2003 until 2014. It shows moderately high correlation between water levels and springflow. Figure 11 quantifies the correlation with an R^2 value of 0.88, which indicates that 88% of the variation of springflow may be attributed to water level

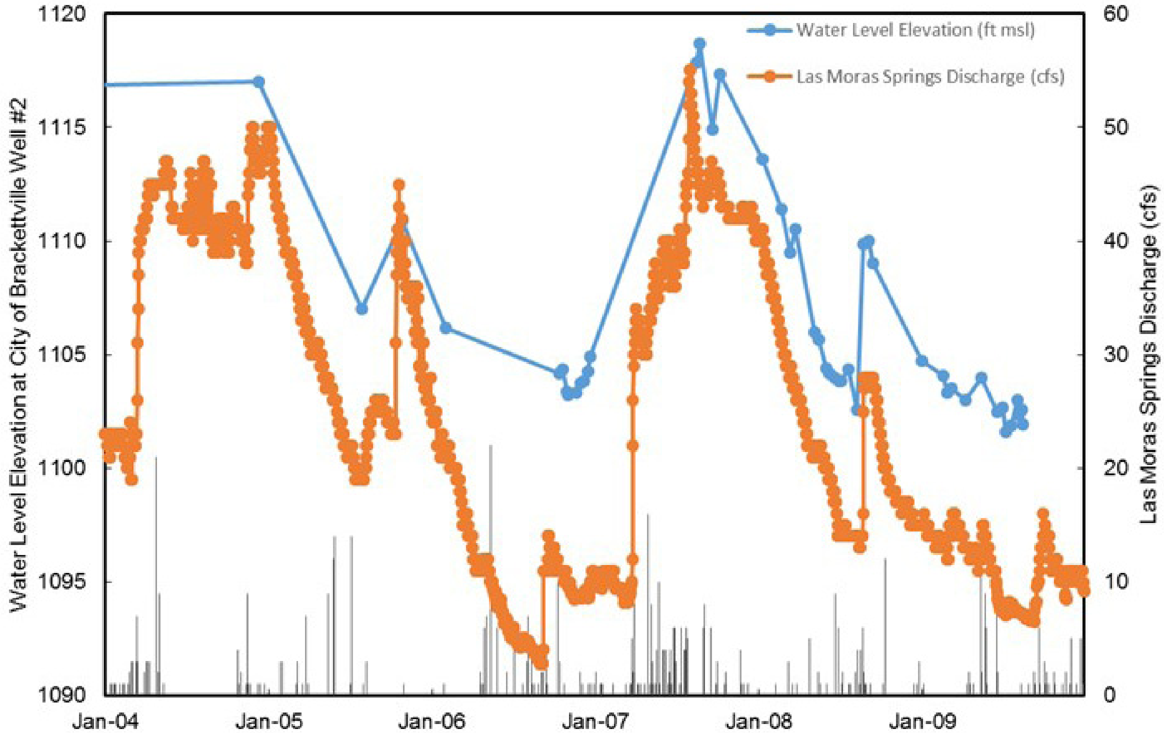

Figure 8. Time Series Hydrograph Comparing City of Brackettville Well #2 (7045601) Water Levels and Las Moras Springs Discharge

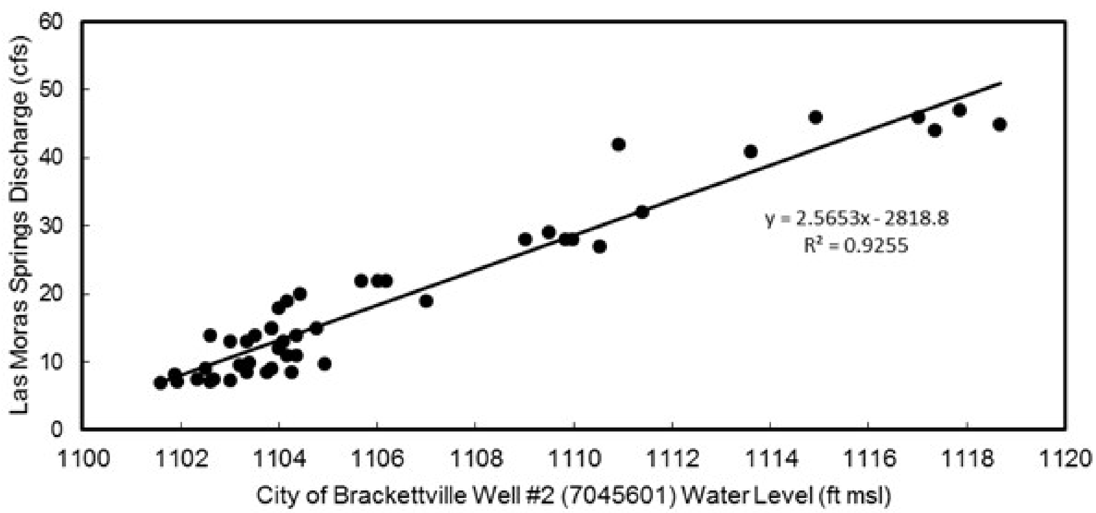

Figure 9. Regression Comparing City of Brackettville Well #2 (7045601) Water Levels and Las Moras Springs Discharge

fluctuations, assuming a hydraulic connection between the two. The correlation is probably better than 88% because a leak was recently discovered in the spring pond that allows springflow to bypass the USGS gauge. Consequently, for an unknown period of time, flow measurements underestimated actual discharges.

Finally, water levels from the Dooley Well in Pinto Valley (see Figure 3 for location), also referred to as the Pinto Vega Well, were collected by the Kinney County Groundwater Conservation District (KCGCD) between 2009 and 2012. During wet climatic conditions, the water level at the Dooley Well was above ground, but

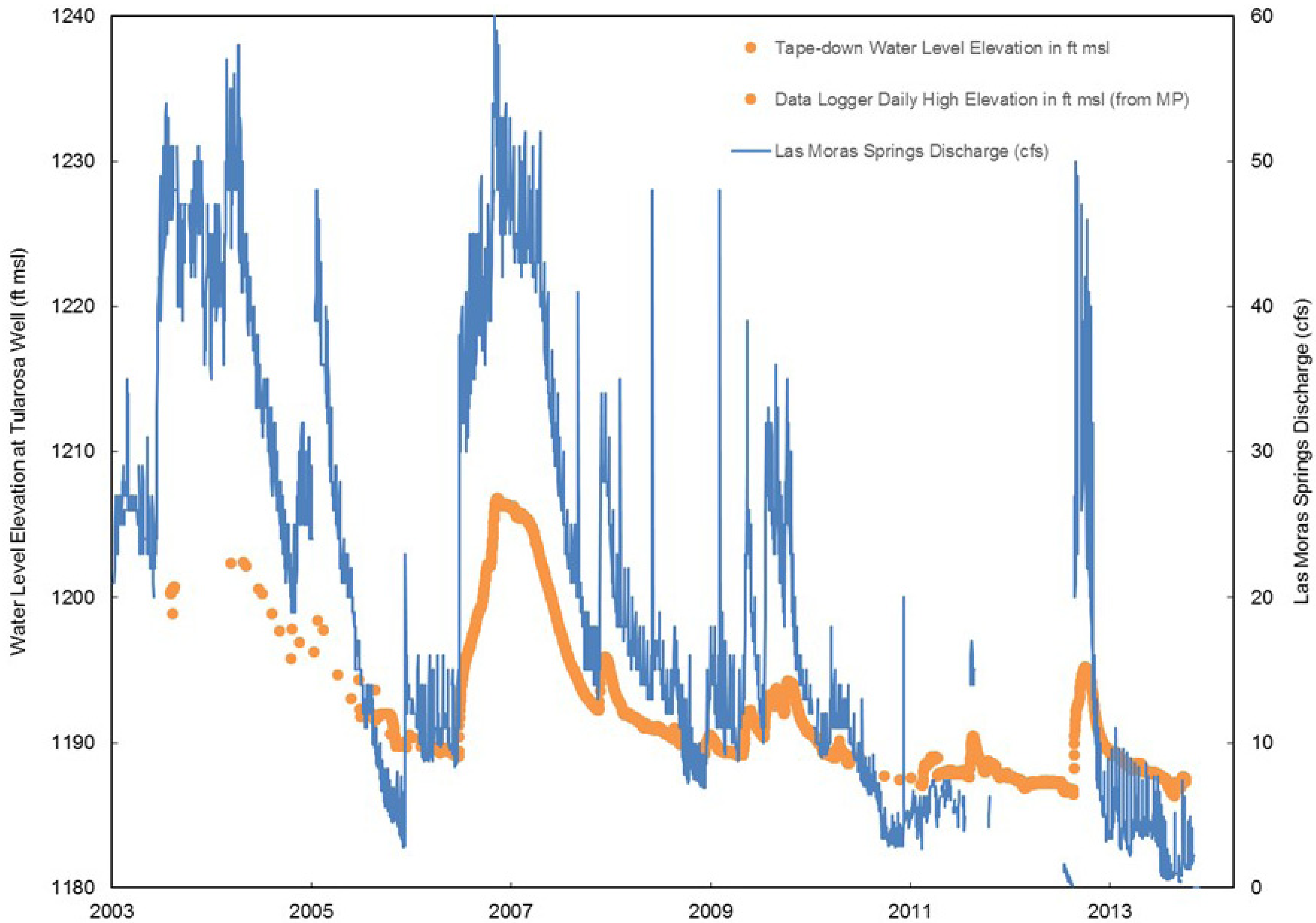

Figure 10. Time Series Hydrograph Comparing Tularosa Well (7038902) Water Levels and Las Moras Springs Discharge

the casing extends to approximately 10 ft (3.3 m) above ground surface, preventing it from flowing. Figure 12 is a time series chart comparing water levels from the Dooley Well and Las Moras Springs discharge. Although there is some parallel movement between the two lines, the regression line in Figure 13 indicates that the correlation coefficient is 0.58, which suggests that a strong hydraulic connection does not exist between the two. Although the hydraulic head at the Dooley Well ranges from 70 to 90 ft (21 to 27 m) higher than Las Moras Springs, there is probably a structural discontinuity between the two that reduces the hydraulic communication.

The potentiometric surface in Kinney County generally slopes toward the south and southwest, according to water levels measured by Bennett and Sayre (1962) and LBG-Guyton Associates (1994). Figure 14 was prepared by LBG-Guyton Associates (1994), with water levels measured in 1994 by LBG-Guyton Associates, EUWD, and IBWC. They concluded that groundwater flows south-southwest toward Las Moras Springs and then eastward past the springs. They also concluded that the 1994 configuration of the potentiometric surface was similar to those of 1937–1940, 1952, 1976, and 1992. Bennett and Sayre (1962) concurred with this interpretation, adding that groundwater may not always flow perpendicularly to the interpreted potentiometric contours. Instead, it may follow easterly flowpaths formed by solution channels in faults and fractures associated with the Balcones Fault Zone.

Green et al. (2006) also interpreted a structural embayment in the Edwards Aquifer in the Grass Valley area in north central Kinney County on the basis of potentiometric contours (Figure 15). The embayment is defined by a depression or synclinal structural feature in the base of the Edwards Aquifer and by water quality analyses. Wells completed in the Edwards Aquifer are

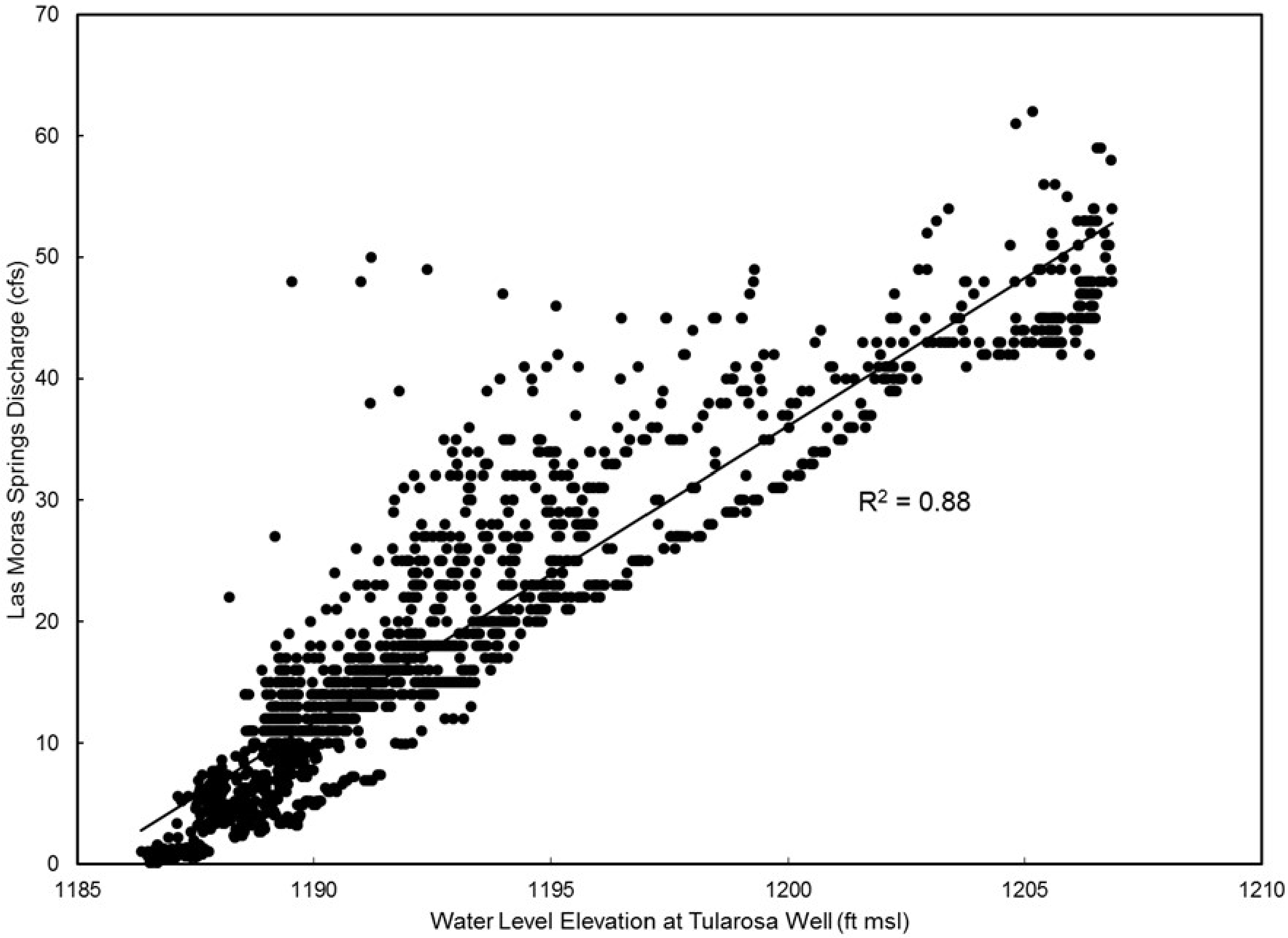

Figure 11. Regression Comparing Las Moras Springs and Tularosa Well (RP-70-38-902)

deeper in the embayment than others in the recharge zone. In addition, the additional saturated thickness increases well yields.

Weather Conditions during Tracer Tests

One of the most severe droughts on record plagued Kinney County during the tracer tests described in this report. Figure 16 shows precipitation during the tracer tests between 2007 and 2013 and Las Moras Springs discharge. Precipitation was close to normal in 2007 and then diminished sharply as the tracer tests progressed. Las Moras Springs discharge also declined significantly. Whereas the drought inconvenienced residents, it also affected the success of the tracer tests in several ways, by changing the characteristics of the groundwater system during the tests. It is well known that groundwater flowpaths in karst aquifers change as the water levels fluctuate. As groundwater levels declined in response to the lack of precipitation, higher flowpaths were abandoned, and groundwater flowed through deeper parts. Dyes must infiltrate deeper through a thicker, unsaturated zone during each injection, and dye can accumulate in the unsaturated zone (epikarst) under the injection point and then mobilize later when stormwater temporarily raises water levels. Flowpaths that exist under wet conditions are possibly blocked during dry conditions. Finally, hydraulic gradients may lessen or steepen as groundwater levels drop.

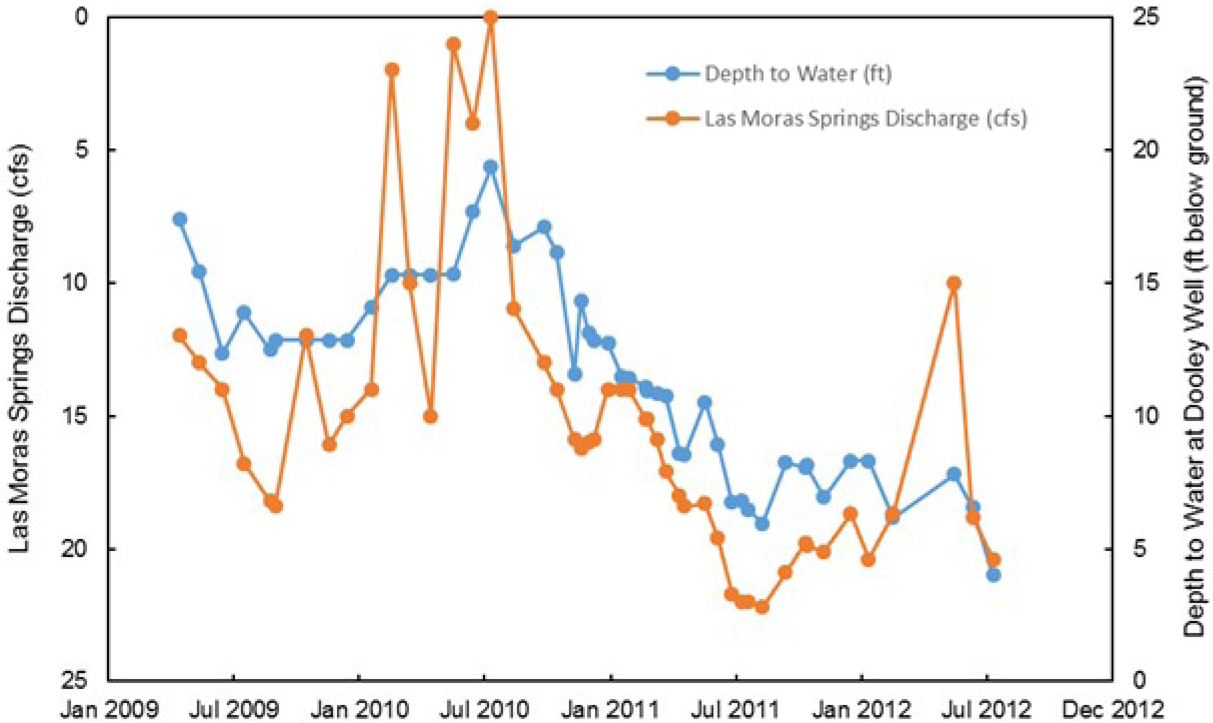

Figure 12. Time Series Hydrograph Comparing Las Moras Springs and Dooley Well (RP-70-37-704)

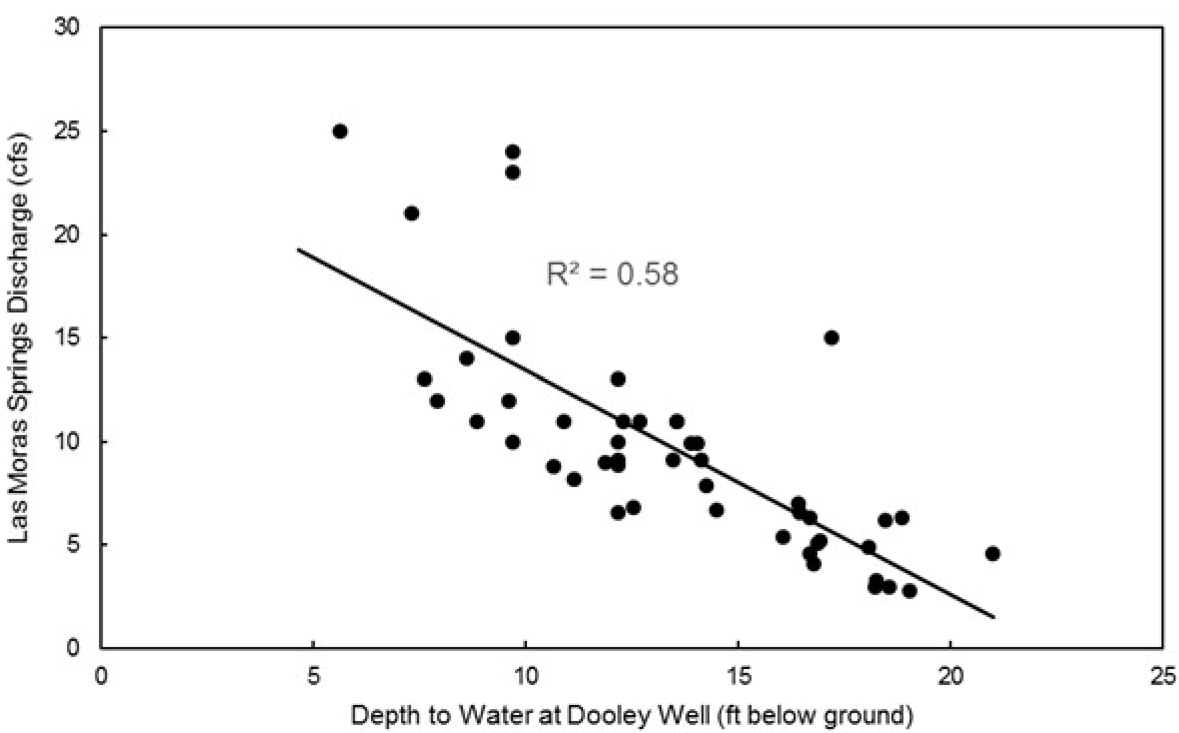

Figure 13. Regression Comparing Las Moras Springs and Dooley Well

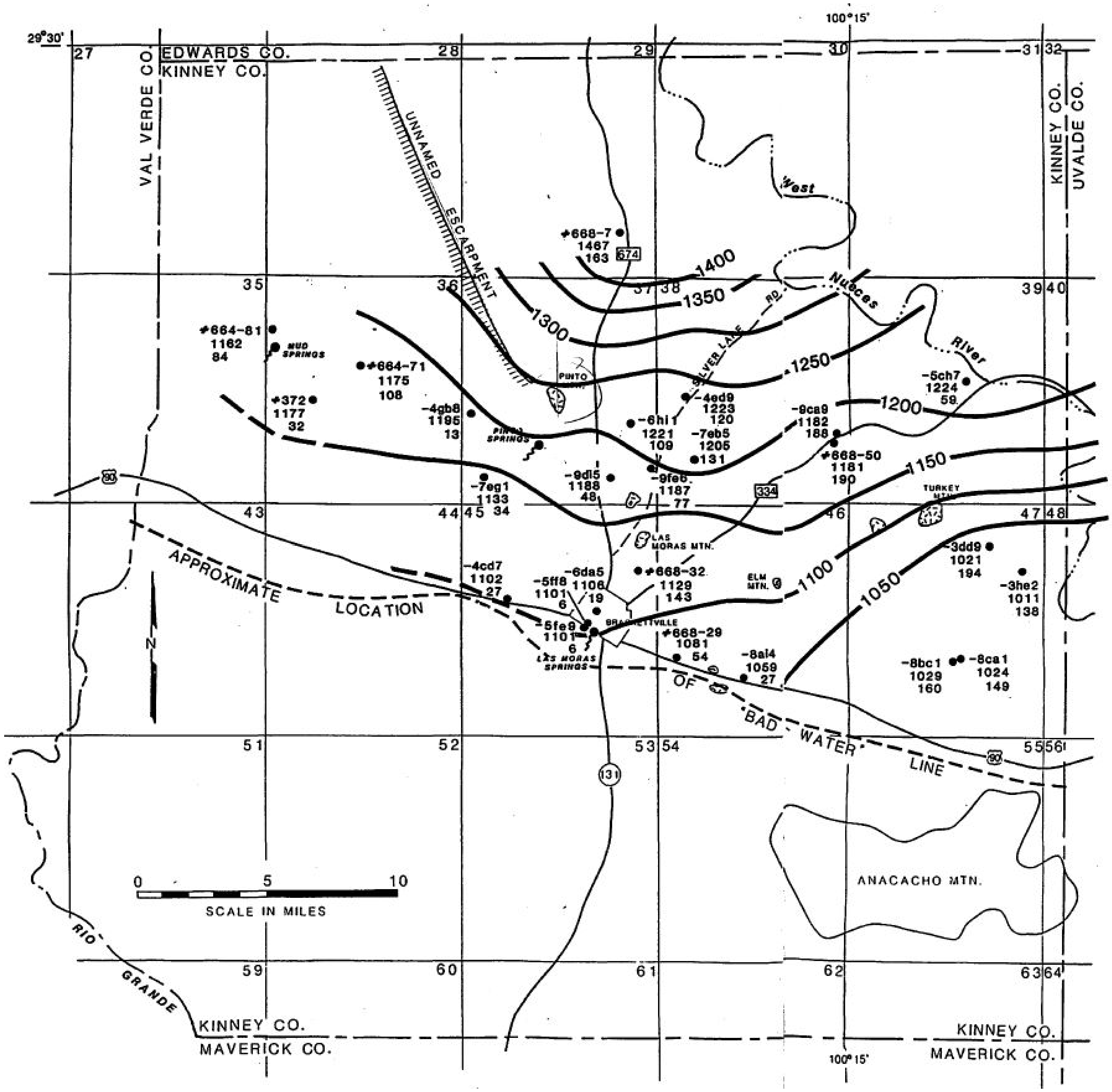

Figure 14. Potentiometric Surface Map of Northern Kinney County (LBG-Guyton Associates, 1994)

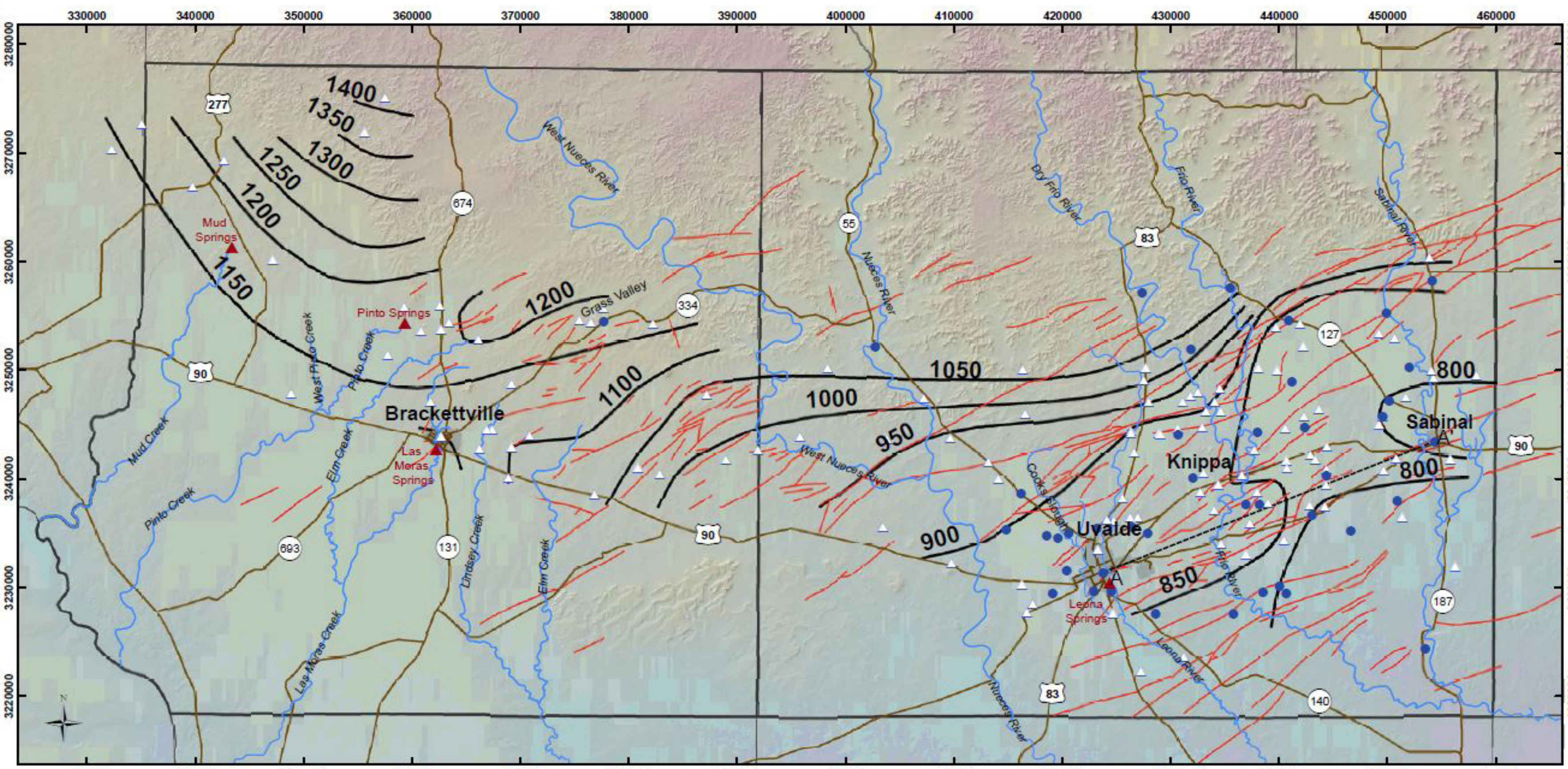

Figure 15. Potentiometric Surface Map of Kinney and Uvalde counties (Green et al., 2006)

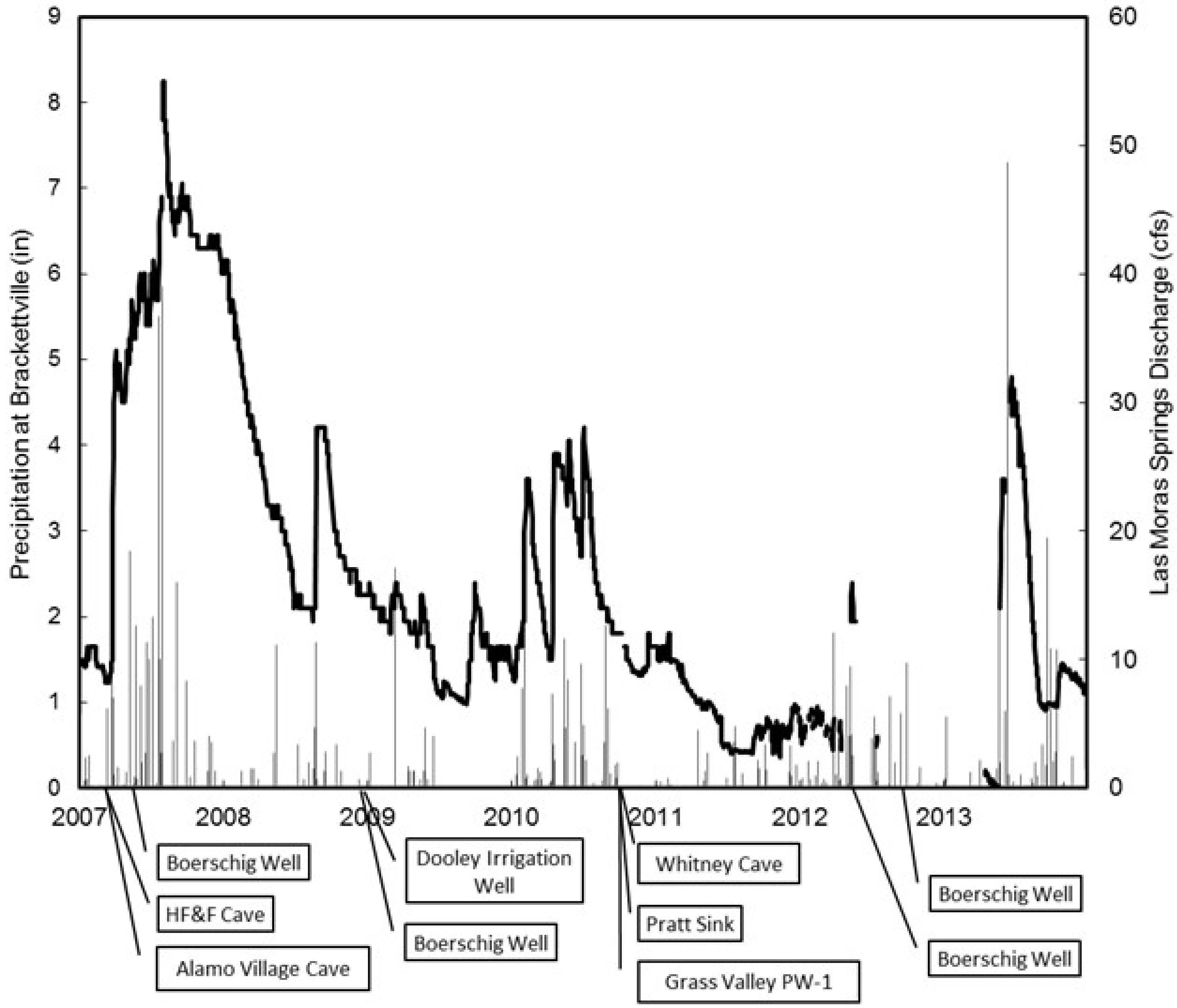

Figure 16. Precipitation during Tracer Tests

METHODOLOGY

Groundwater tracing techniques (tracer tests) are recognized as the only direct method of determining apparent or point-to-point groundwater travel times and flow directions in karst aquifers. Tracer testing involves introducing nontoxic, fluorescent, organic dyes into the subsurface via injection points, such as caves, sinkholes, and wells. Charcoal receptors and water samples are collected from wells and springs and analyzed for the presence of dyes. Alexander and Quinlan (1996) discussed the methodology of groundwater tracing using fluorescent dyes in karst terrains.

EAA and its contractors (George Veni and Associates, in 2007, and Zara Environmental LLC, between 2007 and 2009) completed 12 tracer tests in Kinney County between 2007 and 2013. This section describes the methodologies used for injections, sample collection, and sample analyses for all tracer tests.

Groundwater Tracers (Dyes)

The dyes used in this study were selected because they are nontoxic, inexpensive, widely tested and used, soluble in water, and easily detected. All dyes used in these tests fluoresce, and they are also used as colorants for medicine, foods, cosmetics, and industrial applications. These dyes have been evaluated to be suitable for this and other studies because of their physical characteristics, safety for drinking-water supplies and aquatic habitats, and low background concentrations (Smart, 1984; Field et al., 1995). Table 2 lists the names, molecular weights, and emission wavelengths of the dyes used in this series of tracer tests. For this study, the following dyes and brightening agents were used: Uranine, Sulforhodamine B, and Eosin in liquid form; Phloxine B in powder form (mixed with water before injection); and Tinopal CBS-X. Tinopal CBS-X is an optical brightener or whitening agent used in some detergents to make clothes appear cleaner or brighter by absorbing ultraviolet light and re-emitting most of it as blue fluorescent light.

Tracer tests are generally designed so that the dye is detectable at monitoring locations but at concentrations insufficient to be visible in water. Consequently, dye volumes were calculated so that peak recovery concentration were below visible concentrations of approximately 0.05 g/m^3 (50 µg/L, parts per billion). The volume of dye for injection was calculated using an equation developed by Worthington and Smart (2003) on the basis of empirical data from 185 tracer tests between sinkholes and springs, over distances between 15 m and 31 km, and with tracer recovery times varying from two minutes to two months. The following formula from Worthington and Smart (2003) was used:

$$m = 19\,(LQc)^{0.95},$$

where

m = mass of dye injected in grams,

Q = output discharge in m^3/s,

c = peak recovery dye concentration in g/m^3,

and

L = distance in meters between injection and recovery points.

Table 2. Chemical Characteristics of Dyes

Common Name	Color Index Generic Name	Molecular Weight	CAS Number	D&C No.	Peak Emission Wavelength (nm)
Uranine (Sodium Fluorescein)	Acid Yellow 73	376.27	518-47-8	Yellow No. 8	493
Eosin (Eosin)	Acid Red 87	691.85	17372-87-1	Red No. 22	517
Phloxine B	Acid Red 92	829.63	18472-87-2	Red No. 28	538
Sulforhodamine B (SRB)	Acid Red 52	580.65	3520-42-1	None	567
Optical Brightener Tinopal CBS-X	F.B.A. 35	562	27344-41-8	None	383–400

Table 3. Quantities of Samples Collected for Tracer Tests

Year	Water Samples	Charcoal samples	Cotton sheets	QC Samples	Standards	Maximum Concentration
2007	1,398	539	118	133	536	20.02
2008	121	0	0	19	31	2.39
2009	658	136	0	40	201	3.59
2010	522	503	0	17	192	6.01
2011	1,060	1,096	0	31	611	12.45
2012	1,633	708	0	33	684	51.16
2013	48	44	0	0	33	0.54
	5,440	3,026	118	273	2,288	1.02

Distance (L) used in the calculation is the distance to the closest monitoring wells or water supply wells. The equation was found to work well for Uranine but was slightly less effective for the other, less-fluorescent dyes. Consequently, where Eosin or Phloxine B was used, the target peak dye concentration was generally doubled to 0.10 g/m^3, although the dye might be barely visible.

With one exception, caves and sinkholes were selected for injection points because they are integrated into the regional groundwater flow system. Although the exact pathway is not known, infiltrating water that was sufficient to form a cave or sinkhole recharged the aquifer. In contrast, dyes placed directly in a stream channel or other surface injection point may travel some unknown distance on the surface before entering the subsurface. In addition, dye may be absorbed when it passes over or through soil or alluvium, decreasing the volume of dye entering the groundwater system. Therefore, tracer tests originating in discrete karst features such as caves, sinkholes, or sinking streams (perennial) are expected to be more successful than other injection points. Three wells were used as injection points, although wells are not typically preferred as injection points because they may not be as integrated into the regional groundwater flow system as well as caves. Depending upon the flow regime, measurable concentrations of dye can remain in the well for many months or even years. As described next, the Boerschig, Dooley, and Grass Valley wells were used in the absence of other, more suitable karst features.

The procedure of dye injection consisted of prewetting injection points with water, injecting the dye, and then flushing the dye with additional water to force it into the aquifer. Prewetting reduces adsorption of the dye on rock and soil as it flows through the vadose zone and epikarst. Dyes were injected into the deepest accessible locations to minimize travel and storage in the vadose zone. Finally, tens to hundreds of thousands of liters of water was used to flush dyes into the aquifer and push them into active flowpaths. Water used to inject dyes was obtained from private wells or the City of Brackettville. Injection water was fresh, with a pH near 7.0. The injection of dye into the well involved pouring dye into a tube placed below the water level in the well. After the dye was injected, water was poured into the well from the surface, creating a piston effect that pushed the dye into the aquifer.

Sample Collection

Samples were collected according to EAA protocols and by Authority staff and contractors. Over 10,000 samples were analyzed by EAA during the tracer tests (Table 3).

Water Samples (Grab Sample, Autosampler)

Water samples provided information on instantaneous dye concentrations in the water at the time of sampling. They were collected manually (grab) or by automatic water samplers (autosamplers). Autosamplers were deployed at selected private wells, public water supply wells, or springs and programmed to collect 24 samples at intervals of up to 24 hours. In addition, EAA staff built a system to expose charcoal receptors to well water for 7-d periods unattended. Water sampling was initiated before dye injection to collect samples to analyze for possible background fluorescence. At the end of each automatic cycle, each bottle was decanted into a 13-mm glass, screw-top vial (culture tube) and marked with an identification number written in nonfluorescent permanent ink. Vials were placed in a rack and labeled with the date, time, and location of the sample set. A grab water sample from the well and duplicate samples were taken for each batch of samples.

The EAA collected grab samples in 13-mm glass screw-top vials and marked them with identification numbers written in nonfluorescent permanent ink. The 13-mm glass vials were tested to ensure that they were clean and optically clear and that they did not degrade sample analysis.

All samples were stored in a light-proof box to avoid photodecomposition of dye. The vials were handled using standard chain-of-custody protocols as outlined in the Authority's QC/QA Manual for Tracer Testing (Appendix A). Residual water was disposed of away from the sampling location so that it would not be accidentally resampled or cause cross-contamination. Empty autosampler bottles were rinsed three times with deionized water. The deionized water and rinsate from one of the autosampler bottles were sampled with each batch of samples.

Activated Carbon Receptors

Activated carbon (charcoal) receptors (detectors), also known as bugs, were used to determine whether dye traveled to sites not monitored by autosamplers. Charcoal receptors consist of small nylon-screen-mesh packets about the size of a tea bag containing activated carbon from coconut palm charcoal. Where employed, these packets were placed in wells or in the discharge line of a pump. The EAA used engravable aluminum tags to identify charcoal receptors with a site identification number, site name, date, time, and initials of persons collecting the receptors. The receptors were then submitted for laboratory analysis. During initial placement of the charcoal packets and during each replacement, a grab sample of water was collected for confirmation, as described in the previous section. Charcoal receptors were also placed before the initiation of the tracer test to test for background fluorescence. They were also a redundant form of monitoring for all automatic sampling sites in the event that an autosampler failed or dye arrived at low concentrations over time.

Charcoal adsorbs dye from the water that passes through the receptor. It yields a time-integrated sample that, barring interference from other organic compounds, is a product of continuous sorption of dye whenever dye is present in water. Thus, charcoal receptors can effectively have a much lower detection limit when exposed to low concentrations of dye over time. However, dye concentrations extracted from charcoal packets provide qualitative results that determine only the presence or absence of dye because many variables are uncontrolled in the use of charcoal, such as the degree of activation of the carbon, amount of exposed surface area of the carbon, absorption preference for available organic compounds, and length of exposure to dye.

Optical Brightener Samples

Optical brightener is a fluorescent material that is added to fabric to make it appear cleaner and brighter. It is suitable as a groundwater tracer because it is nontoxic, it dissolves readily in water, and it has an analytical signature that is distinguishable from fluorescent dyes. It was used in the Kinney County study in powder form. Samples consisted of optical brightener dissolved in water and absorbed onto unbleached cotton fabric.

Optical brightener analyses provide qualitative determinations of its presence or absence because no standards exist from which to calculate concentrations. Water samples were collected either as grab samples or using an autosampler, as described earlier. Small, unbleached cotton fabric squares were also placed in the autosampler bottles to accumulate optical brightener.

Preparation and Analyses of Samples

EAA used a Perkin Elmer LS50B Luminescence Spectrometer to analyze water, charcoal eluent, and optical brightener samples, as described next.

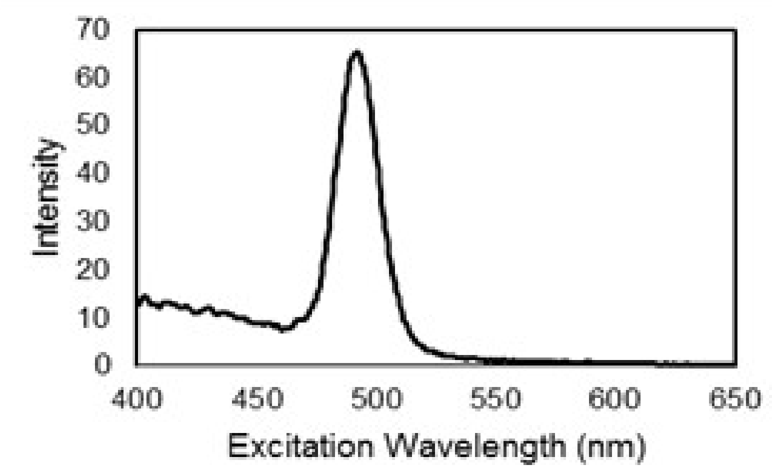

Figure 17. Typical Spectrograph of Uranine Dye

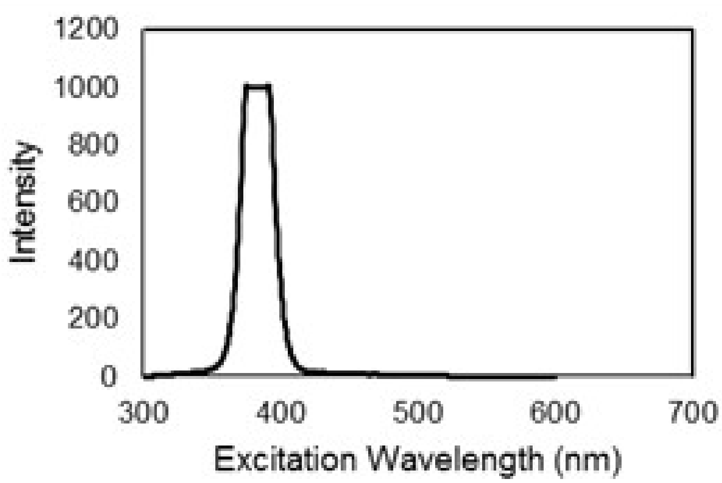

Figure 18. Typical Spectrograph of Optical Brightener in Water

Vials from autosamplers and grab samples required no preparation before analysis, whereas charcoal receptors required additional preparation prior to analysis. We extracted dye from the charcoal receptors by eluting the charcoal for one hour in a solution containing 95% of a 70% solution of 2-propanol in water and 5% sodium hydroxide. The eluent was then decanted into a labeled 13-mm glass screw-top vial and stored in darkness until analyzed.

Laboratory analyses for Uranine, Phloxine B, Eosin, SRB, optical brightener in water, and eluents from charcoal were performed using a Perkin Elmer LS50B Luminescence Spectrometer. Samples were analyzed using synchronous scan and right-angle sampling geometry. The scan spanned 401 to 650 nanometers (nm) at 0.5-nm intervals, with a difference between excitation and emission wavelengths (Δλ) of 15 nm and emission and excitation slits set at 6 nm. Figure 17 shows a typical spectrograph, with an Uranine peak at 492 nm; Appendix B contains all spectrographs for samples that contained dye. Note that the LS50B reports the excitation wavelength for the sample, whereas some instruments report emission wavelength. Results of analysis are recorded in intensity units and converted to concentrations by comparison with known standards.

Cotton fabric containing optical brightener was also analyzed directly in the Perkin Elmer LS50B Luminescence Spectrometer. It was positioned in the path of the excitation light source, and fluorescence emitted by the optical brightener in the fabric was measured by a detector. Similar to the situation involving dyes, samples were analyzed using a synchronous scan and right-angle sampling geometry between 300 and 550 nm at 0.5-nm intervals, with a difference between excitation and emission wavelengths (Δλ) of 15 nm and emission and excitation slits set at 6 nm. Peak fluorescence occurred between 383 and 400 nm at these parameters. Figure 18 shows a typical spectrograph of optical brightener in water. The peak is flattened because the sample signal saturated the spectrometer detector.

Quality Control

Approximately one in ten samples analyzed was a quality control sample, which included dye standards, duplicate and replicate samples, distilled water blanks,

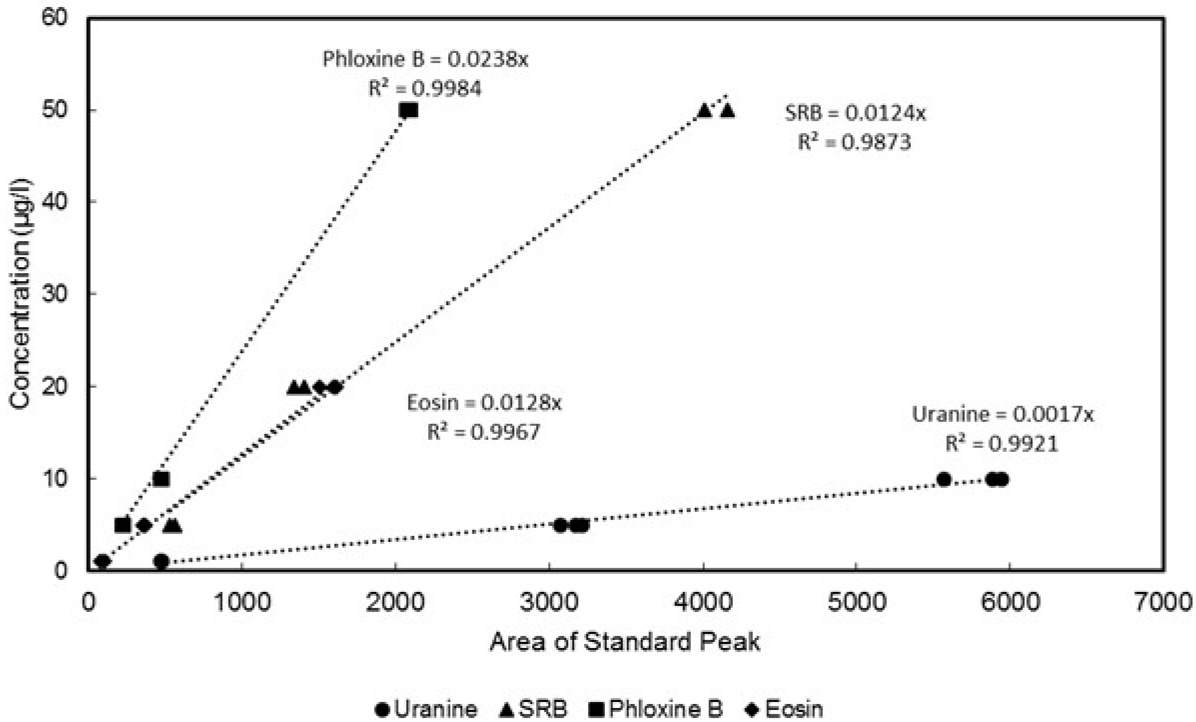

Figure 19. Examples of Regression Curves for Dye Standards

and rinsate samples. Dye standards were analyzed at the beginning and end of each analytical session, and a partial set was analyzed after every 20 samples. Duplicate and rinsate samples were included into the routine sampling and analysis program.

Dye Standards, Duplicate and Replicate Samples, and Rinsate Samples

Three standards were prepared for each of the three dyes used in the tracer tests. Dye solutions were prepared on the basis of mass and diluted with deionized water to produce dye concentrations in the range expected in the water samples. Figure 19 shows examples of regression equations for calculating dye concentrations from peak areas for each dye.

Duplicate Samples

Duplicate samples were analyzed to measure precision of the Perkin-Elmer LS-50B Luminescence Spectrometer. The duplicate samples were prepared by filling two vials from the same sample container. Precision was calculated using relative percent difference (RPD), which is the absolute difference between the two intensities of the samples divided by the mean of the two intensities multiplied by 100. An RPD of zero indicates that the two concentrations are equal.

Detection Limits

Positive Dye Recovery Interpretation

The LS50B measures fluorescence in intensity units, which is directly proportional to the concentration of dye. However, the maximum intensity of each sample is the sum of any dye present plus background fluorescence. Dye peaks were separated from background fluorescence by the curves being fitted to the Pearson VII statistical function using Systat PeakFit® or fityk® software. The difference between sample and background fluorescence is the net

Table 4. Limits of Detection and Quantitation for the Dyes.

Dye	Fit Standard Deviation	Limit of Detection (µg/L)	Limit of Quantitation (µg/L)
Uranine	0.32	0.002	0.005
Eosin	0.32	0.012	0.04
Phloxine B	0.32	0.022	0.076
SRB	0.32	0.012	0.040

intensity. Net intensity measurements were converted to a concentration using the calibration curve determined from analyses of standards, as described in previous sections.

Detection and quantitation limits for each dye were calculated from background fluorescence of naturally occurring fluorophores and instrument noise, following the method of Alexander (2005). This method defines limits of detection (LOD) and quantitation (LOQ) as three and ten times the fit standard error of background fluorescence, respectively. A water sample from Las Moras Springs collected on July 11, 2012, was selected to calculate LOD and LOQ, and fit standard was calculated using PeakFit® or fityk® software. Regression equations (Figure 19) yielded the limits of detection and quantitation for each dye in Table 4. LOD and LOQ are less than one part per billion because background fluorescent materials did not interfere with the analyses.

Breakthrough Curves

Breakthrough curves are graphs displaying dye concentrations over time and were prepared, when data were available, for both spring and well sites. Calculations of initial travel time, duration, and peak concentrations were based on breakthrough curves. The time of first arrival from breakthrough curves is used to calculate apparent velocity of the dye. The rate of dye movement is apparent velocity because the true length of the flowpath is unknown, so it is calculated from the straight-line or point-to-point distance between the injection point and the monitoring point. The duration of travel is measured from the time of injection until first arrival of the dye at the monitoring site. The actual velocity is probably faster than the apparent velocity because the actual distance is certainly a longer, irregular route through saturated and unsaturated parts of the aquifer.

WATER QUALITY SAMPLES

EAA staff collected groundwater, spring water, and surface water samples periodically during the tracer tests to complement tracer test results (Table 5). The purpose of the samples was to help characterize groundwater chemistry to provide additional information on groundwater flowpaths. Samples were collected according to EAA's Water Quality Sampling Plan (Edwards Aquifer Authority, 2013), and results are listed in Appendix B. Map locations are shown in Figure 20.

In general, samples were analyzed for major anions and cations and metals, although some were also analyzed for volatile organic compounds, semivolatile organic compounds, and herbicides and pesticides.

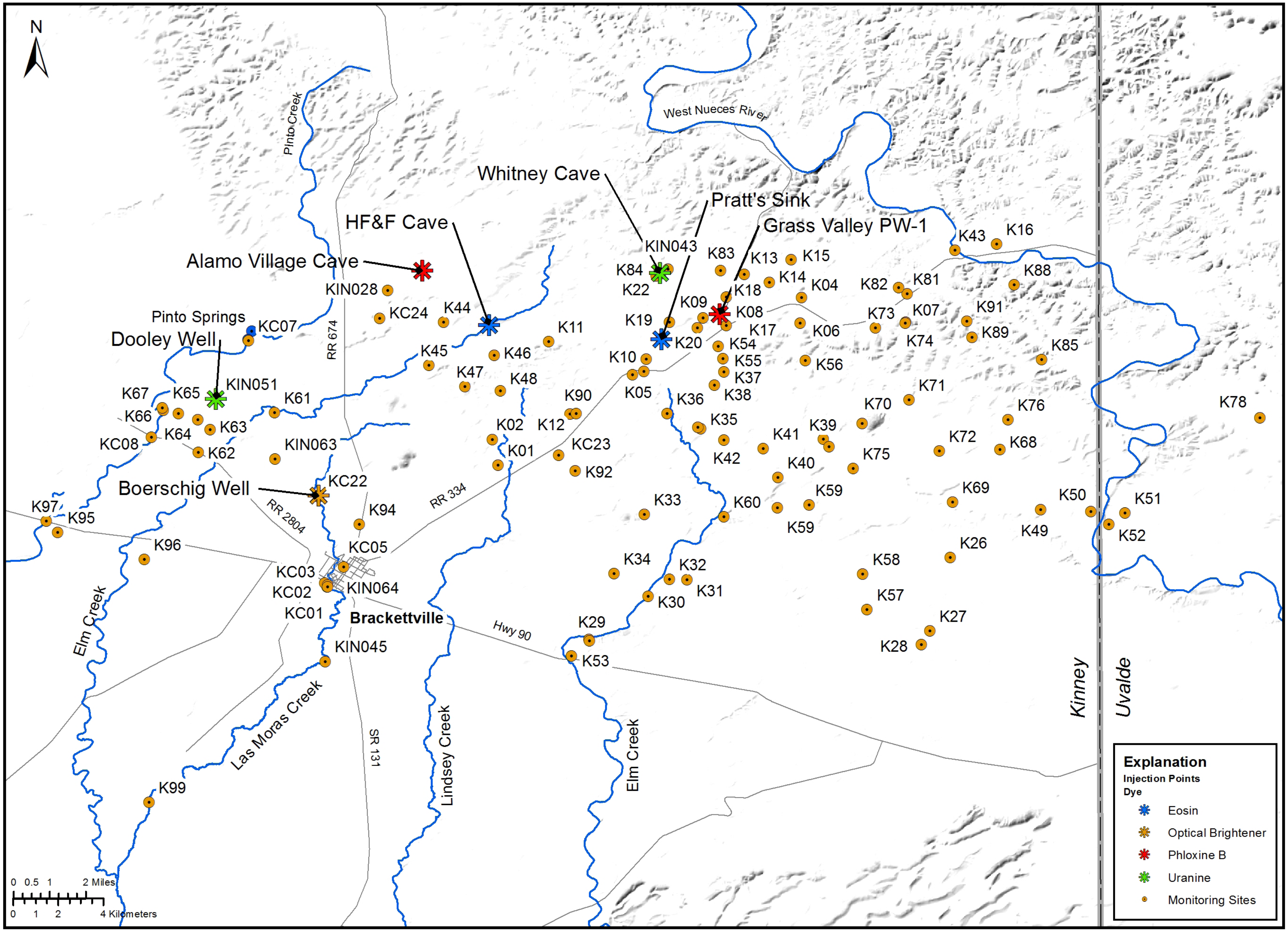

Figure 20. Locations of Injection Points and Monitoring Sites

Table 5. Water Quality Samples Collected by EAA.

Sample Name	Owner	Sample Date	Map Location
Dooley Middle Well RP-70-37-8DW	Bitters	12/17/2008 12:35 PM	DW
Dos Angeles at Fields Ranch RP-70-45-7FE	Fields Ranch	12/17/2008 11:29 AM	FE
Las Moras Creek at Red Bridge	NA	06/16/2010 5:25 PM	KIN045
Las Moras Creek at Red Bridge	NA	11/08/2011 3:45 PM	KIN045
Nueces River at RR334	NA	05/24/2011 4:40 PM	K43
Pinto Creek at CR2804	NA	12/17/2008 10:45 AM	KC08
Pinto Creek at CR2804	NA	06/16/2010 6:35 PM	KC08
Pinto Springs at Mariposa Ranch	Ring Ranch	07/29/2005 12:20 PM	KC07
Pinto Springs at Mariposa Ranch	Ring Ranch	12/07/2006 11:10 AM	KC07
Pinto Springs at Mariposa Ranch	Ring Ranch	10/16/2007 11:35 AM	KC07
Pinto Springs at Mariposa Ranch	Ring Ranch	12/17/2008 3:25 PM	KC07
Pinto Springs at Shahan Ranch	Shahan Ranch	06/30/2005 11:40 AM	KC09
KCGWD observation well	Ring	10/16/2007 12:30 PM	Ring
RP-70-28-3PI	Price Ranch	07/28/2005 11:30 AM	Price
RP-70-29-101	Kickapoo Cavern State Park	06/29/2005 12:00 AM	Not shown
RP-70-36-2EW	Earwood Ranch	07/28/2005 2:40 PM	2EW
RP-70-37-502	Shahan Ranch	06/30/2005 12:25 PM	7037502
RP-70-37-706	Mariposa Ranch	07/29/2005 11:15 AM	7037706
RP-70-37-706	Mariposa Ranch	12/07/2006 10:50 AM	7037706
RP-70-37-706	Mariposa Ranch	10/16/2007 11:00 AM	7037706
RP-70-37-706	Mariposa Ranch	12/17/2008 2:55 PM	7037706
RP-70-37-903	Shahan Ranch	06/30/2005 3:30 PM	7037903
RP-70-38-8MC	Tularosa Ranch	11/09/2011 10:25 AM	KIN043
RP-70-38-902	EAA	12/18/2006 2:25 PM	K17
RP-70-38-902	EAA	08/03/2012 10:20 AM	K17
RP-70-38-902	EAA	08/02/2013 12:00 AM	K17
RP-70-38-902	EAA	08/02/2013 11:45 AM	K17
RP-70-38-902	EAA	05/27/2014 12:00 AM	K17
RP-70-38-9BS	Shank Ranch	10/11/2011 10:30 AM	K36
RP-70-38-9BS	Shank Ranch	09/18/2012 9:45 AM	K36
RP-70-38-9EW	Grass Valley	06/18/2010 12:30 PM	EW-5
RP-70-38-9GV	Grass Valley (EW1)	07/28/2005 4:25 PM	K08
RP-70-38-9HC	Helen Cates	10/11/2011 1:05 PM	K04
RP-70-38-9JM	Agua Dulce Ranch	10/11/2011 11:55 AM	K54
RP-70-38-9SH	Shank Ranch	10/26/2010 11:30 AM	K35
RP-70-38-9TW	Agua Dulce Ranch	11/01/2010 3:25 PM	K55
RP-70-38-9TW	Agua Dulce Ranch	10/11/2011 12:20 PM	K55
RP-70-39-5CA	Helen Cates	10/26/2010 10:10 AM	K04
RP-70-39-5ER	Eagle Rock Ranch	10/26/2010 10:35 AM	K81
RP-70-39-7AD	Agua Dulce Ranch	10/26/2010 9:35 AM	K54
RP-70-39-7CH	Clinto Brown	11/02/2010 10:25 AM	K68

Table 5. (cont.)

Sample Name	Owner	Sample Date	Map Location
RP-70-39-7CW	Clinto Brown	11/02/2010 10:45 AM	K69
RP-70-45-1DF	Davis Ranch	06/29/2005 12:45 PM	K63
RP-70-45-1DF	Davis Ranch	12/17/2008 1:05 PM	K63
RP-70-45-501	Las Moras Springs	06/29/2005 12:00 AM	KC02
RP-70-45-501	Las Moras Springs	12/07/2006 1:00 PM	KC02
RP-70-45-501	Las Moras Springs	10/23/2007 9:10 AM	KC02
RP-70-45-501	Las Moras Springs	12/17/2008 12:05 PM	KC02
RP-70-45-501	Las Moras Springs	07/30/2009 8:40 AM	KC02
RP-70-45-501	Las Moras Springs	06/16/2010 6:00 PM	KC02
RP-70-45-501	Las Moras Springs	10/10/2011 11:20 AM	KC02
RP-70-45-501	Las Moras Springs	08/03/2012 11:20 AM	KC02
RP-70-45-501	Las Moras Springs	09/17/2012 10:25 AM	KC02
RP-70-45-501	Las Moras Springs	08/02/2013 12:00 AM	KC02
RP-70-45-501	Las Moras Springs	08/02/2013 1:20 PM	KC02
RP-70-45-501	Las Moras Springs	09/18/2013 11:45 AM	KC02
RP-70-45-501	Las Moras Springs	05/27/2014 12:00 AM	KC02
RP-70-45-505	Fort Clark MUD	06/29/2005 12:00 AM	KC02
RP-70-45-505	Fort Clark MUD	12/07/2006 1:45 PM	KC02
RP-70-45-505	Fort Clark MUD	10/23/2007 10:05 AM	KC02
RP-70-45-505	Fort Clark MUD	07/30/2009 9:35 AM	KC02
RP-70-45-505	Fort Clark MUD	06/16/2010 4:20 PM	KC02
RP-70-45-505	Fort Clark MUD	11/08/2011 3:20 PM	KC02
RP-70-45-505	Fort Clark MUD	09/17/2012 9:45 AM	KC02
RP-70-45-505	Fort Clark MUD	09/18/2013 4:12 PM	KC02
RP-70-45-601	City of Brackettville	12/07/2006 2:30 PM	KC05
RP-70-45-601	City of Brackettville	10/23/2007 10:25 AM	KC05
RP-70-45-601	City of Brackettville	07/30/2009 10:25 AM	KC05
RP-70-45-601	City of Brackettville	06/16/2010 3:45 PM	KC05
RP-70-45-601	City of Brackettville	10/10/2011 10:55 AM	KC05
RP-70-45-601	City of Brackettville	09/17/2012 11:05 AM	KC05
RP-70-45-601	City of Brackettville	09/18/2013 3:40 PM	KC05
RP-70-45-7LC	Lock	06/30/2005 9:55 AM	Lock
RP-70-46-4DH	Halbert	07/29/2005 2:30 PM	Halbert
RP-70-46-5AK	Krieger Ranch	06/17/2010 5:30 PM	K34
RP-70-46-5AK	Krieger Ranch	10/10/2011 2:20 PM	K34
RP-70-46-5DS	3D Ranch	06/17/2010 2:25 PM	K29
RP-70-46-802	TXDOT Rest Stop	10/10/2011 5:05 PM	K53
RP-70-46-8DS	3D Ranch	10/10/2011 3:50 PM	K29
RP-70-47-6GR	George Rose Ranch	06/17/2010 12:30 PM	K26
RP-70-47-9GR	George Rose Ranch	11/02/2010 9:20 AM	K28
RP-70-47-9GR	George Rose Ranch	10/10/2011 12:55 PM	K28

TRACER TESTS

Testing Phases

For this study, 12 tracer tests (dye injections) were completed between 2007 and 2012 at various locations in Kinney County using one or more injection points and tracers. Table 6 lists the locations, injection dates, dyes, and dye quantities for each of the injections. This section describes the purpose, setting, and results of each of the injections.

Before each injection, water samples were collected, and charcoal receptors were placed at monitoring points and analyzed for the presence of dyes and to determine background fluorescence. EEA obtained a class V injection well permit from the Texas Commission on Environmental Quality for the injections that involved a well. Samples were then collected at intervals ranging from hours to days to months from wells and springs throughout the Brackettville area. Other details of the tracer tests are described in Schindel (2007). Over 100 monitoring sites were sampled at various times during the tracer tests. Table 7 lists the monitoring sites, and their locations are shown in Figure 20.

Definition of a Positive Detection of Dye

The objective of any tracer test is to obtain a positive detection in water or charcoal of a dye that was injected at a known location and time. The positive detection is empirical evidence that supports the conclusion that the

(continued on p. 30)

Table 6. Injection Points, Dates, and Dyes.

Location	Injection Date	Dye	Quantity*	Longitude	Latitude
Alamo Village Cave	3/8/2007	Phloxine B	362 g (0.8 lb)	-100.38300	29.43556
Alamo Village Cave	4/12/2007	Phloxine B	4.54 kg (10 lb)	-100.38300	29.43556
HF&F Cave	3/8/2007	Eosin	1.9 g (4.2 lb)	-100.35621	29.41385
HF&F Cave	4/12/2007	Eosin	14.5 kg (32 lb)	-100.35621	29.41385
Boerschig Well	5/16/2007	Tinopal CBS-X	5.4 kg (12 lb)	-100.42444	29.34556
Boerschig Well	12/15/2008	Eosin	2 kg (4.4 lb)	-100.42444	29.34556
Dooley Irrigation Well	12/17/2008	Uranine	2.5 kg (5.5 lb)	-100.46556	29.38417
Grass Valley PW-1	10/1/2010	Phloxine B	17 kg (37.4 lb)	-100.26389	29.41820
Whitney Cave	10/1/2010	Uranine	15.2 kg (33.6 lb)	-100.28788	29.43461
Pratt's Sink	9/30/2010	Eosin	150 g (0.33 lb)	-100.28722	29.40833
Boerschig Well	5/16/2012	Sulforhodamine B	8.0 kg (17.5 lb)	-100.42444	29.34556
Boerschig Well	9/18/2012	Sulforhodamine B	8.0 kg (17.5 lb)	-100.42444	29.34556

*Weight reported as neat dye (i.e., no solvent).

Table 7. Monitoring Sites.

Label	Name	Type	Longitude	Latitude
K01	John Boerschig	Well	-100.35264	29.35769
K02	John Boerschig	Tank by windmill	-100.35499	29.36803
K04	Helen Davis Cates	Windmill	-100.23111	29.42472
K05	Milford Street Partnership	Well	-100.29427	29.39516
K05	Milford Street Partnership	Tank	-100.29888	29.39397
K06	Richard Tetens	Well and trough	-100.23164	29.41453
K07	Trackin' Trophies	Well	-100.18935	29.41488
K08	Jeffry Jay Johnson (EW-1)	Well	-100.26395	29.41826
K09	Jeffry Jay Johnson (EW-2)	Well	-100.27050	29.41670
K10	C. J. Bitter	Tank	-100.29336	29.40015
K11	C. J. Bitter	Tank	-100.33244	29.40709
K12	C. J. Bitter	Faucet	-100.32376	29.37809
K13	Lloyd Davis	Well	-100.25414	29.43414
K14	Lloyd Davis	Tank	-100.24397	29.43090
K15	Lloyd Davis	Tank	-100.23522	29.44007
K16	Circle D Ranch	Tank	-100.15307	29.44630
K17	EAA (RP-70-38-902)	Well	-100.26125	29.41357
K18	Jeffry Jay Johnson (EW-4)	Well	-100.26119	29.42506
K19	Jeffry Jay Johnson (EW-5)	Well	-100.28397	29.41492
K20	Jeffry Jay Johnson (House)	Well	-100.27288	29.41271
K22	Mark Clark	Cave	-100.28753	29.43436
K26	Geo. Rose Ranch	Windmill	-100.17164	29.32066
K27	Geo. Rose Ranch	Trough	-100.17971	29.29142
K28	Geo. Rose Ranch	Windmill	-100.18307	29.28587
K29	3-D Cattle Co.	Faucet	-100.31624	29.28790
K29	3-D Cattle Co.	Well	-100.31597	29.28728
K30	3-D Cattle Co.	Windmill	-100.29248	29.30527
K31	Dana Schuster/3-D Cattle Co.	Well	-100.27692	29.31191
K32	Allen H. Kreiger	Well	-100.28395	29.31191
K33	Allen H. Kreiger	Windmill	-100.29409	29.33800
K34	Allen H. Kreiger	Well	-100.30621	29.31419
K35	Bill Shank/Lane Nowlin	Well	-100.27140	29.37236
K35	Bill Shank/Lane Nowlin	Pond	-100.27256	29.37278
K36	Bill Shank/Lane Nowlin	Faucet	-100.28490	29.37834
K37	Mountain View Ranch	Faucet	-100.26215	29.39496
K38	Mountain View Ranch	Well	-100.26605	29.38975
K39	Mountain View Ranch	Trough	-100.22247	29.36816
K39	Mountain View Ranch	Trough	-100.22007	29.36513
K40	Mountain View Ranch	Well	-100.24061	29.35269

Table 7. (cont.)

Label	Name	Type	Longitude	Latitude
K41	William C. Wilson	Well	-100.24645	29.36429
K42	Mountain View Ranch	Well	-100.26228	29.36781
K43	West Prong of the Nueces River	Pool	-100.16969	29.44385
K49	Stanley Dunbar	Well	-100.13546	29.33985
K50	Stanley Dunbar	Windmill	-100.11528	29.33917
K51	Stanley Dunbar	Windmill	-100.10163	29.33853
K52	Stanley Dunbar	Windmill	-100.10815	29.33402
K53	TxDOT rest area	Well	-100.32321	29.28128
K54	Agua Dulce Ranch	Well	-100.26445	29.40530
K55	Agua Dulce Ranch	Windmill	-100.26259	29.40032
K56	Agua Dulce Ranch	Windmill	-100.22952	29.39968
K57	Hugh Coates	Windmill	-100.20486	29.29991
K58	Hugh Coates	Well	-100.20656	29.31418
K59	Hugh Coates	Well	-100.22804	29.34183
K59	Hugh Coates	Tank	-100.24073	29.34058
K60	Hugh Coates	Well	-100.26228	29.33694
K61	Hugh Coates	Well	-100.44208	29.37879
K62	McDaniels Farms	Well	-100.47272	29.36276
K63	Zach Davis	Tank	-100.46789	29.37194
K64	Wes Robinson	Well	-100.47287	29.37598
K65	Wes Robinson	Well	-100.48068	29.37828
K66	Wes Robinson	Spring	-100.48670	29.37975
K67	Wes Robinson	Spring	-100.48700	29.38070
K68	Clinto Brown	Well	-100.16272	29.35271
K69	Clinto Brown	Windmill	-100.17060	29.34300
K70	Clinto Brown	Windmill	-100.20691	29.37433
K71	Clinto Brown	Windmill	-100.18805	29.38394
K72	Clinto Brown	Windmill	-100.17601	29.36330
K73	Trackin' Trophies	Well	-100.20152	29.41264
K74	Trackin' Trophies	Well	-100.18956	29.41453
K75	Clinto Brown	Windmill	-100.21047	29.35643
K76	Clinto Brown	Windmill	-100.14847	29.37585
K77	Sky Lewey	Well	-99.95567	29.35256
K78	“Happy” Chivey	Irrigation well	-100.04753	29.37671
K81	Eagle Rock Ranch	Well	-100.18885	29.42626
K82	Eagle Rock Ranch	Well	-100.19232	29.42876
K83	Mark Clark	Well	-100.26344	29.43569

Table 7. (cont.)

Label	Name	Type	Longitude	Latitude
K84	Mark Clark	Well	-100.28933	29.43361
K85	Leonard Wittig	Well	-100.13500	29.40003
K88	Don Mathews	Windmill	-100.14594	29.42986
K89	N-Bar Ranch	Well	-100.16289	29.40889
K90	C. J. Bitter	Tank	-100.32143	29.37844
K91	N-Bar Ranch	Well	-100.16490	29.41538
K92	John Boerschig	Well	-100.32167	29.35533
K45	HF&F Ranch	Well	-100.38028	29.39778
K47	HF&F Ranch	Well	-100.36583	29.38917
K48	HF&F Ranch	Well	-100.35167	29.38750
K44	HF&F Ranch	Windmill	-100.37444	29.41500
K46	HF&F Ranch	Windmill	-100.35417	29.40167
KC02	Las Moras Springs	Spring	-100.42111	29.30889
KC23	Cecil Smith	Well	-100.32833	29.36167
KC05	City of Brackettville	Well (PWS)	-100.41444	29.31694
KC07	Pinto Springs on Mariposa Ranch	Spring	-100.4525	29.4075
KC08	Pinto Creek at Hwy. 2804	Stream	-100.49137	29.36889
KC03	Fort Clark MUD (RP-70-45-505)	Well	-100.42194	29.31056
KIN028	Alamo Village	Well	-100.39677	29.42758
KIN043	Mark Clark/Fermine	Well	-100.28453	29.43618
KIN045	Las Moras Creek at Red Bridge	Creek	-100.42181	29.27911
KIN051	C. J. Bitter	Injection point: Uranine	-100.46556	29.38417
KIN063	John Boerschig	Well	-100.44201	29.36024
KC22	Boerschig Irrigation Well 2	Injection point: SRB	-100.42444	29.34556
KC07	Pinto Springs on Ring Ranch	Springs	-100.45250	29.40750
K97	Pinto Creek at Hwy. 90	Stream	-100.53361	29.33542
K96	James Bader	Well	-100.49417	29.32000
K95	Doc Dorrell	Well	-100.52888	29.33083
K98	Pinto Creek at Standard Road	Stream	-100.60230	29.29764
K94	Murphy	Well	-100.40806	29.33417
K99	Las Moras Creek at Standard Road	Stream	-100.49230	29.22276
K93	Jeffry Jay Johnson (PW1)	Injection point: Phloxine B	-100.26389	29.41820
KC24	Shahan Ranch Stock Tank	Tank	-100.40000	29.41639
KIN064	Las Moras Springs Main Orifice	Spring	-100.42083	29.30972
KC01	Las Moras Springs at USGS Gauge	Spring	-100.42083	29.30889
KC34	Boerschig's Windmill	Windmill	-100.42444	29.34500

Latitude and longitude WGS 84 datum.

(continued from p. 26)

injection point and the monitoring site are hydraulically connected. If multiple positive detections are obtained, then some characteristics of the connection (e.g., apparent velocity, tortuosity) may be interpreted from the results. If the test provides only a single positive detection, then the connection between the injection point and the monitoring site is tentative for the purposes of this report. Every additional positive detection strengthens the case for a hydraulic connection. The best positive detection is a strong dye signal in water. Because Edwards Aquifer water in Kinney County contains little matrix interference, detection limits are relatively low, and dye peaks are readily visible. In water, the concentration is roughly proportional to the degree of dilution that occurred between the injection point and the monitoring site. In contrast, charcoal receptors provide simply a positive or negative indication that dye was present at the monitoring point. Dye absorbs onto charcoal particles at a rate that is determined by the absorptiveness of the dye, the number of absorption sites in the charcoal, temperature, other competing ionic substances in the water, water flow rate, pH of the water, and other variables. Consequently, charcoal receptors provide qualitative results unless some of these variables can be measured or controlled. Like water samples, a strong dye signal is compelling evidence that dye was present at the monitoring site at some time after the injection date, as long as the hydraulic connection makes physical sense. Before it can be determined to be a positive detection, a weak signal has to be evaluated in light of potential analytical and matrix interference caused by charcoal, characteristics of the dye peak, and the hydrogeologic system. For example, the center wavelengths of dye peaks shift slightly higher in the eluent that desorbs dye from charcoal. Unlike water, a weak signal may not be directly proportional to dilution between the injection point and the monitoring site. However, if a weak signal is determined to be a positive detection, then it is evidence of a hydraulic connection between the injection point and the monitoring site.

Alamo Village Cave, HF&F Cave, and Boerschig Irrigation Well (2007)

These tests consisted of three dye injections in 2007: one injection at Alamo Village Cave and one at HF&F Cave, both in Pinto Valley, and one injection at the Boerschig Well, which is located approximately two mi (3.2 km) northwest of Brackettville and approximately 4.5 mi (7.2 km) northwest of Las Moras Springs. Locations are shown in Figure 20.

Purpose

The purpose of the Alamo Village Cave and HF&F Cave injections was to investigate the relationship between groundwater flowpaths in Pinto Valley and discharge at Pinto Springs. The purpose of the Boerschig Well injection was to determine whether groundwater flow immediately north of Brackettville would carry dye to the City of Brackettville wells or Las Moras Springs, or both.

Setting

Alamo Village and HF&F caves (Figure 21) were selected for injections because they were suspected of being hydraulically connected to the Pinto Valley groundwater system. Both caves occur in the Salmon Peak Formation. The Boerschig Well is completed in the undifferentiated Edwards Limestone.

Injections

Alamo Village Cave: 362 g (0.8 lb) of Phloxine B dye was injected into Alamo Village Cave on March 8, 2007. This initial injection was performed with limited dye mass to assess the possibility of discoloring a nearby water supply well, and it was not detected. The trace was repeated on April 12, 2007, using 4.54 kg (10 lb) of Phloxine B. The second injection is considered the starting point for the tests at Alamo Village Cave.

HF&F Cave: 1.9 g (4.2 lb) of Eosin dye was injected into HF&F Cave on March 8, 2007. This initial injection was performed with limited dye mass to assess the possibility of discoloring a nearby water supply well. The trace was repeated on April 12, 2007, using 14.5 kg (32 lb) of Eosin. The second injection is considered the starting point for the tests at HF&F Cave.

Boerschig Well: 5.4 kg (12 lb) of Tinopal CBS-X (optical brightener) was injected into the Boerschig Well to evaluate flowpaths near Las Moras Springs and the City of Brackettville wells. The depth to groundwater at the Boerschig Well was approximately 55 ft (16.8 m) below ground surface (1,109 ft or 338. m msl).

Figure 21. Entrances to Alamo Village Cave (left) and HF&F Cave (right)

Results

Alamo Village Cave Injection: Dye (Phloxine B) was injected into Alamo Village Cave on April 12, 2007, and detected at the following locations: Alamo Village Well, Shahan Ranch Stock Tank (KC24), KC29, KIN071, KIN058, KIN053, KC07, K66, KIN063, K62, K98, K63, and KIN028. Figure 23 indicates the locations of positive detections of dye, owner, arrival date, distance, travel time in days, and apparent velocity. Phloxine B was detectable six d after injection in the Alamo Village Well until sampling ended in 2013, for an apparent groundwater velocity of 128 ft/d (39 m/d). Phloxine B was also detected in Pinto Springs and Pinto Creek at the Ring Ranch several months following injection.

After initial detections, the dye traveled slowly southward for several hundred days to wells located at the Robinson, Davis, and McDaniel ranches, where it was detected in 2012. Dye persisted in the hunter's cabin well (KIN063) and the Alamo Village Well (KIN028) until sampling ended in 2013. It was tentatively detected in Pinto Creek at Standard Road in 2012, which was the farthest detection from the injection site. Groundwater velocities could not be calculated for some of the southern sites because a hiatus occurred in the project from November 2007 through October 2008, and the dye was present when sampling was initiated. The breakthrough curve for selected sites for this trace is shown in Figure 22.

Boerschig Well Injection: Optical brightener (Tinopal CBS-X) was injected into the Boerschig Irrigation Well on May 16, 2007, and was detected at Boerschig Windmill Well (KC34), Los Moras Springs (KC00 and KC01), and City of Brackettville wells (KC05). Table 8 indicates the location of positive detections of dye, owner, arrival date, distance, travel time in days, and apparent velocity. Optical brightener was detected in the windmill well located approximately 150 ft from the Boerschig Well in samples collected on May 23, 2007, although the optical brightener probably arrived at the well before that date (Table 8). This windmill well is reportedly completed in the Buda Limestone, although the water level in the well is coincident with levels observed in the irrigation well. Data are insufficient in the wells to determine the route or cause of migration of the optical brightener to the windmill well. The optical brightener

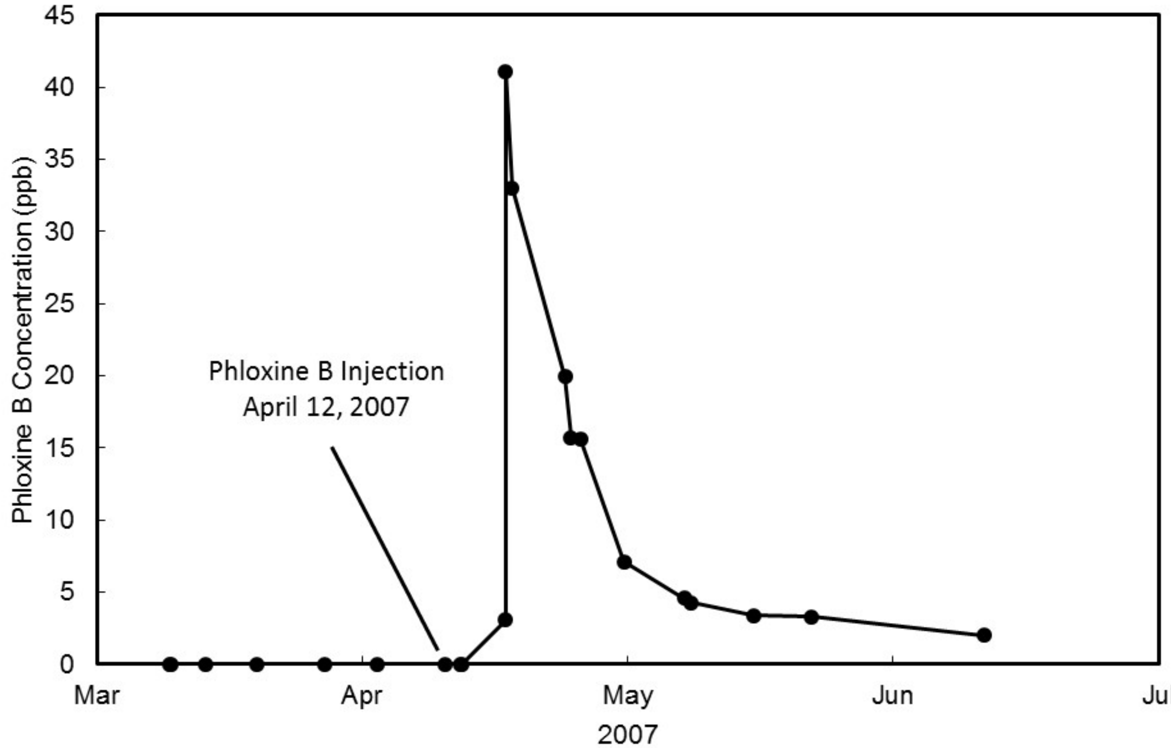

Figure 22. Breakthrough Curve for Phloxine B at Shahan Stock Tank (KC24)

probably reached the windmill well by natural pathways created by fractures and faults in the area, coupled with hydrostatic pressure. These data indicate hydraulic communication between the Edwards Limestone and the Buda Limestone in this area. Optical brightener was also observed on cotton receptors placed in Las Moras Springs on May 26 and City of Brackettville wells (2.1 mi; 3.4 km) between May 25 and May 28, 2007 (Figure 24). Figure 25 shows the optical brightener analyses from Las Moras Springs and the City of Brackettville wells. Las Moras Springs discharge ranged between 36 and 40 cfs during this tracer test.

HF&F Cave Injection: Eosin was injected into HF&F Cave on April 12, 2007, and was not detected until January 15, 2009, at the Boerschig hunting cabin well (KIN063) approximately 6.4 mi (10.4 km) southwest of the cave (Figure 27). Because the charcoal detector was retrieved after the hiatus in the project that occurred from November 2007 through October 2008, the actual arrival date is not known. In addition, it is considered a tentative positive because it was a single detection. No other detections of Eosin occurred from HF&F Cave.

Dooley Irrigation Well (2008)

Purpose

The purpose of the injections at the Dooley Irrigation Well (KIN051; TWDB No. 7037808) was to investigate groundwater flow directions and velocities in Pinto Valley and to determine the relationship between Pinto Valley, Pinto Springs, and Las Moras Springs.

Setting

Pinto Valley is a structural graben caused either by folding or faulting, as described earlier (Figure 2). Groundwater occurs under artesian conditions, with potentiometric heads several feet above ground during wet conditions. During dye injection, water level in the injection well was approximately four ft (1.2 m) above ground surface. The well is completed as an open hole from 375 to 1,010 ft, which penetrates the entire section of Edwards limestone. The casing extends approximately 10 ft above ground (Figure 26).

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Table 8. First Arrival Times for Kinney County Tracer-Test Results (2007)

Monitoring Site Name	Owner	Arrival Date	Distance	Travel Time (days)	Apparent Velocity
Alamo Village Cave	**3/08/2007**	**Phloxine B**	**362 g (0.8 lb)**		
	4/12/2007	**Phloxine B**	**1.5 L (0.4 gal)**		
KC24	Shahan Stock Tank	04/17/2007	1.7 mi (2.7 km)	5	221 ft/d (68 m/d)
KC29	Alamo Village Well (Rains)	04/18/2007	1.0 mi (1.6 km)	6	128 ft/d (39 m/d)
KIN071	Pinto Creek	11/30/2008	4.6 mi (7.4 km)	598	39 ft/d (12 m/d)
KIN058	Robinson	11/30/2008	6.8 mi (10.9 km)	598	57 ft/d (17 m/d)
KIN053	Robinson	01/07/2009	7.3 mi (11.8 km)	636	58 ft/d (18 m/d)
KC07	Pinto Springs	01/07/2009	4.6 mi (7.4 km)	636	36 ft/d (11 m/d)
K66	Robinson Spring	09/28/2010	7.3 mi (11.8 km)	1,265	30 ft/d (9 m/d)
KIN063	Boerschig	12/29/2010	6.3 mi (10.1 km)	1,357	24 ft/d (7 m/d)
K62	McDaniel	05/15/2012	7.4 mi (11.9 km)	1,860	21 ft/d (6 m/d)
K98	Pinto Creek	05/25/2012	16.3 mi (26.2 km)	1,870	45 ft/d (14 m/d)
K63	Davis	09/18/2012	6.7 mi (10.8 km)	1,986	18 ft/d (5 m/d)
HF&F Cave	**4/12/2007**	**Eosin**	**14.5 kg (32 lb)**		
KIN063	Boerschig	01/15/2009	6.4 mi (10.2 km)	<679	>49 ft/d (>15 m/d)
Boerschig Irrigation Well	**5/16/2007**	**Tinopal CBS-X**	**5.4 kg (12 lb)**		
KC34	Boerschig's Windmill	05/23/2007	150 ft (45.7 m)	<7	>20 ft/d (>6 m/d)
KC00	Las Moras Springs	05/24/2007	2.5 mi (4.1 km)	8	7 ft/d (2 m/d)
KC051	City of Brackettville	05/31/2007	2.1 mi (3.3 km)	15	6 ft/d (2 m/d)

*Tentative detection.

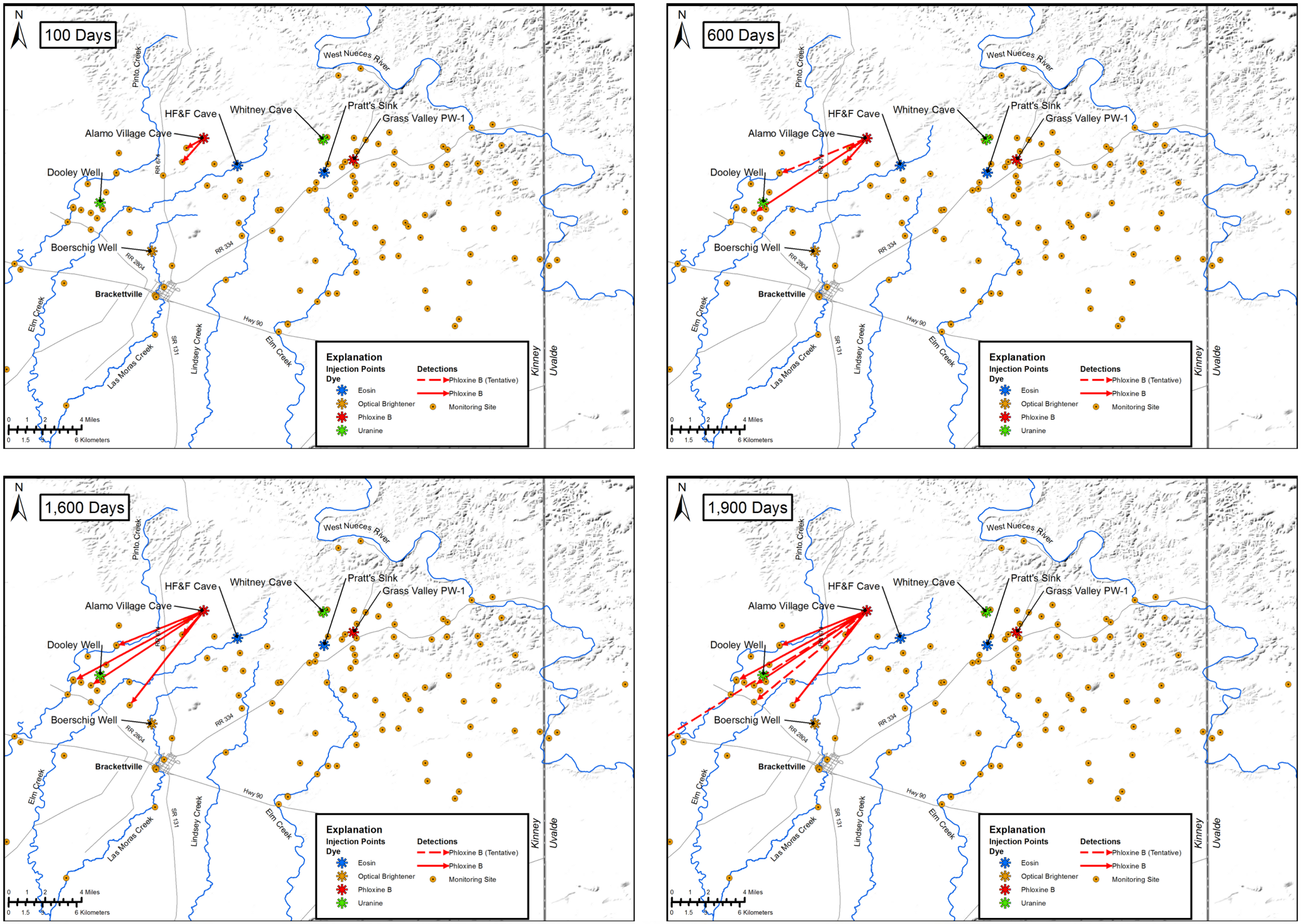


Figure 23. Detections after 100, 600, 1,600, and 1,900 Days following Alamo Village Cave Injection (4/12/2007)

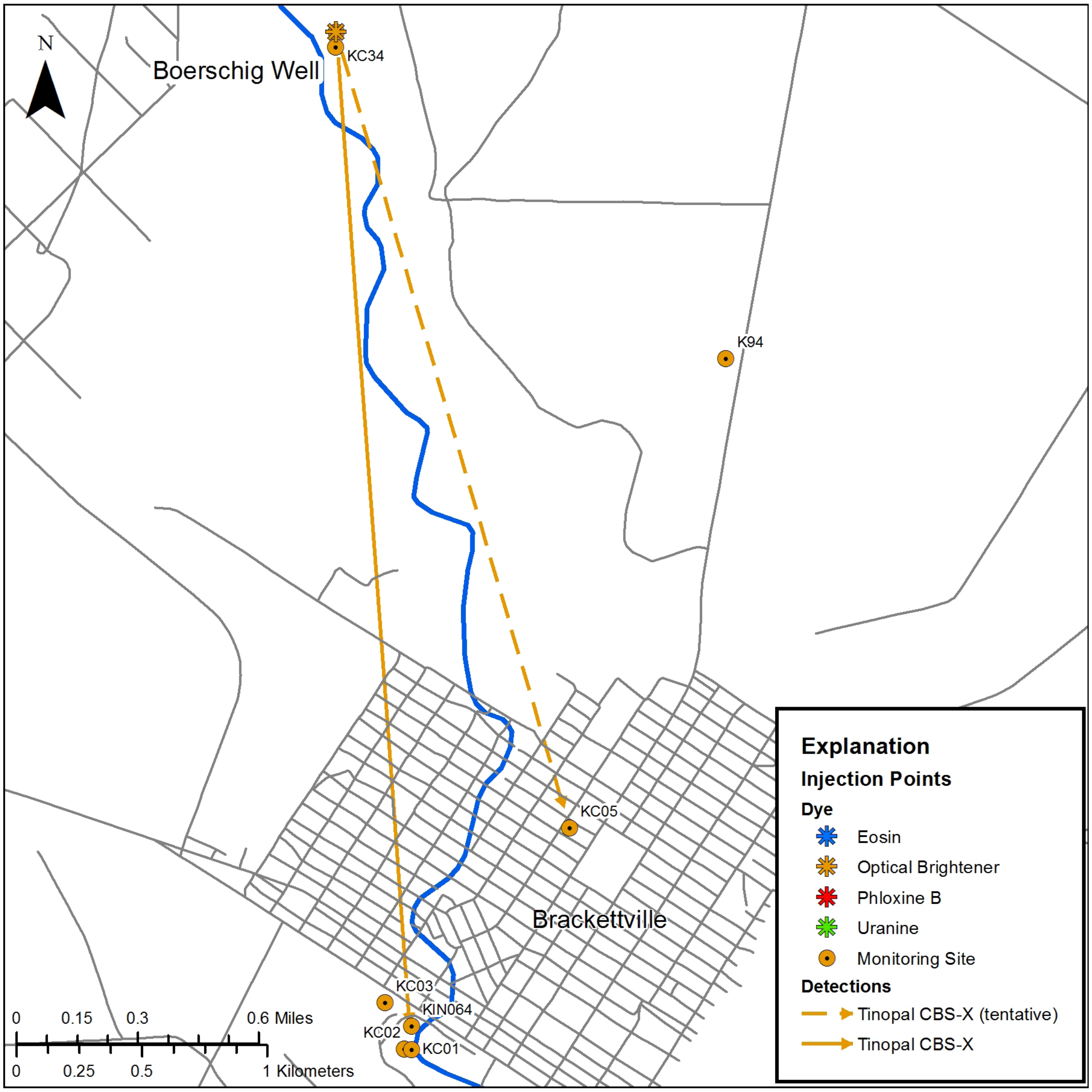


Figure 24. Detections after 7 Days following Boerschig Irrigation Well 2 Injection (5/16/2007)

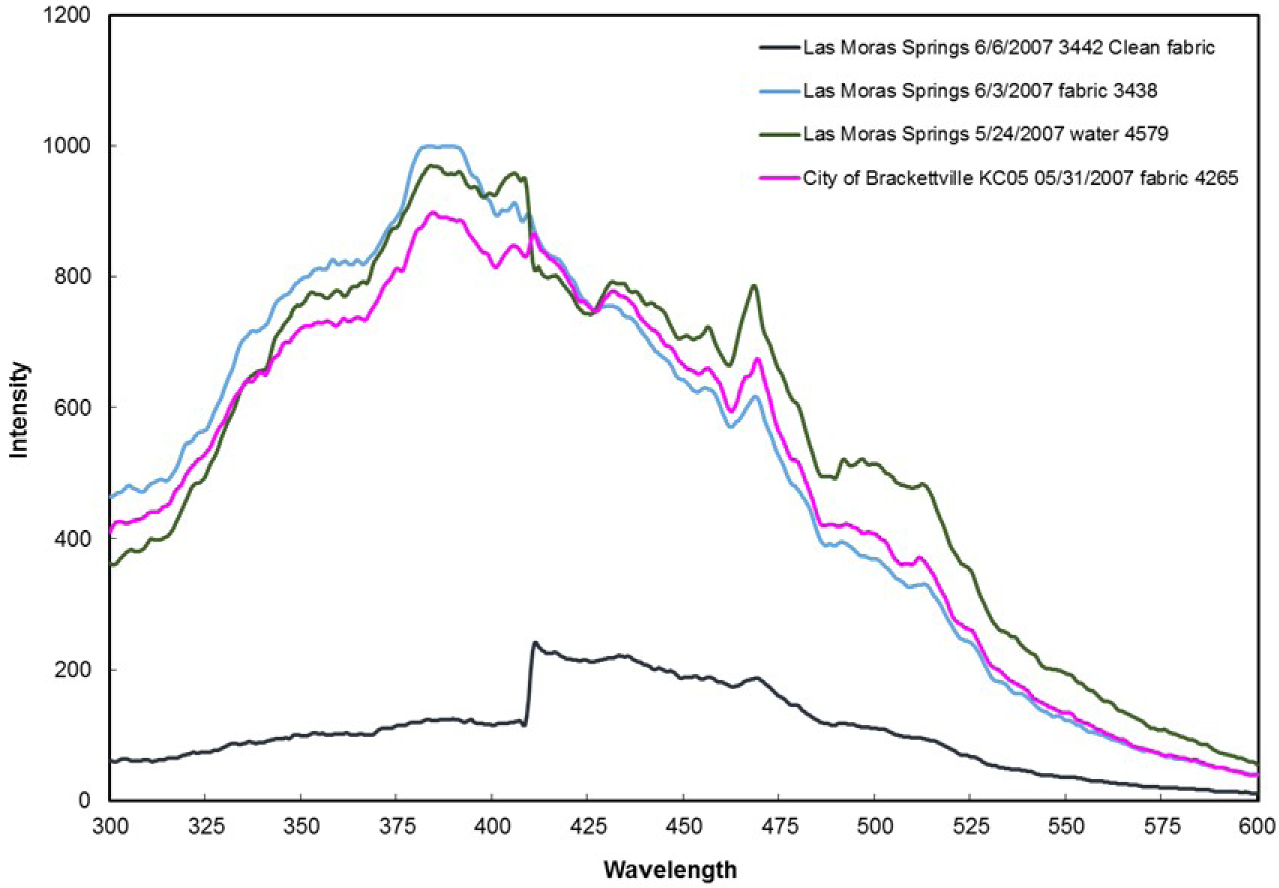


Figure 25. Samples from Optical Brightener Tracer Test

Figure 26. Dooley Irrigation Well Injection (12/17/2008)

Table 9. First Arrival Times for Dooley Well Tracer-Test Results (2008).

Monitoring Site Name	Owner	Arrival Date	Distance	Travel Time (days)	Apparent Velocity
Dooley Irrigation Well	**12/17/2008**	**Uranine**	**2,500 g (5.5 lb)**		
K64	Robinson	02/28/2009	0.7 mi (1.2 km)	73	52 ft/d (16 m/d)
K63	Davis	11/10/2010	0.9 mi (1.4 km)	693	7 ft/d (2 m/d)
K62	McDaniel	05/15/2012	1.5 mi (2.5 km)	1245	7 ft/d (2 m/d)
K98	Pinto Creek at Standard Road	05/25/2012	10.2 mi (16.4 km)	1255	43 ft/d (13 m/d)
K95	Dorrell	07/11/2012	5.3 mi (8.5 km)	1302	21 ft/d (7 m/d)

(continued from p. 32)

Logging and spinner testing previously performed under the direction of URS, Inc. (Snyder, 2008), indicates porosity and velocity changes within the well at depths from about 510 to 760 ft below land surface.

Injection

Uranine dye was injected into the Dooley Well on December 17, 2008. Uranine was selected for injection at this site because of its relatively strong fluorescence at low concentrations and the strong likelihood of dilution if the dye had traveled to Las Moras Springs. Approximately 2,500 g (5.5 lb) of neat (undiluted) dye was pumped below the water level through approximately 700 ft (213 m) of flexible tubing. Approximately 10,000 gal (37,850 L) of water was added to flush the dye into the aquifer.

Results

Uranine dye injected into Dooley Well on December 17, 2008, was detected at the following locations: K64 (Robinson Well), K63 (Davis Well), K62 (McDaniel Well), K98 (Pinto Creek at Standard Road), and K95 (Dorrell Well). Table 9 indicates the locations of positive detections of dye, owner, arrival date, distance, travel time in days, and apparent velocity. Uranine persisted in Dooley Well until sampling ended in 2013.

The first detection of Uranine was in a charcoal receptor in a well located approximately 0.7 mi (1.2 km) south of the injection well at the Robinson Ranch (K64) between 57 and 73 d after the injection 1 (Table 9, Figure 27). Sample collection was discontinued at the Robinson Ranch for almost two years, although it continued at other monitoring sites that would be expected to intercept dye from Dooley Well. Uranine was then detected in a well on the Davis Ranch beginning almost 700 d after injection, and detections also occurred at McDaniel and Dorrell wells in 2012. In addition, Uranine was detected in two samples from Pinto Creek at Standard Road more than 1,200 d after the injection. Unfortunately, no upstream monitoring sites in Pinto Creek or Pinto Springs were available for this test. Apparent groundwater velocities ranged from 7 ft/d (02 m/d) to a high of 52 ft/d (16 m/d).

Whitney Cave, Pratt's Sink, and Grass Valley PW-1 (2010)

Purpose

The purpose of the injections at Whitney Cave, Pratt's Sink, and Grass Valley PW-1 was to investigate sources of water for Pinto Springs and Las Moras Springs and to identify groundwater flowpaths near West Nueces River. These tracer tests were designed to investigate the interaction between West Nueces River and groundwater in the north part of Kinney County. Pinto Springs, Las Moras Springs, and more than 60 wells were monitored during the tracer tests. Joe Goebel, representing the KCGCD, observed all three injections.

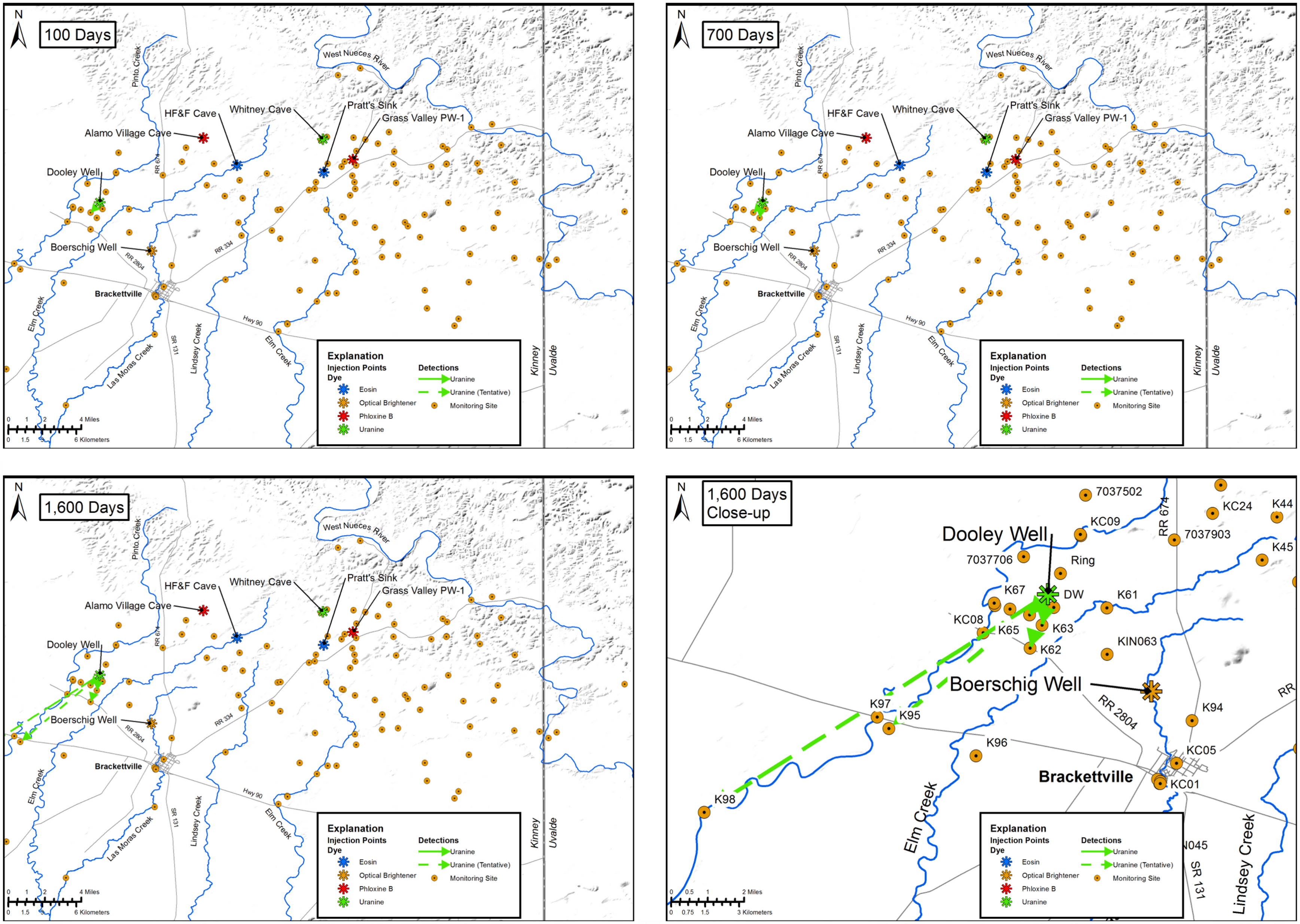


Figure 27. Detections after 100, 700, and 1,600 Days following Dooley Well Injection (12/17/2008)

Setting

All three injection points are located in northern Kinney County near West Nueces River (Figure 20). Whitney Cave, located on the Clark Ranch, occurs in the Salmon Peak Limestone (Figure 1) at an elevation of approximately 1,400 ft (427 m). It is in the recharge zone of the Salmon Peak Limestone, and the entrance is shown in Figure 28. Groundwater was approximately 170 ft (51.8 m) below ground in September 2010, according to measurements at a well on the Clark Ranch (K83) 1,200 ft (365.8 m) from the cave. The cave represents subsurface conditions that are similar to those of the West Nueces River channel with respect to infiltration. Dye injected into Whitney Cave would be expected to move similarly to recharge from the West Nueces River.

Pratt's Sink is a shallow cave in the Buda Limestone, which overlies the Del Rio Clay (Grayson Limestone) and the Salmon Peak Limestone. Water was observed in the cave (Figure 29), although whether the cave is hydraulically connected to the regional groundwater system is unknown. Water in the cave also may be perched on the Del Rio Clay, preventing it from infiltrating to the Salmon Peak Limestone.

Grass Valley Well PW-1, located on the Johnson Ranch, is completed at 645 ft (196.6 m) below ground in the Salmon Peak Limestone. It is cased with 20-in steel casing through the Del Rio Clay to a depth of 117.5 ft (35.8 m), with a 19-in open borehole from 117.5 to 600 ft (35.8 to 182.9 m) and a 15-in open borehole from 600 to 645 ft (182.9 to 196.6 m). The well is also in the recharge zone of the Salmon Peak Limestone at an elevation of approximately 1,345 ft (410 m). Groundwater was at a depth of 160 ft (49 m) below ground in September 2010. Green et al. (2006) concluded that the Grass Valley area is located in a structural embayment in the Salmon Peak Limestone that deepens the Edwards Aquifer and enhances the yield of wells in the valley. The conceptual model presented by Green et al. (2006) includes groundwater flow from the Grass Valley area to Las Moras Springs through solutionally enlarged southwest-trending faults. Similar water quality in Grass Valley wells and Las Moras Springs also supports a hydraulic connection between Grass Valley Well and Las Moras Springs.

Injections

On October 1, 2010, Authority staff injected 12 kg of Phloxine B dye into well PW1 on Johnson Ranch. The dye was flushed with approximately 10,000 gal (37,850 L) of water obtained from the City of Brackettville. It was the second injection involving Phloxine B in the study area since the Alamo Cave injection in April 2007. Any residual Phloxine B from Alamo Village Cave remaining in the groundwater system would have been unlikely to interfere with this test because (1) well PW-1 is 7.3 mi (11.7 km) from Alamo Cave, (2) samples collected from the Alamo Cave area contained no detectable dye by June 2007, and (3) a charcoal receptor from the Shahan Ranch Stock Tank (KC-24) collected on October 22, 2007, contained no detectable dye.

On the same day, Authority staff injected 29 kg of Uranine dye into Whitney Cave on Clark-Tularosa Ranch. The dye was flushed with approximately 6,000 gal (22,710. L) of water obtained from the City of Brackettville. It was the second injection involving Uranine in the study area since the Dooley Well injection in December 2008. Any residual Uranine from the Dooley Well would have been unlikely to interfere with this test because the Dooley Well is 11.3 mi (18.2 km) from Whitney Cave and detections were relatively weak and limited near the Dooley Well. In addition, no Uranine was detected in background samples from the primary monitoring sites for this test, Las Moras Springs, City of Brackettville, or Fort Clark MUD wells.

On September 30, 2010, Authority staff injected 13 kg of Eosin dye into Pratt's Sink Cave. The dye was flushed with approximately 10,000 gal (37,850 L) of water obtained from the City of Brackettville. It was the second injection involving Eosin in the study area since the Boerschig Well injection in December 2008. Because no Eosin was detected after that injection, any residual Eosin would have been unlikely to interfere with this test. In addition, no Eosin was detected in background samples from the primary monitoring sites for this test, Las Moras Springs, City of Brackettville, or Fort Clark MUD wells.

Figure 28. Whitney Cave Entrance (2010)

Figure 29. Pratt's Sink Entrance with Water Visible (2010)

Results

Dyes injected at Whitney Cave, Pratt's Sink, and Grass Valley PW-1 were tracked throughout central Kinney County from September 2010 until sampling ended in March 2013. Table 10 indicates the location of positive detections of dye, owner, arrival date, distance, travel time in days, and apparent velocity. In general, dyes were detected at relatively low concentrations on charcoal samples rather than in water samples. Arrival times correspond to the date the charcoal samples were retrieved after their deployment of up to several days or weeks. Consequently, calculated velocities should be considered the minimum because the dyes could have arrived some time before the charcoal sample was picked up. With few exceptions, dye was typically detected only on one to three samples. Where there is doubt regarding a detection, a dashed line is used to connect the injection point with the detection site. Results from each injection point are described next.

Whitney Cave Results

Uranine dye was injected into Whitney Cave on October 1, 2010, and was detected in more samples and at more monitoring sites than injections at Pratt's Sink or Grass Valley PW-1. Dye was detected either as a positive or tentative detection at 64 monitoring sites when sampling ended in March 2013, indicating that the cave is a recharge point for the aquifer. Dye was detected most often at the TXDOT rest stop well (K53) on Hwy 90 (30 times out of 64 samples), at EAA's Tularosa Well (14 times out of 85 samples), a Bitter Ranch well (K12) (seven times out of 71 samples), and a Clark Ranch well (K83) (six times out of 69 samples). Table 10 reports the locations of positive detections of dye, owner, arrival date, distance, travel time in days, and apparent velocity. At most sites, Uranine was detected in four samples or fewer. In general, dye concentrations were relatively low in all samples. Dye was detected in water samples only at the TXDOT well (K53); all other detections at other sites were in charcoal receptors.

Uranine dye from Whitney Cave was detected for the first time in December 2010 fewer than 100 d after injection (Table 10) at wells K82, K36, K14, K17, K53, and the West Nueces River (K43), which represented groundwater velocities of as much as 638 ft/d (194 m/d). The fastest groundwater velocities were to the TXDOT well on Hwy 90 and to the West Nueces River (Figure 30). Other locations that yielded detections during the first 100 d were at a distance of up to 11 mi (17.7 km) south, southeast, and east of Whitney Cave. Subsequent initial detections 100 to 200 d following injection were more widespread and within approximately 6 mi (9.7 km) south, southwest, and southeast of Whitney Cave.

Between 200 and 300 d following injection, initial detections occurred at a distance of as much as 9 mi (14.5 km) south, southwest, and southeast of Whitney Cave. Subsequent initial detections were also south, southwest, and southeast of Whitney Cave as long as 900 d after injection. Dye arrived at Las Moras Springs approximately 313 d following injection, which represents a groundwater velocity of approximately 199 ft/d (61 m/d). Because dye was detected in only a single sample, results are considered tentative. It was detected at the City of Brackettville Well (KC05) in September 2012, approximately 728 days after injection, and it persisted through October 2012. Between 200 and 500 d, Uranine was detected at several other sites south and southwest of Whitney Cave, although many of the detections were tentative (single detections). When monitoring ended after 900 d, monitoring sites with detections had fanned out from southwest to southeast from Whitney Cave.

Pratt's Sink Results

On September 30, 2010, Eosin dye was injected into a small flowing stream in Pratt's Sink, but few detections of Eosin occurred from Pratt's Sink (Table 10, Figure 31). Initial detections occurred at Cates Well (K04) and Bowen Well (K05) 202 d after injection. All detections were tentative except for that of the Bitter Well (K11), where Eosin was detected twice. Like in other tracer tests, dye concentrations were low, and apparent velocities were relatively slow. These results indicate that Pratt's Sink is poorly connected to the groundwater system. Whether the relatively slow groundwater velocities are an indication of geologic controls between the Buda Limestone and the Edwards Limestone or whether they reflect the continuing, deep drought in the area is unclear.

May and June 2013 brought two rainy periods in Kinney County (Figure 16) that mobilized Eosin dye from Pratt's Sink (Figure 31). Figure 32 indicates a rise of almost

(continued on p. 44)

Table 10. First Arrival Times for Whitney Cave, Pratt's Sink, and Grass Valley PW-1 Tracer-Test Results (2010).

Monitoring Site Name	Owner	Arrival Date	Distance	Travel Time (days)	Apparent Velocity
Whitney Cave	**10/1/2010**	**Uranine**	**15.2 kg (33.6 lb)**		
K36	Shank	12/14/2010	3.9 mi (6.2 km)	74	275 ft/d (84 m/d)
K43	West Nueces River	12/14/2010	7.1 mi (11.5 km)	74	509 ft/d (155 m/d)
K14	Davis	12/14/2010	2.6 mi (4.2 km)	74	188 ft/d (57 m/d)
K17	EAA	12/14/2010	2.1 mi (3.4 km)	74	152 ft/d (46 m/d)
K82	Brown	12/14/2010	5.8 mi (9.3 km)	74	410 ft/d (126 m/d)
K53	TXDOT	12/29/2010	10.8 mi (17.3 km)	89	638 ft/d (194 m/d)
K92	Boerschig	02/23/2011	5.8 mi (9.4 km)	145	212 ft/d (65 m/d)
K08	Johnson	02/23/2011	1.8 mi (2.9 km)	145	65 ft/d (20 m/d)
K54	Morgan	02/23/2011	2.4 mi (3.9 km)	145	89 ft/d (27 m/d)
K35	Shank	03/22/2011	4.3 mi (7.0 km)	172	133 ft/d (41 m/d)
K04	Cates	03/22/2011	3.5 mi (5.6 km)	172	106 ft/d (33 m/d)
K37	Rehmann	03/22/2011	3.1 mi (5.0 km)	172	96 ft/d (29 m/d)
K39	Rehmann	03/22/2011	6.3 mi (10.1 km)	172	192 ft/d (59 m/d)
K84	Clark	03/23/2011	0.1 mi (0.2 km)	173	4 ft/d (1 m/d)
KIN028	Rains	04/18/2011	6.6 mi (10.6 km)	199	175 ft/d (53 m/d)
K47	Fuqua	04/18/2011	5.7 mi (9.1 km)	199	150 ft/d (46 m/d)
K83	Clark	04/19/2011	1.5 mi (2.3 km)	200	38 ft/d (12 m/d)
K55	Morgan	04/20/2011	2.8 mi (4.5 km)	201	73 ft/d (22 m/d)
K33	Krieger	04/21/2011	6.6 mi (10.7 km)	202	174 ft/d (53 m/d)
K09	Johnson	05/18/2011	1.6 mi (2.6 km)	229	37 ft/d (11 m/d)
K93	Johnson	05/18/2011	1.8 mi (2.9 km)	229	42 ft/d (13 m/d)
K34	Krieger	05/19/2011	8.4 mi (13.4 km)	230	192 ft/d (58 m/d)
K60	Coates	05/19/2011	6.9 mi (11.1 km)	230	158 ft/d (48 m/d)
K28	Beard	05/19/2011	12.0 mi (19.3 km)	230	276 ft/d (84 m/d)
K07	Hope	05/19/2011	6.1 mi (9.8 km)	230	139 ft/d (43 m/d)
K59	Coates	05/19/2011	7.0 mi (11.3 km)	230	162 ft/d (49 m/d)
K76	Brown	06/20/2011	9.3 mi (15.0 km)	262	187 ft/d (57 m/d)
K20	Johnson	06/22/2011	1.7 mi (2.8 km)	264	35 ft/d (11 m/d)
K45	Fuqua	06/22/2011	6.1 mi (9.9 km)	264	123 ft/d (38 m/d)
K12	Bitter	06/23/2011	4.4 mi (7.2 km)	265	89 ft/d (27 m/d)
K30	Schuster	07/18/2011	8.9 mi (14.3 km)	290	162 ft/d (49 m/d)
K81	Brown	07/19/2011	6.0 mi (9.6 km)	291	108 ft/d (33 m/d)
K40	Rehmann	07/19/2011	6.3 mi (10.1 km)	291	114 ft/d (35 m/d)
K01	Boerschig	07/21/2011	6.6 mi (10.6 km)	293	119 ft/d (36 m/d)
KC23	Smith	08/10/2011	5.6 mi (9.0 km)	313	94 ft/d (29 m/d)
KC02	Las Moras Springs	08/10/2011	11.8 mi (19.0 km)	313	199 ft/d (61 m/d)

Table 10. (cont.)

Monitoring Site Name	Owner	Arrival Date	Distance	Travel Time (days)	Apparent Velocity
K06	Tetens	08/10/2011	3.6 mi (5.9 km)	313	61 ft/d (19 m/d)
K44	Fuqua	08/10/2011	5.4 mi (8.7 km)	313	91 ft/d (28 m/d)
K90	Bitter	08/11/2011	4.4 mi (7.0 km)	314	73 ft/d (22 m/d)
K32	Krieger	10/10/2011	8.4 mi (13.6 km)	374	119 ft/d (36 m/d)
K02	Boerschig	10/11/2011	6.1 mi (9.8 km)	375	86 ft/d (26 m/d)
KIN043	Clark	10/12/2011	0.2 mi (0.4 km)	376	3 ft/d (1 m/d)
K42	Rehmann	01/10/2012	4.8 mi (7.8 km)	466	55 ft/d (17 m/d)
K48	Fuqua	01/12/2012	5.0 mi (8.1 km)	468	57 ft/d (17 m/d)
K29	Schuster	02/06/2012	10.3 mi (16.5 km)	493	110 ft/d (33 m/d)
K05	Bowen	02/07/2012	2.9 mi (4.6 km)	494	31 ft/d (9 m/d)
K69	Brown	03/05/2012	9.4 mi (15.1 km)	521	95 ft/d (29 m/d)
K15	Davis	03/06/2012	3.2 mi (5.1 km)	522	32 ft/d (10 m/d)
K56	Morgan	03/06/2012	4.2 mi (6.8 km)	522	43 ft/d (13 m/d)
K10	Bitter	03/07/2012	2.4 mi (3.8 km)	523	24 ft/d (7 m/d)
K71	Brown	04/10/2012	6.9 mi (11.2 km)	557	66 ft/d (20 m/d)
K73	Hope	04/10/2012	5.4 mi (8.7 km)	557	51 ft/d (16 m/d)
K41	Wilson	04/10/2012	5.4 mi (8.7 km)	557	51 ft/d (16 m/d)
K16	DeGeorge	04/10/2012	8.1 mi (13.1 km)	557	77 ft/d (24 m/d)
K46	Fuqua	05/16/2012	4.6 mi (7.4 km)	593	41 ft/d (12 m/d)
K19	Johnson	05/17/2012	1.4 mi (2.2 km)	594	12 ft/d (4 m/d)
K26	Beard	07/10/2012	10.5 mi (16.9 km)	648	86 ft/d (26 m/d)
K94	Murphey	09/18/2012	10.0 mi (16.2 km)	718	74 ft/d (23 m/d)
K13	Davis	09/18/2012	2.0 mi (3.2 km)	718	15 ft/d (4 m/d)
KC05	City of Brackettville	09/28/2012	11.1 mi (17.9 km)	728	81 ft/d (25 m/d)
K68	Brown	11/13/2012	9.5 mi (15.3 km)	774	65 ft/d (20 m/d)
K38	Rehmann	01/23/2013	3.3 mi (5.4 km)	845	21 ft/d (6 m/d)
KC22	Boerschig	01/23/2013	10.3 mi (16.5 km)	845	64 ft/d (20 m/d)
K18	Johnson	03/19/2013	1.7 mi (2.8 km)	900	10 ft/d (3 m/d)
Pratt's Sink	**9/30/2010**	**Eosin**	**9.1 kg (20 lb)**		
K05	Bowen	04/20/2011	1.2 mi (2.0 km)	202	32 ft/d (10 m/d)
K04	Cates	04/20/2011	3.6 mi (5.7 km)	202	93 ft/d (28 m/d)
K76	Brown	07/10/2012	8.7 mi (13.9 km)	649	70 ft/d (21 m/d)
K75	Brown	07/10/2012	5.8 mi (9.4 km)	649	48 ft/d (14 m/d)
K11	Bitter	09/19/2012	2.7 mi (4.4 km)	720	20 ft/d (6 m/d)
K14	Davis	03/18/2013	3.0 mi (4.9 km)	900	18 ft/d (5 m/d)

Table 10. (cont.)

Monitoring Site Name	Owner	Arrival Date	Distance	Travel Time (days)	Apparent Velocity
Grass Valley PW-1	**10/1/2010**	**Phloxine B**	**17 kg (37.4 lb)**		
K20	Johnson	11/03/2010	0.7 mi (1.1 km)	33	106 ft/d (33 m/d)
K18	Johnson	02/08/2011	0.5 mi (0.8 km)	130	20 ft/d (6 m/d)
K09	Johnson	03/23/2011	0.4 mi (0.7 km)	173	12 ft/d (4 m/d)
K54	Morgan	05/20/2011	0.9 mi (1.4 km)	231	20 ft/d (6 m/d)
K17	EAA	07/19/2011	0.4 mi (0.6 km)	291	7 ft/d (2 m/d)
K55	Morgan	01/10/2012	1.2 mi (2.0 km)	466	14 ft/d (4 m/d)
K29	Schuster	02/06/2012	9.6 mi (15.4 km)	493	102 ft/d (31 m/d)
K30	Schuster	02/06/2012	8.0 mi (12.8 km)	493	85 ft/d (26 m/d)
K04	Cates	02/07/2012	2.0 mi (3.3 km)	494	22 ft/d (7 m/d)
K15	Davis	03/06/2012	2.3 mi (3.7 km)	522	23 ft/d (7 m/d)
K05	Bowen	04/12/2012	2.7 mi (4.3 km)	559	25 ft/d (8 m/d)
K38	Rehmann	05/15/2012	2.0 mi (3.2 km)	592	18 ft/d (5 m/d)
KC03	Fort Clark MUD	06/01/2012	12.1 mi (19.4 km)	609	105 ft/d (32 m/d)
K16	DeGeorge	07/10/2012	7.0 mi (11.2 km)	648	57 ft/d (17 m/d)
K26	Beard	07/10/2012	8.7 mi (14.0 km)	648	71 ft/d (22 m/d)
K36	Shank	09/18/2012	3.0 mi (4.9 km)	718	22 ft/d (7 m/d)
K13	Davis	09/18/2012	1.2 mi (2.0 km)	718	9 ft/d (3 m/d)
K94	Murphey	09/18/2012	10.4 mi (16.8 km)	718	77 ft/d (23 m/d)
KC05	City of Brackettville	10/05/2012	11.4 mi (18.4 km)	735	82 ft/d (25 m/d)
K82	Brown	11/14/2012	4.4 mi (7.0 km)	775	30 ft/d (9 m/d)

*Tentative detection.

(continued from p. 41)

10 ft (3.0 m) in water level at the Tularosa Well, and Las Moras Springs discharge increased approximately 30 cfs (0.8 m3/s) in response to the rainfall. Dye from Pratt's Sink had been detected at few monitoring sites until the July 2013 sampling round, when it was detected in charcoal detectors at more than 20 sites. Most of the charcoal detectors had been placed at the sites on March 19, 2013. Although Eosin was also injected into HF&F Cave, Pratt's Sink was probably the source for this Eosin because it was detected at sites that are upgradient from HF&F Cave, such as Alamo Village Well (KIN028) and sites near the West Nueces River. The detections indicated that dye had traveled west, east, south, and southeast to monitoring sites between May and early July 2013.

Grass Valley PW-1 Results

Phloxine B dye was injected into Grass Valley PW-1 Well on October 1, 2010, and was detected in 20 monitoring sites (Table 10, Figure 33). It was detected after 33 d at nearby well K20 (Johnson house well). Dye was also detected in three other nearby wells, K08, K09, and K18, which are monitoring wells EW-1, EW-2, and EW-4, respectively, in fewer than 200 d. In contrast, dye was never detected at K19, which is identified as

(continued on p. 46)

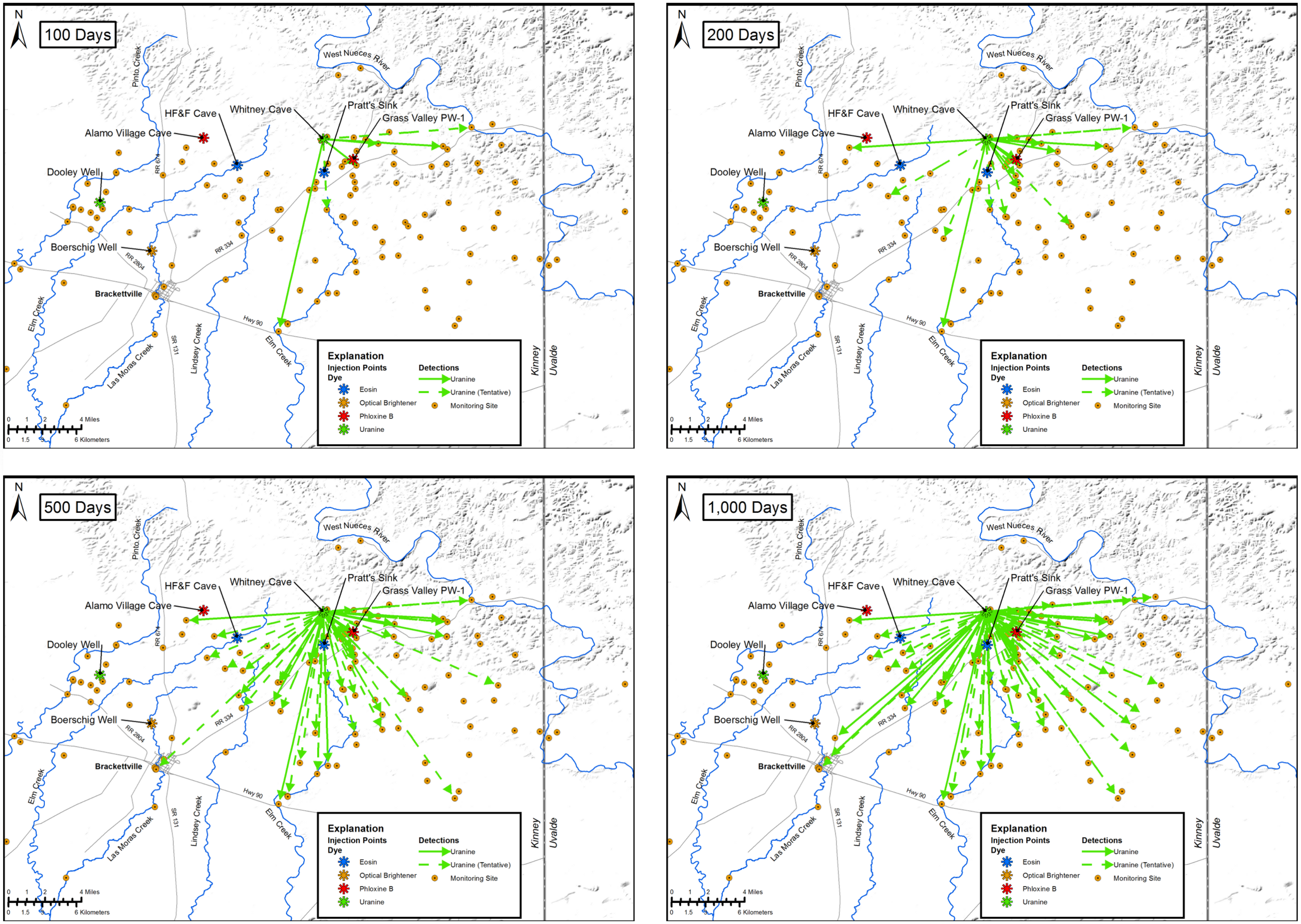


Figure 30. Detections after 100, 200, 500, and 1,000 Days following Whitney Cave Injection (10/1/2010)

(continued from p. 44)

"EW-5" by the owner. Apparent velocities were less than 100 ft/d (30 m/d). It traveled to EAA's Tularosa Well (K17) in 291 d, which is less than 1 mi from PW-1. Subsequent detections occurred more than a year later at wells southwest and southeast of the injection point. However, the southeastern detections were tentative. It was detected at the Fort Clark MUD Well (KC03) 609 d after injection and tentatively detected at the City of Brackettville well after more than two years (735 d). The detections form a radial pattern similar to those of detections of Uranine from Whitney Cave (Figure 30), although detections of Phloxine B from PW-1 were significantly fewer. Dye was barely detectable in a charcoal receptor from PW-1 when sampling ended in October 2013.

Boerschig Irrigation Well (2008 and 2012)

Purpose

The purpose of the tracer tests involving the Boerschig Irrigation Well was to investigate groundwater flowpaths to Las Moras Springs and Fort Clark MUD and City of Brackettville wells. Although the optical brightener tracer test in 2007 showed a connection, EAA wanted to obtain a detailed breakthrough curve from analyses of fluorescent dye in water. Three additional tracer tests were attempted with this well as an injection point: Eosin in 2008 and two injections of Sulforhodamine B (SRB) in 2012. Table 6 lists the injection dates and tracers.

Setting

As described earlier, the Boerschig Irrigation Well, completed in the Edwards Aquifer, is located approximately two mi northwest of Brackettville and approximately 4.5 mi northwest of Las Moras Springs. Locations are shown in Figure 20.

Injections

The Eosin injection on December 15, 2008, consisted of 2 kg (4.4 lb) of Eosin, followed by 6,000 gal (22,700 L) of flush water from the City of Brackettville. Sampling was focused on Las Moras Springs and Fort Clark MUD wells. Las Moras springflow ranged from 13 to 16 cfs during the tracer test. It was the second injection involving Eosin in the study area since it had been injected into HF&F Cave in April 2007. Any residual Eosin in the groundwater system would have been unlikely to interfere with this test because background water and charcoal receptor samples from the City of Brackettville Well and Las Moras Springs collected prior to the injection contained no detectable Eosin.

A mass of 8.0 kg (17.5 lb) SRB was injected into the Boerschig Well on May 16, 2012, and it was detected at all three principal monitoring sites. Las Moras springflow decreased from 15 to approximately 3 cfs during the two months following injection. On September 18, 2012, the test was reproduced to determine whether changes in flowpaths or time of travel as a result of decreasing aquifer levels and spring discharge were significant. A mass of 8.0 kg (17.5 lb) SRB was injected, followed by 5,700 gal (21,580 L) of flush water from the City of Brackettville. Although a small amount of residual SRB was in the groundwater system, we expected that additional SRB from the second injection would be identifiable by higher concentrations. Because of the limited number of fluorescent dyes suitable for tracer tests, repetitive injections with the same dye are common practice.

Results

No Eosin from the December 15, 2008, injection was detected at any of the monitoring sites when monitoring ended in February 2009. Negative results may mean that insufficient dye was used, the monitoring period was too short, or the dye traveled outside of the monitoring network. The most likely cause of negative results is insufficient dye volume because Tinopal CBS-X traveled from the Boerschig Well to Las Moras Springs and the City of Brackettville Well in 15 d or less in 2007. The Eosin dye was probably diluted below detection limits.

The SRB dye that was injected on May 16, 2012, was successfully detected at Las Moras Springs and the City of Brackettville Well as described next (Figure 34). However, water samples displayed fluorescent peaks at wavelengths of approximately 520 nm, which were shorter than the wavelength of the laboratory standard of

(continued on p. 50)

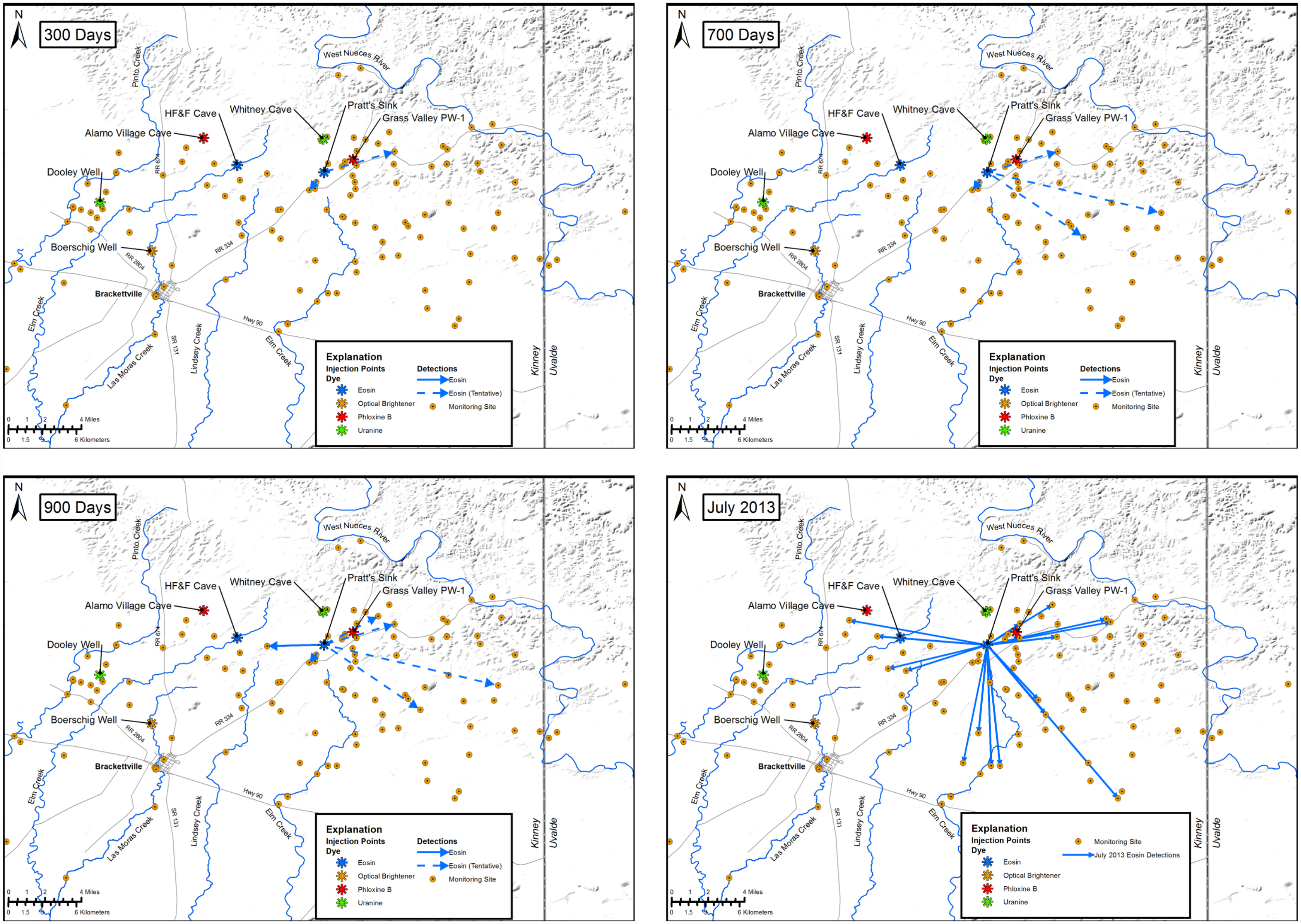


Figure 31. Detections after 300, 700, 800, and 900 Days following Pratt's Sink Injection (10/1/2010)

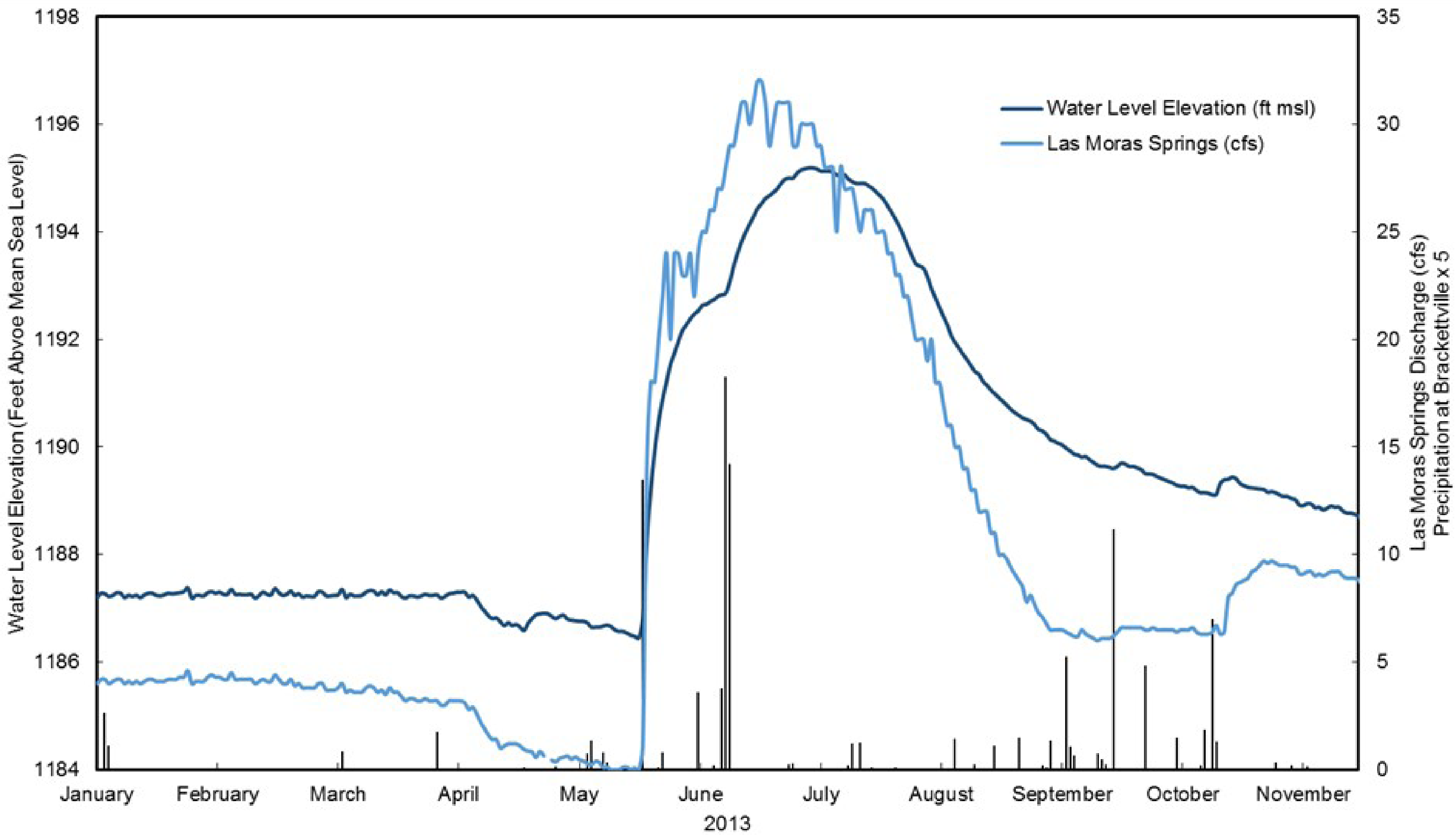


Figure 32. Water Level Elevation at Tularosa Road Well in 2013

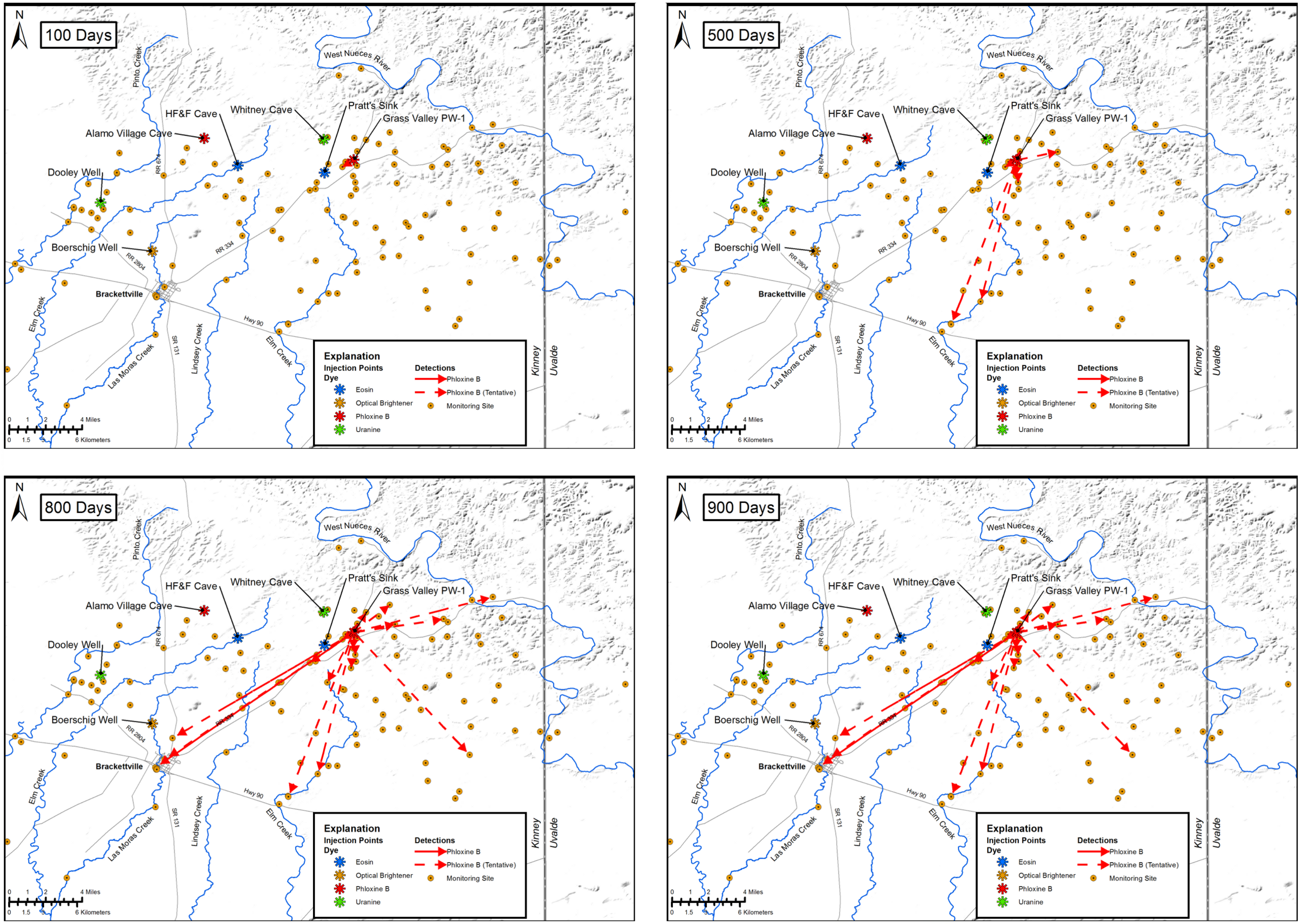


Figure 33. Detections after 100, 500, 800, and 900 Days following Grass Valley PW-1 Injection (10/1/2010)

(continued from p. 46)

approximately 567 nm. SRB was degraded by a process called *deaminoalkylation*, which results in fluorescence at a shorter wavelength than in unaltered SRB normal (Käss, 1998). Craig Glenn et al. (2012) described the effect while tracing with SRB, and Idstein and Ewers (2002) observed the effect using Rhodamine WT. Consequently, results (Table 11) are for dye detections at approximately 520 nm, which will be considered a surrogate for unaltered SRB, because no fluorescent peaks were detected at 567 nm.

SRB was detected at Las Moras Springs three d after injection for an apparent velocity of 4,458 ft/d (1,367 m/d). It was detected at the City of Brackettville Well five d after injection, for an apparent velocity of 2,176 ft/d (660 m/d). The breakthrough curve for SRB at Las Moras Springs and the City of Brackettville Well is shown in Figure 35. Only raw intensities are shown because no standards are available for 520 nm. Breakthrough curves for the SRB tracer tests are typical for quantitative tracer tests. Dye concentrations rise quickly to a maximum and then decrease somewhat more slowly, indicating limited mixing (dispersion) with groundwater. SRB amplitudes were approximately ten times higher at Las Moras Springs than for samples from the City of Brackettville Well. The slightly longer flowpath to the springs probably diluted the dye. It persisted at Las Moras Springs through May 2012 and at the City of Brackettville well until July 2012 but was detectable only in charcoal receptors. However, a charcoal receptor collected in October 2012 contained a trace amount of SRB. The dye arrived at the Boerschig Windmill adjacent to the injection well in fewer than 57 d, but no samples were collected before that time. SRB was tentatively detected in Las Moras Creek at Standard Road and Las Moras Creek at Red Bridge, consistent with discharge of SRB from Las Moras Springs.

SRB injected on September 18, 2012, was not detected at Las Moras Springs or at the City of Brackettville Well. A few samples from Fort Clark MUD wells contained SRB, and it persisted until monitoring ended in October 2013. Las Moras Springs discharge ranged from one to four cfs during the tracer test beginning in September 2012, which means that groundwater levels were also generally lower than those of the previous injection in May 2012. Perhaps changes in the groundwater system due to the lower water levels caused detections at Fort Clark MUD wells but prevented dye from reaching Las Moras Springs and the City of Brackettville Well. Changes in flowpaths based on aquifer conditions are well documented in the karst literature.

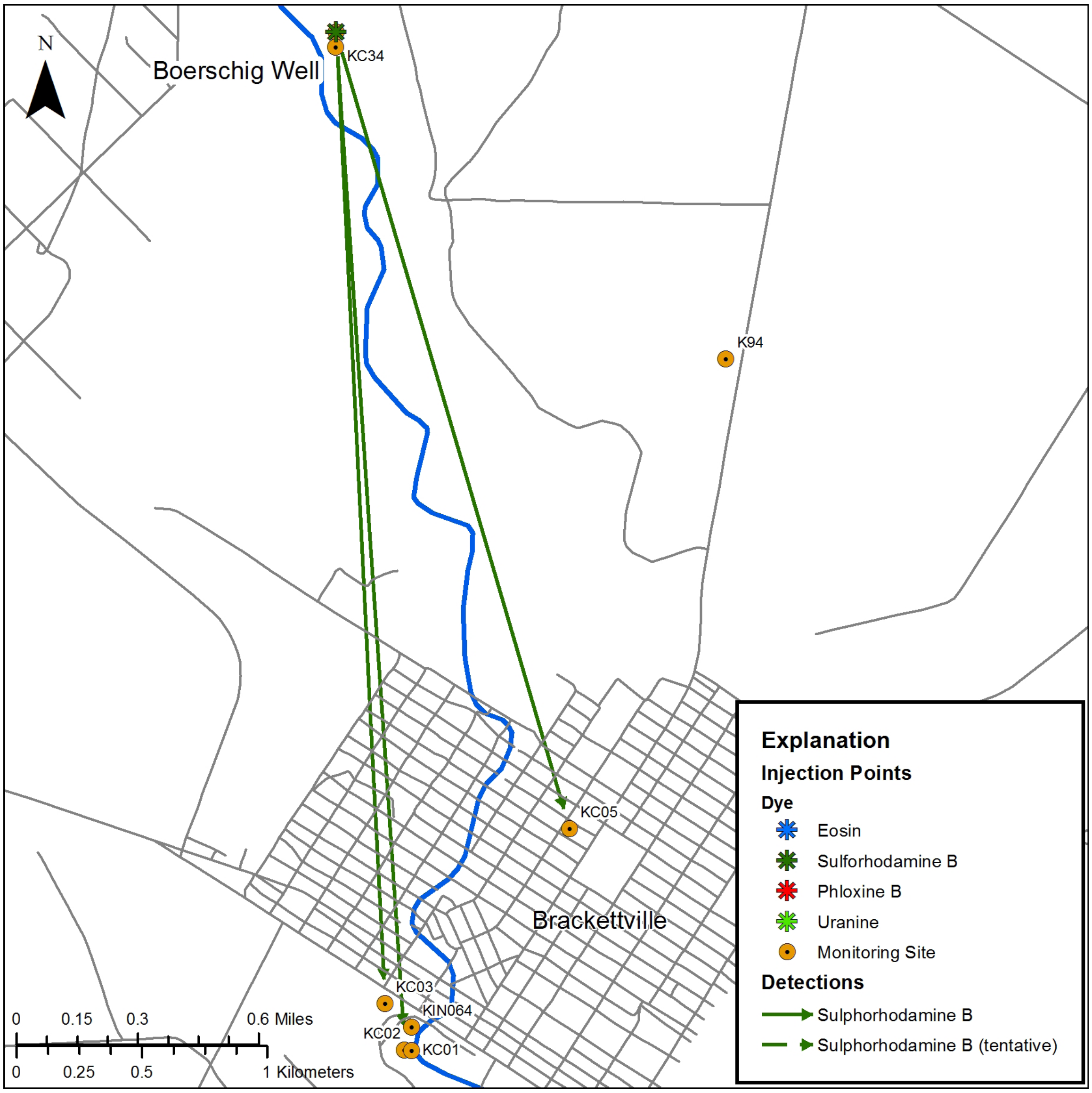


Figure 34. Boerschig Irrigation Well Injections

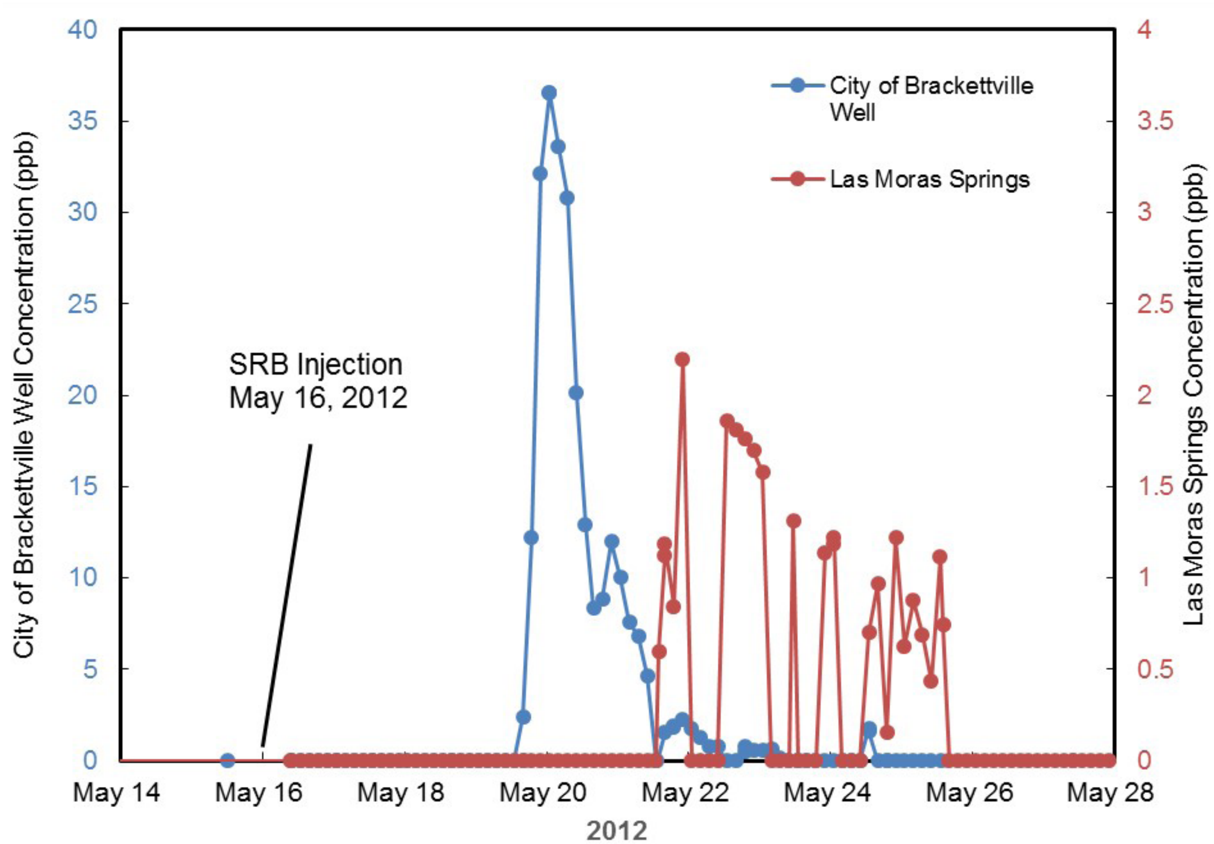


Figure 35. Breakthrough Curve in Water for Las Moras Springs and City of Brackettville Well after Boerschig Irrigation Well Injection (5/16/2012)

Table 11. First Arrival Times for Boerschig Irrigation Well Tracer Tests (2008 and 2012).

Monitoring Site Name	Owner	Arrival Date	Distance	Travel Time (days)	Apparent Velocity
Boerschig Irrigation Well	**12/15/2008**	**Eosin**	**2 kg (4.4 lb)**		
Boerschig Irrigation Well	**5/16/2012**	**Sulforhodamine B**	**8.0 kg (17.5 lb)**		
KC02	Las Moras Springs	05/19/2012	2.5 mi (4.1 km)	3	4,458 ft/d (1,367 m/d)
KC05	City of Brackettville	05/21/2012	2.1 mi (3.3 km)	5	2,176 ft/d (660 m/d)
KIN045[1]	Las Moras Creek at Red Bridge	05/23/2012	4.6 mi (7.4 km)	7	3,453 ft/d (1,057 m/d)
KC34	Boerschig Windmill	07/12/2012	0.06 mi (0.1 km)	57	4 ft/d (2 m/d)
KC03	Fort Clark MUD	09/17/2012	2.4 mi (3.9 km)	124	103 ft/d (31 m/d)
K99[1]	Las Moras Creek at Standard Road	03/19/2013	9.4 mi (15.1 km)	307	162 ft/d (49 m/d)
Boerschig Irrigation Well	**Sulforhodamine B**	**9/18/2012**	**8.0 kg (17.5 lb)**		
KC03	Fort Clark MUD	09/28/2012	2.4 mi (3.9 km)	10	1,267 ft/d (386 m/d)

[1] Tentative detection.

GROUNDWATER COMPOSITION IN KINNEY COUNTY

We evaluated analyses of groundwater samples collected by EAA since 2005 and historical groundwater samples collected by others to gain further insight into the groundwater system in Kinney County. Besides EAA, groundwater samples have been collected by the USGS and TWDB from the Edwards Aquifer and other aquifers since 1937, for a total of 537 analyses. The most frequently sampled locations are Las Moras Springs (RP-70-45-501), Fort Clark MUD wells, City of Brackettville wells, the TxDOT rest stop well (RP-70-46-901), and a brackish water well (RP-70-45-401) near Hwy 90. This section describes groundwater compositions in Kinney County on the basis of water quality analyses. Appendix B lists all analyses used in this study.

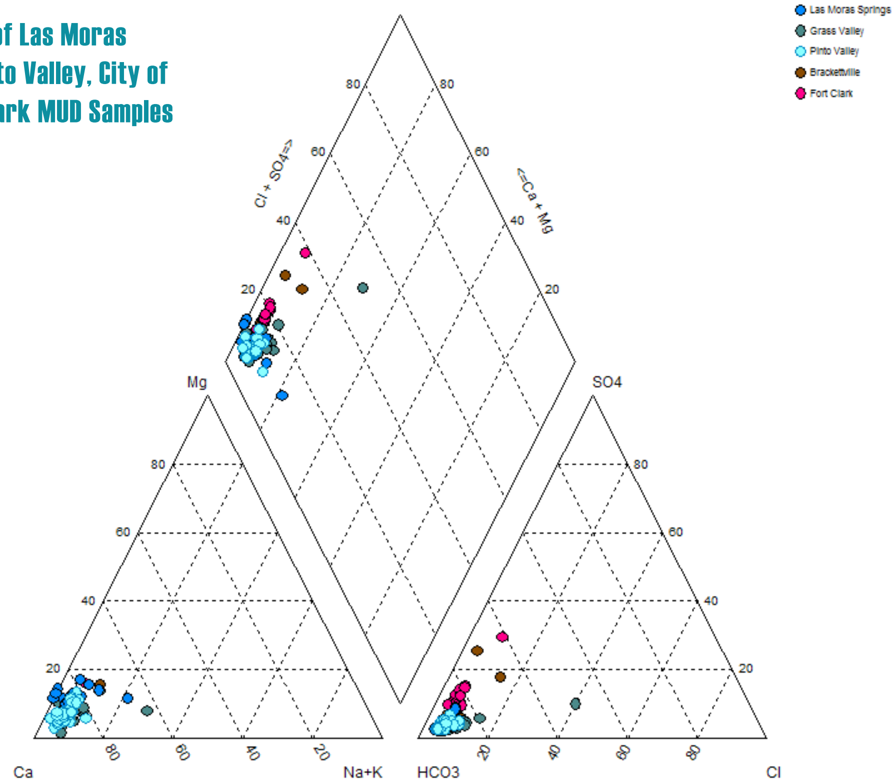
Groundwater quality in Kinney County ranges from fresh in the recharge zone and artesian zone to brackish in the artesian zone south of Hwy 90. The brackish water area is also referred to as the saline water zone. Fresh groundwater is generally classified as a calcium-bicarbonate type, which is typical of the Edwards Aquifer. However, proportions of anions and cations vary according to geologic setting, groundwater flowpaths, groundwater residence time, and other influences. As groundwater flows through the aquifer, it dissolves anions and cations, changing its composition, and variations of groundwater composition can complement tracer-test results to help identify groundwater flowpaths.

The groundwater flowpaths of most interest connect recharge areas of the county near the West Nueces River with the discharge areas in Pinto Valley and at Las Moras Springs, including the City of Brackettville and Fort Clark MUD wells. Recharge groundwater composition is defined by samples collected from wells in the Grass Valley area and other wells near the West Nueces River, which is assumed to be the primary source of recharge for the county. Rain falling directly onto the Edwards Limestone outcrop is another important source of recharge in the county. Pinto Valley groundwater composition is defined by samples from Pinto Springs and wells at nearby ranches, such as Shahan, Mariposa, Davis, McDaniel, Dooley, and others.

Figure 36 is a Piper diagram of Las Moras Springs, City of Brackettville, Fort Clark MUD, Grass Valley, and Pinto Valley samples. A Piper (or trilinear) diagram plots the concentrations of major anions and cations in milliequivalents per liter to show relationships among the samples. Samples that plot close together have similar compositions with respect to major anions and cations. In this case, Pinto Springs and Grass Valley samples have similar compositions, classified as strongly calcium-bicarbonate types, and plot in the extreme lower left-hand corner of the triangles. They are similar to other groundwater samples from Pinto Valley. In contrast, Las Moras Springs, City of Brackettville, and Fort Clark MUD well samples show more variability because of relatively higher magnesium (Mg), sulfate (SO4), and chloride (Cl) concentrations, which move the sample markers toward the apex of the Piper triangle away from the Pinto Springs samples. Although groundwater generally originates from the West Nueces River, the differences in composition are evidence that the Pinto Springs water has followed a different flowpath than from that of the other samples. In addition, the linearity of the trend between the Pinto Springs samples and the other samples is probably a mixing line. That is, all samples had an original composition similar to that of Pinto Springs, which is typical of the Edwards Aquifer, and sample compositions from Las Moras Springs and Brackettville and Fort Clark wells are the result of subsequent mixing with other groundwater or dissolving anions from sediments along their flowpaths.

Strontium and magnesium differentiate groundwater types in Kinney County. For example, Las Moras Springs water and Brackettville Well water contain similar concentrations of calcium and magnesium, although Brackettville Well water contains higher concentrations of strontium. Las Moras Springs water contains slightly higher concentrations of magnesium than Pinto Valley groundwater. Figure 37 compares calcium concentrations with molar ratios of magnesium/calcium and strontium/calcium for Las Moras Springs, Grass Valley, Pinto Valley, City of Brackettville, and Fort Clark MUD samples. The ratios suggest that Pinto Valley, Grass Valley, and Las Moras Springs waters are similar with respect to magnesium, but differ on the basis of strontium. Brackettville and Fort Clark groundwater compositions differ from the others because of their higher strontium concentrations. These results suggest

Figure 36. Piper Diagram of Las Moras Springs, Grass Valley, Pinto Valley, City of Brackettville, and Fort Clark MUD Samples



that groundwater from Las Moras Springs and City of Brackettville and Fort Clark MUD wells has traveled through a pathway in which it dissolved strontium. Pinto Valley groundwater probably flows largely through the Salmon Peak Formation, whereas groundwater issuing from Las Moras Springs and the Brackettville and Fort Clark wells probably flows through the Salmon Peak Formation, as well as other formations, such as the McKnight Formation and West Nueces Formation, and igneous intrusions, possibly at greater depths. The only exception is water from RP-70-37-706 in Pinto Valley, which has a composition similar to the City of Brackettville wells. TxDOT well water composition is more similar to Pinto and Grass valley water than the City of Brackettville, although one of the samples was an outlier.

Another technique for characterizing groundwater composition is principal components analysis (PCA), which groups samples on the basis of one or more principal components. Each principal component or factor is made up of one or more selected geochemical parameters that create a fingerprint for each sample. The principal components reveal correlations among the samples. For Kinney County groundwater and spring water samples, most of the variance among samples is reflected by calcium, magnesium, and strontium concentrations. Consequently, principal components may be calculated by weighting concentrations of these three ions in a way that maximizes their differences. Then the principal components may be mapped to show the geographical relationships of groundwater compositions in Kinney County.

The same five groups of samples just described were analyzed using PCA: Las Moras Springs, Grass Valley area wells, Pinto Springs and Pinto Valley area wells, City of Brackettville wells, and Fort Clark MUD wells. Calcium, magnesium, and strontium concentrations account for approximately 85% of the variance of the samples (Table 12). Factor 1 is weighted with approximately equal percentages of calcium and magnesium concentrations, and Factor 2 is weighted almost entirely by strontium concentrations (Table 13). Spatially, Factor 1 displays the most contrast among the five groundwater sample groups as shown in (Figure 38). The blue area near the West Nueces River, represented by Grass Valley wells, reflects relatively high calcium/low magnesium concentrations, and it extends southward into Pinto Valley and the Brackettville area. This area corresponds to the embayment described by Green et al. (2006). According to tracer-test results,

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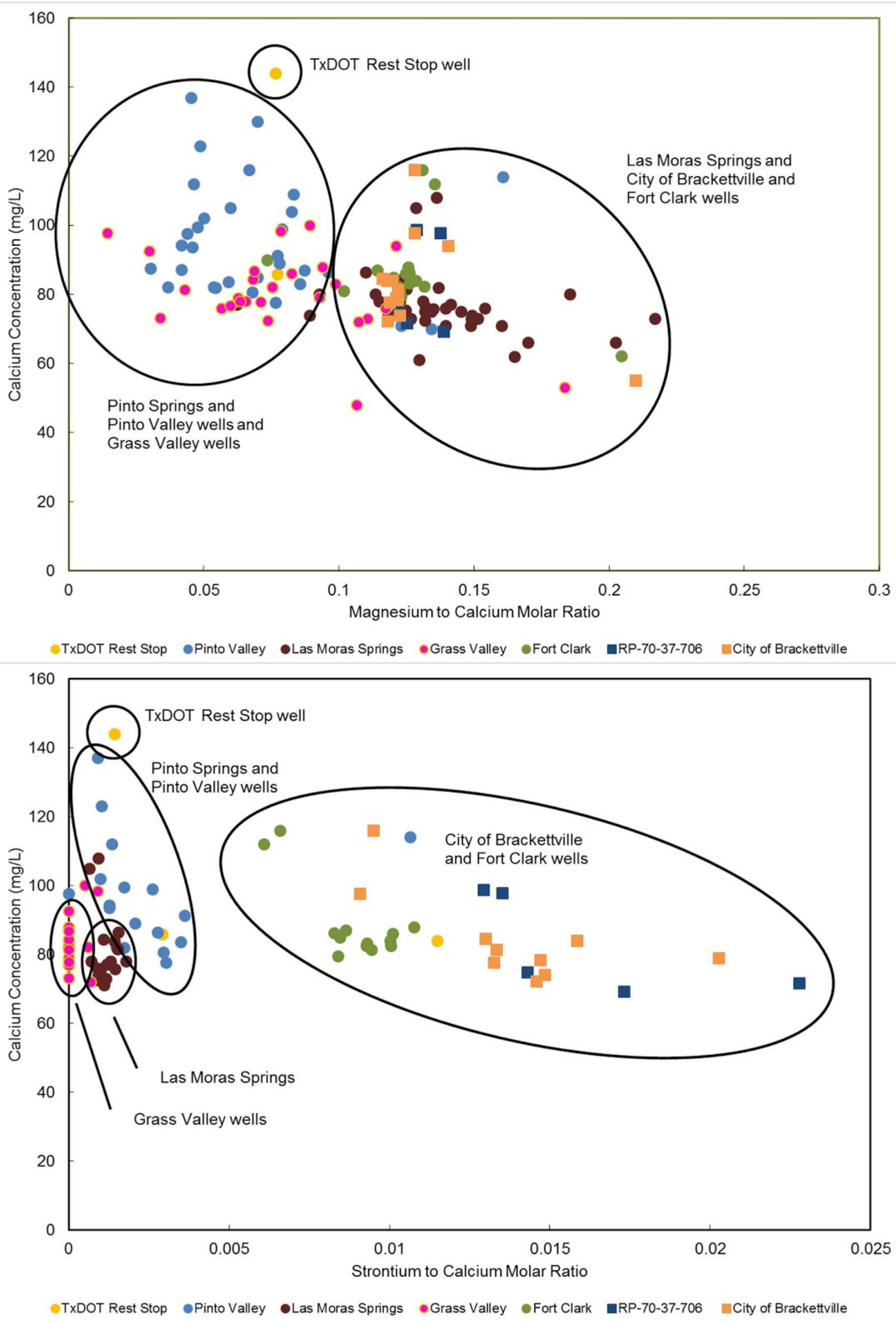

Figure 37. Relationship of Calcium Concentrations to Molar Ratios of Magnesium/ Calcium (Upper) and Strontium/Calcium (Lower) for Las Moras Springs, Grass Valley, Pinto Valley, City of Brackettville, and Fort Clark MUD Samples

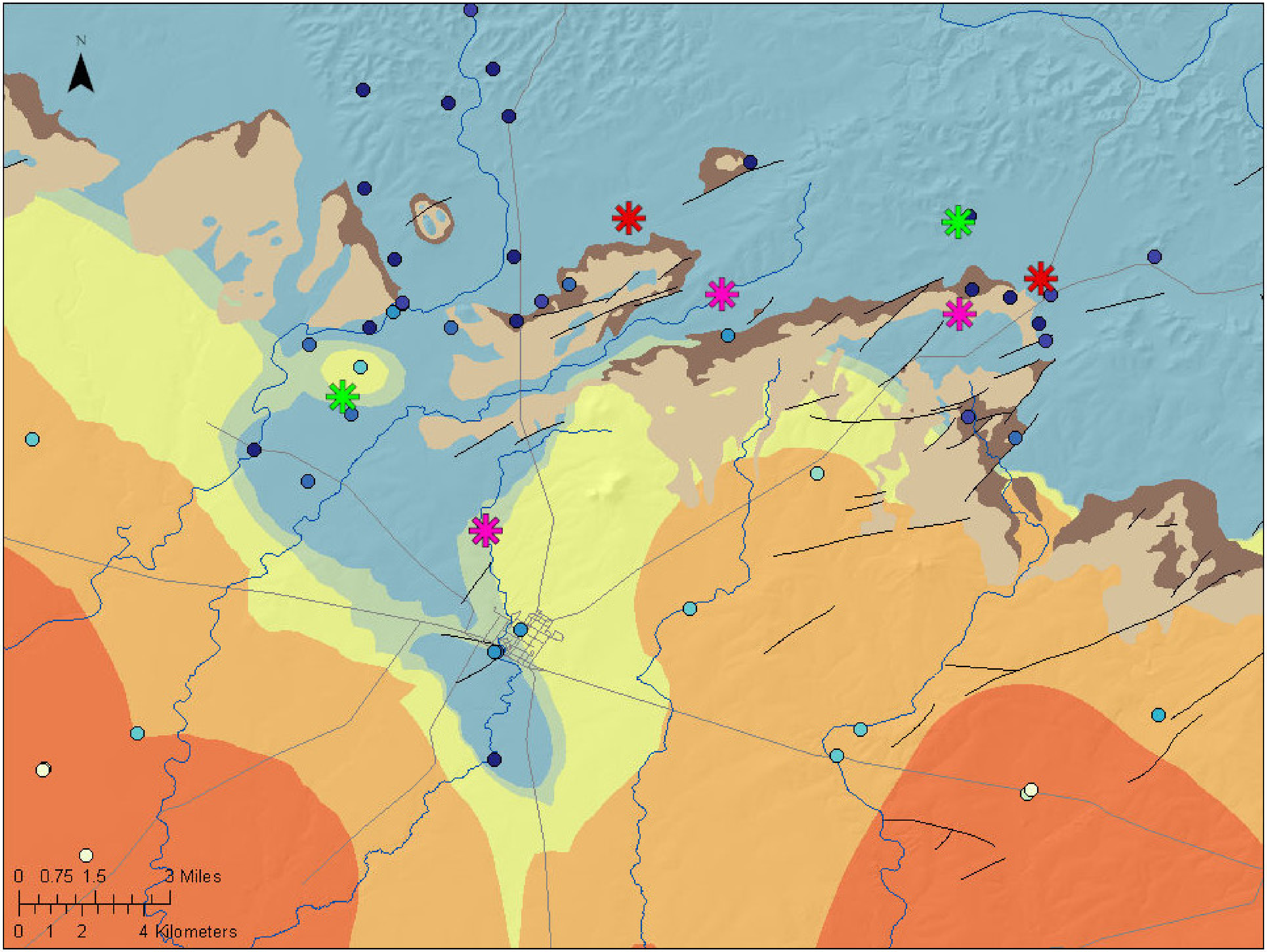

Figure 38. Groundwater Composition Defined by PCA Factor 1 (Calcium, Magnesium, and Strontium)

Table 12. Variance Explained by Each Factor.

Factor	Variance	Percent	Cumulative Percent
Factor 1	1.5372	51.240	51.24
Factor 2	1.0193	33.975	85.22

Table 13. Varimax Factor Loading for Magnesium, Calcium, and Strontium.

Row	Factor 1	Factor 2
Magnesium	0.8516	0.2012
Calcium	0.8910	0.0499
Strontium	0.1341	0.9881

(continued from p. 54)

groundwater flows both eastward and westward in this area. Yellow areas reflect relatively higher magnesium concentrations and occur immediately south of Grass Valley along RR 334. These areas include Las Moras Mountain and other igneous intrusions. The boundary between the two areas parallels the Balcones fault strike, as shown by the outcrops of Del Rio Clay and Eagle Ford Limestone, and the saline water line. The yellow areas are probably zones of lower permeability resulting from the presence of igneous intrusions or structural features, and contact time between groundwater and rock formations is longer, increasing concentrations of magnesium, strontium, and other ions. In some areas, mixing may be occurring between groundwater from the Salmon Peak and underlying formations (West Nueces and McKnight) that contain higher concentrations of anions and cations.

GROUNDWATER FLOWPATHS IN KINNEY COUNTY

Groundwater flow in Kinney County is controlled by rock formations, geologic structure, hydraulic gradients, and permeability. Subsurface information gathered for this study included hydrogeologic characteristics of the units that are present in the county, water levels, water quality analyses, and tracer test results. All of these sources of information are drawn from to describe groundwater flowpaths in Kinney County.

In general, information collected to date by EAA and other investigators supports the concept of a groundwater pool in Kinney County separate from Uvalde County, which was advanced by Green et al. (2006). The Kinney County pool was defined by Green et al. (2006) by the groundwater divide on the west between Mud Springs and Pinto Springs, on the east by low-permeability rocks near the Kinney/Uvalde county line, and on the north by the north edge of the recharge zone. According to groundwater composition, the southern boundary of the Kinney County pool is maintained by an upward hydraulic gradient that causes groundwater to upwell from the Edwards Aquifer into overlying aquifers.

Within the pool, evidence suggests three primary groundwater flowpaths originating near the West Nueces River. One flowpath carries groundwater east toward Uvalde County, a second carries groundwater west toward Pinto Springs and Pinto Valley, and the third flowpath carries groundwater south toward Las Moras Springs. The flowpaths are shown in Figure 39 and will be described in detail.

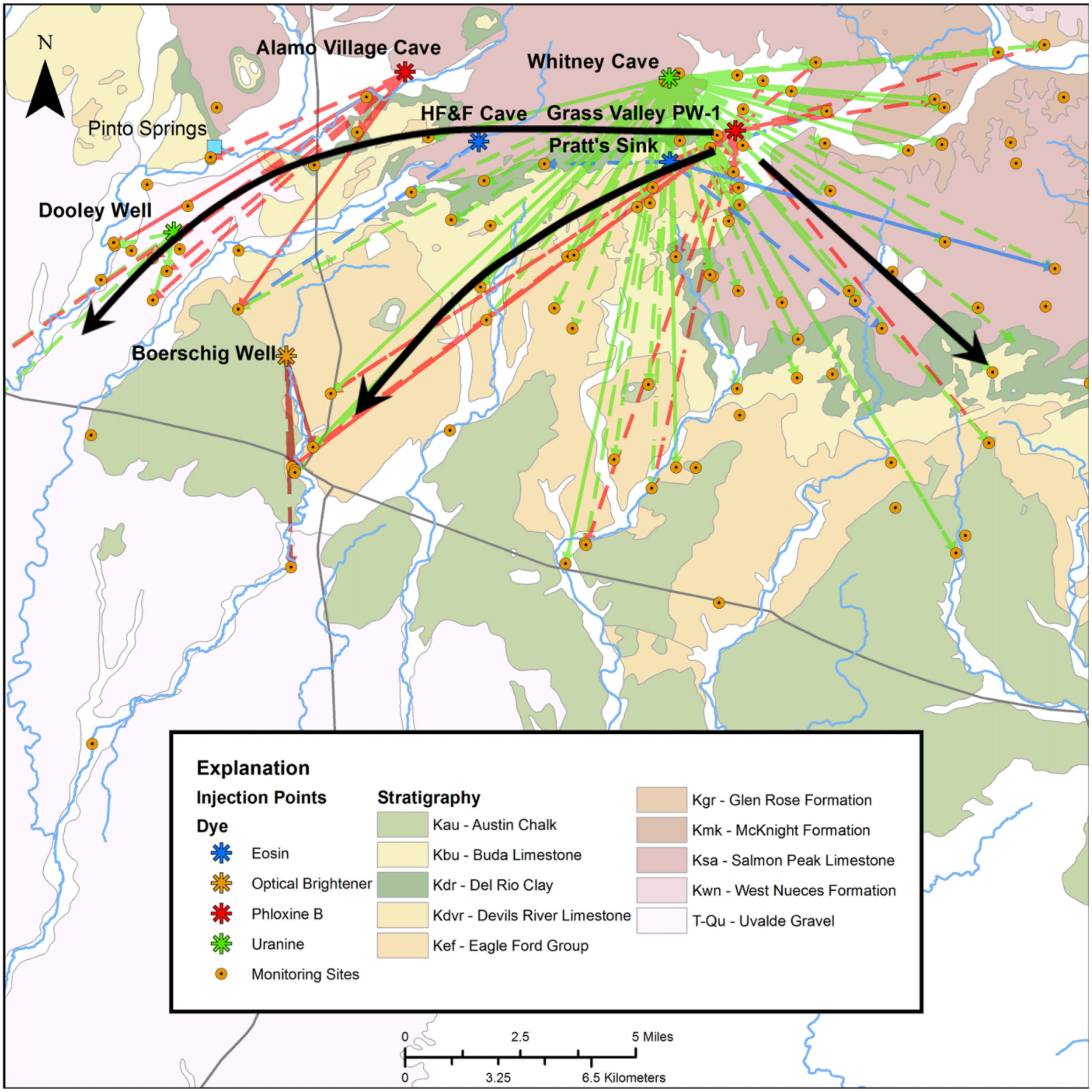

Figure 39. Groundwater Flowpaths (black arrows) Interpreted from Tracer Tests

FLOWPATHS TOWARD PINTO SPRINGS

Water infiltrates from the West Nueces River into a structural embayment (Green et al., 2006) in the Salmon Peak Limestone. Groundwater flows westward, as indicated by results of the Whitney Cave tracer test. Groundwater velocities were relatively slow to the Alamo Village Well (KINO28; <200 ft/d; <60 m/d) because the hydraulic gradient is relatively flat.

Alamo Village Cave tracer-test results indicate that groundwater flows southwestward from the embayment to Pinto Springs (KC07 in Figure 20) and other nearby wells. Pinto Springs and other downstream springs, such as Blue Hole near the Robinson Ranch, also feed Pinto Creek. Like other tracer-test results, groundwater flowed slowly (<50 ft/d; <15 m/d) from Alamo Village Cave to Pinto Springs and points on Pinto Creek. Igneous intrusions near Las Moras Mountain may reduce the permeability of the aquifer and divert groundwater flow to the west. In addition, the traces were conducted during a period of diminished rainfall, a factor which may have decreased groundwater velocities. Results of the PCA analyses also corroborate this flowpath (Figure 38). Groundwater probably flows counter clockwise around the igneous intrusions represented by Las Moras Mountain.

Tracer-test results suggest that groundwater flow in Pinto Valley is controlled by discrete flowpaths because of the few monitoring sites that intercepted dye. Samples from K64 (Robinson Ranch Well) contained strong concentrations of Uranine from the Dooley Well between 208 and 2011, but a single sample each from K62 (McDaniel Ranch) and K63 (Davis Ranch) contained weak concentrations of dyes from Alamo Village Cave (Phloxine B) and Dooley Well (Uranine). Samples from K66 (Robinson Spring) contained strong concentrations of Phloxine B from Alamo Village Cave.

FLOWPATHS TOWARD LAS MORAS SPRINGS

Results of the Whitney Cave tracer test indicate that groundwater flows from the embayment area toward the south. Dye from Whitney Cave was detected at K53 (TxDOT well) approximately 89 d after the injection, representing an apparent velocity of more than 600 ft/d (>183 m/d), and persisted there until sampling ended in 2013. It was the fastest apparent velocity measured during any tracer test, perhaps reflecting the approximately 140 ft (43 m) head difference between that of the Whitney Cave area and that of the well. Uranine was subsequently detected at several other monitoring points south of the cave (Figure 30). Phloxine B from the Grass Valley Well was also tentatively detected south of the injection point.

Although the Whitney Cave tracer test established southward groundwater flowpaths, only results of the tracer test at the Boerschig Well on May 16, 2012, provided compelling evidence of flowpaths to Las Moras Springs. Although many samples contained SRB from that injection, only one sample after the September 18, 2012, test contained SRB. The head difference between the Boerschig Well and the Brackettville area is less than five ft (1.5 m), and because it decreased between May and September 2012, the hydraulic gradient may have been insufficient to induce groundwater flow to the springs, or travel times and dilution were greatly depressed.

Uranine from Whitney Cave and optical brightener from the Boerschig Well were only tentatively detected at Las Moras Springs. The Uranine was attributed to Whitney Cave instead of the Dooley Well because (1) the Whitney Cave injection occured closer in time to that of the detections than to that of the Dooley Well injection, (2) Las Moras Springs groundwater composition is different from Pinto Valley groundwater, (3) the groundwater flowpath from Whitney Cave was probably influenced by the southerly trending anticlines and igneous intrusions, and (4) a correlation exists between

Las Moras Springs discharge and Tularosa Well water levels. Therefore, available evidence suggests that the principal recharge area for Las Moras Springs is the structural embayment area (Green et al., 2006) near Grass Valley and Whitney Cave. The flowpath, however, is probably relatively deep through the Edwards Aquifer, and, if so, groundwater travels approximately 200 ft/d to Las Moras Springs—an approximation calculated from the Whitney Cave tracer test.

As described earlier, deep flowpaths may also connect City of Brackettville and Fort Clark wells to the embayment area, given groundwater compositions. Several samples from KC05 (City of Brackettville Well) contained Uranine from Whitney Cave, suggesting a preferential flowpath, although apparent velocities were less than 100 ft/d (<30 m/d). Like Las Moras Springs, Whitney Cave was deduced to be the origin of the Uranine rather than the Dooley Well because of timing of the injection, geologic structure, and groundwater composition. Water from the City of Brackettville Well contained higher concentrations of strontium and magnesium, differentiating it from that of Pinto Valley. KC05 (City of Brackettville Well) also tentatively intercepted Phloxine B from the Grass Valley Well.

FLOWPATHS TOWARD UVALDE COUNTY

Results of the Whitney Cave tracer test indicate groundwater flowpaths to the east toward Uvalde County. Although few wells were available for monitoring points, multiple detections occurred at K43 (West Nueces River), K17 (Tularosa Well), K81 and K82 (Brown), K04 (Cates), K16 (DeGeorge), K13, K14, and K15 (Davis Ranch), and K83 (Clark Ranch). The highest apparent velocity was approximately 500 ft/d (150 m/d) between Whitney Cave and the West Nueces River.

CONCLUSIONS

Tracer tests completed by EAA between 2007 and 2012, combined with other groundwater information, have helped to identify and refine groundwater flowpaths in Kinney County. The tracer tests were characterized by few detections, low concentrations, and relatively slow apparent velocities. Although EAA collected and analyzed over 8,000 samples, only 697 samples contained dye. Results were influenced partly by hydrogeologic conditions in Kinney County and partly by the drought that began soon after the tracer tests were initiated. The drought lowered groundwater gradients, slowed groundwater velocities, and reduced springflow, which in turn limited dye movement. The rain events during May and June 2013 indicate how wet conditions can mobilize dye.

Using the tracer-test results and other information, the conceptual model of the groundwater system in Kinney County can be characterized by the following attributes:

- Principal sources of recharge are infiltration from the West Nueces River, followed by direct precipitation on the Edwards Limestone.
- Water from the West Nueces River enters a structural embayment in the Salmon Peak Limestone.
- Groundwater flows eastward from the embayment toward Uvalde County, westward toward Pinto Springs, and southward through deeper flowpaths in the Salmon Peak and possibly the McKnight and West Nueces formations. As it moves southward, groundwater either dissolves ions or mixes with groundwater from other formations, according to samples from Las Moras Springs and City of Bracketville and Fort Clark MUD wells.
- Groundwater moving westward through the embayment issues from Pinto Springs and recharges Pinto Valley. Eventually, it flows southward and upwells into rock units overlying the Edwards Aquifer, such as the Austin Chalk. It appears to be isolated from Las Moras Springs by a structural depression.
- The recharge area for Las Moras Springs appears to be the embayment near the West Nueces River. Evidence for this conclusion consists of limited dye detections from Whitney Cave, geochemical contrasts with Pinto Valley groundwater, geologic structure that promotes southward flow, and no detections of dye from the Dooley Well in Pinto Valley.
- The tracer tests were not designed to determine occurrence or volume of interformational flow between the Edwards Limestone or units both above or below.

ACKNOWLEDGMENTS

The Edwards Aquifer Authority thanks private well owners in Kinney County who allowed access to their wells, the Kinney County Groundwater Conservation District, the Fort Clark MUD, and the City of Brackettville. The data we collected from your wells and springs were important to enable us to better protect and manage the Edwards Aquifer. EAA is indebted to Dr. Joe Goebel for obtaining access to many wells, accompanying EAA staff on sampling rounds, and providing valuable water level measurements.

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APPENDIX A. Edwards Aquifer Authority QC/QA Manual for Tracer Testing

February 2012

These Quality Control/Quality Assurance (QC/QA) protocols were prepared to define field and laboratory operations and methods for the performance of tracer testing of groundwater in karst terranes using fluorescent dyes. The operations and procedures contained in this manual define a very high standard of data collection. However, depending on the data quality objectives of the project, the user may determine that some of the QC/QA methods are not necessary.

A 1.0 SAMPLING PROCEDURES

The initial field investigation for tracer test studies will be conducted by an Edwards Aquifer Authority (EAA) hydrogeologist experienced in the identification of karst features. Work will be supervised by EAA's Chief Technical Officer. The hydrogeologist doing the initial field investigation will also place the background charcoal detectors and oversee other personnel in the collection and replacement of charcoal detectors.

A 1.1 PROCEDURES FOR SAMPLING GROUNDWATER AND SURFACE WATER FOR DYE

Water samples may be collected for direct analysis of dye or in support of data from passive charcoal detectors. Water samples from springs and surface streams will be collected by submerging a laboratory-supplied container directly into the water. The clean sample bottle will be rinsed with sample water before being used to collect a sample for analysis. When a sample is collected from a spring or stream, the container will be held upstream of the sampler and oriented in an upstream direction during sample collection.

Samples from groundwater monitoring wells will be collected with precleaned, dedicated PVC or Teflon bailers or a dedicated submersible pump. Prior to sampling, the water level in the well will be determined with an electronic water level meter, fiberglass tape, or steel tape and recorded in a field book. Date, time, location, tracing project name, and other relevant field data will be recorded in a field book. Groundwater will not be purged from the well before the sample is collected.

Table A-1 lists the sample containers, preservatives, holding times, and conditions for groundwater and eluent samples. Only new sample containers will be used for sample collection. For each shipment of containers received, blanks will be taken from the lot and analyzed for the presence of dye. Results will be reviewed before any containers from the lot are used.

All sample containers will be stored in an area isolated from the extraction laboratory. Trip blanks for dye will also be prepared in this area.

TABLE A-1

REQUIRED CONTAINERS, SAMPLE STORAGE TECHNIQUES, AND RECOMMENDED HOLDING TIMES

Parameter	Sample Container	Sample Storage/Preservation	Recommended Maximum Holding Times
Uranine (Sodium Fluorescein) (Acid Yellow 73)	13-mm glass bottle with screw top lid or 50-mL plastic culture tube with screw top lid	Store in dark at four° C	six months
Rhodamine WT (Acid Red 388)	13-mm glass bottle with screw top lid or 50-mL plastic culture tube with screw top lid	Store in dark at four° C	six months
Sulforhodamine B (Acid Red 52)	13-mm glass bottle with screw top lid or 50-mL plastic culture tube with screw top lid	Store in dark at four° C	six months
Eosin (Acid Red 87)	13-mm glass bottle with screw top lid or 50-mL plastic culture tube with screw top lid	Store in dark at four° C	6 months
Phloxine B (Acid Red 92)	13-mm glass bottle with screw top lid or 50-mL plastic culture tube with screw top lid	Store in dark at four° C	six months
Optical Brightener Solophenyl (Direct yellow 96) Blankophor (F.B.A. 28) Tinopal CBSX (F.B.A. 35)	13-mm glass bottle with screw top lid or 50-mL plastic culture tube with screw top lid	Store in dark at four° C	six months

A 1.2 PROCEDURES FOR USE OF CHARCOAL DETECTORS

Dye receptors (detectors) consisting of granular-activated coconut carbon (charcoal) will be used to adsorb dye present in surface or groundwater. Approximately 20 grams of charcoal will be placed in a packet constructed from nylon screen mesh or a milk filter sock and placed in springs, cave streams, surface streams, and monitoring wells. Charcoal is used to adsorb Uranine, Rhodamine WT, Sulforhodamine B, Phloxine B, and Eosin.

Charcoal detectors will be suspended in a surface stream, spring, or cave stream using a wire, string, pins, and/or weight. The detectors will be placed so that they are exposed to any flow that may be present. A rock, brick, or concrete weight (gum drop) will be used to help maximize the volume of water flowing through the packet and secured with dark-colored nylon string to a nearby tree, tree root, rock, or pin. The dark-colored string is used to blend with the surroundings and help to minimize tampering.

The placement of charcoal detectors in monitor wells will also utilize the packet but will be weighted using new glass marbles to submerge the charcoal detectors below the surface water.

For sampling water wells, a PVC pipe will be fitted with a hose for attaching to a faucet. The PVC pipe will be constructed such that it will allow placement of a nylon screen packet within the pipe that will channel flow through the packet.

A 1.3 PROCEDURES FOR USE OF UNBRIGHTENED COTTON

Charcoal detectors consisting of unbrightened cotton, polyethersulfone (PES) film, or other absorbent media will be used to absorb dyes and brightening agents—specifically, Direct Yellow 96 and F.B.A. 28 and F.B.A. 351. A piece of cotton or filter media will be placed in a nylon screen mesh packet and suspended in water as described in Section A1.2.

A 2.0 SAMPLE CUSTODY

A 2.1 FIELD COLLECTION AND SHIPMENT

When samples are transferred/shipped from the field, they will be accompanied by chain-of-custody records. The records will include signatures of the relinquisher and the receiver, date and time of the exchange, and any pertinent remarks. Sample chain-of-custody forms are shown in Figures A-1 and A-2 at the end of this QA/QC document.

During sample collection, the following procedures will be observed:

- To maintain validity of the sample, on-site procedures will be reviewed prior to arrival in the field.
- Sample handling will be minimized in order to reduce the chance of error, confusion, and damage.
- Sample bags will be marked in the field with waterproof ink to prevent misidentification due to illegible labels.
- The shipping container will be either padlocked or secured with a tamperproof seal.

Samples will be shipped in one of the following ways so that safeguards in chain of custody can be observed:

- Hand carried and delivered.
- Registered mail, so that a return receipt can be requested and available for documentation.
- Common carrier, so that a bill of lading can serve this purpose.
- Air freight collect, for complete documentation.

Samples collected in the field under supervision of EAA's staff for field analysis will contain a sample identification form but will not require a chain-of-custody form. All samples determined to be hazardous, according to the U.S. Department of Transportation (U.S. DOT) (49 CFR Section 172.1 or 49 CFR 173.3), will be shipped in strict accordance with U.S. DOT regulations.

A 2.2 DOCUMENT AND SAMPLE CONTROL

A field log book will be maintained by the sampler as a permanent record of all activities relating to the collection of a sample. Information included in the log book will include a list of those responsible for a sample, the date collected, a description of the location, a sample number, and the testing objective. The log book will also include data on the weather at the sampling time and location and other related field conditions. If the field book is lost or damaged, its loss will promptly be reported to the EAA's Chief Technical Officer. This procedure will also be used for field-data and in-house records. Table A-2 presents a list of specific information that will be recorded at the time a sample is collected.

A sample log book will also be maintained by the sample custodian as a permanent record of all activities relating to receipt and disposition of the sample. Information in the log book will include initials of sampler, sample number and location, date collected, date received, project, and testing parameters.

Identification of samples will be serialized in an alpha-numeric system consistent with the procedures of the study. If a sample is contaminated, it is to be disposed of properly and noted in the log book. Similarly, if a sample is lost, the sampler will document the loss and promptly notify the EAA's Chief Technical Officer. Tags or labels affixed to the sample will include all of the information listed above and the sample number.

A 2.3 PACKAGING

Sample packaging for shipment is done such that, under normal handling, there is no release or damage of charcoal detectors, effectiveness of the packing is not reduced, and there is no internal mixing of substances. The procedures followed to achieve these objectives are:

- The volume of the sample will be limited to the quantity needed for analysis.
- Plastic containers will be used whenever possible. The plastic container will be protected from puncture. If glass containers are used, the glass will be well cushioned.
- Screw lids will be used whenever possible.
- Charcoal and cotton detectors will be placed in sealed plastic bags with a minimal volume of air.

TABLE A-2

SAMPLE INFORMATION

IN SITU SAMPLES, if collected (e.g., temperature, conductivity)	
DATA in LOG BOOK	**project name or code**
	identification number
	location name
	date
	time
	sampler(s) initials
	field observations—weather, problems, etc.
	remarks
	value of parameters measured
TRANSPORTED SAMPLES	
DATA on TAGS or LABELS	**all above information**
	split sample/duplicate
	sample/blank

A 2.4 SAMPLE RECEIPT

Upon receipt, the sample custodian will follow these procedures:

- If samples have been damaged during shipment, the remaining samples will be carefully examined to determine whether they were affected. Any affected samples will also be considered damaged. It will be noted on the chain-of-custody record that specific samples were damaged and that the samples will be removed from the analytical schedule.
- Samples received will be compared against those listed on the chain-of-custody form.
- The chain-of-custody form will be signed and dated and attached to the waybill.
- Samples will be entered in the sample log book, containing the following information:
  - Project identification
    - Sample numbers
    - Sample location name
    - Type of samples
    - Date and time sampled
    - Date and time received
- The samples will be placed in adequate storage.
- The appropriate project manager will be notified of sample arrival.
- The completed chain-of-custody records will be placed in the project file.

If samples arrive either without a chain-of-custody record or with an incorrect chain-of-custody record, the following procedure will be undertaken by the sample custodian:

- If the chain-of-custody form is incorrect or incomplete, a memorandum to the project manager and field personnel will be prepared, stating the inaccuracy and necessary correction. The memorandum must be signed and dated by the person originating the chain-of-custody form. The memorandum serves as an amendment to the chain-of-custody form. If the information on the chain-of-custody form cannot be corrected by the project manager or field personnel, the affected samples will be removed from the analytical schedule.
- If the chain-of-custody record is not shipped with the samples, field personnel will be contacted and a memorandum prepared, listing the persons involved in collection, shipment, and receipt, as well as the times, dates, and events of such. Each person involved must sign and date this memorandum. The completed memorandum will be maintained in lieu of the chain-of-custody record.

A 2.5 SAMPLE STORAGE

Water samples will be stored in a secure area in the dark unless signed out for analysis by analytical personnel.

A 2.6 CUSTODY DURING TESTING PROGRAM

When chain-of-custody samples are being analyzed or processed, they will be signed out by the appropriate analyst. The individual performing the tests becomes responsible for the samples at that point. The samples will be maintained within sight or in the secure possession of the individual performing the test. When the work is complete, the samples will be returned and logged in to secure them in the proper storage location. During processing, the sample may be split into several fractions, depending on the analysis required. The chain-of-custody record remains intact, however, for all sample fractions with the corresponding sample number.

After the analytical results have been reported, the chain-of-custody samples remain secured in storage. Restricted access to these samples is maintained.

A 3.0 CALIBRATION PROCEDURES

A 3.1 LABORATORY INSTRUMENTS

The following procedures will be followed for calibration of laboratory instruments:

A 3.1.1 Filter Fluorometer

The filter fluorometer is standardized for the parameter of interest by the analysis of calibration standards prepared by diluting a stock solution of known concentration. Five working standards are prepared from the stock solution with concentrations that cover the working range of the instrument. Subsequently, all measurements are made within this range. After the working standards are prepared, instrument response is calibrated to provide a direct readout. The calibration curve is completed by plotting instrument response versus concentration (in µg/L) of the parameter being analyzed. The calibration curve is verified by analyzing a midpoint standard. For the filter fluorometer, the accuracy checks must conform to within 20%.

Once the filter fluorometer has been initially calibrated, check standards are analyzed every twentieth sample to confirm the initial calibration curve. A typical analysis sequence is as follows:

- Working standards are prepared by dilution of a stock standard solution of the parameter of interest.
- A calibration curve is established within the working range of the instrument by analysis of five calibration standards.
- Samples are analyzed for the parameter of interest.
- During sample analysis, a calibration check standard is analyzed every twentieth sample to monitor instrument stability. If analysis indicates that instrument calibration is not within 20%, the instrument is recalibrated, and analysis is repeated.

- Following completion of the sample analysis, the calibration check standard is reanalyzed to confirm instrument calibration.

If calibration is confirmed (within 20%), the analysis is complete. However, if calibration is not confirmed, the instrument may be recalibrated, and the analysis should be repeated.

A 3.1.2 Luminescence Spectrometer (Perkin Elmer LS-50B)

The luminescence spectrometer is standardized for the parameter of interest by an analysis of calibration standards prepared by diluting a stock solution of known concentration. Four or five working standards are prepared from the stock solution with concentrations that cover the working range of the instrument. Subsequently, all measurements are made within this range. After the working standards are prepared, instrument response is calibrated to provide a direct readout. The calibration curve is completed by plotting instrument response versus concentration (in μg/L) of the parameter being analyzed. The calibration curve is verified by analyzing a midpoint standard. For the luminescence spectrometer, accuracy checks must conform to within 20%.

Once the luminescence spectrometer has been initially calibrated, check standards are analyzed approximately every twentieth sample to confirm the initial calibration curve. A typical analysis sequence is as follows:

- Working standards are prepared by dilution of a stock standard solution of the parameter of interest.
- A calibration curve is established within the working range of the instrument by the analysis of five calibration standards.
- Samples are analyzed for the parameter of interest.
- During sample analysis, a calibration check standard is analyzed every twentieth sample to monitor instrument stability. If the analysis indicates that instrument calibration is not within 20%, the instrument is recalibrated, and the analysis is repeated.

- Following completion of the sample analysis, the calibration check standard is reanalyzed to confirm instrument calibration.

If calibration is confirmed (within 20%), the analysis is complete. However, if calibration is not confirmed, the instrument may be recalibrated, and the analysis should be repeated.

A 4.0 QUALITY CONTROL SAMPLES

A 4.1 TRIP BLANKS

A trip blank for water samples will consist of dye-free distilled water that is placed in a sample bottle before fieldwork. Trip blank water will have been tested and shown to be negative for the presence of fluorescent dyes. The purpose of the trip blank is to test for the inadvertent presence of contamination by dye. A trip blank will accompany field personnel during all charcoal detector collection activities. A trip blank will not be used for activated carbon (charcoal) or unbleached cotton detectors.

All water samples will be collected in plastic or glass containers. A prepared trip blank will utilize the same type of container as is used for water sampling.

A 4.2 FIELD BLANKS

A field blank for water will be obtained by pouring dye-free distilled water into a sample bottle in the field at the first site sampled. One field blank will be collected for each sampling event. The field blank will be used to test for the presence of airborne dye particles as tracer injection artifacts.

A 4.3 CONTROL BLANKS

A control blank for activated charcoal will consist of an activated-charcoal detector that has been placed in a spring or well located in an area out of the influence of the tracer test. The control blank will have been placed during the previous sampling round and will be collected at the start of the current sampling round. Doing so assures that the control blank will be handled and treated like other charcoal detectors. This protocol better replicates field conditions, thus achieving one of the purposes of using blanks and enhancing the QC/QA program. The term *control blank* is used because, strictly speaking, it is neither a trip blank nor a field blank. A control blank will be utilized during the entire tracer test and will be collected during each charcoal detector collection event.

A 4.4 FIELD REPLICATES

A field replicate is a second water or charcoal sample collected from a location that is monitored as part of a tracer testing program. The field replicate must be placed, collected, and analyzed exactly like the original sample from the site. Replicate samples should be collected from one site in 20 that will be analyzed for the tracer test.

A 4.5 PREPARATION BLANKS

Eluent is used in the extraction of dye from charcoal. Preparation blanks consist of eluent solution that is analyzed before the elution is performed, ensuring that dye in the eluent is not an artifact from the eluent and making it possible to prevent contamination before it occurs. A preparation blank will be prepared for each batch of eluent solution used.

A 4.6 METHOD BLANK

Distilled water is analyzed so that it can be shown that the dye signal indicated is not a property of water itself. It will be analyzed once for every 20 samples.

A 4.7 LAB CONTROL STANDARDS

Lab control standards consist of serial dilutions by mass of a known concentration of dye. Five working standards are prepared from a stock solution. Concentrations of the calibration standards are chosen to cover the working range of the instrument. Subsequently, all measurements are made within this range. After the working standards are prepared, instrument response is calibrated to provide a direct readout. The calibration curve is verified by plotting instrument response versus concentration (in µg/L) of the parameter being analyzed. The calibration curve is verified by analyzing a midpoint standard. Lab control standards indicate that the instrument is capable of detection of at least the lowest standard concentration of dye if it were present.

Method blanks (distilled water) and lab control standards for each dye expected to possibly be in the samples are analyzed before and after a set of samples. A lab control standard for each expected dye is also analyzed after every 20 samples.

A 4.8 TEMPERATURE CONTROL

Air temperature will be recorded at the beginning and end of each dye analysis session because some dyes have a thermal coefficient of fluorescence of three %. Standard calibration for this particular dye can be adversely affected by ambient temperature.

A 4.9 DYE ABSORPTION/ELUTION VERIFICATION

A protocol will be followed for one sample of activated charcoal from each batch used in this investigation. The protocol has been developed to verify that the activated charcoal is capable of absorbing and eluting dye. The proposed procedure for testing the adsorption capacity for each lot of activated charcoal consists of the following steps:

- Tap water will be used to prewash approximately 40 grams of charcoal for three hours at about 0.25 gallon per minute (gpm) using a charcoal-holding device that forces all water to flow through charcoal.
- The charcoal will be split into halves.
- Half of the charcoal will be eluted using the standard procedure and the eluent analyzed for Uranine. The eluent will be analyzed to establish that there is no dye-like fluorescence compound in the charcoal.
- The remaining 10 grams of charcoal will be placed in a nylon mesh bag and suspended in a 1,000-mL beaker containing 250 mL of a 100-ppb solution of Uranine in water. The beaker will be fitted with a magnetic stirring device and stirred for one hour on a low setting.
- The remaining charcoal will be eluted using the standard procedure and analyzed for Uranine.
- Concentration of Uranine, if present, will be reported.

A 4.10 MATRIX SPIKES FOR CHARCOAL

The following protocol will be followed for one sample of activated charcoal for each sampling event using charcoal. The protocol has been developed to verify that the activated charcoal is capable of adsorbing and eluting dye after placement and recovery from the field. The procedure is proposed for testing the adsorption capacity after sample collection. If, after elution and analysis, no dye is detected, then the sampling event has the possibility of creating a false-negative result. Testing of charcoal using the matrix spike method is as follows:

- One charcoal packet that had been placed in the field for dye monitoring will be selected for a matrix spike and matrix spike duplicate. The packet will be rinsed with tap water for 30 to 60 seconds using a charcoal-holding device that forces water to flow through the charcoal to remove sediment.
- The charcoal will be split into halves.
- Half of the charcoal will be eluted using the standard procedure and analyzed for Uranine.
- If analysis indicates that there are no dye-like fluorescent compounds in the charcoal, the other half of the charcoal may be used for MS/MSD testing. If Uranine compounds are detected, another charcoal packet will be chosen.
- The remaining charcoal will be placed in a nylon mesh bag and suspended in a 1,000-mL beaker containing 250 mL of a 100-ppb solution of Uranine in water. The beaker will be placed on a magnetic stirring device and stirred for one hour on a low setting.
- The charcoal will then be eluted using the standard procedure and analyzed for Uranine.
- The concentration of Uranine will be reported, if present.

A 4.11 MATRIX SPIKES AND MATRIX SPIKE DUPLICATES FOR WATER

The following protocol will be followed for each sampling event in which water is collected and analyzed for the detection of fluorescent dyes. The protocol has been developed to determine whether the matrix interferes with the ability to detect fluorescent dyes in water. If the matrix interferes with the ability to detect fluorescent dyes, then the sampling event has the possibility of creating a false-negative result. The procedure for testing for matrix interference of water is as follows:

- Two additional water samples will be collected from a spring or well during each sampling event for matrix spike and matrix spike duplicate analyses.
- Each sample will be analyzed for the presence of fluorescent dyes.
- If the analysis indicates that there are dye-like fluorescent compounds in the water samples, the concentration will be recorded.
- A known volume of each sample will be measured and placed in a separate clean glass container with an equal volume of a known standard. The known standard will be a dye that is being considered or used in the tracer test. Each sample will then be analyzed for the presence of fluorescent dyes and the concentrations recorded. If fluorescent dyes were present in the original samples, a volume-adjusted concentration will be added to the calculated concentration.
- Each sample will be analyzed for the presence of fluorescent compounds.
- The first sample will be designated the matrix spike. The matrix spike should be between 30 and 170% of the calculated concentration of the sample.
- The second sample will be designated the matrix spike duplicate. Results of the analysis of the matrix spike duplicate will be recorded. The relative percent difference (RPD) of the matrix and matrix spike duplicate will be calculated using the following formula: $C_1 – C_2$/Average (C_1, C_2). The RPD should be less than 50%.

Figure A-1: Automatic Water Sampler Tracking Form

Tracking # EAA-WS-0051

EAA Tracer Project, 2006: Water Samples

Segment:		
Crew:		
Collection Date(MM/DD/YY)		
Location Name: ISCO Sampler ID #:		
Start time/date:		End Time/Date:
Water Level		Other comments:
Grab Sample?	Datum Type: ͥ Top of Well ͥ Staff Gauge	

Bottle #	Sample date (MM/DD/YY)	Sample Time	Other Comments
1	/ /		
2	/ /		
3	/ /		
4	/ /		
5	/ /		
6	/ /		
7	/ /		
8	/ /		
9	/ /		
10	/ /		
11	/ /		
12	/ /		
13	/ /		
14	/ /		
15	/ /		
16	/ /		
17	/ /		
18	/ /		
19	/ /		
20	/ /		
21	/ /		
22	/ /		
23	/ /		
24	/ /		
25	/ /		duplicate from bottle #:
26	/ /		rinsate with DI water
27	/ /		stock (tap water used for rinsing)
28	/ /		Trip blank (stock DI water poured up on site)

*Chain-of-Custody information should have signature, date and time

relinquished by:	received by:
relinquished by:	received by:
relinquished by:	received by:
relinquished by:	received by:
relinquished by:	received by:

Figure A-2: Charcoal Detector Sampler Tracking Form

Figure A-2: Charcoal Detector Sampler Tracking Form

Tracking # EAA-CD-0005

EAA Tracer Project, 2003: Charcoal Detectors

Segment: ☐ San Marcos ☐ Comal ☐ Hueco ☐ Other	
Crew:	
Collection Date(MM/DD/YY)	
Start time/date:	End Time/Date:
Datum Type Options (for below) **Top of Well** or **Staff Gauge**	

Location	**Grab Sample**	**In date (MM/DD/YY)**	**Out Time/ Date (MM/DD/YY)**	**Water Level**	**Datum Type**	**Other Comments**
Blank						blank detector

*Chain-of-Custody information should have signature and date

relinquished by:	received by:
relinquished by:	received by:
relinquished by:	received by:
relinquished by:	received by:

APPENDIX B. Water Quality Analytical Results

Table B-1. Field measurements from wells and streams in Kinney County.

Sample Name	Sample Date	Sample Time	Site Name	Field Temperature (°C)	Field Conductivity (µS/cm)	Field pH	Field Dissolved Oxygen (mg/L)	Field Alkalinity (mg/L)	Turbidity (NTU)
Dos Angeles at Fields Ranch	12/17/2008	11:29	Dos Angeles at Fields Ranch	24.20	327	6.43	1.90	286	NA
KCGWD Observation Well	10/16/2007	12:30	KCGWD Observation Well	25.10	517	NA	NA	213	0.25
RP-70-28-3PI	07/28/2005	11:30	Price Ranch	23.50	432	7.16	NA	193	0.77
RP-70-29-101	06/29/2005	16:10	Kickapoo Cavern State Park	24.20	398	6.79	3.86	180	1.11
RP-70-36-2EW	07/28/2005	14:40	Earwood	25.70	514	6.71	NA	237	0.11
RP-70-37-502	06/30/2005	12:25	Shahan Ranch	24.60	468	7.11	NA	207	1.33
RP-70-37-706	07/29/2005	11:15	Mariposa Ranch	28.00	426	7.25	3.30	205	0.10
RP-70-37-706	12/07/2006	10:50	Mariposa Ranch	27.79	299	7.14	3.97	194	0.12
RP-70-37-706	10/16/2007	11:00	Mariposa Ranch	26.30	452	7.31	NA	100	0.00
RP-70-37-706	12/17/2008	15:00	Mariposa Ranch	26.51	399	7.32	3.17	202	0.22
RP-70-37-810	08/25/2004	16:30	Shahan Mill #1	24.50	520	7.13	NA	226	0.18
RP-70-37-8DW	12/17/2008	12:35	Dooley Middle Well	14.84	469	7.02	31.20	241	NA
RP-70-37-903	06/30/2005	15:30	Shahan Ranch	25.70	450	7.06	1.40	218	1.06
RP-70-38-8MC	11/09/2011	10:25	Tularosa Ranch (KIN043)	23.70	375	7.36	NA	193	0.40
RP-70-38-902	12/18/2006	14:25	Tularosa Well	24.56	382	6.57	6.59	194	1.38
RP-70-38-902	08/03/2012	10:20	Tularosa Well	25.90	405	7.25	5.06	190	0.75
RP-70-38-902	08/02/2013	10:45	Tularosa Well	25.60	414	7.22	5.21	190	1.07
RP-70-38-9AD	10/11/2011	12:20	Agua Dulce Ranch (K54)	23.90	437	6.00	NA	224	28.60
RP-70-38-9BS	10/11/2011	10:30	Shank Ranch (K36)	23.60	436	6.00	NA	206	2.21
RP-70-38-9BS	09/18/2012	9:45	Shank Ranch (K36)	24.70	1463	7.74	5.42	209	1.14
RP-70-38-9EW	06/18/2010	12:30	Grass Valley (EW-5)	25.00	402	7.08	NA	192	1.90
RP-70-38-9GV	07/28/2005	16:25	Grass Valley (EW-1)	31.50	421	7.16	NA	209	0.11
RP-70-38-9HC	10/11/2011	13:05	Helen Cates (K4)	24.50	436	6.00	NA	NA	1.77
RP-70-38-9JM	10/11/2011	11:55	Agua Dulce Ranch (K54)	24.50	395	6.00	NA	210	0.97
RP-70-38-9SH	10/26/2010	11:30	Shank Ranch (K35)	24.90	326	6.60	NA	236	0.39
RP-70-38-9TW	11/01/2010	15:25	Agua Dulce Ranch (K55)	24.70	473	6.60	NA	228	9.65
RP-70-38-9TW	10/11/2011	12:20	Agua Dulce Ranch (K55)	23.90	437	6.00	NA	224	28.60
RP-70-39-5CA	10/26/2010	10:10	Helen Cates	24.80	314	6.60	NA	245	1.40
RP-70-39-5ER	10/26/2010	10:35	Eagle Rock Ranch (K81)	31.60	328	6.60	NA	214	1.42
RP-70-39-7AD	10/26/2010	9:35	Agua Dulce Ranch	23.60	286	6.60	NA	220	0.51

Table B-1. (cont.) Field measurements from wells and streams in Kinney County.

Sample Name	Sample Date	Sample Time	Site Name	Field Temperature (°C)	Field Conductivity (µS/cm)	Field pH	Field Dissolved Oxygen (mg/L)	Field Alkalinity (mg/L)	Turbidity (NTU)
RP-70-39-7CH	11/02/2010	10:25	Clinto Brown (K68)	23.60	436	6.20	NA	228	0.26
RP-70-39-7CW	11/02/2010	10:45	Clinto Brown (K69)	24.00	1628	6.40	NA	190	0.49
RP-70-45-1DF	06/29/2005	12:45	Davis Flowing Well	28.80	257	7.70	3.13	224	0.14
RP-70-45-1DF	12/17/2008	13:05	Davis Flowing Well	27.40	392	7.24	NA	232	0.10
RP-70-45-501	10/23/2007	9:10	Las Moras Springs	22.80	447	NA	NA	184	0.32
RP-70-45-501	12/17/2008	12:05	Las Moras Springs	21.80	383	7.42	NA	213	0.29
RP-70-45-501	07/30/2009	8:40	Las Moras Springs	24.00	437	6.96	NA	217	0.74
RP-70-45-501	06/16/2010	18:00	Las Moras Springs	23.40	403	7.24	NA	224	0.78
RP-70-45-501	10/10/2011	11:20	Las Moras Springs	23.40	397	6.20	NA	208	1.23
RP-70-45-501	08/03/2012	11:20	Las Moras Springs	24.00	427	7.17	5.62	213	0.94
RP-70-45-501	09/17/2012	10:25	Las Moras Springs	23.30	1331	7.28	6.40	NA	0.83
RP-70-45-505	06/29/2005	11:40	Fort Clark MUD	23.30	428	7.12	4.16	200	0.44
RP-70-45-505	12/07/2006	13:45	Fort Clark MUD	24.32	333	7.02	2.77	208	0.09
RP-70-45-505	10/23/2007	10:25	Fort Clark MUD	23.20	502	NA	NA	189	0.02
RP-70-45-505	07/30/2009	9:35	Fort Clark MUD	24.50	484	7.01	NA	224	0.36
RP-70-45-505	06/16/2010	16:20	Fort Clark MUD	24.70	468	6.86	NA	232	1.12
RP-70-45-505	11/08/2011	15:00	Fort Clark MUD	24.60	445	7.16	NA	203	0.38
RP-70-45-505	09/17/2012	9:45	Fort Clark MUD	24.60	1494	7.21	2.76	NA	0.27
RP-70-45-505	09/18/2013	16:12	Fort Clark MUD	24.46	489	7.22	2.63	217	0.16
RP-70-45-601	12/07/2006	14:30	City of Brackettville	24.75	321	7.06	3.24	205	0.08
RP-70-45-601	10/23/2007	10:25	City of Brackettville	24.70	473	NA	NA	202	0.03
RP-70-45-601	07/30/2009	10:25	City of Brackettville	25.10	459	7.01	NA	223	0.68
RP-70-45-601	06/16/2010	15:45	City of Brackettville	25.10	441	7.09	NA	222	0.54
RP-70-45-601	10/10/2011	10:55	City of Brackettville	25.20	425	6.40	NA	214	NA
RP-70-45-601	09/17/2012	11:05	City of Brackettville	24.50	1442	7.22	3.13	NA	0.22
RP-70-45-601	09/18/2013	15:40	City of Brackettville	25.04	470	7.24	2.90	211	0.17
RP-70-45-7LC	06/30/2005	9:55	Lock	26.90	1843	6.84	0.77	347	4.27
RP-70-46-4DH	07/29/2005	14:30	Dr. Halbert House Well	26.40	537	7.12	NA	256	0.13
RP-70-46-5AK	06/17/2010	17:30	Krieger Ranch	25.30	514	7.06	NA	229	3.65
RP-70-46-5AK	10/10/2011	14:40	Krieger Ranch	25.40	471	6.20	NA	226	1.96
RP-70-46-5DS	06/17/2010	14:25	3D Ranch (K29)	25.80	NA	7.79	NA	347	0.80
RP-70-46-802	10/10/2011	17:05	TXDOT Rest Stop (K53)	27.80	225	6.20	NA	225	1.19
RP-70-46-8DS	10/10/2011	15:50	3D Ranch (K29)	26.00	736	6.00	NA	355	1.09
RP-70-47-6GR	06/17/2010	12:30	George Rose Ranch (K26)	25.00	559	6.92	NA	266	0.98
RP-70-47-9GR	11/02/2010	9:20	George Rose Ranch (K28)	22.10	8320	6.40	NA	313	NA

Table B-1. (cont.) Field measurements from wells and streams in Kinney County.

Sample Name	Sample Date	Sample Time	Site Name	Field Temperature (°C)	Field Conductivity (μS/cm)	Field pH	Field Dissolved Oxygen (mg/L)	Field Alkalinity (mg/L)	Turbidity (NTU)
Las Moras Creek at Red Bridge	06/16/10	17:25	Las Moras Creek at Red Bridge	28.7	432	7.82	NA	218	11.1
Pinto Creek at 2804	12/17/08	10:45	Pinto Creek at 2804	12.5	411	8	NA	224	0.47
Pinto Creek at 2804	06/16/10	18:35	Pinto Creek at 2804	31.3	475	7.84	NA	220	3.07
Nueces River at FM 334	05/24/11	16:40	Nueces River at FM 334	32.4	284	7.94	NA	95	0.86
Las Moras Creek at Red Bridge	11/08/11	15:45	Las Moras Creek at Red Bridge	22.5	376	8.11	NA	204	14.9
Pinto Springs at Shahan Ranch	06/30/2005	11:40	Pinto Springs at Shahan Ranch	24.20	492	7.03	2.40	243	4.32
Pinto Springs at Mariposa Ranch	07/29/2005	12:20	Pinto Springs at Mariposa Ranch	27.70	467	8.13	NA	248	5.96
Pinto Springs at Mariposa Ranch	12/17/2008	15:25	Pinto Springs at Mariposa Ranch	21.47	455	7.42	6.65	224	0.47
Pinto Springs at Mariposa Ranch	10/16/2007	11:35	Pinto Springs at Mariposa Ranch	23.30	545	NA	NA	218	0.15
Pinto Springs at Mariposa Ranch	12/07/2006	11:10	Pinto Springs at Mariposa Ranch	21.52	319	7.36	8.06	227	0.15

NA = Not Analyzed

Table B-2. Analytical data for major ions from wells in Kinney County.

Station Name	Date Sampled	Calcium (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Silicon (µg/L)	Sodium (mg/L)	Sulfate (mg/L)	Total Dissolved Solids (mg/L)
Dooley Middle Well	12/17/08	99.5	8.04	<0.50	2.88	0.840	NA	5.80	5.92	247
Dos Angeles at Fields Ranch	12/17/08	745	17.2	2.46	158	13.0	NA	79.0	2490	307
KCGWD Observation Well	10/16/07	114	9.03	0.37J	11.1	1.66	NA	8.57	10.7	360
RP-70-28-3PI	07/28/05	71.7	9.03	<0.50	5.44	0.288	NA	6.00	5.60	260
RP-70-29-101	06/29/05	68.4	8.40	0.142	6.55	0.779	NA	5.31	4.23	NA
RP-70-36-2EW	07/28/05	98.4	10.7	<0.50	4.68	0.435	NA	6.40	5.54	280
RP-70-37-502	06/30/05	82.1	19.5	<0.50	2.67	0.634	NA	8.70	9.73	312
RP-70-37-706	07/29/05	69.2	7.75	<0.50	5.82	<0.166	NA	5.00	9.97	174
RP-70-37-706	12/07/06	98.7	8.38	0.494	7.71	1.23	NA	8.78	10.7	232
RP-70-37-706	10/16/07	97.8	8.51	0.19J	8.15	0.870	NA	6.37	11.7	330
RP-70-37-706	12/17/08	74.9	7.54	0.040J	5.54	0.735	NA	5.83	10.2	220
RP-70-37-903	06/30/05	77.7	8.28	<0.50	3.60	0.642	NA	5.50	6.58	230
RP-70-38-8MC	11/09/11	73.1	11.3	0.0840J	1.50	0.556J	5060	5.86	5.30	266
RP-70-38-902	12/18/06	100	8.08	0.143	5.40	1.12	NA	8.62	4.88	364
RP-70-38-902	08/03/12	72.4	NA	NA	3.23	0.73	NA	4.79	NA	219
RP-70-38-902	08/02/13	82.1	8.99	0.134	3.75	0.706J	5460	5.48	4.60	214
RP-70-38-902	08/02/13	*63.6	NA	NA	*14.3	*1.25	NA	*6.72	*40.7	*266
RP-70-38-9BS	10/11/11	79.2	17.9	0.260	4.45	0.608J	6090	11.5	8.60	264
RP-70-38-9BS	09/18/12	83.0	20.9	0.412	4.97	0.575J	5510	11.3	10.2	286
RP-70-38-9EW	06/18/10	76.8	9.12	0.055J	2.79	0.617	NA	5.86	17.0	272
RP-70-38-9GV	07/28/05	72.0	7.75	<0.50	4.68	0.286	NA	5.00	5.97	190
RP-70-38-9HC	10/11/11	92.5	10.1	0.0794J	1.67	0.472J	5680	6.16	3.47	266
RP-70-38-9JM	10/11/11	77.8	9.16	0.0965J	3.35	0.705J	5230	5.53	3.31	220
RP-70-38-9SH	10/26/10	87.9	17.0	0.346	5.01	0.504J	7.07	11.2	9.62	274
RP-70-38-9TW	11/01/10	84.3	14.4	0.150	3.48	0.799J	5.99	6.58	5.87	302
RP-70-38-9TW	10/11/11	86.8	14.8	0.126	3.61	0.888J	6010	8.29	5.48	256
RP-70-39-5CA	10/26/10	96.2	10.0	0.109	1.77	<1.00	6.18	6.16	4.44	288
RP-70-39-5ER	10/26/10	81.4	9.19	0.112	2.11	0.434J	5.62	5.04	7.26	253

Table B-2. (cont.) Analytical data for major ions from wells in Kinney County.

Station Name	Date Sampled	Calcium (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Silicon (µg/L)	Sodium (mg/L)	Sulfate (mg/L)	Total Dissolved Solids (mg/L)
RP-70-39-7AD	10/26/10	85.8	9.09	0.175	3.77	0.652J	6.06	5.87	4.54	246
RP-70-39-7CH	11/02/10	83.2	10.0	0.178	2.64	0.803J	5.63	5.28	4.67	248
RP-70-39-7CW	11/02/10	67.6	7.96	0.0891J	2.54	0.777J	5.63	4.10	4.10	213
RP-70-45-1DF	06/29/05	86.5	8.22	<0.50	5.04	1.37	NA	6.40	7.36	272
RP-70-45-1DF	12/17/08	98.9	7.81	<0.50	4.73	0.878	NA	6.09	6.76	247
RP-70-45-505	06/29/05	76.0	8.61	0.125	6.43	0.768	NA	5.59	5.71	NA
RP-70-45-505	12/07/06	116	8.38	0.0440	9.20	1.24	NA	8.37	26.2	268
RP-70-45-505	10/23/07	112	8.38	<0.50	9.20	0.810	NA	6.02	27.6	356
RP-70-45-505	06/16/10	84.9	8.40	0.38J	6.18	0.787	NA	5.33	30.1	304
RP-70-45-505	11/08/11	79.5	9.53	0.451	5.93	0.801J	5360	5.04	29.8	295
RP-70-45-505	09/17/12	87.0	10.1	0.581	6.02	0.700J	5300	4.84	26.3	283
RP-70-45-505	09/18/13	82.4	10.1	0.542	6.08	0.724J	5140	5.38	25.4	293
RP-70-45-601	12/07/06	116	8.83	0.246	9.01	1.25	NA	9.29	13.3	254
RP-70-45-601	10/23/07	97.7	9.06	<0.50	7.59	0.860	NA	6.12	13.3	366
RP-70-45-601	06/16/10	77.7	8.38	0.20J	5.59	0.861	NA	5.55	17.8	298
RP-70-45-601	10/10/11	72.2	9.19	0.213	5.17	0.775J	5310	5.83	13.6	228
RP-70-45-601	09/17/12	84.5	10.1	0.344	5.95	0.768J	5380	5.42	15.8	296
RP-70-45-601	09/18/13	78.4	10.5	0.326	5.79	0.787J	5330	6.02	15.2	273
RP-70-45-7LC	06/30/05	186	97.9	1.71	56.9	12.9	NA	125	516	1240
RP-70-46-4DH	07/29/05	70.8	12.9	1.40	11.9	1.77	NA	11.4	31.5	308
RP-70-46-5AK	06/17/10	88.9	14.6	0.556	6.14	1.37	NA	10.1	21.6	316
RP-70-46-5AK	10/10/11	83.4	15.9	0.601	6.06	1.33	6590	10.5	20.3	271
RP-70-46-5DS	06/17/10	137	23.0	0.18J	9.35	1.88	NA	13.4	33.8	568
RP-70-46-802	10/10/11	85.8	9.09	0.178	4.02	0.992J	5590	6.18	5.91	250
RP-70-46-8DS	10/10/11	130	22.5	0.254	14.3	2.15	8110	14.5	30.1	434
RP-70-47-6GR	06/17/10	104	14.3	0.22J	4.24	1.03	NA	9.39	41.7	440
RP-70-47-9GR	11/02/10	81.0	51.9	1.76	40.4	8.46	6.75	36.4	84.6	496

* = Sample collected by the Authority and analyzed by the TWDB.

NA = Not Analyzed

Table B-3. Analytical data for metals from wells in Kinney County.

Station Name	Date Sampled	Aluminum (µg/L)	Antimony (µg/L)	Arsenic (µg/L)	Barium (µg/L)	Beryllium (µg/L)	Boron (µg/L)	Bromide (mg/L)	Cadmium (µg/L)	Chromium (µg/L)
Dooley Middle Well	12/17/08	<0.22	1.10	0.52J	69.1	<0.84	NA	0.0470	<0.65	<1.17
Dos Angeles at Fields Ranch	12/17/08	1.67	<0.84	0.28J	3.48	<0.84	NA	2.48	<0.65	0.42J
KCGWD Observation Well	10/16/07	3.72	<0.84	0.58J	331	<0.84	NA	0.0550	<0.65	<1.17
RP-70-28-3PI	07/28/05	<0.22	<0.836	<0.733	70.9	<0.835	NA	0.0540	<0.654	<1.17
RP-70-29-101	06/29/05	<4.08	<1.02	<2.04	60.4	<1.02	73.6	0.0570	<1.02	<1.02
RP-70-36-2EW	07/28/05	<0.22	<0.836	<0.733	71.8	<0.835	NA	0.0510	<0.654	<1.17
RP-70-37-502	06/30/05	<0.22	<0.836	<0.733	63.6	<0.835	NA	0.0500	<0.654	<1.17
RP-70-37-706	07/29/05	<0.22	<0.836	<0.733	382	<0.835	NA	0.0590	<0.654	<1.17
RP-70-37-706	12/07/06	<0.22	1.55	<0.73	347	<0.84	NA	0.0440	<0.65	<1.17
RP-70-37-706	10/16/07	1.34	<0.84	0.788	370	<0.84	NA	0.0510	<0.65	<1.17
RP-70-37-706	12/17/08	0.508	0.38J	0.795	375	<0.84	NA	0.338	<0.65	<1.17
RP-70-37-903	06/30/05	<0.22	<0.836	<0.733	58.1	<0.835	NA	0.0370	<0.654	<1.17
RP-70-38-8MC	11/09/11	<50.0	<5.00	1.43J	43.5	<4.00	NA	NA	<2.00	<5.00
RP-70-38-902	12/18/06	<0.22	<0.84	<0.73	39.6	<0.84	NA	0.0480	<0.65	<1.17
RP-70-38-902	08/03/12	NA	NA	NA	42.2	NA	<100	0.04	NA	NA
RP-70-38-902	08/02/13	<50.0	<5.00	1.21J	42.0	<4.00	NA	0.357J	<2.00	<5.00
RP-70-38-902	08/02/13	NA	NA	NA	*30.1	NA	NA	*0.0773	NA	NA
RP-70-38-9BS	10/11/11	<50.0	<5.00	<5.00	92.2	<4.00	NA	NA	<2.00	<5.00
RP-70-38-9BS	09/18/12	<50.0	<5.00	<5.00	92.9	<4.00	NA	NA	<2.00	<5.00
RP-70-38-9EW	06/18/10	<1.00	<1.00	0.57J	40.6	<1.00	NA	0.105	<1.00	<1.00
RP-70-38-9GV	07/28/05	<0.22	<0.836	<0.733	44.6	<0.835	NA	0.0470	<0.654	<1.17
RP-70-38-9HC	10/11/11	<50.0	<5.00	<5.00	43.8	<4.00	NA	NA	<2.00	<5.00
RP-70-38-9JM	10/11/11	<50.0	<5.00	<5.00	41.4	<4.00	NA	NA	<2.00	<5.00
RP-70-38-9SH	10/26/10	<50.0	<5.00	1.12J	98.8	<4.00	NA	NA	<2.00	<5.00
RP-70-38-9TW	11/01/10	<50.0	<5.00	<5.00	55.2	<4.00	NA	NA	<2.00	<5.00
RP-70-38-9TW	10/11/11	<50.0	<5.00	<5.00	59.1	<4.00	NA	NA	<2.00	<5.00
RP-70-39-5CA	10/26/10	<50.0	<5.00	<5.00	43.0	<4.00	NA	NA	<2.00	<5.00

Table B-3. (cont.) Analytical data for metals from wells in Kinney County.

Station Name	Date Sampled	Aluminum (µg/L)	Antimony (µg/L)	Arsenic (µg/L)	Barium (µg/L)	Beryllium (µg/L)	Boron (µg/L)	Bromide (mg/L)	Cadmium (µg/L)	Chromium (µg/L)
RP-70-39-5ER	10/26/10	<50.0	<5.00	1.36J	29.3	<4.00	NA	NA	<2.00	<5.00
RP-70-39-7AD	10/26/10	<50.0	<5.00	1.90J	45.1	<4.00	NA	NA	<2.00	<5.00
RP-70-39-7CH	11/02/10	<50.0	<5.00	<5.00	40.1	<4.00	NA	NA	<2.00	<5.00
RP-70-39-7CW	11/02/10	<50.0	<5.00	<5.00	40.5	<4.00	NA	NA	<2.00	<5.00
RP-70-45-1DF	06/29/05	52.4	<0.836	0.745	346	<0.835	NA	0.0300	<0.654	<1.17
RP-70-45-1DF	12/17/08	<0.22	<0.84	0.911	401	<0.84	NA	0.299	<0.65	<1.17
RP-70-45-505	06/29/05	<4.08	<1.02	<2.04	36.9	<1.02	69.5	0.0600	<1.02	<1.02
RP-70-45-505	12/07/06	<0.22	1.12	<0.73	46.3	<0.84	NA	0.0500	<0.65	<1.17
RP-70-45-505	10/23/07	1.10	<0.84	0.57J	45.8	<0.84	NA	0.0180	<0.65	<1.17
RP-70-45-505	06/16/10	1.13	0.47J	0.61J	46.4	<1.00	NA	0.171	<1.00	<1.00
RP-70-45-505	11/08/11	<50.0	<5.00	1.25J	45.5	<4.00	NA	NA	<2.00	<5.00
RP-70-45-505	09/17/12	<50.0	<5.00	<5.00	50.4	<4.00	NA	NA	<2.00	<5.00
RP-70-45-505	09/18/13	<50.0	<5.00	<5.00	46.0	<4.00	NA	0.367J	<2.00	<5.00
RP-70-45-601	12/07/06	<0.22	<0.84	<0.73	53.7	<0.84	NA	0.0470	<0.65	<1.17
RP-70-45-601	10/23/07	2.35	<0.84	0.55J	52.2	<0.84	NA	0.0400	<0.65	<1.17
RP-70-45-601	06/16/10	3.40	0.47J	0.53J	51.2	<1.00	NA	0.039J	<1.00	<1.00
RP-70-45-601	10/10/11	<50.0	<5.00	<5.00	51.0	<4.00	NA	NA	<2.00	<5.00
RP-70-45-601	09/17/12	<50.0	<5.00	<5.00	58.9	<4.00	NA	NA	<2.00	<5.00
RP-70-45-601	09/18/13	<50.0	<5.00	1.29J	55.5	<4.00	NA	0.368J	<2.00	<5.00
RP-70-45-7LC	06/30/05	<0.22	<0.836	<0.733	22.3	<0.835	NA	<0.002	<0.654	<1.17
RP-70-46-4DH	07/29/05	<0.22	<0.836	<0.733	87.2	<0.835	NA	0.0940	<0.654	<1.17
RP-70-46-5AK	06/17/10	1.14	<1.00	<1.00	163	<1.00	NA	0.059J	<1.00	<1.00
RP-70-46-5AK	10/10/11	<50.0	<5.00	<5.00	160	<4.00	NA	NA	<2.00	<5.00
RP-70-46-5DS	06/17/10	3.35	<1.00	0.43J	136	<1.00	NA	0.113	<1.00	<1.00
RP-70-46-802	10/10/11	<50.0	<5.00	1.24J	359	<4.00	NA	NA	<2.00	<5.00
RP-70-46-8DS	10/10/11	<50.0	<5.00	<5.00	143	<4.00	NA	NA	<2.00	<5.00
RP-70-47-6GR	06/17/10	4.60	<1.00	0.50J	94.4	<1.00	NA	0.056	<1.00	<1.00
RP-70-47-9GR	11/02/10	<50.0	<5.00	<5.00	57.6	<4.00	NA	NA	<2.00	<5.00
RP-70-47-9GR	10/10/11	<50.0	<5.00	1.75J	61.6	<4.00	NA	NA	<2.00	<5.00

Table B-3. (cont.) Analytical data for metals from wells in Kinney County.

Station Name	Date Sampled	Cobalt (µg/L)	Copper (µg/L)	Iron (µg/L)	Lead (µg/L)	Lithium (µg/L)	Manganese (µg/L)	Mercury (µg/L)	Molybdenum (µg/L)	Nickel (µg/L)
Dooley Middle Well	12/17/08	NA	10.1	0.761	0.32J	NA	1.89	0.39J	NA	0.965
Dos Angeles at Fields Ranch	12/17/08	NA	<0.90	17.0	0.888	NA	5.04	<1.14	NA	<0.62
KCGWD Observation Well	10/16/07	NA	<0.90	244	0.71J	NA	3.70	<1.14	NA	0.794
RP-70-28-3PI	07/28/05	NA	<0.904	<0.739	<0.843	NA	<0.137	<1.14	NA	<0.617
RP-70-29-101	06/29/05	<1.02	1.85	<51	<1.02	<2.04	<1.02	NA	<1.02	NA
RP-70-36-2EW	07/28/05	NA	7.94	<0.739	1.20	NA	<0.137	<1.14	NA	<0.617
RP-70-37-502	06/30/05	NA	4.86	28.9	<0.843	NA	1.91	<1.14	NA	<0.617
RP-70-37-706	07/29/05	NA	<0.904	<0.739	<0.843	NA	0.361	<1.14	NA	<0.617
RP-70-37-706	12/07/06	NA	<0.90	0.980	<0.84	NA	0.560	<1.14	NA	1.08
RP-70-37-706	10/16/07	NA	<0.90	3.74	<0.84	NA	0.710	<1.14	NA	1.01
RP-70-37-706	12/17/08	NA	1.76	1.48	<0.84	NA	0.712	<1.14	NA	0.970
RP-70-37-903	06/30/05	NA	1.75	1.61	4.16	NA	0.213	<1.14	NA	<0.617
RP-70-38-8MC	11/09/11	NA	<10.0	<250	<5.00	NA	<50.0	0.000149J	NA	<5.00
RP-70-38-902	12/18/06	NA	<0.90	<0.74	<0.84	NA	<0.14	<1.14	NA	<0.62
RP-70-38-902	08/03/12	NA	NA	<50	NA	2.2	NA	<0.2	NA	NA
RP-70-38-902	08/02/13	NA	<10.0	<250	0.739J	NA	<50.0	<0.00200	NA	<5.00
RP-70-38-902	08/02/13	NA	*1.61	*<50	NA	*4.36	NA	*<0.2	NA	NA
RP-70-38-9BS	10/11/11	NA	8.00J	<250	<5.00	NA	<50.0	<0.00200	NA	<5.00
RP-70-38-9BS	09/18/12	NA	<10.0	<250	<5.00	NA	<50.0	<0.00200	NA	<5.00
RP-70-38-9EW	06/18/10	NA	<1.00	0.40J	<1.00	NA	0.077J	<0.50	NA	0.23J
RP-70-38-9GV	07/28/05	NA	3.08	<0.739	1.71	NA	1.14	<1.14	NA	<0.617
RP-70-38-9HC	10/11/11	NA	6.44J	<250	<5.00	NA	<50.0	<0.00200	NA	<5.00
RP-70-38-9JM	10/11/11	NA	<10.0	<250	<5.00	NA	<50.0	<0.00200	NA	<5.00
RP-70-38-9SH	10/26/10	NA	6.45J	<250	<5.00	NA	<50.0	<0.00200	NA	<5.00
RP-70-38-9TW	11/01/10	NA	<10.0	<250	<5.00	NA	<50.0	<0.00200	NA	<5.00
RP-70-38-9TW	10/11/11	NA	<10.0	<250	<5.00	NA	<50.0	<0.00200	NA	<5.00
RP-70-39-5CA	10/26/10	NA	27.7	<250	<5.00	NA	<50.0	<0.00200	NA	<5.00

Table B-3. (cont.) Analytical data for metals from wells in Kinney County.

Station Name	Date Sampled	Cobalt (µg/L)	Copper (µg/L)	Iron (µg/L)	Lead (µg/L)	Lithium (µg/L)	Manganese (µg/L)	Mercury (µg/L)	Molybdenum (µg/L)	Nickel (µg/L)
RP-70-39-5ER	10/26/10	NA	1.76J	<250	<5.00	NA	<50.0	<0.00200	NA	<5.00
RP-70-39-7AD	10/26/10	NA	4.70J	<250	<5.00	NA	<50.0	<0.00200	NA	<5.00
RP-70-39-7CH	11/02/10	NA	<10.0	<250	<5.00	NA	<50.0	<0.00200	NA	<5.00
RP-70-39-7CW	11/02/10	NA	<10.0	<250	<5.00	NA	<50.0	<0.00200	NA	<5.00
RP-70-45-1DF	06/29/05	NA	0.995	4.06	2.10	NA	4.48	<1.14	NA	<0.617
RP-70-45-1DF	12/17/08	NA	1.30	<0.74	1.13	NA	0.420	<1.14	NA	0.24J
RP-70-45-505	06/29/05	<1.02	<1.02	<51	<1.02	<2.04	<1.02	NA	<1.02	NA
RP-70-45-505	12/07/06	NA	1.89	<0.74	<0.84	NA	<0.14	<1.14	NA	1.38
RP-70-45-505	10/23/07	NA	0.74J	4.49	<0.84	NA	0.074J	<1.14	NA	1.55
RP-70-45-505	06/16/10	NA	2.91	0.39J	1.05	NA	0.15J	<0.50	NA	0.79J
RP-70-45-505	11/08/11	NA	<10.0	<250	<5.00	NA	<50.0	<0.00200	NA	<5.00
RP-70-45-505	09/17/12	NA	<10.0	<250	<5.00	NA	<50.0	<0.00200	NA	<5.00
RP-70-45-505	09/18/13	NA	<10.0	<250	<5.00	NA	<50.0	<0.00200	NA	<5.00
RP-70-45-601	12/07/06	NA	2.67	<0.74	0.920	NA	<0.14	<1.14	NA	0.750
RP-70-45-601	10/23/07	NA	0.31J	3.19	<0.84	NA	0.144	<1.14	NA	0.61J
RP-70-45-601	06/16/10	NA	1.19	1.78	0.86J	NA	0.30J	<0.50	NA	0.66J
RP-70-45-601	10/10/11	NA	<10.0	<250	<5.00	NA	<50.0	<0.00200	NA	<5.00
RP-70-45-601	09/17/12	NA	<10.0	<250	<5.00	NA	<50.0	<0.00200	NA	<5.00
RP-70-45-601	09/18/13	NA	<10.0	<250	<5.00	NA	<50.0	<0.00200	NA	<5.00
RP-70-45-7LC	06/30/05	NA	<0.904	3.94	<0.843	NA	9.08	<1.14	NA	<0.617
RP-70-46-4DH	07/29/05	NA	<0.904	6.04	<0.843	NA	1.24	<1.14	NA	<0.617
RP-70-46-5AK	06/17/10	NA	<1.00	144	<1.00	NA	4.12	<0.50	NA	0.24J
RP-70-46-5AK	10/10/11	NA	<10.0	<250	<5.00	NA	<50.0	<0.00200	NA	<5.00
RP-70-46-5DS	06/17/10	NA	1.66	1.71	0.31J	NA	0.51J	<0.50	NA	0.83J
RP-70-46-802	10/10/11	NA	<10.0	<250	<5.00	NA	<50.0	<0.00200	NA	<5.00
RP-70-46-8DS	10/10/11	NA	<10.0	<250	<5.00	NA	<50.0	<0.00200	NA	<5.00
RP-70-47-6GR	06/17/10	NA	1.30	4.68	<1.00	NA	0.55J	<0.50	NA	0.61J
RP-70-47-9GR	11/02/10	NA	<10.0	372	<5.00	NA	<50.0	<0.00200	NA	<5.00
RP-70-47-9GR	10/10/11	NA	<10.0	283	1.83J	NA	<50.0	<0.00200	NA	2.43J

Table B-3. Analytical data for metals from wells in Kinney County.

Station Name	Sample Date	Selenium (µg/L)	Silica (mg/L)	Silver (µg/L)	Strontium (µg/L)	Thallium (µg/L)	Vanadium (µg/L)	Zinc (µg/L)
Dooley Middle Well	12/17/08	1.53	NA	<0.89	375	0.17J	NA	29.1
Dos Angeles at Fields Ranch	12/17/08	10.0J	NA	<0.89	12700	<0.36	NA	2.32
KCGWD Observation Well	10/16/07	2.40	NA	<0.89	2650	0.20J	NA	6.32
RP-70-28-3PI	07/28/05	1.51	NA	<0.886	158	<0.363	NA	2.44
RP-70-29-101	06/29/05	<4.08	NA	NA	76.1	<1.02	4.66	18.7
RP-70-36-2EW	07/28/05	<0.989	NA	<0.886	194	<0.363	NA	7.34
RP-70-37-502	06/30/05	1.41	NA	<0.886	224	0.390	NA	14.6
RP-70-37-706	07/29/05	3.05	NA	<0.886	2620	0.492	NA	2.34
RP-70-37-706	12/07/06	2.88	NA	<0.89	2790	0.430	NA	<0.68
RP-70-37-706	10/16/07	2.46	NA	<0.89	2890	0.32J	NA	6.51
RP-70-37-706	12/17/08	3.77	NA	<0.89	2340	0.25J	NA	3.16
RP-70-37-903	06/30/05	1.19	NA	<0.886	514	<0.363	NA	1.51
RP-70-38-8MC	11/09/11	3.98J	NA	<5.00	145	<1.00	NA	22.4J
RP-70-38-902	12/18/06	<0.99	NA	<0.89	109	<0.36	NA	<0.68
RP-70-38-902	08/03/12	NA	NA	NA	101	NA	4.4	NA
RP-70-38-902	08/02/13	3.22J	NA	<5.00	108	<2.00	NA	<25.0
RP-70-38-902	08/02/13	NA	*11.8	NA	*550	NA	*2.3	*4.42
RP-70-38-9BS	10/11/11	<5.00	NA	<5.00	294	<1.00	NA	164
RP-70-38-9BS	09/18/12	1.63J	NA	<5.00	303	<2.00	NA	168
RP-70-38-9EW	06/18/10	<1.00	NA	<0.50	129	<1.00	NA	1.20
RP-70-38-9GV	07/28/05	<0.989	NA	<0.886	108	<0.363	NA	162
RP-70-38-9HC	10/11/11	<5.00	NA	<5.00	87.3	<1.00	NA	368
RP-70-38-9JM	10/11/11	<5.00	NA	<5.00	95.1	<1.00	NA	8.80J
RP-70-38-9SH	10/26/10	<5.00	NA	<5.00	298	<1.00	NA	140
RP-70-38-9TW	11/01/10	<5.00	NA	<5.00	116	<1.00	NA	59.4
RP-70-38-9TW	10/11/11	<5.00	NA	<5.00	123	<1.00	NA	617
RP-70-39-5CA	10/26/10	<5.00	NA	<5.00	83.6	<1.00	NA	396
RP-70-39-5ER	10/26/10	<5.00	NA	<5.00	115	<1.00	NA	6.32J
RP-70-39-7AD	10/26/10	1.77J	NA	<5.00	95.6	0.878J	NA	27.1
RP-70-39-7CH	11/02/10	<5.00	NA	<5.00	107	<1.00	NA	6.03J
RP-70-39-7CW	11/02/10	<5.00	NA	<5.00	111	<1.00	NA	277
RP-70-45-1DF	06/29/05	8.48	NA	<0.886	522	1.88	NA	4.04
RP-70-45-1DF	12/17/08	5.32	NA	<0.89	565	0.25J	NA	2.54
RP-70-45-505	06/29/05	<4.08	NA	NA	146	<1.02	3.82	<4.08
RP-70-45-505	12/07/06	<0.99	NA	<0.89	1670	<0.36	NA	1.16
RP-70-45-505	10/23/07	0.57J	NA	<0.89	1490	<0.36	NA	3.18
RP-70-45-505	06/16/10	0.54J	NA	<0.50	1570	<1.00	NA	7.07
RP-70-45-505	11/08/11	8.35	NA	<5.00	1460	<1.00	NA	7.50J

Table B-3. (cont.) Analytical data for metals from wells in Kinney County.

Station Name	Sample Date	Selenium (µg/L)	Silica (mg/L)	Silver (µg/L)	Strontium (µg/L)	Thallium (µg/L)	Vanadium (µg/L)	Zinc (µg/L)
RP-70-45-505	09/17/12	1.16J	NA	<5.00	1640	<2.00	NA	<25.0
RP-70-45-505	09/18/13	2.39J	NA	<5.00	1670	<2.00	NA	<25.0
RP-70-45-601	12/07/06	1.00	NA	<0.89	2410	<0.36	NA	3.10
RP-70-45-601	10/23/07	0.56J	NA	<0.89	1940	<0.36	NA	2.36
RP-70-45-601	06/16/10	<1.00	NA	<0.50	2250	<1.00	NA	48.5
RP-70-45-601	10/10/11	<5.00	NA	<5.00	2300	0.955J	NA	<25.0
RP-70-45-601	09/17/12	1.08J	NA	<5.00	2400	<2.00	NA	3.71J
RP-70-45-601	09/18/13	3.40J	NA	<5.00	2520	<2.00	NA	4.62J
RP-70-45-7LC	06/30/05	1.15	NA	<0.886	7450	<0.363	NA	1.32
RP-70-46-4DH	07/29/05	<0.989	NA	<0.886	8410	<0.363	NA	1.19
RP-70-46-5AK	06/17/10	<1.00	NA	<0.50	1100	<1.00	NA	56.0
RP-70-46-5AK	10/10/11	<5.00	NA	<5.00	1260	<1.00	NA	38.9
RP-70-46-5DS	06/17/10	0.78J	NA	<0.50	471	0.36J	NA	7.56
RP-70-46-802	10/10/11	3.23J	NA	<5.00	544	<1.00	NA	<25.0
RP-70-46-8DS	10/10/11	<5.00	NA	<5.00	626	<1.00	NA	<25.0
RP-70-47-6GR	06/17/10	0.86J	NA	<0.50	648	0.13J	NA	11.8
RP-70-47-9GR	11/02/10	<5.00	NA	<5.00	1490	<1.00	NA	<25.0

* = Sample collected by the EAA and analyzed by the TWDB.

NA = Not Analyzed

Table B-4. Analytical data for nutrients from wells in Kinney County.

Station Name	Date Sampled	Nitrate-N (mg/L as N)	Phosphorus (mg/L)
Dooley Middle Well	12/17/08	1.92	NA
Dos Angeles@ Fields Ranch	12/17/08	<0.15	NA
KCGWD Observation Well	10/16/07	1.49	NA
RP-70-28-3PI	07/28/05	1.67	NA
RP-70-29-101	06/29/05	2.63	NA
RP-70-36-2EW	07/28/05	1.96	NA
RP-70-37-502	06/30/05	2.97	NA
RP-70-37-706	07/29/05	1.35	NA
RP-70-37-706	12/07/06	1.65	NA
RP-70-37-706	10/16/07	1.80	NA
RP-70-37-706	12/17/08	1.44	NA
RP-70-37-903	06/30/05	1.30	NA
RP-70-38-8MC	11/09/11	2.01	NA
RP-70-38-902	12/18/06	1.36	NA
RP-70-38-902	08/03/12	1.30	<0.02
RP-70-38-902	08/02/13	1.52	NA
RP-70-38-902	08/02/13	*1.19	*<0.02
RP-70-38-9BS	10/11/11	1.25	NA
RP-70-38-9BS	09/18/12	2.06	NA
RP-70-38-9EW	06/18/10	2.87	NA
RP-70-38-9GV	07/28/05	1.16	NA
RP-70-38-9HC	10/11/11	1.66	NA
RP-70-38-9JM	10/11/11	1.59	NA
RP-70-38-9SH	10/26/10	1.45	NA
RP-70-38-9TW	11/01/10	3.00	NA
RP-70-38-9TW	10/11/11	2.67	NA
RP-70-39-5CA	10/26/10	1.93	NA
RP-70-39-5ER	10/26/10	1.63	NA
RP-70-39-7AD	10/26/10	1.83	NA
RP-70-39-7CH	11/02/10	2.11	NA
RP-70-39-7CW	11/02/10	1.62	NA
RP-70-45-1DF	06/29/05	<0.15	NA
RP-70-45-1DF	12/17/08	1.61	NA
RP-70-45-505	06/29/05	1.45	NA
RP-70-45-505	12/07/06	1.26	NA
RP-70-45-505	10/23/07	0.772	NA
RP-70-45-505	06/16/10	4.24	NA
RP-70-45-505	11/08/11	1.21	NA
RP-70-45-505	09/17/12	1.16	NA
RP-70-45-505	09/18/13	1.15	NA

Table B-4. (cont.) Analytical data for nutrients from wells in Kinney County.

Station Name	Date Sampled	Nitrate-N (mg/L as N)	Phosphorus (mg/L)
RP-70-45-601	12/07/06	1.49	NA
RP-70-45-601	10/23/07	1.17	NA
RP-70-45-601	06/16/10	4.09	NA
RP-70-45-601	10/10/11	0.955	NA
RP-70-45-601	09/17/12	1.33	NA
RP-70-45-601	09/18/13	1.30	NA
RP-70-45-7LC	06/30/05	<0.15	NA
RP-70-46-4DH	07/29/05	0.408	NA
RP-70-46-5AK	06/17/10	<0.15	NA
RP-70-46-5AK	10/10/11	<0.500	NA
RP-70-46-5DS	06/17/10	5.02	NA
RP-70-46-802	10/10/11	1.34	NA
RP-70-46-8DS	10/10/11	0.893	NA
RP-70-47-6GR	06/17/10	1.11	NA
RP-70-47-9GR	11/02/10	<0.500	NA
RP-70-47-9GR	10/10/11	0.121	NA

NA = Not Analyzed

Table B-5. Analytical data for pesticides, herbicides, and PCB (Aroclors) wells in Kinney County.

Station Name	Date Sampled	2,4,5-T (mg/L)	2,4,5-TP (mg/L)	2,4-D (mg/L)	2,4-DB (µg/L)	4,4'-DDD (µg/L)	4,4'-DDE (µg/L)	4,4'-DDT (µg/L)	Aldrin (µg/L)	alpha-BHC (µg/L)
KCGWD Observation Well	10/16/07	NA	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-37-706	07/29/05	NA	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-37-706	12/07/06	NA	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-37-706	10/16/07	NA	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-38-902	12/18/06	NA	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-38-902	08/03/12	<0.500	<0.500	<0.500	<0.500	<0.100	<0.100	<0.100	<0.0500	<0.0500
RP-70-38-902	08/02/13	<0.487	<0.487	<0.487	<0.487	<0.0564	<0.0564	<0.0564	<0.0564	<0.0564
RP-70-38-9BS	09/18/12	<0.500	<0.500	<0.500	<0.500	<0.100	<0.100	<0.100	<0.0500	<0.0500
RP-70-45-505	12/07/06	NA	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-45-505	10/23/07	NA	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-45-505	07/30/09	NA	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-45-505	09/17/12	<0.500	<0.500	<0.500	<0.500	<0.100	<0.100	<0.100	<0.0500	<0.0500
RP-70-45-601	12/07/06	NA	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-45-601	10/23/07	NA	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-45-601	07/30/09	NA	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-45-601	09/17/12	<0.500	<0.500	<0.500	<0.500	<0.100	<0.100	<0.100	<0.0500	<0.0500

Table B-5. (cont.) Analytical data for pesticides, herbicides, and PCB (Aroclors) wells in Kinney County.

Station Name	Date Sampled	alpha-Chlordane (µg/L)	Aroclor 1016 (µg/L)	Aroclor 1221 (µg/L)	Aroclor 1232 (µg/L)	Aroclor 1242 (µg/L)	Aroclor 1248 (µg/L)	Aroclor 1254 (µg/L)	Aroclor 1260 (µg/L)	Aroclor 1262 (µg/L)
KCGWD Observation Well	10/16/07	NA	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-37-706	07/29/05	NA	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-37-706	12/07/06	NA	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-37-706	10/16/07	NA	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-38-902	12/18/06	NA	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-38-902	08/03/12	<0.0500	<0.943	<0.943	<0.943	<0.943	<0.943	<0.943	<0.943	<0.943
RP-70-38-902	08/02/13	<0.0567	<0.562	<0.562	<0.749	<0.562	<0.562	<0.562	<0.562	<0.562
RP-70-38-9BS	09/18/12	<0.0500	<0.943	<0.943	<0.943	<0.943	<0.943	<0.943	<0.943	<0.943
RP-70-45-505	12/07/06	NA	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-45-505	10/23/07	NA	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-45-505	07/30/09	NA	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-45-505	09/17/12	<0.0500	<0.943	<0.943	<0.943	<0.943	<0.943	<0.943	<0.943	<0.943
RP-70-45-601	12/07/06	NA	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-45-601	10/23/07	NA	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-45-601	07/30/09	NA	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-45-601	09/17/12	<0.0500	<0.943	<0.943	<0.943	<0.943	<0.943	<0.943	<0.943	<0.943

Table B-5. (cont.) Analytical data for pesticides, herbicides, and PCB (Aroclors) wells in Kinney County.

Station Name	Date Sampled	Aroclor 1268 (µg/L)	Atrazine (µg/L)	Azinphos-methyl- (µg/L)	beta-BHC (µg/L)	Bolstar (Sulprofos) (µg/L)	Chlordane (technical) (µg/L)	Chloropyrifos (µg/L)	Coumaphos (µg/L)	Dalapon (µg/L)
KCGWD Observation Well	10/16/07	NA	<0.05	<0.05	NA	<0.05	NA	<0.05	<0.05	NA
RP-70-37-706	07/29/05	NA	<0.3	<0.5	NA	<0.5	NA	<0.5	<0.3	NA
RP-70-37-706	12/07/06	NA	<0.30	<0.50	NA	<0.50	NA	<0.50	<0.30	NA
RP-70-37-706	10/16/07	NA	<0.05	<0.05	NA	<0.05	NA	<0.05	<0.05	NA
RP-70-38-902	12/18/06	NA	<0.30	<0.50	NA	<0.50	NA	<0.50	<0.30	NA
RP-70-38-902	08/03/12	<0.943	NA	<1.00	<0.0500	<1.00	<0.500	<1.00	<1.00	<120
RP-70-38-902	08/02/13	<0.562	NA	<0.943	<0.0564	<0.943	<0.564	<0.943	<0.943	<9.74
RP-70-38-9BS	09/18/12	<0.943	NA	<0.943	<0.0500	<0.943	<0.500	<0.943	<0.943	<120
RP-70-45-505	12/07/06	NA	<0.30	<0.50	NA	<0.50	NA	<0.50	<0.30	NA
RP-70-45-505	10/23/07	NA	<0.05	<0.05	NA	<0.05	NA	<0.05	<0.05	NA
RP-70-45-505	07/30/09	NA	<0.05	<0.05	NA	<0.05	NA	<0.05	<0.05	NA
RP-70-45-505	09/17/12	<0.943	NA	<0.943	<0.0500	<0.943	<0.500	<0.943	<0.943	<120
RP-70-45-601	12/07/06	NA	<0.30	<0.50	NA	<0.50	NA	<0.50	<0.30	NA
RP-70-45-601	10/23/07	NA	<0.05	<0.05	NA	<0.05	NA	<0.05	<0.05	NA
RP-70-45-601	07/30/09	NA	<0.05	<0.05	NA	<0.05	NA	<0.05	<0.05	NA
RP-70-45-601	09/17/12	<0.943	NA	<0.943	<0.0500	<0.943	<0.500	<0.943	<0.943	<120

Table B-5. (cont.) Analytical data for pesticides, herbicides, and PCB (Aroclors) wells in Kinney County.

Station Name	Date Sampled	delta-BHC (µg/L)	Demeton (µg/L)	Demeton, Total (µg/L)	Demeton-O (µg/L)	Diazinon (µg/L)	Dicamba (µg/L)	Dichloro—prop (µg/L)	Dichloro—vos (µg/L)	Dieldrin (µg/L)
KCGWD Observation Well	10/16/07	NA	NA	<0.05	NA	<0.05	NA	NA	<0.05	NA
RP-70-37-706	07/29/05	NA	NA	<0.5	NA	<0.4	NA	NA	<0.4	NA
RP-70-37-706	12/07/06	NA	NA	<0.50	NA	<0.40	NA	NA	<0.40	NA
RP-70-37-706	10/16/07	NA	NA	<0.05	NA	<0.05	NA	NA	<0.05	NA
RP-70-38-902	12/18/06	NA	NA	<0.50	NA	<0.40	NA	NA	<0.40	NA
RP-70-38-902	08/03/12	<0.0500	<2.50	NA	<2.50	<1.00	<1.20	<6.00	<2.00	<0.100
RP-70-38-902	08/02/13	<0.0564	<2.36	NA	<2.36	<0.943	<0.487	<0.487	<1.89	<0.0567
RP-70-38-9BS	09/18/12	<0.0500	<2.36	NA	<2.36	<0.943	<1.20	<6.00	<1.89	<0.100
RP-70-45-505	12/07/06	NA	NA	<0.50	NA	<0.40	NA	NA	<0.40	NA
RP-70-45-505	10/23/07	NA	NA	<0.05	NA	<0.05	NA	NA	<0.05	NA
RP-70-45-505	07/30/09	NA	NA	<0.05	NA	<0.05	NA	NA	<0.05	NA
RP-70-45-505	09/17/12	<0.0500	<2.36	NA	<2.36	<0.943	<1.20	<6.00	<1.89	<0.100
RP-70-45-601	12/07/06	NA	NA	<0.50	NA	<0.40	NA	NA	<0.40	NA
RP-70-45-601	10/23/07	NA	NA	<0.05	NA	<0.05	NA	NA	<0.05	NA
RP-70-45-601	07/30/09	NA	NA	<0.05	NA	<0.05	NA	NA	<0.05	NA
RP-70-45-601	09/17/12	<0.0500	<2.36	NA	<2.36	<0.943	<1.20	<6.00	<1.89	<0.100

Table B-5. (cont.) Analytical data for pesticides, herbicides, and PCB (Aroclors) wells in Kinney County.

Station Name	Date Sampled	Dimethoate (µg/L)	Dinoseb (mg/L)	Disulfoton (µg/L)	Endo--sulfan I (µg/L)	Endo--sulfan II (µg/L)	Endo--sulfan sulfate (µg/L)	Endrin (µg/L)	Endrin aldehyde (µg/L)	Endrin ketone (µg/L)
KCGWD Observation Well	10/16/07	<0.05	NA	<0.05	NA	NA	NA	NA	NA	NA
RP-70-37-706	07/29/05	<0.4	NA	<0.4	NA	NA	NA	NA	NA	NA
RP-70-37-706	12/07/06	<0.40	NA	<0.40	NA	NA	NA	NA	NA	NA
RP-70-37-706	10/16/07	<0.05	NA	<0.05	NA	NA	NA	NA	NA	NA
RP-70-38-902	12/18/06	<0.40	NA	<0.40	NA	NA	NA	NA	NA	NA
RP-70-38-902	08/03/12	<2.00	<6.00	<2.00	<0.0500	<0.100	<0.100	<0.100	<0.100	<0.100
RP-70-38-902	08/02/13	<1.89	<5.84	<1.89	<0.0564	<0.0564	<0.0564	<0.0564	<0.0564	<0.0564
RP-70-38-9BS	09/18/12	<1.89	<6.00	<1.89	<0.0500	<0.100	<0.100	<0.100	<0.100	<0.100
RP-70-45-505	12/07/06	<0.40	NA	<0.40	NA	NA	NA	NA	NA	NA
RP-70-45-505	10/23/07	<0.05	NA	<0.05	NA	NA	NA	NA	NA	NA
RP-70-45-505	07/30/09	<0.05	NA	<0.05	NA	NA	NA	NA	NA	NA
RP-70-45-505	09/17/12	<1.89	<6.00	<1.89	<0.0500	<0.100	<0.100	<0.100	<0.100	<0.100
RP-70-45-601	12/07/06	<0.40	NA	<0.40	NA	NA	NA	NA	NA	NA
RP-70-45-601	10/23/07	<0.05	NA	<0.05	NA	NA	NA	NA	NA	NA
RP-70-45-601	07/30/09	<0.05	NA	<0.05	NA	NA	NA	NA	NA	NA
RP-70-45-601	09/17/12	<1.89	<6.00	<1.89	<0.0500	<0.100	<0.100	<0.100	<0.100	<0.100

Table B-5. (cont.) Analytical data for pesticides, herbicides, and PCB (Aroclors) wells in Kinney County.

Station Name	Date Sampled	EPN (µg/L)	Ethoprop (µg/L)	Famphur (µg/L)	Fensulfo-thion (µg/L)	Fenthion (µg/L)	gamma-BHC (µg/L)	gamma-Chlordane (µg/L)	Hepta-chlor (µg/L)	Hepta-chlor epoxide (µg/L)
KCGWD Observation Well	10/16/07	<0.05	<0.05	NA	<0.05	<0.05	NA	NA	NA	NA
RP-70-37-706	07/29/05	<0.4	<0.7	NA	<0.7	<0.3	NA	NA	NA	NA
RP-70-37-706	12/07/06	<0.40	<0.70	NA	<0.70	<0.30	NA	NA	NA	NA
RP-70-37-706	10/16/07	<0.05	<0.05	NA	<0.05	<0.05	NA	NA	NA	NA
RP-70-38-902	12/18/06	<0.40	<0.70	NA	<0.70	<0.30	NA	NA	NA	NA
RP-70-38-902	08/03/12	<1.00	<0.500	<2.00	<5.00	<1.00	<0.0500	<0.0500	<0.0500	<0.0500
RP-70-38-902	08/02/13	<0.943	<0.472	<1.89	<4.72	<0.943	<0.0564	<0.0564	<0.0564	<0.0564
RP-70-38-9BS	09/18/12	<0.943	<0.472	<1.89	<4.72	<0.943	<0.0500	<0.0500	<0.0500	<0.0500
RP-70-45-505	12/07/06	<0.40	<0.70	NA	<0.70	<0.30	NA	NA	NA	NA
RP-70-45-505	10/23/07	<0.05	<0.05	NA	<0.05	<0.05	NA	NA	NA	NA
RP-70-45-505	07/30/09	<0.05	<0.05	NA	<0.05	<0.05	NA	NA	NA	NA
RP-70-45-505	09/17/12	<0.943	<0.472	<1.89	<4.72	<0.943	<0.0500	<0.0500	<0.0500	<0.0500
RP-70-45-601	12/07/06	<0.40	<0.70	NA	<0.70	<0.30	NA	NA	NA	NA
RP-70-45-601	10/23/07	<0.05	<0.05	NA	<0.05	<0.05	NA	NA	NA	NA
RP-70-45-601	07/30/09	<0.05	<0.05	NA	<0.05	<0.05	NA	NA	NA	NA
RP-70-45-601	09/17/12	<0.943	<0.472	<1.89	<4.72	<0.943	<0.0500	<0.0500	<0.0500	<0.0500

Table B-5. (cont.) Analytical data for pesticides, herbicides, and PCB (Aroclors) wells in Kinney County.

Station Name	Date Sampled	Malathion (µg/L)	MCPA (µg/L)	MCPP (µg/L)	Merphos (µg/L)	Methoxy—chlor (µg/L)	Methyl-parathion (µg/L)	Mevinphos (µg/L)	Mono-ncrotophos (µg/L)	Naled (µg/L)
KCGWD Observation Well	10/16/07	<0.05	NA	NA	<0.05	NA	<0.05	NA	<0.05	<0.05
RP-70-37-706	07/29/05	<0.5	NA	NA	<0.3	NA	<0.5	NA	<0.7	<0.75
RP-70-37-706	12/07/06	<0.50	NA	NA	<0.30	NA	<0.50	NA	<0.70	<0.75
RP-70-37-706	10/16/07	<0.05	NA	NA	<0.05	NA	<0.05	NA	<0.05	<0.05
RP-70-38-902	12/18/06	<0.50	NA	NA	<0.30	NA	<0.50	NA	<0.70	<0.75
RP-70-38-902	08/03/12	<1.00	<120	<120	<1.00	<0.500	<0.500	<2.00	<10.0	<5.00
RP-70-38-902	08/02/13	<0.943	<117	<117	<0.943	<0.0564	<0.472	<1.89	<9.43	<4.72
RP-70-38-9BS	09/18/12	<0.943	<120	<120	<0.943	<0.500	<0.472	<1.89	<9.43	<4.72
RP-70-45-505	12/07/06	<0.50	NA	NA	<0.30	NA	<0.50	NA	<0.70	<0.75
RP-70-45-505	10/23/07	<0.05	NA	NA	<0.05	NA	<0.05	NA	<0.05	<0.05
RP-70-45-505	07/30/09	<0.05	NA	NA	<0.05	NA	<0.05	NA	<0.05	<0.05
RP-70-45-505	09/17/12	<0.943	<120	<120	<0.943	<0.500	<0.472	<1.89	<9.43	<4.72
RP-70-45-601	12/07/06	<0.50	NA	NA	<0.30	NA	<0.50	NA	<0.70	<0.75
RP-70-45-601	10/23/07	<0.05	NA	NA	<0.05	NA	<0.05	NA	<0.05	<0.05
RP-70-45-601	07/30/09	<0.05	NA	NA	<0.05	NA	<0.05	NA	<0.05	<0.05
RP-70-45-601	09/17/12	<0.943	<120	<120	<0.943	<0.500	<0.472	<1.89	<9.43	<4.72

Table B-5. (cont.) Analytical data for pesticides, herbicides, and PCB (Aroclors) wells in Kinney County.

Station Name	Date Sampled	Parathion (µg/L)	Penta-chloro-phenol (µg/L)	Phorate (µg/L)	Ronnel (µg/L)	Simazine (µg/L)	Stirophos (µg/L)	Sulfotepp (µg/L)	TEPP (µg/L)	Thionazin (µg/L)
KCGWD Observation Well	10/16/07	<0.05	NA	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA
RP-70-37-706	07/29/05	<0.5	NA	<0.4	<0.4	<0.3	<0.4	<0.4	<0.4	NA
RP-70-37-706	12/07/06	<0.50	NA	<0.40	<0.40	<0.30	<0.40	<0.40	<0.40	NA
RP-70-37-706	10/16/07	<0.05	NA	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA
RP-70-38-902	12/18/06	<0.50	NA	<0.40	<0.40	<0.30	<0.40	<0.40	<0.40	NA
RP-70-38-902	08/03/12	<1.00	<1.00	<1.00	<1.00	NA	<1.00	<0.500	NA	<1.00
RP-70-38-902	08/02/13	<0.943	<0.244	<0.943	<0.943	NA	<0.943	<0.472	NA	<0.943
RP-70-38-9BS	09/18/12	<0.943	<1.00	<0.943	<0.943	NA	<0.943	<0.472	NA	<0.943
RP-70-45-505	12/07/06	<0.50	NA	<0.40	<0.40	<0.30	<0.40	<0.40	<0.40	NA
RP-70-45-505	10/23/07	<0.05	NA	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA
RP-70-45-505	07/30/09	<0.05	NA	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA
RP-70-45-505	09/17/12	<0.943	<1.00	<0.943	<0.943	NA	<0.943	<0.472	NA	<0.943
RP-70-45-601	12/07/06	<0.50	NA	<0.40	<0.40	<0.30	<0.40	<0.40	<0.40	NA
RP-70-45-601	10/23/07	<0.05	NA	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA
RP-70-45-601	07/30/09	<0.05	NA	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA
RP-70-45-601	09/17/12	<0.943	<1.00	<0.943	<0.943	NA	<0.943	<0.472	NA	<0.943

Table B-5. (cont.) Analytical data for pesticides, herbicides, and PCB (Aroclors) wells in Kinney County.

Station Name	Date Sampled	Tokuthion (µg/L)	Toxaphene (µg/L)	Trichloronate (µg/L)
KCGWD Observation Well	10/16/07	<0.05	NA	<0.05
RP-70-37-706	07/29/05	<0.4	NA	<0.4
RP-70-37-706	12/07/06	<0.40	NA	<0.40
RP-70-37-706	10/16/07	<0.05	NA	<0.05
RP-70-38-902	12/18/06	<0.40	NA	<0.40
RP-70-38-902	08/03/12	<1.00	<5.00	<1.00
RP-70-38-902	08/02/13	<0.943	<5.64	<0.943
RP-70-38-9BS	09/18/12	<0.943	<5.00	<0.943
RP-70-45-505	12/07/06	<0.40	NA	<0.40
RP-70-45-505	10/23/07	<0.05	NA	<0.05
RP-70-45-505	07/30/09	<0.05	NA	<0.05
RP-70-45-505	09/17/12	<0.943	<5.00	<0.943
RP-70-45-601	12/07/06	<0.40	NA	<0.40
RP-70-45-601	10/23/07	<0.05	NA	<0.05
RP-70-45-601	07/30/09	<0.05	NA	<0.05
RP-70-45-601	09/17/12	<0.943	<5.00	<0.943

NA = Not Analyzed

Table B-6. Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	1,1,1,2-Trichloro-ethane (µg/L)	1,1,1-Trichloro-ethane (µg/L)	1,1,2,2-Tetrachloro-ethane (µg/L)	1,1,2-Trichloro-ethane (µg/L)	1,1,2-Trichloro-trifluoro-ethane (µg/L)	1,1-Dichloro—ethane (µg/L)	1,1-Dichloro—ethene (µg/L)	1,1-Dichloro—propene (µg/L)	1,2,3-Trichloro-benzene (µg/L)
KCGWD Observation Well	10/16/07	<10.0	<2.00	<2.00	<2.00	NA	<2.00	<2.00	<2.00	<10.0
RP-70-37-706	07/29/05	<1.42	<1.26	<0.629	<0.799	NA	<1.45	<0.875	<1.23	<3.69
RP-70-37-706	12/07/06	<10.0	<2.00	<2.00	<2.00	NA	<2.00	<2.00	<2.00	<10.0
RP-70-37-706	10/16/07	<10.0	<2.00	<2.00	<2.00	NA	<2.00	<2.00	<2.00	<10.0
RP-70-38-8MC	11/09/11	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-38-902	12/18/06	<10.0	<2.00	<2.00	<2.00	NA	<2.00	<2.00	<2.00	<10.0
RP-70-38-902	08/03/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-38-902	08/02/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-38-9BS	10/11/11	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-38-9BS	09/18/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-38-9EW	06/18/10	<0.50	<0.50	<0.50	<0.50	NA	<0.50	<0.50	<0.50	<1.00
RP-70-38-9HC	10/11/11	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-38-9JM	10/11/11	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-38-9SH	10/26/10	NA	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-38-9TW	11/01/10	NA	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-38-9TW	10/11/11	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-39-5CA	10/26/10	NA	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-39-5ER	10/26/10	NA	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-39-7AD	10/26/10	NA	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-39-7CH	11/02/10	NA	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-39-7CW	11/02/10	NA	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-45-505	12/07/06	<10.0	<2.00	<2.00	<2.00	NA	<2.00	<2.00	<2.00	<10.0
RP-70-45-505	10/23/07	<10.0	<2.00	<2.00	<2.00	NA	<2.00	<2.00	<2.00	<10.0
RP-70-45-505	07/30/09	<0.50	<0.50	<0.50	<0.50	NA	<0.50	<0.50	<0.50	<1.00
RP-70-45-505	06/16/10	<0.50	<0.50	<0.50	<0.50	NA	<0.50	<0.50	<0.50	<1.00
RP-70-45-505	11/08/11	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	1,1,1,2-Trichloro-ethane (µg/L)	1,1,1-Trichloro-ethane (µg/L)	1,1,2,2-Tetrachloro-ethane (µg/L)	1,1,2-Trichloro-ethane (µg/L)	1,1,2-Trichloro-trifluoro-ethane (µg/L)	1,1-Dichloro—ethane (µg/L)	1,1-Dichloro—ethene (µg/L)	1,1-Dichloro—propene (µg/L)	1,2,3-Trichloro-benzene (µg/L)
RP-70-45-505	09/17/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-45-505	09/18/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-45-601	12/07/06	<10.0	<2.00	<2.00	<2.00	NA	<2.00	<2.00	<2.00	<10.0
RP-70-45-601	10/23/07	<10.0	<2.00	<2.00	<2.00	NA	<2.00	<2.00	<2.00	<10.0
RP-70-45-601	07/30/09	<0.50	<0.50	<0.50	<0.50	NA	<0.50	<0.50	<0.50	<1.00
RP-70-45-601	06/16/10	<0.50	<0.50	<0.50	<0.50	NA	<0.50	<0.50	<0.50	<1.00
RP-70-45-601	10/10/11	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-45-601	09/17/12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-45-601	09/18/13	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-46-5AK	06/17/10	<0.50	<0.50	<0.50	<0.50	NA	<0.50	<0.50	<0.50	<1.00
RP-70-46-5AK	10/10/11	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-46-5DS	06/17/10	<0.50	<0.50	<0.50	<0.50	NA	<0.50	<0.50	<0.50	<1.00
RP-70-46-802	10/10/11	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-46-8DS	10/10/11	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-47-6GR	06/17/10	<0.50	<0.50	<0.50	<0.50	NA	<0.50	<0.50	<0.50	<1.00
RP-70-47-9GR	11/02/10	NA	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-47-9GR	10/10/11	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-39-5ER	10/26/10	NA	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-39-7AD	10/26/10	NA	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-39-7CH	11/02/10	NA	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-39-7CW	11/02/10	NA	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00
RP-70-45-505	12/07/06	<10.0	<2.00	<2.00	<2.00	NA	<2.00	<2.00	<2.00	<10.0
RP-70-45-505	10/23/07	<10.0	<2.00	<2.00	<2.00	NA	<2.00	<2.00	<2.00	<10.0
RP-70-45-505	07/30/09	<0.50	<0.50	<0.50	<0.50	NA	<0.50	<0.50	<0.50	<1.00
RP-70-45-505	06/16/10	<0.50	<0.50	<0.50	<0.50	NA	<0.50	<0.50	<0.50	<1.00
RP-70-45-505	11/08/11	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<5.00

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	1,2,3-Trichloro-propane (µg/L)	1,2,4,5-Tetra-chloro-benzene (µg/L)	1,2,4-Trichloro-benzene (µg/L)	1,2,4-Trimethyl-benzene (µg/L)	1,2-Dibromo--3-chloro-propane (µg/L)	1,2-Dibromo-ethane (µg/L)	1,2-Dichloro—benzene (µg/L)	1,2-Dichloro—ethane (µg/L)
KCGWD Observation Well	10/16/07	<10.0	<10.0	<10.0	<2.00	<2.00	<2.00	<2.00	<2.00
RP-70-37-706	07/29/05	<2.8	<10.0	<3.23	<1.5	<2.14	<0.425	<1.24	<0.666
RP-70-37-706	12/07/06	<10.0	<10.0	<10.0	<2.00	<2.00	<2.00	<2.00	<2.00
RP-70-37-706	10/16/07	<10.0	<10.0	<10.0	<2.00	<2.00	<2.00	<2.00	<2.00
RP-70-38-8MC	11/09/11	<1.00	NA	<5.00	<1.00	<5.00	<1.00	<1.00	<1.00
RP-70-38-902	12/18/06	<10.0	<10.0	<10.0	<2.00	<2.00	<2.00	<2.00	<2.00
RP-70-38-902	08/03/12	<1.00	NA	<5.00	<2.00	<5.00	<1.00	<1.00	<1.00
RP-70-38-902	08/02/13	<1.00	NA	<5.00	<2.00	<5.00	<1.00	<1.00	<1.00
RP-70-38-9BS	10/11/11	<1.00	NA	<5.00	<1.00	<5.00	<1.00	<1.00	<1.00
RP-70-38-9BS	09/18/12	<1.00	NA	<5.00	<2.00	<5.00	<1.00	<1.00	<1.00
RP-70-38-9EW	06/18/10	<1.00	<1.00	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50
RP-70-38-9HC	10/11/11	<1.00	NA	<5.00	<1.00	<5.00	<1.00	<1.00	<1.00
RP-70-38-9JM	10/11/11	<1.00	NA	<5.00	<1.00	<5.00	<1.00	<1.00	<1.00
RP-70-38-9SH	10/26/10	<1.00	NA	NA	<1.00	NA	<1.00	NA	<1.00
RP-70-38-9TW	11/01/10	<1.00	NA	NA	<1.00	NA	<1.00	NA	<1.00
RP-70-38-9TW	10/11/11	<1.00	NA	<5.00	<1.00	<5.00	<1.00	<1.00	<1.00
RP-70-39-5CA	10/26/10	<1.00	NA	NA	<1.00	NA	<1.00	NA	<1.00
RP-70-39-5ER	10/26/10	<1.00	NA	NA	<1.00	NA	<1.00	NA	<1.00
RP-70-39-7AD	10/26/10	<1.00	NA	NA	<1.00	NA	<1.00	NA	<1.00
RP-70-39-7CH	11/02/10	<1.00	NA	NA	<1.00	NA	<1.00	NA	<1.00
RP-70-39-7CW	11/02/10	<1.00	NA	NA	<1.00	NA	<1.00	NA	<1.00
RP-70-45-505	12/07/06	<10.0	<10.0	<10.0	<2.00	<2.00	<2.00	<2.00	<2.00
RP-70-45-505	10/23/07	<10.0	<10.0	<10.0	<2.00	<2.00	<2.00	<2.00	<2.00
RP-70-45-505	07/30/09	<1.00	<1.00	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50
RP-70-45-505	06/16/10	<1.00	<1.00	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50
RP-70-45-505	11/08/11	<1.00	NA	<5.00	<1.00	<5.00	<1.00	<1.00	<1.00

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	1,2,3-Trichloro-propane (µg/L)	1,2,4,5-Tetra-chloro-benzene (µg/L)	1,2,4-Trichloro-benzene (µg/L)	1,2,4-Trimethyl-benzene (µg/L)	1,2-Dibromo--3-chloro-propane	1,2-Dibromo-ethane (µg/L)	1,2-Dichloro—benzene (µg/L)	1,2-Dichloro—ethane (µg/L)
RP-70-45-505	09/17/12	<1.00	NA	<5.00	<2.00	<5.00	<1.00	<1.00	<1.00
RP-70-45-505	09/18/13	<1.00	NA	<5.00	<2.00	<5.00	<1.00	<1.00	<1.00
RP-70-45-601	12/07/06	<10.0	<10.0	<10.0	<2.00	<2.00	<2.00	<2.00	<2.00
RP-70-45-601	10/23/07	<10.0	<10.0	<10.0	<2.00	<2.00	<2.00	<2.00	<2.00
RP-70-45-601	07/30/09	<1.00	<1.00	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50
RP-70-45-601	06/16/10	<1.00	<1.00	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50
RP-70-45-601	10/10/11	<1.00	NA	<5.00	<1.00	<5.00	<1.00	<1.00	<1.00
RP-70-45-601	09/17/12	<1.00	NA	<5.00	<2.00	<5.00	<1.00	<1.00	<1.00
RP-70-45-601	09/18/13	<1.00	NA	<5.00	<2.00	<5.00	<1.00	<1.00	<1.00
RP-70-46-5AK	06/17/10	<1.00	<1.00	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50
RP-70-46-5AK	10/10/11	<1.00	NA	<5.00	<1.00	<5.00	<1.00	<1.00	<1.00
RP-70-46-5DS	06/17/10	<1.00	<1.00	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50
RP-70-46-802	10/10/11	<1.00	NA	<5.00	<1.00	<5.00	<1.00	<1.00	<1.00
RP-70-46-8DS	10/10/11	<1.00	NA	<5.00	<1.00	<5.00	<1.00	<1.00	<1.00
RP-70-47-6GR	06/17/10	<1.00	<1.00	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50
RP-70-47-9GR	11/02/10	<1.00	NA	NA	<1.00	NA	<1.00	NA	<1.00
RP-70-47-9GR	10/10/11	<1.00	NA	<5.00	<1.00	<5.00	<1.00	<1.00	<1.00
RP-70-39-5ER	10/26/10	<1.00	NA	NA	<1.00	NA	<1.00	NA	<1.00
RP-70-39-7AD	10/26/10	<1.00	NA	NA	<1.00	NA	<1.00	NA	<1.00
RP-70-39-7CH	11/02/10	<1.00	NA	NA	<1.00	NA	<1.00	NA	<1.00
RP-70-39-7CW	11/02/10	<1.00	NA	NA	<1.00	NA	<1.00	NA	<1.00
RP-70-45-505	12/07/06	<10.0	<10.0	<10.0	<2.00	<2.00	<2.00	<2.00	<2.00
RP-70-45-505	10/23/07	<10.0	<10.0	<10.0	<2.00	<2.00	<2.00	<2.00	<2.00
RP-70-45-505	07/30/09	<1.00	<1.00	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50
RP-70-45-505	06/16/10	<1.00	<1.00	<0.50	<0.50	<1.00	<0.50	<0.50	<0.50
RP-70-45-505	11/08/11	<1.00	NA	<5.00	<1.00	<5.00	<1.00	<1.00	<1.00

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	1,2-Dichloro--ethene, Total (µg/L)	1,2-Dichloro—propane (µg/L)	1,3,5-Trichloro-benzene (µg/L)	1,3,5-Trimethyl-benzene (µg/L)	1,3-Butadiene (µg/L)	1,3-Dichloro—benzene (µg/L)	1,3-Dichloro—propane (µg/L)	1,3-Dichloro—propene (µg/L)	1,4-Dichloro--benzene (µg/L)
KCGWD Observation Well	10/16/07	NA	<2.00	NA	<2.00	NA	<2.00	<2.00	<5.00	<2.00
RP-70-37-706	07/29/05	NA	<1.22	NA	<1.38	NA	<1.20	<0.650	<5.00	<1.09
RP-70-37-706	12/07/06	NA	<2.00	NA	<2.00	NA	<2.00	<2.00	<5.00	<2.00
RP-70-37-706	10/16/07	NA	<2.00	NA	<2.00	NA	<2.00	<2.00	<5.00	<2.00
RP-70-38-8MC	11/09/11	<2.00	<1.00	<5.00	<1.00	<1.00	<1.00	<1.00	NA	<1.00
RP-70-38-902	12/18/06	NA	<2.00	NA	<2.00	NA	<2.00	<2.00	<5.00	<2.00
RP-70-38-902	08/03/12	<2.00	<1.00	<5.00	<2.00	<1.00	<1.00	<1.00	NA	<1.00
RP-70-38-902	08/02/13	<2.00	<1.00	<5.00	<2.00	<1.00	<1.00	<1.00	NA	<1.00
RP-70-38-9BS	10/11/11	<2.00	<1.00	<5.00	<1.00	<1.00	<1.00	<1.00	NA	<1.00
RP-70-38-9BS	09/18/12	<2.00	<1.00	<5.00	<2.00	<1.00	<1.00	<1.00	NA	<1.00
RP-70-38-9EW	06/18/10	NA	<0.50	NA	<0.50	NA	<0.50	<0.50	<1.00	<0.50
RP-70-38-9HC	10/11/11	<2.00	<1.00	<5.00	<1.00	<1.00	<1.00	<1.00	NA	<1.00
RP-70-38-9JM	10/11/11	<2.00	<1.00	<5.00	<1.00	<1.00	<1.00	<1.00	NA	<1.00
RP-70-38-9SH	10/26/10	NA	<1.00	NA	<1.00	NA	NA	<1.00	NA	NA
RP-70-38-9TW	11/01/10	NA	<1.00	NA	<1.00	NA	NA	<1.00	NA	NA
RP-70-38-9TW	10/11/11	<2.00	<1.00	<5.00	<1.00	<1.00	<1.00	<1.00	NA	<1.00
RP-70-39-5CA	10/26/10	NA	<1.00	NA	<1.00	NA	NA	<1.00	NA	NA
RP-70-39-5ER	10/26/10	NA	<1.00	NA	<1.00	NA	NA	<1.00	NA	NA
RP-70-39-7AD	10/26/10	NA	<1.00	NA	<1.00	NA	NA	<1.00	NA	NA
RP-70-39-7CH	11/02/10	NA	<1.00	NA	<1.00	NA	NA	<1.00	NA	NA
RP-70-39-7CW	11/02/10	NA	<1.00	NA	<1.00	NA	NA	<1.00	NA	NA
RP-70-45-505	12/07/06	NA	<2.00	NA	<2.00	NA	<2.00	<2.00	<5.00	<2.00
RP-70-45-505	10/23/07	NA	<2.00	NA	<2.00	NA	<2.00	<2.00	<5.00	<2.00
RP-70-45-505	07/30/09	NA	<0.50	NA	<0.50	NA	<0.50	<0.50	<1.00	<0.50
RP-70-45-505	06/16/10	NA	<0.50	NA	<0.50	NA	<0.50	<0.50	<1.00	<0.50
RP-70-45-505	11/08/11	<2.00	<1.00	<5.00	<1.00	<1.00	<1.00	<1.00	NA	<1.00

Table B-6. Analytical data for volatile organic compounds (VOC) from wells in Kinney County

Station Name	Date Sampled	1,2-Dichloro--ethene, Total (µg/L)	1,2-Dichloro--propane (µg/L)	1,3,5-Trichloro-benzene (µg/L)	1,3,5-Trimethyl-benzene (µg/L)	1,3-Butadiene (µg/L)	1,3-Dichloro--benzene (µg/L)	1,3-Dichloro--propane (µg/L)	1,3-Dichloro--propene (µg/L)	1,4-Dichloro--benzene (µg/L)
RP-70-45-505	09/17/12	<2.00	<1.00	<5.00	<2.00	<1.00	<1.00	<1.00	NA	<1.00
RP-70-45-505	09/18/13	<2.00	<1.00	<5.00	<2.00	<1.00	<1.00	<1.00	NA	<1.00
RP-70-45-601	12/07/06	NA	<2.00	NA	<2.00	NA	<2.00	<2.00	<5.00	<2.00
RP-70-45-601	10/23/07	NA	<2.00	NA	<2.00	NA	<2.00	<2.00	<5.00	<2.00
RP-70-45-601	07/30/09	NA	<0.50	NA	<0.50	NA	<0.50	<0.50	<1.00	<0.50
RP-70-45-601	06/16/10	NA	<0.50	NA	<0.50	NA	<0.50	<0.50	<1.00	<0.50
RP-70-45-601	10/10/11	<2.00	<1.00	<5.00	<1.00	<1.00	<1.00	<1.00	NA	<1.00
RP-70-45-601	09/17/12	<2.00	<1.00	<5.00	<2.00	<1.00	<1.00	<1.00	NA	<1.00
RP-70-45-601	09/18/13	<2.00	<1.00	<5.00	<2.00	<1.00	<1.00	<1.00	NA	<1.00
RP-70-46-5AK	06/17/10	NA	<0.50	NA	<0.50	NA	<0.50	<0.50	<1.00	<0.50
RP-70-46-5AK	10/10/11	<2.00	<1.00	<5.00	<1.00	<1.00	<1.00	<1.00	NA	<1.00
RP-70-46-5DS	06/17/10	NA	<0.50	NA	<0.50	NA	<0.50	<0.50	<1.00	<0.50
RP-70-46-802	10/10/11	<2.00	<1.00	<5.00	<1.00	<1.00	<1.00	<1.00	NA	<1.00
RP-70-46-8DS	10/10/11	<2.00	<1.00	<5.00	<1.00	<1.00	<1.00	<1.00	NA	<1.00
RP-70-47-6GR	06/17/10	NA	<0.50	NA	<0.50	NA	<0.50	<0.50	<1.00	<0.50
RP-70-47-9GR	11/02/10	NA	<1.00	NA	<1.00	NA	NA	<1.00	NA	NA
RP-70-47-9GR	10/10/11	<2.00	<1.00	<5.00	<1.00	<1.00	<1.00	<1.00	NA	<1.00

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	1,4-Dioxane (µg/L)	1-Chlorohexane (µg/L)	1-Octene (µg/L)	2,2-Dichloro-propane (µg/L)	2-Butanone (µg/L)	2-Chloroethyl-vinyl ether (µg/L)	2-Chlorotoluene (µg/L)	2-Hexa-none (µg/L)	2-Nitro-propane (µg/L)
KCGWD Observation Well	10/16/07	NA	NA	NA	<2.00	<10.0	<10.0	<10.0	<10.0	NA
RP-70-37-706	07/29/05	NA	NA	NA	<1.28	<9.82	<8.65	<1.58	<9.60	NA
RP-70-37-706	12/07/06	NA	NA	NA	<2.00	<10.0	<10.0	<10.0	<10.0	NA
RP-70-37-706	10/16/07	NA	NA	NA	<2.00	<10.0	<10.0	<10.0	<10.0	NA
RP-70-38-8MC	11/09/11	<100	<5.00	<5.00	<1.00	<20.0	NA	<1.00	<5.00	<5.00
RP-70-38-902	12/18/06	NA	NA	NA	<2.00	<10.0	<10.0	<10.0	<10.0	NA
RP-70-38-902	08/03/12	<100	<5.00	<5.00	<1.00	<20.0	NA	<1.00	<5.00	<5.00
RP-70-38-902	08/02/13	<100	<5.00	<5.00	<1.00	<20.0	NA	<1.00	<5.00	<5.00
RP-70-38-9BS	10/11/11	<100	<5.00	<5.00	<1.00	<5.00	NA	<1.00	<5.00	<5.00
RP-70-38-9BS	09/18/12	<100	<5.00	<5.00	<1.00	<20.0	NA	<1.00	<5.00	<5.00
RP-70-38-9EW	06/18/10	NA	NA	NA	<0.50	<0.50	<0.50	<0.50	<0.50	NA
RP-70-38-9HC	10/11/11	<100	<5.00	<5.00	<1.00	<5.00	NA	<1.00	<5.00	<5.00
RP-70-38-9JM	10/11/11	<100	<5.00	<5.00	<1.00	<5.00	NA	<1.00	<5.00	<5.00
RP-70-38-9SH	10/26/10	<100	NA	NA	<1.00	<5.00	NA	NA	<5.00	<5.00
RP-70-38-9TW	11/01/10	<100	NA	NA	<1.00	<5.00	NA	NA	<5.00	<5.00
RP-70-38-9TW	10/11/11	<100	<5.00	<5.00	<1.00	<5.00	NA	<1.00	<5.00	<5.00
RP-70-39-5CA	10/26/10	<100	NA	NA	<1.00	<5.00	NA	NA	<5.00	<5.00
RP-70-39-5ER	10/26/10	<100	NA	NA	<1.00	<5.00	NA	NA	<5.00	<5.00
RP-70-39-7AD	10/26/10	<100	NA	NA	<1.00	<5.00	NA	NA	<5.00	<5.00
RP-70-39-7CH	11/02/10	<100	NA	NA	<1.00	<5.00	NA	NA	<5.00	<5.00
RP-70-39-7CW	11/02/10	<100	NA	NA	<1.00	<5.00	NA	NA	<5.00	<5.00
RP-70-45-505	12/07/06	NA	NA	NA	<2.00	<10.0	<10.0	<10.0	<10.0	NA
RP-70-45-505	10/23/07	NA	NA	NA	<2.00	<10.0	<10.0	<10.0	<10.0	NA
RP-70-45-505	07/30/09	NA	NA	NA	<0.50	<0.50	<0.50	<0.50	<0.50	NA
RP-70-45-505	06/16/10	NA	NA	NA	<0.50	<0.50	<0.50	<0.50	<0.50	NA
RP-70-45-505	11/08/11	<100	<5.00	<5.00	<1.00	<20.0	NA	<1.00	<5.00	<5.00

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	1,4-Dioxane (µg/L)	1-Chlorohexane (µg/L)	1-Octene (µg/L)	2,2-Dichloro--propane (µg/L)	2-Butanone (µg/L)	2-Chloroethyl-vinyl ether (µg/L)	2-Chlorotoluene (µg/L)	2-Hexa-none (µg/L)	2-Nitro-propane (µg/L)
RP-70-45-505	09/17/12	<100	<5.00	<5.00	<1.00	<20.0	NA	<1.00	<5.00	<5.00
RP-70-45-505	09/18/13	<100	<5.00	<5.00	<1.00	<20.0	NA	<1.00	<5.00	<5.00
RP-70-45-601	12/07/06	NA	NA	NA	<2.00	<10.0	<10.0	<10.0	<10.0	NA
RP-70-45-601	10/23/07	NA	NA	NA	<2.00	<10.0	<10.0	<10.0	<10.0	NA
RP-70-45-601	07/30/09	NA	NA	NA	<0.50	<0.50	<0.50	<0.50	<0.50	NA
RP-70-45-601	06/16/10	NA	NA	NA	<0.50	<0.50	<0.50	<0.50	<0.50	NA
RP-70-45-601	10/10/11	<100	<5.00	<5.00	<1.00	<5.00	NA	<1.00	<5.00	<5.00
RP-70-45-601	09/17/12	<100	<5.00	<5.00	<1.00	<20.0	NA	<1.00	<5.00	<5.00
RP-70-45-601	09/18/13	<100	<5.00	<5.00	<1.00	<20.0	NA	<1.00	<5.00	<5.00
RP-70-46-5AK	06/17/10	NA	NA	NA	<0.50	<0.50	<0.50	<0.50	<0.50	NA
RP-70-46-5AK	10/10/11	<100	<5.00	<5.00	<1.00	<5.00	NA	<1.00	<5.00	<5.00
RP-70-46-5DS	06/17/10	NA	NA	NA	<0.50	<0.50	<0.50	<0.50	<0.50	NA
RP-70-46-802	10/10/11	<100	<5.00	<5.00	<1.00	<5.00	NA	<1.00	<5.00	<5.00
RP-70-46-8DS	10/10/11	<100	<5.00	<5.00	<1.00	<5.00	NA	<1.00	<5.00	<5.00
RP-70-47-6GR	06/17/10	NA	NA	NA	<0.50	<0.50	<0.50	<0.50	<0.50	NA
RP-70-47-9GR	11/02/10	<100	NA	NA	<1.00	<5.00	NA	NA	<5.00	<5.00
RP-70-47-9GR	10/10/11	<100	<5.00	<5.00	<1.00	<5.00	NA	<1.00	<5.00	<5.00

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	4-Bromofluoro-benzene (µg/L)	4-Chlorotoluene (µg/L)	4-Isopropyl-toluene (µg/L)	4-Methyl--2-pentanone (µg/L)	Acetone (µg/L)	Acetonitrile (µg/L)	Acrolein (µg/L)	Acrylo-nitrile (µg/L)	Allyl Chloride (µg/L)
RP-70-45-505	09/17/12	NA	<1.00	<1.00	<5.00	<10.0	<50.0	NA	NA	<1.00
RP-70-45-505	09/18/13	NA	<1.00	<1.00	<5.00	<10.0	<50.0	NA	NA	<1.00
RP-70-45-601	12/07/06	NA	<2.00	<2.00	<10.0	<10.0	<5.00	<5.00	<5.00	<5.00
RP-70-45-601	10/23/07	NA	<2.00	<2.00	<10.0	<10.0	<5.00	<5.00	<5.00	<5.00
RP-70-45-601	07/30/09	NA	<0.50	<0.50	<0.50	<1.00	<1.00	<0.50	<0.50	<1.00
RP-70-45-601	06/16/10	NA	<0.50	<0.50	<0.50	<1.00	<1.00	<0.50	<0.50	<1.00
RP-70-45-601	10/10/11	NA	<1.00	<1.00	<5.00	<10.0	<50.0	NA	NA	<1.00
RP-70-45-601	09/17/12	NA	<1.00	<1.00	<5.00	<10.0	<50.0	NA	NA	<1.00
RP-70-45-601	09/18/13	NA	<1.00	<1.00	<5.00	<10.0	<50.0	NA	NA	<1.00
RP-70-46-5AK	06/17/10	NA	<0.50	<0.50	<0.50	<1.00	<1.00	<0.50	<0.50	<1.00
RP-70-46-5AK	10/10/11	NA	<1.00	<1.00	<5.00	<10.0	<50.0	NA	NA	<1.00
RP-70-46-5DS	06/17/10	NA	<0.50	<0.50	<0.50	<1.00	<1.00	<0.50	<0.50	<1.00
RP-70-46-802	10/10/11	NA	<1.00	<1.00	<5.00	<10.0	<50.0	NA	NA	<1.00
RP-70-46-8DS	10/10/11	NA	<1.00	<1.00	<5.00	<10.0	<50.0	NA	NA	<1.00
RP-70-47-6GR	06/17/10	NA	<0.50	<0.50	<0.50	<1.00	<1.00	<0.50	<0.50	<1.00
RP-70-47-9GR	11/02/10	NA	NA	NA	<5.00	<10.0	<50.0	NA	NA	NA
RP-70-47-9GR	10/10/11	NA	<1.00	<1.00	<5.00	<10.0	<50.0	NA	NA	<1.00

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	4-Bromofluoro-benzene (µg/L)	4-Chlorotoluene (µg/L)	4-Isopropyl-toluene (µg/L)	4-Methyl--2-pentanone (µg/L)	Acetone (µg/L)	Acetonitrile (µg/L)	Acrolein (µg/L)	Acrylo-nitrile (µg/L)	Allyl Chloride (µg/L)
RP-70-45-505	09/17/12	NA	<1.00	<1.00	<5.00	<10.0	<50.0	NA	NA	<1.00
RP-70-45-505	09/18/13	NA	<1.00	<1.00	<5.00	<10.0	<50.0	NA	NA	<1.00
RP-70-45-601	12/07/06	NA	<2.00	<2.00	<10.0	<10.0	<5.00	<5.00	<5.00	<5.00
RP-70-45-601	10/23/07	NA	<2.00	<2.00	<10.0	<10.0	<5.00	<5.00	<5.00	<5.00
RP-70-45-601	07/30/09	NA	<0.50	<0.50	<0.50	<1.00	<1.00	<0.50	<0.50	<1.00
RP-70-45-601	06/16/10	NA	<0.50	<0.50	<0.50	<1.00	<1.00	<0.50	<0.50	<1.00
RP-70-45-601	10/10/11	NA	<1.00	<1.00	<5.00	<10.0	<50.0	NA	NA	<1.00
RP-70-45-601	09/17/12	NA	<1.00	<1.00	<5.00	<10.0	<50.0	NA	NA	<1.00
RP-70-45-601	09/18/13	NA	<1.00	<1.00	<5.00	<10.0	<50.0	NA	NA	<1.00
RP-70-46-5AK	06/17/10	NA	<0.50	<0.50	<0.50	<1.00	<1.00	<0.50	<0.50	<1.00
RP-70-46-5AK	10/10/11	NA	<1.00	<1.00	<5.00	<10.0	<50.0	NA	NA	<1.00
RP-70-46-5DS	06/17/10	NA	<0.50	<0.50	<0.50	<1.00	<1.00	<0.50	<0.50	<1.00
RP-70-46-802	10/10/11	NA	<1.00	<1.00	<5.00	<10.0	<50.0	NA	NA	<1.00
RP-70-46-8DS	10/10/11	NA	<1.00	<1.00	<5.00	<10.0	<50.0	NA	NA	<1.00
RP-70-47-6GR	06/17/10	NA	<0.50	<0.50	<0.50	<1.00	<1.00	<0.50	<0.50	<1.00
RP-70-47-9GR	11/02/10	NA	NA	NA	<5.00	<10.0	<50.0	NA	NA	NA
RP-70-47-9GR	10/10/11	NA	<1.00	<1.00	<5.00	<10.0	<50.0	NA	NA	<1.00

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	Benzene (µg/L)	Benzyl Chloride (µg/L)	Bromoace-tone (µg/L)	Bromo-benzene (µg/L)	Bromo-chloro-methane (µg/L)	Bromo-dichloro-methane (µg/L)	Bromoform (µg/L)	Bromo-methane (µg/L)
KCGWD Observation Well	10/16/07	<2.00	<5.00	<5.00	<2.00	<10.0	<2.00	<2.00	<10.0
RP-70-37-706	07/29/05	<1.41	<5.00	<5.00	<1.27	<1.43	<1.50	<1.59	<2.70
RP-70-37-706	12/07/06	<2.00	<5.00	<5.00	<2.00	<10.0	<2.00	<2.00	<10.0
RP-70-37-706	10/16/07	<2.00	<5.00	<5.00	<2.00	<10.0	<2.00	<2.00	<10.0
RP-70-38-8MC	11/09/11	<1.00	<5.00	NA	<1.00	<1.00	<1.00	<5.00	<5.00
RP-70-38-902	12/18/06	<2.00	<5.00	<5.00	<2.00	<10.0	<2.00	<2.00	<10.0
RP-70-38-902	08/03/12	<1.00	<5.00	NA	<1.00	<1.00	<1.00	<5.00	<5.00
RP-70-38-902	08/02/13	<1.00	<5.00	NA	<1.00	<1.00	<1.00	<5.00	<5.00
RP-70-38-9BS	10/11/11	<1.00	<5.00	NA	<1.00	<1.00	<1.00	<5.00	<5.00
RP-70-38-9BS	09/18/12	<1.00	<5.00	NA	<1.00	<1.00	<1.00	<5.00	<5.00
RP-70-38-9EW	06/18/10	<0.50	<1.00	<1.00	<0.50	<1.00	<1.00	<0.50	<1.00
RP-70-38-9HC	10/11/11	<1.00	<5.00	NA	<1.00	<1.00	<1.00	<5.00	<5.00
RP-70-38-9JM	10/11/11	<1.00	<5.00	NA	<1.00	<1.00	<1.00	<5.00	<5.00
RP-70-38-9SH	10/26/10	<1.00	NA	NA	NA	NA	<1.00	<5.00	<5.00
RP-70-38-9TW	11/01/10	<1.00	NA	NA	NA	NA	<1.00	<5.00	<5.00
RP-70-38-9TW	10/11/11	<1.00	<5.00	NA	<1.00	<1.00	<1.00	<5.00	<5.00
RP-70-39-5CA	10/26/10	<1.00	NA	NA	NA	NA	<1.00	<5.00	<5.00
RP-70-39-5ER	10/26/10	<1.00	NA	NA	NA	NA	<1.00	<5.00	<5.00
RP-70-39-7AD	10/26/10	<1.00	NA	NA	NA	NA	<1.00	<5.00	<5.00
RP-70-39-7CH	11/02/10	<1.00	NA	NA	NA	NA	<1.00	<5.00	<5.00
RP-70-39-7CW	11/02/10	<1.00	NA	NA	NA	NA	<1.00	<5.00	<5.00
RP-70-45-505	12/07/06	<2.00	<5.00	<5.00	<2.00	<10.0	<2.00	<2.00	<10.0
RP-70-45-505	10/23/07	<2.00	<5.00	<5.00	<2.00	<10.0	<2.00	<2.00	<10.0
RP-70-45-505	07/30/09	<0.50	<1.00	<1.00	<0.50	<1.00	<1.00	<0.50	<1.00
RP-70-45-505	06/16/10	<0.50	<1.00	<1.00	<0.50	<1.00	<1.00	<0.50	<1.00
RP-70-45-505	11/08/11	<1.00	<5.00	NA	<1.00	<1.00	<1.00	<5.00	<5.00

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	Benzene (µg/L)	Benzyl Chloride (µg/L)	Bromo-acetone (µg/L)	Bromo-benzene (µg/L)	Bromochloro-methane (µg/L)	Bromodichloro-methane (µg/L)	Bromoform (µg/L)	Bromo-methane (µg/L)
RP-70-45-505	09/17/12	<1.00	<5.00	NA	<1.00	<1.00	<1.00	<5.00	<5.00
RP-70-45-505	09/18/13	<1.00	<5.00	NA	<1.00	<1.00	<1.00	<5.00	<5.00
RP-70-45-601	12/07/06	<2.00	<5.00	<5.00	<2.00	<10.0	<2.00	<2.00	<10.0
RP-70-45-601	10/23/07	<2.00	<5.00	<5.00	<2.00	<10.0	<2.00	<2.00	<10.0
RP-70-45-601	07/30/09	<0.50	<1.00	<1.00	<0.50	<1.00	<1.00	<0.50	<1.00
RP-70-45-601	06/16/10	<0.50	<1.00	<1.00	<0.50	<1.00	<1.00	<0.50	<1.00
RP-70-45-601	10/10/11	<1.00	<5.00	NA	<1.00	<1.00	<1.00	<5.00	<5.00
RP-70-45-601	09/17/12	<1.00	<5.00	NA	<1.00	<1.00	<1.00	<5.00	<5.00
RP-70-45-601	09/18/13	<1.00	<5.00	NA	<1.00	<1.00	<1.00	<5.00	<5.00
RP-70-46-5AK	06/17/10	<0.50	<1.00	<1.00	<0.50	<1.00	<1.00	<0.50	<1.00
RP-70-46-5AK	10/10/11	<1.00	<5.00	NA	<1.00	<1.00	<1.00	<5.00	<5.00
RP-70-46-5DS	06/17/10	<0.50	<1.00	<1.00	<0.50	<1.00	<1.00	<0.50	<1.00
RP-70-46-802	10/10/11	<1.00	<5.00	NA	<1.00	<1.00	<1.00	<5.00	<5.00
RP-70-46-8DS	10/10/11	<1.00	<5.00	NA	<1.00	<1.00	<1.00	<5.00	<5.00
RP-70-47-6GR	06/17/10	<0.50	<1.00	<1.00	<0.50	<1.00	<1.00	<0.50	<1.00
RP-70-47-9GR	11/02/10	<1.00	NA	NA	NA	NA	<1.00	<5.00	<5.00
RP-70-47-9GR	10/10/11	<1.00	<5.00	NA	<1.00	<1.00	<1.00	<5.00	<5.00

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	C6-C35 (mg/L)	Carbon disulfide (µg/L)	Carbon tetrachloride (µg/L)	Chloral Hydrate (µg/L)	Chloro-benzene (µg/L)	Chloro-ethane (µg/L)	Chloroform (µg/L)	Chloro-methane (µg/L)	Chloro-prene (µg/L)
KCGWD Observation Well	10/16/07	NA	<2.00	<10.0	<5.00	<2.00	<10.0	<2.00	<2.00	NA
RP-70-37-706	07/29/05	NA	<1.00	<0.908	<5.00	<1.56	<1.86	<1.60	<2.24	NA
RP-70-37-706	12/07/06	NA	<2.00	<10.0	<5.00	<2.00	<10.0	<2.00	<2.00	NA
RP-70-37-706	10/16/07	NA	<2.00	<10.0	<5.00	<2.00	<10.0	<2.00	<2.00	NA
RP-70-38-8MC	11/09/11	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	<1.00
RP-70-38-902	12/18/06	NA	<2.00	<10.0	<5.00	<2.00	<10.0	<2.00	<2.00	NA
RP-70-38-902	08/03/12	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	<1.00
RP-70-38-902	08/02/13	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	<1.00
RP-70-38-9BS	10/11/11	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	<1.00
RP-70-38-9BS	09/18/12	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	<1.00
RP-70-38-9EW	06/18/10	NA	<0.50	<0.50	<1.00	<0.50	<1.00	<1.00	<0.50	NA
RP-70-38-9HC	10/11/11	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	<1.00
RP-70-38-9JM	10/11/11	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	<1.00
RP-70-38-9SH	10/26/10	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	NA
RP-70-38-9TW	11/01/10	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	NA
RP-70-38-9TW	10/11/11	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	<1.00
RP-70-39-5CA	10/26/10	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	NA
RP-70-39-5ER	10/26/10	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	NA
RP-70-39-7AD	10/26/10	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	NA
RP-70-39-7CH	11/02/10	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	NA
RP-70-39-7CW	11/02/10	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	0.467J	NA
RP-70-45-505	12/07/06	NA	<2.00	<10.0	<5.00	<2.00	<10.0	<2.00	<2.00	NA
RP-70-45-505	10/23/07	NA	<2.00	<10.0	<5.00	<2.00	<10.0	<2.00	<2.00	NA
RP-70-45-505	07/30/09	NA	<0.50	<0.50	<1.00	<0.50	<1.00	<1.00	<0.50	NA
RP-70-45-505	06/16/10	NA	<0.50	<0.50	<1.00	<0.50	<1.00	<1.00	<0.50	NA
RP-70-45-505	11/08/11	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	<1.00

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	C6-C35 (mg/L)	Carbon disulfide (µg/L)	Carbon tetrachloride (µg/L)	Chloral Hydrate (µg/L)	Chloro-benzene (µg/L)	Chloro-ethane (µg/L)	Chloroform (µg/L)	Chloro-methane (µg/L)	Chloroprene (µg/L)
RP-70-45-505	09/17/12	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	<1.00
RP-70-45-505	09/18/13	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	<1.00
RP-70-45-601	12/07/06	NA	<2.00	<10.0	<5.00	<2.00	<10.0	<2.00	<2.00	NA
RP-70-45-601	10/23/07	NA	<2.00	<10.0	<5.00	<2.00	<10.0	<2.00	<2.00	NA
RP-70-45-601	07/30/09	NA	<0.50	<0.50	<1.00	<0.50	<1.00	<1.00	<0.50	NA
RP-70-45-601	06/16/10	NA	<0.50	<0.50	<1.00	<0.50	<1.00	<1.00	<0.50	NA
RP-70-45-601	10/10/11	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	<1.00
RP-70-45-601	09/17/12	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	<1.00
RP-70-45-601	09/18/13	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	<1.00
RP-70-46-5AK	06/17/10	NA	<0.50	<0.50	<1.00	<0.50	<1.00	<1.00	<0.50	NA
RP-70-46-5AK	10/10/11	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	<1.00
RP-70-46-5DS	06/17/10	NA	<0.50	<0.50	<1.00	<0.50	<1.00	<1.00	<0.50	NA
RP-70-46-802	10/10/11	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	<1.00
RP-70-46-8DS	10/10/11	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	<1.00
RP-70-47-6GR	06/17/10	NA	<0.50	<0.50	<1.00	<0.50	<1.00	<1.00	<0.50	NA
RP-70-47-9GR	11/02/10	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	NA
RP-70-47-9GR	10/10/11	NA	<5.00	<1.00	NA	<1.00	<5.00	<1.00	<5.00	<1.00

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	cis-1,2-Dichloro--ethene (µg/L)	cis-1,3-Dichloro--propene (µg/L)	cis-1,4-Dichloro--2-butene (µg/L)	Cyclo-hexane (µg/L)	Cyclo-hexanone (µg/L)	Dibromo-chloro-methane (µg/L)	Dibromo-fluoro-methane (percent)	Dibromo-methane (µg/L)	Dichloro--difluoro-methane (µg/L)
KCGWD Observation Well	10/16/07	<2.00	<2.00	NA	NA	NA	<2.00	NA	<10.0	<2.00
RP-70-37-706	07/29/05	<1.68	<1.38	NA	NA	NA	<1.44	NA	<0.568	<0.697
RP-70-37-706	12/07/06	<2.00	<2.00	NA	NA	NA	<2.00	NA	<10.0	<2.00
RP-70-37-706	10/16/07	<2.00	<2.00	NA	NA	NA	<2.00	NA	<10.0	<2.00
RP-70-38-8MC	11/09/11	<1.00	<1.00	<5.00	<2.00	<25.0	<1.00	NA	<1.00	<5.00
RP-70-38-902	12/18/06	<2.00	<2.00	NA	NA	NA	<2.00	NA	<10.0	<2.00
RP-70-38-902	08/03/12	<1.00	<1.00	<5.00	<2.00	<25.0	<1.00	NA	<1.00	<5.00
RP-70-38-902	08/02/13	<1.00	<1.00	<5.00	<2.00	<50.0	<1.00	NA	<1.00	<5.00
RP-70-38-9BS	10/11/11	<1.00	<1.00	<5.00	<2.00	<25.0	<1.00	NA	<1.00	<5.00
RP-70-38-9BS	09/18/12	<1.00	<1.00	<5.00	<2.00	<25.0	<1.00	NA	<1.00	<5.00
RP-70-38-9EW	06/18/10	<0.50	<0.50	NA	NA	NA	<0.50	NA	<0.50	<0.50
RP-70-38-9HC	10/11/11	<1.00	<1.00	<5.00	<2.00	<25.0	<1.00	NA	<1.00	<5.00
RP-70-38-9JM	10/11/11	<1.00	<1.00	<5.00	<2.00	<25.0	<1.00	NA	<1.00	<5.00
RP-70-38-9SH	10/26/10	<1.00	<1.00	NA	NA	NA	<1.00	NA	<1.00	<5.00
RP-70-38-9TW	11/01/10	<1.00	<1.00	NA	NA	NA	<1.00	NA	<1.00	<5.00
RP-70-38-9TW	10/11/11	<1.00	<1.00	<5.00	<2.00	<25.0	<1.00	NA	<1.00	<5.00
RP-70-39-5CA	10/26/10	<1.00	<1.00	NA	NA	NA	<1.00	NA	<1.00	<5.00
RP-70-39-5ER	10/26/10	<1.00	<1.00	NA	NA	NA	<1.00	NA	<1.00	<5.00
RP-70-39-7AD	10/26/10	<1.00	<1.00	NA	NA	NA	<1.00	NA	<1.00	<5.00
RP-70-39-7CH	11/02/10	<1.00	<1.00	NA	NA	NA	<1.00	NA	<1.00	<5.00
RP-70-39-7CW	11/02/10	<1.00	<1.00	NA	NA	NA	<1.00	NA	<1.00	<5.00
RP-70-45-505	12/07/06	<2.00	<2.00	NA	NA	NA	<2.00	NA	<10.0	<2.00
RP-70-45-505	10/23/07	<2.00	<2.00	NA	NA	NA	<2.00	NA	<10.0	<2.00
RP-70-45-505	07/30/09	<0.50	<0.50	NA	NA	NA	<0.50	NA	<0.50	<0.50
RP-70-45-505	06/16/10	<0.50	<0.50	NA	NA	NA	<0.50	NA	<0.50	<0.50
RP-70-45-505	11/08/11	<1.00	<1.00	<5.00	<2.00	<25.0	<1.00	NA	<1.00	<5.00

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	cis-1,2-Dichloro--ethene (µg/L)	cis-1,3-Dichloro--propene (µg/L)	cis-1,4-Dichloro---2-butene (µg/L)	Cyclo-hexane (µg/L)	Cyclo-hexanone (µg/L)	Dibromo-chloro-methane (µg/L)	Dibromo-fluoro-methane (percent)	Dibromo-methane (µg/L)	Dichloro--difluoro-methane (µg/L)
RP-70-45-505	09/17/12	<1.00	<1.00	<5.00	<2.00	<25.0	<1.00	NA	<1.00	<5.00
RP-70-45-505	09/18/13	<1.00	<1.00	<5.00	<2.00	<50.0	<1.00	NA	<1.00	<5.00
RP-70-45-601	12/07/06	<2.00	<2.00	NA	NA	NA	<2.00	NA	<10.0	<2.00
RP-70-45-601	10/23/07	<2.00	<2.00	NA	NA	NA	<2.00	NA	<10.0	<2.00
RP-70-45-601	07/30/09	<0.50	<0.50	NA	NA	NA	<0.50	NA	<0.50	<0.50
RP-70-45-601	06/16/10	<0.50	<0.50	NA	NA	NA	<0.50	NA	<0.50	<0.50
RP-70-45-601	10/10/11	<1.00	<1.00	<5.00	<2.00	<25.0	<1.00	NA	<1.00	<5.00
RP-70-45-601	09/17/12	<1.00	<1.00	<5.00	<2.00	<25.0	<1.00	NA	<1.00	<5.00
RP-70-45-601	09/18/13	<1.00	<1.00	<5.00	<2.00	<50.0	<1.00	NA	<1.00	<5.00
RP-70-46-5AK	06/17/10	<0.50	<0.50	NA	NA	NA	<0.50	NA	<0.50	<0.50
RP-70-46-5AK	10/10/11	<1.00	<1.00	<5.00	<2.00	<25.0	<1.00	NA	<1.00	<5.00
RP-70-46-5DS	06/17/10	<0.50	<0.50	NA	NA	NA	<0.50	NA	<0.50	<0.50
RP-70-46-802	10/10/11	<1.00	<1.00	<5.00	<2.00	<25.0	<1.00	NA	<1.00	<5.00
RP-70-46-8DS	10/10/11	<1.00	<1.00	<5.00	<2.00	<25.0	<1.00	NA	<1.00	<5.00
RP-70-47-6GR	06/17/10	<0.50	<0.50	NA	NA	NA	<0.50	NA	<0.50	<0.50
RP-70-47-9GR	11/02/10	<1.00	<1.00	NA	NA	NA	<1.00	NA	<1.00	<5.00
RP-70-47-9GR	10/10/11	<1.00	<1.00	<5.00	<2.00	<25.0	<1.00	NA	<1.00	<5.00

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	Over C12-C28 (mg/L)	Ethyl acetate (µg/L)	Ethyl ether (µg/L)	Ethyl methacrylate (µg/L)	Ethylbenzene (µg/L)	Ethylene oxide (µg/L)	GRO hydrocarbons (mg/L)	Hexa-chloro-butadiene (µg/L)	Hexane (µg/L)
KCGWD Observation Well	10/16/07	NA	NA	NA	NA	<2.00	NA	NA	<10.0	NA
RP-70-37-706	07/29/05	NA	NA	NA	NA	<1.24	NA	NA	<3.41	NA
RP-70-37-706	12/07/06	NA	NA	NA	NA	<2.00	NA	NA	<10.0	NA
RP-70-37-706	10/16/07	NA	NA	NA	NA	<2.00	NA	NA	<10.0	NA
RP-70-38-8MC	11/09/11	NA	<5.00	<1.00	<5.00	<1.00	<20.0	NA	<5.00	<5.00
RP-70-38-902	12/18/06	NA	NA	NA	NA	<2.00	NA	NA	<10.0	NA
RP-70-38-902	08/03/12	NA	<5.00	<1.00	<5.00	<1.00	<20.0	NA	<5.00	<5.00
RP-70-38-902	08/02/13	NA	<5.00	<1.00	<5.00	<1.00	<20.0	NA	<5.00	<5.00
RP-70-38-9BS	10/11/11	NA	<5.00	<1.00	<5.00	<1.00	<20.0	NA	<5.00	<5.00
RP-70-38-9BS	09/18/12	NA	<5.00	<1.00	<5.00	<1.00	<20.0	NA	<5.00	<5.00
RP-70-38-9EW	06/18/10	NA	NA	NA	NA	<0.50	NA	NA	<0.50	NA
RP-70-38-9HC	10/11/11	NA	<5.00	<1.00	<5.00	<1.00	<20.0	NA	<5.00	<5.00
RP-70-38-9JM	10/11/11	NA	<5.00	<1.00	<5.00	<1.00	<20.0	NA	<5.00	<5.00
RP-70-38-9SH	10/26/10	NA	<5.00	<1.00	<5.00	<1.00	NA	NA	NA	NA
RP-70-38-9TW	11/01/10	NA	<5.00	<1.00	<5.00	<1.00	NA	NA	NA	NA
RP-70-38-9TW	10/11/11	NA	<5.00	<1.00	<5.00	<1.00	<20.0	NA	<5.00	<5.00
RP-70-39-5CA	10/26/10	NA	<5.00	<1.00	<5.00	<1.00	NA	NA	NA	NA
RP-70-39-5ER	10/26/10	NA	<5.00	<1.00	<5.00	<1.00	NA	NA	NA	NA
RP-70-39-7AD	10/26/10	NA	<5.00	<1.00	<5.00	<1.00	NA	NA	NA	NA
RP-70-39-7CH	11/02/10	NA	<5.00	<1.00	<5.00	<1.00	NA	NA	NA	NA
RP-70-39-7CW	11/02/10	NA	<5.00	<1.00	<5.00	<1.00	NA	NA	NA	NA
RP-70-45-505	12/07/06	NA	NA	NA	NA	<2.00	NA	NA	<10.0	NA
RP-70-45-505	10/23/07	NA	NA	NA	NA	<2.00	NA	NA	<10.0	NA
RP-70-45-505	07/30/09	NA	NA	NA	NA	<0.50	NA	NA	<0.50	NA
RP-70-45-505	06/16/10	NA	NA	NA	NA	<0.50	NA	NA	<0.50	NA
RP-70-45-505	11/08/11	NA	<5.00	<1.00	<5.00	<1.00	<20.0	NA	<5.00	<5.00

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	Iodomethane (µg/L)	Isobutyl-alcohol (µg/L)	Isooctane (µg/L)	Isopropyl-benzene (µg/L)	m,p-Xylene (µg/L)	m,p-Xylene (µg/L)	Methyl-methacrylate (µg/L)	Methyl-tert-butyl-ether (µg/L)	Methyl-acrylonitrile (µg/L)
KCGWD Observation Well	10/16/07	<2.00	NA	NA	<2.00	NA	<2.00	NA	<2.00	NA
RP-70-37-706	07/29/05	<2.40	NA	NA	<1.10	NA	<2.88	NA	<0.50	NA
RP-70-37-706	12/07/06	<2.00	NA	NA	<2.00	NA	<2.00	NA	<2.00	NA
RP-70-37-706	10/16/07	<2.00	NA	NA	<2.00	NA	<2.00	NA	<2.00	NA
RP-70-38-8MC	11/09/11	<1.00	<20.0	<1.00	<1.00	<2.00	<3.00	<5.00	<1.00	<10.0
RP-70-38-902	12/18/06	<2.00	NA	NA	<2.00	NA	<2.00	NA	<2.00	NA
RP-70-38-902	08/03/12	<2.00	<20.0	<5.00	<5.00	<2.00	<3.00	<5.00	<1.00	<10.0
RP-70-38-902	08/02/13	<2.00	<20.0	<5.00	<5.00	<2.00	<3.00	<5.00	<1.00	<2.50
RP-70-38-9BS	10/11/11	<1.00	<20.0	<1.00	<1.00	<2.00	<3.00	<5.00	<1.00	<10.0
RP-70-38-9BS	09/18/12	<2.00	<20.0	<5.00	<5.00	<2.00	<3.00	<5.00	<1.00	<10.0
RP-70-38-9EW	06/18/10	<0.50	NA	NA	<0.50	NA	<1.00	NA	<0.50	NA
RP-70-38-9HC	10/11/11	<1.00	<20.0	<1.00	<1.00	<2.00	<3.00	<5.00	<1.00	<10.0
RP-70-38-9JM	10/11/11	<1.00	<20.0	<1.00	<1.00	<2.00	<3.00	<5.00	<1.00	<10.0
RP-70-38-9SH	10/26/10	<1.00	NA	NA	NA	NA	<3.00	<5.00	<1.00	NA
RP-70-38-9TW	11/01/10	<1.00	NA	NA	NA	NA	<3.00	<5.00	<1.00	NA
RP-70-38-9TW	10/11/11	<1.00	<20.0	<1.00	<1.00	<2.00	<3.00	<5.00	<1.00	<10.0
RP-70-39-5CA	10/26/10	<1.00	NA	NA	NA	NA	<3.00	<5.00	<1.00	NA
RP-70-39-5ER	10/26/10	<1.00	NA	NA	NA	NA	<3.00	<5.00	<1.00	NA
RP-70-39-7AD	10/26/10	<1.00	NA	NA	NA	NA	<3.00	<5.00	<1.00	NA
RP-70-39-7CH	11/02/10	<1.00	NA	NA	NA	NA	<3.00	<5.00	<1.00	NA
RP-70-39-7CW	11/02/10	<1.00	NA	NA	NA	NA	<3.00	<5.00	<1.00	NA
RP-70-45-505	12/07/06	<2.00	NA	NA	<2.00	NA	<2.00	NA	<2.00	NA
RP-70-45-505	10/23/07	<2.00	NA	NA	<2.00	NA	<2.00	NA	<2.00	NA
RP-70-45-505	07/30/09	<0.50	NA	NA	<0.50	NA	<1.00	NA	<0.50	NA
RP-70-45-505	06/16/10	<0.50	NA	NA	<0.50	NA	<1.00	NA	<0.50	NA
RP-70-45-505	11/08/11	<1.00	<20.0	<1.00	<1.00	<2.00	<3.00	<5.00	<1.00	<10.0

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	Iodo-methane (µg/L)	Isobutyl-alcohol (µg/L)	Isooctane (µg/L)	Isopropyl-benzene (µg/L)	m,p-Xylene (µg/L)	m,p-Xylene (µg/L)	Methyl-methacrylate (µg/L)	Methyl-tert-butyl-ether (µg/L)	Methyl-acrylonitrile (µg/L)
RP-70-45-505	09/17/12	<2.00	<20.0	<5.00	<5.00	<2.00	<3.00	<5.00	<1.00	<10.0
RP-70-45-505	09/18/13	<2.00	<50.0	<5.00	<5.00	<2.00	<3.00	<5.00	<1.00	<2.50
RP-70-45-601	12/07/06	<2.00	NA	NA	<2.00	NA	<2.00	NA	<2.00	NA
RP-70-45-601	10/23/07	<2.00	NA	NA	<2.00	NA	<2.00	NA	<2.00	NA
RP-70-45-601	07/30/09	<0.50	NA	NA	<0.50	NA	<1.00	NA	<0.50	NA
RP-70-45-601	06/16/10	<0.50	NA	NA	<0.50	NA	<1.00	NA	<0.50	NA
RP-70-45-601	10/10/11	<1.00	<20.0	<1.00	<1.00	<2.00	<3.00	<5.00	<1.00	<10.0
RP-70-45-601	09/17/12	<2.00	<20.0	<5.00	<5.00	<2.00	<3.00	<5.00	<1.00	<10.0
RP-70-45-601	09/18/13	<2.00	<50.0	<5.00	<5.00	<2.00	<3.00	<5.00	<1.00	<2.50
RP-70-46-5AK	06/17/10	<0.50	NA	NA	<0.50	NA	<1.00	NA	<0.50	NA
RP-70-46-5AK	10/10/11	<1.00	<20.0	<1.00	<1.00	<2.00	<3.00	<5.00	<1.00	<10.0
RP-70-46-5DS	06/17/10	<0.50	NA	NA	<0.50	NA	<1.00	NA	<0.50	NA
RP-70-46-802	10/10/11	<1.00	<20.0	<1.00	<1.00	<2.00	<3.00	<5.00	<1.00	<10.0
RP-70-46-8DS	10/10/11	<1.00	<20.0	<1.00	<1.00	<2.00	<3.00	<5.00	<1.00	<10.0
RP-70-47-6GR	06/17/10	<0.50	NA	NA	<0.50	NA	<1.00	NA	<0.50	NA
RP-70-47-9GR	11/02/10	<1.00	NA	NA	NA	NA	<3.00	<5.00	<1.00	NA
RP-70-47-9GR	10/10/11	<1.00	<20.0	<1.00	<1.00	<2.00	<3.00	<5.00	<1.00	<10.0

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	Methyl-ene Chloride (µg/L)	Naph-thalene (µg/L)	n-Butanol (µg/L)	n-Butylbenzene (µg/L)	n-Heptane (µg/L)	n-Propylbenzene (µg/L)
KCGWD Observation Well	10/16/07	<2.00	<10.0	<5.00	<2.00	NA	<2.00
RP-70-37-706	07/29/05	<1.75	<3.96	<5.00	<2.23	NA	<1.22
RP-70-37-706	12/07/06	<2.00	<10.0	<5.00	<2.00	NA	<2.00
RP-70-37-706	10/16/07	<2.00	<10.0	<5.00	<2.00	NA	<2.00
RP-70-38-8MC	11/09/11	<5.00	<5.00	NA	<1.00	<5.00	<1.00
RP-70-38-902	12/18/06	<2.00	<10.0	<5.00	<2.00	NA	<2.00
RP-70-38-902	08/03/12	<5.00	<5.00	NA	<1.00	<5.00	<1.00
RP-70-38-902	08/02/13	<5.00	<0.104	NA	<1.00	<5.00	<1.00
RP-70-38-9BS	10/11/11	<5.00	<5.00	NA	<1.00	<5.00	<1.00
RP-70-38-9BS	09/18/12	<5.00	<5.00	NA	<1.00	<5.00	<1.00
RP-70-38-9EW	06/18/10	<0.50	<1.00	<1.00	<0.50	NA	<0.50
RP-70-38-9HC	10/11/11	<5.00	<5.00	NA	<1.00	<5.00	<1.00
RP-70-38-9JM	10/11/11	<5.00	<5.00	NA	<1.00	<5.00	<1.00
RP-70-38-9SH	10/26/10	<5.00	NA	NA	NA	NA	NA
RP-70-38-9TW	11/01/10	<5.00	NA	NA	NA	NA	NA
RP-70-38-9TW	10/11/11	<5.00	<5.00	NA	<1.00	<5.00	<1.00
RP-70-39-5CA	10/26/10	<5.00	NA	NA	NA	NA	NA
RP-70-39-5ER	10/26/10	<5.00	NA	NA	NA	NA	NA
RP-70-39-7AD	10/26/10	<5.00	NA	NA	NA	NA	NA
RP-70-39-7CH	11/02/10	<5.00	NA	NA	NA	NA	NA
RP-70-39-7CW	11/02/10	<5.00	NA	NA	NA	NA	NA
RP-70-45-505	12/07/06	<2.00	<10.0	<5.00	<2.00	NA	<2.00
RP-70-45-505	10/23/07	<2.00	<10.0	<5.00	<2.00	NA	<2.00
RP-70-45-505	07/30/09	<0.50	<1.00	<1.00	<0.50	NA	<0.50
RP-70-45-505	06/16/10	<0.50	<1.00	<1.00	<0.50	NA	<0.50
RP-70-45-505	11/08/11	<5.00	<5.00	NA	<1.00	<5.00	<1.00

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	Methyl-ene Chloride (µg/L)	Naph-thalene (µg/L)	n-Butanol (µg/L)	n-Butylbenzene (µg/L)	n-Heptane (µg/L)	n-Propylbenzene (µg/L)
RP-70-45-505	09/17/12	<5.00	<5.00	NA	<1.00	<5.00	<1.00
RP-70-45-505	09/18/13	<5.00	<5.00	NA	<1.00	<5.00	<1.00
RP-70-45-601	12/07/06	<2.00	<10.0	<5.00	<2.00	NA	<2.00
RP-70-45-601	10/23/07	<2.00	<10.0	<5.00	<2.00	NA	<2.00
RP-70-45-601	07/30/09	<0.50	<1.00	<1.00	<0.50	NA	<0.50
RP-70-45-601	06/16/10	<0.50	<1.00	<1.00	<0.50	NA	<0.50
RP-70-45-601	10/10/11	<5.00	<5.00	NA	<1.00	<5.00	<1.00
RP-70-45-601	09/17/12	<5.00	<5.00	NA	<1.00	<5.00	<1.00
RP-70-45-601	09/18/13	<5.00	<5.00	NA	<1.00	<5.00	<1.00
RP-70-46-5AK	06/17/10	<0.50	<1.00	<1.00	<0.50	NA	<0.50
RP-70-46-5AK	10/10/11	<5.00	<5.00	NA	<1.00	<5.00	<1.00
RP-70-46-5DS	06/17/10	<0.50	<1.00	<1.00	<0.50	NA	<0.50
RP-70-46-802	10/10/11	<5.00	<5.00	NA	<1.00	<5.00	<1.00
RP-70-46-8DS	10/10/11	<5.00	<5.00	NA	<1.00	<5.00	<1.00
RP-70-47-6GR	06/17/10	<0.50	<1.00	<1.00	<0.50	NA	<0.50
RP-70-47-9GR	11/02/10	<5.00	NA	NA	NA	NA	NA
RP-70-47-9GR	10/10/11	<5.00	<5.00	NA	<1.00	<5.00	<1.00

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	o-Xylene (µg/L)	Penta-chloro-ethane (µg/L)	Propionitrile (µg/L)	sec-Butylbenzene (µg/L)	Styrene (µg/L)	tert-Butylbenzene (µg/L)	Tetra-chloro-ethene (µg/L)	Toluene (µg/L)
KCGWD Observation Well	10/16/07	<2.00	NA	NA	<2.00	<2.00	<2.00	<2.00	<2.00
RP-70-37-706	07/29/05	<1.28	NA	NA	<1.39	<1.37	<1.28	<1.35	<1.18
RP-70-37-706	12/07/06	<2.00	NA	NA	<2.00	<2.00	<2.00	<2.00	<2.00
RP-70-37-706	10/16/07	<2.00	NA	NA	<2.00	<2.00	<2.00	<2.00	<2.00
RP-70-38-8MC	11/09/11	<1.00	<5.00	<10.0	<1.00	<1.00	<1.00	<1.00	<1.00
RP-70-38-902	12/18/06	<2.00	NA	NA	<2.00	<2.00	<2.00	<2.00	<2.00
RP-70-38-902	08/03/12	<1.00	<5.00	<10.0	<2.00	<1.00	<2.00	<1.00	<1.00
RP-70-38-902	08/02/13	<1.00	<5.00	<10.0	<2.00	<1.00	<2.00	<1.00	<1.00
RP-70-38-9BS	10/11/11	<1.00	<5.00	<10.0	<1.00	<1.00	<1.00	<1.00	<1.00
RP-70-38-9BS	09/18/12	<1.00	<5.00	<10.0	<2.00	<1.00	<2.00	<1.00	<1.00
RP-70-38-9EW	06/18/10	<0.50	NA	NA	<0.50	<1.00	<0.50	<0.50	<0.50
RP-70-38-9HC	10/11/11	<1.00	<5.00	<10.0	<1.00	<1.00	<1.00	<1.00	<1.00
RP-70-38-9JM	10/11/11	<1.00	<5.00	<10.0	<1.00	<1.00	<1.00	<1.00	<1.00
RP-70-38-9SH	10/26/10	NA	NA	NA	NA	<1.00	NA	<1.00	<1.00
RP-70-38-9TW	11/01/10	NA	NA	NA	NA	<1.00	NA	<1.00	<1.00
RP-70-38-9TW	10/11/11	<1.00	<5.00	<10.0	<1.00	<1.00	<1.00	<1.00	<1.00
RP-70-39-5CA	10/26/10	NA	NA	NA	NA	<1.00	NA	<1.00	0.225J
RP-70-39-5ER	10/26/10	NA	NA	NA	NA	<1.00	NA	<1.00	0.254J
RP-70-39-7AD	10/26/10	NA	NA	NA	NA	<1.00	NA	<1.00	0.263J
RP-70-39-7CH	11/02/10	NA	NA	NA	NA	<1.00	NA	<1.00	<1.00
RP-70-39-7CW	11/02/10	NA	NA	NA	NA	<1.00	NA	<1.00	<1.00
RP-70-45-505	12/07/06	<2.00	NA	NA	<2.00	<2.00	<2.00	<2.00	<2.00
RP-70-45-505	10/23/07	<2.00	NA	NA	<2.00	<2.00	<2.00	<2.00	<2.00
RP-70-45-505	07/30/09	<0.50	NA	NA	<0.50	<1.00	<0.50	<0.50	<0.50
RP-70-45-505	06/16/10	<0.50	NA	NA	<0.50	<1.00	<0.50	<0.50	<0.50
RP-70-45-505	11/08/11	<1.00	<5.00	<10.0	<1.00	<1.00	<1.00	<1.00	<1.00

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	o-Xylene (µg/L)	Penta-chloro-ethane (µg/L)	Propionitrile (µg/L)	sec-Butylbenzene (µg/L)	Styrene (µg/L)	tert-Butylbenzene (µg/L)	Tetra-chloro-ethene (µg/L)	Toluene (µg/L)
RP-70-45-505	09/17/12	<1.00	<5.00	<10.0	<2.00	<1.00	<2.00	<1.00	<1.00
RP-70-45-505	09/18/13	<1.00	<5.00	<10.0	<2.00	<1.00	<2.00	<1.00	<1.00
RP-70-45-601	12/07/06	<2.00	NA	NA	<2.00	<2.00	<2.00	<2.00	<2.00
RP-70-45-601	10/23/07	<2.00	NA	NA	<2.00	<2.00	<2.00	<2.00	<2.00
RP-70-45-601	07/30/09	<0.50	NA	NA	<0.50	<1.00	<0.50	<0.50	<0.50
RP-70-45-601	06/16/10	<0.50	NA	NA	<0.50	<1.00	<0.50	<0.50	<0.50
RP-70-45-601	10/10/11	<1.00	<5.00	<10.0	<1.00	<1.00	<1.00	<1.00	<1.00
RP-70-45-601	09/17/12	<1.00	<5.00	<10.0	<2.00	<1.00	<2.00	<1.00	<1.00
RP-70-45-601	09/18/13	<1.00	<5.00	<10.0	<2.00	<1.00	<2.00	<1.00	<1.00
RP-70-46-5AK	06/17/10	<0.50	NA	NA	<0.50	<1.00	<0.50	<0.50	<0.50
RP-70-46-5AK	10/10/11	<1.00	<5.00	<10.0	<1.00	<1.00	<1.00	<1.00	<1.00
RP-70-46-5DS	06/17/10	<0.50	NA	NA	<0.50	<1.00	<0.50	<0.50	<0.50
RP-70-46-802	10/10/11	<1.00	<5.00	<10.0	<1.00	<1.00	<1.00	<1.00	<1.00
RP-70-46-8DS	10/10/11	<1.00	<5.00	<10.0	<1.00	<1.00	<1.00	<1.00	<1.00
RP-70-47-6GR	06/17/10	<0.50	NA	NA	<0.50	<1.00	<0.50	<0.50	<0.50
RP-70-47-9GR	11/02/10	NA	NA	NA	NA	<1.00	NA	<1.00	<1.00
RP-70-47-9GR	10/10/11	<1.00	<5.00	<10.0	<1.00	<1.00	<1.00	<1.00	<1.00

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	trans 1,4-Dichloro--2-butene (µg/L)	trans-1,2-Dichloro--ethene (µg/L)	trans-1,3-Dichloro--propene (µg/L)	Trichloro-ethene (µg/L)	Trichloro-fluoro-methane (µg/L)	Vinyl acetate (µg/L)	Vinyl chloride (µg/L)
KCGWD Observation Well	10/16/07	NA	<2.00	<10.0	<2.00	<2.00	<10.0	<2.00
RP-70-37-706	07/29/05	NA	<1.69	<1.21	<1.30	<0.471	<28.3	<1.27
RP-70-37-706	12/07/06	NA	<2.00	<10.0	<2.00	<2.00	<10.0	<2.00
RP-70-37-706	10/16/07	NA	<2.00	<10.0	<2.00	<2.00	<10.0	<2.00
RP-70-38-8MC	11/09/11	<5.00	<1.00	<1.00	<1.00	<1.00	<5.00	<1.00
RP-70-38-902	12/18/06	NA	<2.00	<10.0	<2.00	<2.00	<10.0	<2.00
RP-70-38-902	08/03/12	<5.00	<1.00	<1.00	<1.00	<1.00	<5.00	<1.00
RP-70-38-902	08/02/13	<5.00	<1.00	<1.00	<1.00	<1.00	<5.00	<1.00
RP-70-38-9BS	10/11/11	<5.00	<1.00	<1.00	<1.00	<1.00	<5.00	<1.00
RP-70-38-9BS	09/18/12	<5.00	<1.00	<1.00	<1.00	<1.00	<5.00	<1.00
RP-70-38-9EW	06/18/10	NA	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
RP-70-38-9HC	10/11/11	<5.00	<1.00	<1.00	<1.00	<1.00	<5.00	<1.00
RP-70-38-9JM	10/11/11	<5.00	<1.00	<1.00	<1.00	<1.00	<5.00	<1.00
RP-70-38-9SH	10/26/10	NA	<1.00	<1.00	<1.00	<1.00	<5.00	<1.00
RP-70-38-9TW	11/01/10	NA	<1.00	<1.00	<1.00	<1.00	<5.00	<1.00
RP-70-38-9TW	10/11/11	<5.00	<1.00	<1.00	<1.00	<1.00	<5.00	<1.00
RP-70-39-5CA	10/26/10	NA	<1.00	<1.00	<1.00	<1.00	<5.00	<1.00
RP-70-39-5ER	10/26/10	NA	<1.00	<1.00	<1.00	<1.00	<5.00	<1.00
RP-70-39-7AD	10/26/10	NA	<1.00	<1.00	<1.00	<1.00	<5.00	<1.00
RP-70-39-7CH	11/02/10	NA	<1.00	<1.00	<1.00	<1.00	<5.00	<1.00
RP-70-39-7CW	11/02/10	NA	<1.00	<1.00	<1.00	<1.00	<5.00	<1.00
RP-70-45-505	12/07/06	NA	<2.00	<10.0	<2.00	<2.00	<10.0	<2.00
RP-70-45-505	10/23/07	NA	<2.00	<10.0	<2.00	<2.00	<10.0	<2.00
RP-70-45-505	07/30/09	NA	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
RP-70-45-505	06/16/10	NA	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
RP-70-45-505	11/08/11	<5.00	<1.00	<1.00	<1.00	<1.00	<5.00	<1.00

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	trans 1,4-Dichloro---2-butene (µg/L)	trans-1,2-Dichloro--ethene (µg/L)	trans-1,3-Dichloro--propene (µg/L)	Trichloro-ethene (µg/L)	Trichloro-fluoro-methane (µg/L)
RP-70-45-505	09/17/12	<5.00	<1.00	<1.00	<1.00	<1.00
RP-70-45-505	09/18/13	<5.00	<1.00	<1.00	<1.00	<1.00
RP-70-45-601	12/07/06	NA	<2.00	<10.0	<2.00	<2.00
RP-70-45-601	10/23/07	NA	<2.00	<10.0	<2.00	<2.00
RP-70-45-601	07/30/09	NA	<0.50	<0.50	<0.50	<0.50
RP-70-45-601	06/16/10	NA	<0.50	<0.50	<0.50	<0.50
RP-70-45-601	10/10/11	<5.00	<1.00	<1.00	<1.00	<1.00
RP-70-45-601	09/17/12	<5.00	<1.00	<1.00	<1.00	<1.00
RP-70-45-601	09/18/13	<5.00	<1.00	<1.00	<1.00	<1.00
RP-70-46-5AK	06/17/10	NA	<0.50	<0.50	<0.50	<0.50
RP-70-46-5AK	10/10/11	<5.00	<1.00	<1.00	<1.00	<1.00
RP-70-46-5DS	06/17/10	NA	<0.50	<0.50	<0.50	<0.50
RP-70-46-802	10/10/11	<5.00	<1.00	<1.00	<1.00	<1.00
RP-70-46-8DS	10/10/11	<5.00	<1.00	<1.00	<1.00	<1.00
RP-70-47-6GR	06/17/10	NA	<0.50	<0.50	<0.50	<0.50
RP-70-47-9GR	11/02/10	NA	<1.00	<1.00	<1.00	<1.00
RP-70-47-9GR	10/10/11	<5.00	<1.00	<1.00	<1.00	<1.00

Table B-6. (cont.) Analytical data for volatile organic compounds (VOC) from wells in Kinney County.

Station Name	Date Sampled	Vinyl acetate (µg/L)	Vinyl chloride (µg/L)
KCGWD Observation Well	10/16/07	<10.0	<2.00
RP-70-37-706	07/29/05	<28.3	<1.27
RP-70-37-706	12/07/06	<10.0	<2.00
RP-70-37-706	10/16/07	<10.0	<2.00
RP-70-38-8MC	11/09/11	<5.00	<1.00
RP-70-38-902	12/18/06	<10.0	<2.00
RP-70-38-902	08/03/12	<5.00	<1.00
RP-70-38-902	08/02/13	<5.00	<1.00
RP-70-38-9BS	10/11/11	<5.00	<1.00
RP-70-38-9BS	09/18/12	<5.00	<1.00
RP-70-38-9EW	06/18/10	<0.50	<0.50
RP-70-38-9HC	10/11/11	<5.00	<1.00
RP-70-38-9JM	10/11/11	<5.00	<1.00
RP-70-38-9SH	10/26/10	<5.00	<1.00
RP-70-38-9TW	11/01/10	<5.00	<1.00
RP-70-38-9TW	10/11/11	<5.00	<1.00
RP-70-39-5CA	10/26/10	<5.00	<1.00
RP-70-39-5ER	10/26/10	<5.00	<1.00
RP-70-39-7AD	10/26/10	<5.00	<1.00
RP-70-39-7CH	11/02/10	<5.00	<1.00
RP-70-39-7CW	11/02/10	<5.00	<1.00
RP-70-45-505	12/07/06	<10.0	<2.00
RP-70-45-505	10/23/07	<10.0	<2.00
RP-70-45-505	07/30/09	<0.50	<0.50
RP-70-45-505	06/16/10	<0.50	<0.50
RP-70-45-505	11/08/11	<5.00	<1.00
RP-70-45-505	09/17/12	<5.00	<1.00
RP-70-45-505	09/18/13	<5.00	<1.00
RP-70-45-601	12/07/06	<10.0	<2.00
RP-70-45-601	10/23/07	<10.0	<2.00
RP-70-45-601	07/30/09	<0.50	<0.50
RP-70-45-601	06/16/10	<0.50	<0.50
RP-70-45-601	10/10/11	<5.00	<1.00
RP-70-45-601	09/17/12	<5.00	<1.00
RP-70-45-601	09/18/13	<5.00	<1.00
RP-70-46-5AK	06/17/10	<0.50	<0.50
RP-70-46-5AK	10/10/11	<5.00	<1.00
RP-70-46-5DS	06/17/10	<0.50	<0.50
RP-70-46-802	10/10/11	<5.00	<1.00
RP-70-46-8DS	10/10/11	<5.00	<1.00
RP-70-47-6GR	06/17/10	<0.50	<0.50
RP-70-47-9GR	11/02/10	<5.00	<1.00
RP-70-47-9GR	10/10/11	<5.00	<1.00

NA = Not Analyzed

Table B-7. Analytical data for semivolatile (SVOC) organic compounds from wells in Kinney County.

Station Name	Date Sampled	1,2,4-Trichloro-benzene (µg/L)	1,2-Dichloro--benzene (µg/L)	1,3-Dichloro--benzene (µg/L)	1,3-Dimethyl-naphthalene (µg/L)	1,4-Dichloro--benzene (µg/L)	1-Methyl-naphthalene (µg/L)	2,4,5-Trichloro-phenol (µg/L)	2,4,6-Trichloro-phenol (µg/L)	2,4-Dichloro--phenol (µg/L)
RP-70-37-706	07/29/05	<0.9	<0.84	<0.8	NA	<0.77	NA	<1.42	<1.16	<0.98
RP-70-38-902	08/02/13	NA	NA	NA	<0.0521	NA	<0.104	NA	NA	NA
RP-70-45-601	12/07/06	<0.9	<0.84	<0.8	NA	<0.77	NA	<1.42	<1.16	<0.98

Station Name	Date Sampled	2,4-Dimethyl-phenol (µg/L)	2,4-Dinitro-phenol (µg/L)	2,4-Dinitro-toluene (µg/L)	2,6-Dichloro--phenol (µg/L)	2,6-Dinitro-toluene (µg/L)	2-Chloro-naphthalene (µg/L)	2-Chloro-phenol(µg/L)	2-Methyl-naphthalene (µg/L)	2-Methyl-phenol (µg/L)
RP-70-37-706	07/29/05	<0.37	<0.12	<1.11	<0.91	<1.19	<1.2	<0.74	<1.01	<1.04
RP-70-38-902	08/02/13	NA	NA	NA	NA	NA	NA	NA	<0.104	NA
RP-70-45-601	12/07/06	<0.37	<0.12	<1.11	<0.91	<1.19	<1.20	<0.74	<1.01	<1.04

Station Name	Date Sampled	2-Nitro-aniline (µg/L)	2-Nitro-phenol (µg/L)	3,3'-Dichloro--benzidine (µg/L)	3,4-Methyl-phenol (µg/L)	3-Nitro-aniline (µg/L)	4,6-Dinitro--2-methyl-phenol (µg/L)	4-Bromophenyl phenyl ether (µg/L)	4-Chloro-3-methyl-phenol (µg/L)	4-Chloroaniline (µg/L)
RP-70-37-706	07/29/05	<0.77	<1.13	<2.59	NA	<1.11	<1.21	<0.95	<0.73	<0.75
RP-70-38-902	08/02/13	NA	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-45-601	12/07/06	<0.77	<1.13	<2.59	NA	<1.11	<1.21	<0.95	<0.73	<0.75

Station Name	Date Sampled	4-Chlorophenyl phenyl ether (µg/L)	4-Methyl-phenol (µg/L)	4-Nitro-aniline (µg/L)	4-Nitro-phenol (µg/L)	Acena-phthene (µg/L)	Acena-phthylene (µg/L)	Aniline (µg/L)	Anthracene (µg/L)	Azobenzene (µg/L)
RP-70-37-706	07/29/05	<1.06	<0.98	<1.21	<0.2	<0.99	<1.11	<0.44	<1.01	<0.73
RP-70-38-902	08/02/13	NA	NA	NA	NA	<0.0521	<0.0521	NA	<0.0521	NA
RP-70-45-601	12/07/06	<1.06	<0.98	<1.21	<0.20	<0.99	<1.11	<0.44	<1.01	<0.73

Table B-7. (cont.) Analytical data for semivolatile (SVOC) organic compounds from wells in Kinney County.

Station Name	Date Sampled	Benzidine (µg/L)	Benzo-(a) anthra-cene (µg/L)	Benzo-(a) pyrene (µg/L)	Benzo-(b) fluoran-thene (µg/L)	Benzo-(g,h,i) pery-lene (µg/L)	Benzo-(k) fluoran-thene (µg/L)	Benzo-(a) pyrene (µg/L)	Benzo-ic acid (µg/L)	Benzyl Alcohol (µg/L)
RP-70-37-706	07/29/05	<0.25	<1.03	<1.01	<1.54	<1.12	<1.05	<1.01	<1.0	<0.54
RP-70-38-902	08/02/13	NA	<0.0521	<0.0521	<0.0521	<0.0521	<0.0521	<0.0521	NA	NA
RP-70-45-601	12/07/06	<0.25	<1.03	<1.01	<1.54	<1.12	<1.05	<1.01	<1.00	<0.54

Station Name	Date Sampled	bis(2-chloro-ethoxy) methane (µg/L)	bis(2-chloro-ethyl) ether (µg/L)	bis(2-chloro-isopropyl) ether (µg/L)	bis(2-ethyl-hexyl) adi-pate (µg/L)	bis(2-ethyl-hexyl) phtha-late (µg/L)	Butyl benzyl phthalate (µg/L)	Chrysene (µg/L)	Cresols (total) (µg/L)	Dibenz (a,h) anthra-cene (µg/L)
RP-70-37-706	07/29/05	<0.86	<0.72	<1.66	<2.77	<1.77	<2.08	<1.01	<2.02	<1.2
RP-70-38-902	08/02/13	NA	NA	NA	NA	NA	NA	<0.0521	NA	<0.0521
RP-70-45-601	12/07/06	<0.86	<0.72	<1.66	<2.77	<1.77	<2.08	<1.01	<2.02	<1.20

Station Name	Date Sampled	Dibenz(a,j) acridine (µg/L)	Dibenzofu-ran (µg/L)	Diethyl-phthalate (µg/L)	Dimethyl-phthalate (µg/L)	Di-n-butyl-phthalate (µg/L)	Di-n-octyl phthalate (µg/L)	Fluoran-thene (µg/L)	Fluorene (µg/L)	Hexa-chloro-benzene (µg/L)
RP-70-37-706	07/29/05	<5.0	<0.99	<1.1	<0.86	<1.07	<2.58	<0.95	<1.15	<1.01
RP-70-38-902	08/02/13	NA	<0.0521	NA	NA	NA	NA	<0.0521	<0.0521	NA
RP-70-45-601	12/07/06	<5.00	<0.99	<1.10	<0.86	<1.07	<2.58	<0.95	<1.15	<1.01

Station Name	Date Sampled	Hexa-chloro-butadiene (µg/L)	Hexa-chloro-cyclopent-adiene (µg/L)	Hexa-chloro-ethane (µg/L)	Indeno (1,2,3-cd) pyrene (µg/L)	Isophorone (µg/L)	M&P Cresol (µg/L)	Naph-thalene (µg/L)	Nitro-benzene (µg/L)	n-Nitro-sodiethyl-amine (µg/L)
RP-70-37-706	07/29/05	<1.25	<0.81	<1.03	<1.12	<0.8	NA	<0.93	<0.65	<2.0
RP-70-38-902	08/02/13	NA	NA	NA	<0.0521	NA	NA	NA	NA	NA
RP-70-45-601	12/07/06	<1.25	<0.81	<1.03	<1.12	<0.80	NA	<0.93	<0.65	<2.00

Table B-7. (cont.) Analytical data for semivolatile (SVOC) organic compounds from wells in Kinney County.

Station Name	Date Sampled	n-Nitro-sodi-methyl-amine (µg/L)	n-Nitro-sodinpropyl-amine (µg/L)	n-Nitro-sodi-phenyl-amine (µg/L)	o,o,o-Triethyl-phosphoro-thioate (µg/L)	Penta-chloro-benzene (µg/L)	Penta-chloro-phenol (µg/L)	Phenan-threne (µg/L)	Phenol (µg/L)	Pronamide (µg/L)
RP-70-37-706	07/29/05	<7.47	<0.68	<1.85	NA	<1.05	<1.29	<0.96	<0.27	NA
RP-70-38-902	08/02/13	NA	NA	NA	NA	NA	NA	<0.104	NA	NA
RP-70-45-601	12/07/06	<7.47	<0.68	<1.85	NA	<1.05	<1.29	<0.96	<0.27	NA

Station Name	Date Sampled	Pyrene (µg/L)	Pyridine (µg/L)
RP-70-37-706	07/29/05	<2.28	<0.51
RP-70-38-902	08/02/13	<0.0521	NA
RP-70-45-601	12/07/06	<2.28	<0.51

NA = Not Analyzed

Table B-8. Analytical data for major ions from streams in Kinney County.

Station Name	Date Sampled	Calcium (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Silicon (µg/L)	Sodium (mg/L)	Sulfate (mg/L)	Total Dissolved Solids (mg/L)
Las Moras Creek at Red Bridge	06/16/10	73.1	7.90	<0.50	5.70	0.631	NA	5.03	5.77	314
Las Moras Creek at Red Bridge	11/08/11	70.4	10.1	0.134	5.43	0.942J	5080	5.16	6.56	270
Nueces @ FM334	05/24/11	35.7	12.8	0.105	4.36	0.946J	5.34	5.99	14.8	191
Pinto Creek at CR2804	12/17/08	117	11.0	<0.50	4.36	1.14	NA	15.3	8.53	193
Pinto Creek at CR2804	06/16/10	74.8	11.9	0.14J	3.19	1.02	NA	12.1	7.99	262
Pinto Springs at Mariposa Ranch	07/29/05	82.1	8.94	<0.50	1.82	<0.166	NA	5.40	5.79	254
Pinto Springs at Mariposa Ranch	12/07/06	123	9.01	0.108	3.62	1.07	NA	9.21	6.06	290
Pinto Springs at Mariposa Ranch	10/16/07	137	11.1	<0.50	3.75	0.860	NA	7.90	6.34	346
Pinto Springs at Mariposa Ranch	12/17/08	112	9.00	<0.50	3.14	0.722	NA	7.87	5.83	307
Pinto Springs at Shahan Ranch	06/30/05	93.6	9.61	<0.50	2.59	1.22	NA	6.20	5.93	288
RP-70-45-501	06/29/05	83.2	8.32	0.533	6.36	0.768	NA	5.51	25.1	NA
RP-70-45-501	12/07/06	108	9.51	0.0930	8.92	0.990	NA	8.58	6.02	248
RP-70-45-501	10/23/07	105	7.50	<0.50	8.18	0.800	NA	6.52	6.11	352
RP-70-45-501	12/17/08	83.8	8.04	<0.50	6.41	0.647	NA	5.38	6.28	227
RP-70-45-501	06/16/10	72.9	7.88	<0.50	5.59	0.676	NA	5.06	5.65	342
RP-70-45-501	10/10/11	78.0	9.39	0.215	5.43	0.696J	5680	5.80	4.54	222
RP-70-45-501	08/03/12	76.3	NA	NA	6.11	0.63	NA	5.12	NA	238
RP-70-45-501	09/17/12	81.5	10.3	0.158	6.17	0.524J	5270	5.25	6.18	257
RP-70-45-501	08/02/13	84.4	10.8	0.0860J	6.32	0.683J	5260	5.20	7.03	267
RP-70-45-501	08/02/13	*73.3	*9.69	NA	*5.46	*0.7	NA	*4.94	*6.01	*240
RP-70-45-501	09/18/13	86.5	10.6	0.136	5.76	0.683J	5510	5.77	6.85	260

* = Sample collected by the Authority and analyzed by the TWDB.

NA = Not Analyzed

Table B-9. Analytical data for metals from streams in Kinney County.

Station Name	Date Sampled	Aluminum (µg/L)	Antimony (µg/L)	Arsenic (µg/L)	Barium (µg/L)	Beryllium (µg/L)	Boron (µg/L)	Bromide (mg/L)
Las Moras Creek at Red Bridge	06/16/10	3.13	0.31J	0.46J	39.0	<1.00	NA	0.097J
Las Moras Creek at Red Bridge	11/08/11	<50.0	<5.00	1.28J	47.2	<4.00	NA	NA
Nueces @ FM334	05/24/11	<50.0	<5.00	1.19J	36.3	<4.00	NA	NA
Pinto Creek at CR2804	12/17/08	1.64	0.39J	0.65J	60.1	<0.84	NA	0.339
Pinto Creek at CR2804	06/16/10	10.1	<1.00	1.20	66.7	<1.00	NA	0.060J
Pinto Springs at Mariposa Ranch	07/29/05	<0.22	<0.836	<0.733	42.2	<0.835	NA	0.0530
Pinto Springs at Mariposa Ranch	12/07/06	<0.22	<0.84	<0.73	51.0	<0.84	NA	0.0480
Pinto Springs at Mariposa Ranch	10/16/07	0.786	<0.84	0.50J	58.4	<0.84	NA	0.0590
Pinto Springs at Mariposa Ranch	12/17/08	2.27	0.33J	0.61J	57.0	<0.84	NA	0.0700
Pinto Springs at Shahan Ranch	06/30/05	4.01	<0.836	<0.733	55.8	<0.835	NA	0.0380
RP-70-45-501	06/29/05	<4.08	<1.02	<2.04	50.7	<1.02	69.0	0.0550
RP-70-45-501	12/07/06	<0.22	<0.84	<0.73	42.4	<0.84	NA	0.0510
RP-70-45-501	10/23/07	0.361	<0.84	0.56J	37.7	<0.84	NA	0.0180
RP-70-45-501	12/17/08	0.853	<0.84	0.56J	43.2	<0.84	NA	0.277
RP-70-45-501	06/16/10	16.1	<1.00	0.45J	40.3	<1.00	NA	0.103
RP-70-45-501	10/10/11	<50.0	<5.00	<5.00	45.1	<4.00	NA	NA
RP-70-45-501	08/03/12	NA	NA	NA	40.8	NA	<100	0.06
RP-70-45-501	09/17/12	<50.0	<5.00	<5.00	45.0	<4.00	NA	NA
RP-70-45-501	08/02/13	<50.0	<5.00	<5.00	40.9	<4.00	NA	0.367J
RP-70-45-501	08/02/13	NA	NA	NA	*38.3	NA	*76.8	*0.0601
RP-70-45-501	09/18/13	<50.0	<5.00	1.12J	47.6	<4.00	NA	0.370J

Table B-9. (cont.) Analytical data for metals from streams in Kinney County.

Station Name	Date Sampled	Cadmium (µg/L)	Chromium (µg/L)	Cobalt (µg/L)	Copper (µg/L)	Iron (µg/L)	Lead (µg/L)	Lithium (µg/L)
Las Moras Creek at Red Bridge	06/16/10	<1.00	<1.00	NA	0.31J	1.33	<1.00	NA
Las Moras Creek at Red Bridge	11/08/11	<2.00	<5.00	NA	<10.0	<250	<5.00	NA
Nueces @ FM334	05/24/11	<2.00	<5.00	NA	<10.0	<250	<5.00	NA
Pinto Creek at CR2804	12/17/08	<0.65	0.45J	NA	<0.90	1.42	0.876	NA
Pinto Creek at CR2804	06/16/10	<1.00	<1.00	NA	<1.00	9.84	<1.00	NA
Pinto Springs at Mariposa Ranch	07/29/05	<0.654	<1.17	NA	<0.904	<0.739	<0.843	NA
Pinto Springs at Mariposa Ranch	12/07/06	<0.65	<1.17	NA	<0.90	0.890	<0.84	NA
Pinto Springs at Mariposa Ranch	10/16/07	<0.65	<1.17	NA	<0.90	2.29	<0.84	NA
Pinto Springs at Mariposa Ranch	12/17/08	<0.65	0.58J	NA	0.58J	3.81	0.76J	NA
Pinto Springs at Shahan Ranch	06/30/05	<0.654	<1.17	NA	<0.904	11.9	<0.843	NA
RP-70-45-501	06/29/05	<1.02	<1.02	<1.02	2.08	<51	<1.02	2.72
RP-70-45-501	12/07/06	<0.65	<1.17	NA	<0.90	0.990	<0.84	NA
RP-70-45-501	10/23/07	<0.65	<1.17	NA	<0.90	2.20	<0.84	NA
RP-70-45-501	12/17/08	<0.65	0.44J	NA	<0.90	0.947	1.89	NA
RP-70-45-501	06/16/10	<1.00	<1.00	NA	0.66J	1.57	1.29	NA
RP-70-45-501	10/10/11	<2.00	<5.00	NA	<10.0	<250	<5.00	NA
RP-70-45-501	08/03/12	NA	NA	NA	NA	<50	NA	NA
RP-70-45-501	09/17/12	<2.00	<5.00	NA	<10.0	<250	<5.00	NA
RP-70-45-501	08/02/13	<2.00	<5.00	NA	<10.0	<250	<5.00	NA
RP-70-45-501	08/02/13	NA	NA	NA	NA	*<50	NA	NA
RP-70-45-501	09/18/13	<2.00	<5.00	NA	<10.0	<250	<5.00	NA

Table B-9. (cont.) Analytical data for metals from streams in Kinney County.

Station Name	Date Sampled	Manganese (µg/L)	Mercury (µg/L)	Molybdenum (µg/L)	Nickel (µg/L)	Selenium (µg/L)	Silica (mg/L)	Silver (µg/L)
Las Moras Creek at Red Bridge	06/16/10	0.99J	<0.50	NA	0.35J	<1.00	NA	<0.50
Las Moras Creek at Red Bridge	11/08/11	<50.0	0.000210J	NA	<5.00	5.14	NA	<5.00
Nueces @ FM334	05/24/11	<50.0	<0.00200	NA	<5.00	<5.00	NA	<5.00
Pinto Creek at CR2804	12/17/08	0.157	<1.14	NA	<0.62	0.40J	NA	<0.89
Pinto Creek at CR2804	06/16/10	2.18	<0.50	NA	0.61J	<1.00	NA	<0.50
Pinto Springs at Mariposa Ranch	07/29/05	1.68	<1.14	NA	<0.617	<0.989	NA	<0.886
Pinto Springs at Mariposa Ranch	12/07/06	0.230	<1.14	NA	0.710	<0.99	NA	<0.89
Pinto Springs at Mariposa Ranch	10/16/07	0.687	<1.14	NA	0.59J	0.54J	NA	<0.89
Pinto Springs at Mariposa Ranch	12/17/08	0.334	<1.14	NA	<0.62	0.52J	NA	<0.89
Pinto Springs at Shahan Ranch	06/30/05	1.26	<1.14	NA	<0.617	1.57	NA	<0.886
RP-70-45-501	06/29/05	<1.02	NA	<1.02	NA	<4.08	NA	NA
RP-70-45-501	12/07/06	<0.14	1.18	NA	0.640	<0.99	NA	<0.89
RP-70-45-501	10/23/07	1.25	<1.14	NA	1.66	0.40J	NA	<0.89
RP-70-45-501	12/17/08	0.12J	<1.14	NA	<0.62	1.50	NA	<0.89
RP-70-45-501	06/16/10	0.79J	<0.50	NA	0.67J	0.41J	NA	<0.50
RP-70-45-501	10/10/11	<50.0	<0.00200	NA	<5.00	<5.00	NA	<5.00
RP-70-45-501	08/03/12	NA	<0.2	2.1	NA	NA	NA	NA
RP-70-45-501	09/17/12	<50.0	<0.00200	NA	<5.00	1.48J	NA	<5.00
RP-70-45-501	08/02/13	<50.0	<0.00200	NA	<5.00	2.16J	NA	<5.00
RP-70-45-501	08/02/13	NA	*<0.2	NA	NA	NA	*11.7	NA
RP-70-45-501	09/18/13	<50.0	<0.00200	NA	<5.00	3.32J	NA	<5.00

Table B-9. (cont.) Analytical data for metals from streams in Kinney County.

Station Name	Date Sampled	Strontium (µg/L)	Thallium (µg/L)	Vanadium (µg/L)	Zinc (µg/L)
Las Moras Creek at Red Bridge	06/16/10	189	<1.00	NA	2.90
Las Moras Creek at Red Bridge	11/08/11	273	<1.00	NA	<25.0
Nueces @ FM334	05/24/11	113	<1.00	NA	5.95J
Pinto Creek at CR2804	12/17/08	373	<0.36	NA	0.57J
Pinto Creek at CR2804	06/16/10	377	<1.00	NA	11.9
Pinto Springs at Mariposa Ranch	07/29/05	266	<0.363	NA	<0.679
Pinto Springs at Mariposa Ranch	12/07/06	273	<0.36	NA	<0.68
Pinto Springs at Mariposa Ranch	10/16/07	269	<0.36	NA	3.63
Pinto Springs at Mariposa Ranch	12/17/08	326	<0.36	NA	4.57
Pinto Springs at Shahan Ranch	06/30/05	259	<0.363	NA	3.48
RP-70-45-501	06/29/05	1690	<1.02	11.6	6.17
RP-70-45-501	12/07/06	219	<0.36	NA	<0.68
RP-70-45-501	10/23/07	145	<0.36	NA	3.63
RP-70-45-501	12/17/08	259	<0.36	NA	1.10
RP-70-45-501	06/16/10	184	<1.00	NA	13.2
RP-70-45-501	10/10/11	303	<1.00	NA	<25.0
RP-70-45-501	08/03/12	229	NA	3.8	NA
RP-70-45-501	09/17/12	270	<2.00	NA	<25.0
RP-70-45-501	08/02/13	198	<2.00	NA	<25.0
RP-70-45-501	08/02/13	*190	NA	*3.63	NA
RP-70-45-501	09/18/13	292	<2.00	NA	4.37J

* = Sample collected by the Authority and analyzed by the TWDB.

NA = Not Analyzed

Table B-10. Analytical data for nutrients from streams in Kinney County.

Station Name	Date Sampled	Nitrate-N (mg/L as N)	Phosphorus (mg/L)
Las Moras Creek at Red Bridge	06/16/10	5.63	NA
Las Moras Creek at Red Bridge	11/08/11	0.916	NA
Nueces @ FM334	05/24/11	0.718	NA
Pinto Creek at CR2804	12/17/08	0.883	<3.0
Pinto Creek at CR2804	06/16/10	10.6	NA
Pinto Springs at Mariposa Ranch	07/29/05	1.45	NA
Pinto Springs at Mariposa Ranch	12/07/06	2.14	NA
Pinto Springs at Mariposa Ranch	10/16/07	1.56	NA
Pinto Springs at Mariposa Ranch	12/17/08	1.95	NA
Pinto Springs at Shahan Ranch	06/30/05	1.79	NA
RP-70-45-501	06/29/05	1.15	NA
RP-70-45-501	12/07/06	2.07	NA
RP-70-45-501	10/23/07	1.20	NA
RP-70-45-501	12/17/08	1.37	NA
RP-70-45-501	06/16/10	3.70	NA
RP-70-45-501	10/10/11	1.05	NA
RP-70-45-501	08/03/12	1.06	<0.02
RP-70-45-501	09/17/12	1.29	NA
RP-70-45-501	08/02/13	1.68	NA
RP-70-45-501	08/02/13	*3.17	*<0.02
RP-70-45-501	09/18/13	1.37	NA

* = Sample collected by the Authority and analyzed by the TWDB.

NA = Not Analyzed

Table B-11. Analytical data for pesticides, herbicides, and PCB (Aroclors) from streams in Kinney County.

Station Name	Date Sampled	2,4,5-T (mg/L)	2,4,5-TP (mg/L)	2,4-D (mg/L)	2,4-DB (µg/L)	4,4'-DDD (µg/L)	4,4'-DDE (µg/L)	4,4'-DDT (µg/L)	Aldrin (µg/L)
Pinto Springs at Mariposa Ranch	07/29/05	NA	NA	NA	NA	NA	NA	NA	NA
Pinto Springs at Mariposa Ranch	12/07/06	NA	NA	NA	NA	NA	NA	NA	NA
Pinto Springs at Mariposa Ranch	10/16/07	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-45-501	12/07/06	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-45-501	10/23/07	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-45-501	07/30/09	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-45-501	09/17/12	<0.500	<0.500	<0.500	<0.500	<0.100	<0.100	<0.100	<0.0500
RP-70-45-501	08/02/13	<0.494	<0.494	<0.494	<0.494	<0.0568	<0.0568	<0.0568	<0.0568

Station Name	Date Sampled	alpha-BHC (µg/L)	alpha-Chlordane (µg/L)	Aroclor 1016 (µg/L)	Aroclor 1221 (µg/L)	Aroclor 1232 (µg/L)	Aroclor 1242 (µg/L)	Aroclor 1248 (µg/L)	Aroclor 1254 (µg/L)
Pinto Springs at Mariposa Ranch	07/29/05	NA	NA	NA	NA	NA	NA	NA	NA
Pinto Springs at Mariposa Ranch	12/07/06	NA	NA	NA	NA	NA	NA	NA	NA
Pinto Springs at Mariposa Ranch	10/16/07	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-45-501	12/07/06	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-45-501	10/23/07	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-45-501	07/30/09	NA	NA	NA	NA	NA	NA	NA	NA
RP-70-45-501	09/17/12	<0.0500	<0.0500	<0.935	<0.935	<0.935	<0.935	<0.935	<0.935
RP-70-45-501	08/02/13	<0.0568	<0.0564	<0.568	<0.568	<0.758	<0.568	<0.568	<0.568

Table B-11. (cont.) Analytical data for pesticides, herbicides, and PCB (Aroclors) from streams in Kinney County.

Station Name	Date Sampled	Aroclor 1260 (µg/L)	Aroclor 1262 (µg/L)	Aroclor 1268 (µg/L)	Atrazine (µg/L)	Azinphos-methyl (µg/L)	beta-BHC (µg/L)	Bolstar (Sulprofos) (µg/L)	Chlordane (technical) (µg/L)
Pinto Springs at Mariposa Ranch	07/29/05	NA	NA	NA	<0.3	<0.5	NA	<0.5	NA
Pinto Springs at Mariposa Ranch	12/07/06	NA	NA	NA	<0.30	<0.50	NA	<0.50	NA
Pinto Springs at Mariposa Ranch	10/16/07	NA	NA	NA	<0.05	<0.05	NA	<0.05	NA
RP-70-45-501	12/07/06	NA	NA	NA	<0.30	<0.50	NA	<0.50	NA
RP-70-45-501	10/23/07	NA	NA	NA	<0.05	<0.05	NA	<0.05	NA
RP-70-45-501	07/30/09	NA	NA	NA	<0.05	<0.05	NA	<0.05	NA
RP-70-45-501	09/17/12	<0.935	<0.935	<0.935	NA	<0.943	<0.0500	<0.943	<0.500
RP-70-45-501	08/02/13	<0.568	<0.568	<0.568	NA	<0.943	<0.0568	<0.943	<0.568

Station Name	Date Sampled	Chloro-pyrifos (µg/L)	Coumaphos (µg/L)	Dalapon (µg/L)	delta-BHC (µg/L)	Demeton (µg/L)	Demeton, Total (µg/L)	Demeton-O (µg/L)	Diazinon (µg/L)
Pinto Springs at Mariposa Ranch	07/29/05	<0.5	<0.3	NA	NA	NA	<0.5	NA	<0.4
Pinto Springs at Mariposa Ranch	12/07/06	<0.50	<0.30	NA	NA	NA	<0.50	NA	<0.40
Pinto Springs at Mariposa Ranch	10/16/07	<0.05	<0.05	NA	NA	NA	<0.05	NA	<0.05
RP-70-45-501	12/07/06	<0.50	<0.30	NA	NA	NA	<0.50	NA	<0.40
RP-70-45-501	10/23/07	<0.05	<0.05	NA	NA	NA	<0.05	NA	<0.05
RP-70-45-501	07/30/09	<0.05	<0.05	NA	NA	NA	<0.05	NA	<0.05
RP-70-45-501	09/17/12	<0.943	<0.943	<120	<0.0500	<2.36	NA	<2.36	<0.943
RP-70-45-501	08/02/13	<0.943	<0.943	<9.88	<0.0568	<2.36	NA	<2.36	<0.943

Table B-11. (cont.) Analytical data for pesticides, herbicides, and PCB (Aroclors) from streams in Kinney County.

Station Name	Date Sampled	Dicamba (µg/L)	Dichloroprop (µg/L)	Dichlorovos (µg/L)	Dieldrin (µg/L)	Dimethoate (µg/L)	Dinoseb (mg/L)	Disulfoton (µg/L)	Endo-sulfan I (µg/L)
Pinto Springs at Mariposa Ranch	07/29/05	NA	NA	<0.4	NA	<0.4	NA	<0.4	NA
Pinto Springs at Mariposa Ranch	12/07/06	NA	NA	<0.40	NA	<0.40	NA	<0.40	NA
Pinto Springs at Mariposa Ranch	10/16/07	NA	NA	<0.05	NA	<0.05	NA	<0.05	NA
RP-70-45-501	12/07/06	NA	NA	<0.40	NA	<0.40	NA	<0.40	NA
RP-70-45-501	10/23/07	NA	NA	<0.05	NA	<0.05	NA	<0.05	NA
RP-70-45-501	07/30/09	NA	NA	<0.05	NA	<0.05	NA	<0.05	NA
RP-70-45-501	09/17/12	<1.20	<6.00	<1.89	<0.100	<1.89	<6.00	<1.89	<0.0500
RP-70-45-501	08/02/13	<0.494	<0.494	<1.89	<0.0564	<1.89	<5.93	<1.89	<0.0568

Station Name	Date Sampled	Endosulfan II (µg/L)	Endosulfan sulfate (µg/L)	Endrin (µg/L)	Endrin aldehyde (µg/L)	Endrin ketone (µg/L)	EPN (µg/L)	Ethoprop (µg/L)	Famphur (µg/L)
Pinto Springs at Mariposa Ranch	07/29/05	NA	NA	NA	NA	NA	<0.4	<0.7	NA
Pinto Springs at Mariposa Ranch	12/07/06	NA	NA	NA	NA	NA	<0.40	<0.70	NA
Pinto Springs at Mariposa Ranch	10/16/07	NA	NA	NA	NA	NA	<0.05	<0.05	NA
RP-70-45-501	12/07/06	NA	NA	NA	NA	NA	<0.40	<0.70	NA
RP-70-45-501	10/23/07	NA	NA	NA	NA	NA	<0.05	<0.05	NA
RP-70-45-501	07/30/09	NA	NA	NA	NA	NA	<0.05	<0.05	NA
RP-70-45-501	09/17/12	<0.100	<0.100	<0.100	<0.100	<0.100	<0.943	<0.472	<1.89
RP-70-45-501	08/02/13	<0.0568	<0.0568	<0.0568	<0.0568	<0.0568	<0.943	<0.472	<1.89

Table B-11. (cont.) Analytical data for pesticides, herbicides, and PCB (Aroclors) from streams in Kinney County.

Station Name	Date Sampled	Fensulfothion (µg/L)	Fenthion (µg/L)	gamma-BHC (µg/L)	gamma-Chlordane (µg/L)	Heptachlor (µg/L)	Heptachlor epoxide (µg/L)	Malathion (µg/L)	MCPA (µg/L)
Pinto Springs at Mariposa Ranch	07/29/05	<0.7	<0.3	NA	NA	NA	NA	<0.5	NA
Pinto Springs at Mariposa Ranch	12/07/06	<0.70	<0.30	NA	NA	NA	NA	<0.50	NA
Pinto Springs at Mariposa Ranch	10/16/07	<0.05	<0.05	NA	NA	NA	NA	<0.05	NA
RP-70-45-501	12/07/06	<0.70	<0.30	NA	NA	NA	NA	<0.50	NA
RP-70-45-501	10/23/07	<0.05	<0.05	NA	NA	NA	NA	<0.05	NA
RP-70-45-501	07/30/09	<0.05	<0.05	NA	NA	NA	NA	<0.05	NA
RP-70-45-501	09/17/12	<4.72	<0.943	<0.0500	<0.0500	<0.0500	<0.0500	<0.943	<120
RP-70-45-501	08/02/13	<4.72	<0.943	<0.0568	<0.0568	<0.0568	<0.0568	<0.943	<119

Station Name	Date Sampled	MCPP (µg/L)	Merphos (µg/L)	Methoxy-chlor (µg/L)	Methyl parathion (µg/L)	Mevinphos (µg/L)	Monon-crotophos (µg/L)	Naled (µg/L)	Parathion (µg/L)
Pinto Springs at Mariposa Ranch	07/29/05	<0.7	<0.3	NA	NA	NA	NA	<0.5	NA
Pinto Springs at Mariposa Ranch	12/07/06	<0.70	<0.30	NA	NA	NA	NA	<0.50	NA
Pinto Springs at Mariposa Ranch	10/16/07	<0.05	<0.05	NA	NA	NA	NA	<0.05	NA
RP-70-45-501	12/07/06	<0.70	<0.30	NA	NA	NA	NA	<0.50	NA
RP-70-45-501	10/23/07	<0.05	<0.05	NA	NA	NA	NA	<0.05	NA
RP-70-45-501	07/30/09	<0.05	<0.05	NA	NA	NA	NA	<0.05	NA
RP-70-45-501	09/17/12	<4.72	<0.943	<0.0500	<0.0500	<0.0500	<0.0500	<0.943	<120
RP-70-45-501	08/02/13	<4.72	<0.943	<0.0568	<0.0568	<0.0568	<0.0568	<0.943	<119

Table B-11. (cont.) Analytical data for pesticides, herbicides, and PCB (Aroclors) from streams in Kinney County.

Station Name	Date Sampled	Pentachloro-phenol (mg/L)	Phorate (µg/L)	Ronnel (µg/L)	Simazine (µg/L)	Stirophos (µg/L)	Sulfotepp (µg/L)	TEPP (µg/L)	Thionazin (µg/L)
Pinto Springs at Mariposa Ranch	07/29/05	NA	<0.4	<0.4	<0.3	<0.4	<0.4	<0.4	NA
Pinto Springs at Mariposa Ranch	12/07/06	NA	<0.40	<0.40	<0.30	<0.40	<0.40	<0.40	NA
Pinto Springs at Mariposa Ranch	10/16/07	NA	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA
RP-70-45-501	12/07/06	NA	<0.40	<0.40	<0.30	<0.40	<0.40	<0.40	NA
RP-70-45-501	10/23/07	NA	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA
RP-70-45-501	07/30/09	NA	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA
RP-70-45-501	09/17/12	<1.00	<0.943	<0.943	NA	<0.943	<0.472	NA	<0.943
RP-70-45-501	08/02/13	<0.247	<0.943	<0.943	NA	<0.943	<0.472	NA	<0.943

Station Name	Date Sampled	Tokuthion (µg/L)	Toxaphene (µg/L)	Trichloronate (µg/L)
Pinto Springs at Mariposa Ranch	07/29/05	<0.4	NA	<0.4
Pinto Springs at Mariposa Ranch	12/07/06	<0.40	NA	<0.40
Pinto Springs at Mariposa Ranch	10/16/07	<0.05	NA	<0.05
RP-70-45-501	12/07/06	<0.40	NA	<0.40
RP-70-45-501	10/23/07	<0.05	NA	<0.05
RP-70-45-501	07/30/09	<0.05	NA	<0.05
RP-70-45-501	09/17/12	<0.943	<5.00	<0.943
RP-70-45-501	08/02/13	<0.943	<5.68	<0.943

NA = Not Analyzed