Dye Trace Simulation of an Accidental Spill
Phase 10: State Highway 45 Southwest and MoPac South into the Barton Springs Segment of the Edwards Aquifer
Travis County, Texas
Short Report SR-13-01

October 2012

City of Austin Watershed Protection Department
Nico M. Hauwert, Ph.D., P.G., Senior Hydrogeologist, Project Manager

Cover photo: Runoff and debris entering Flint Ridge Cave after a storm 150 feet (46 m) from the proposed State Highway 45 Southwest right-of-way. Photo taken by Mark Sanders of CoA BCP on January 16, 2001.

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Abstract

Spills of potentially hazardous materials along State Highway 45 Southwest (SH45 SW) and Loop 1 (MoPac South) Expressway have the potential to negatively impact drinking water wells and Barton Springs. Organic dyes were utilized as groundwater tracers to simulate groundwater migration of potential spills from the SH45 SW and MoPac South area through the Barton Springs Segment of the Edwards Aquifer to Barton Springs in 2007 and 2010. These traces are included within Phase 10 of an aquifer-wide tracing project. Relatively low dye mass mixtures (5 to 45 pounds or 2 to 20 kg) were injected in three upland caves and within the channel of Bear Creek during 2007 tracing that arrived at Barton Springs within two to four days. This initial arrival time is significantly shorter than previous estimates of three years. Tracer recoveries on numerous wells, vadose cave drips, and Blowing Sink cave stream allowed definition of flow paths from the traces. Dye injected in Hangtree Cave near existing SH45 SW was detected in numerous wells in the Shady Hollow and Marbridge areas. A tracer inundating a mile stretch of Bear Creek just west of Flint Ridge Cave was not detected in lower elevation drips in that cave.

The tracer breakthroughs at Barton Springs were monitored with autosamplers and analyzed in three of the four traces injected in 2007, and one repeat trace in 2010 where sufficient concentrations of dye were measured to characterize groundwater flow through the vadose and phreatic zones of the Edwards Aquifer. The tracers were recovered at Barton Springs between 45% of injected mass to less than 4%. Measured peak water concentrations of the tracers approached 10 parts per billion. The mean residence time of the 2007 tracer injections was five to eight days. Ratios of advection to dispersion and diffusion (Peclét number) ranged from 4,225 to 202,922 m^2/hr, and show a strong component of advection in groundwater flow. Analysis of the tracing results suggests that flow from the four cave and creek injection sites to Barton Springs occurs through conduits that provide little natural attenuation of materials that have properties similar to the tracers used.

One of the four 2007 traces (10D Wildflower Cave) was repeated in 2010 under similar aquifer conditions. Dye injected in Wildflower Cave was recovered in Blowing Sink Cave, a phreatic cave stream about a mile east of Wildflower Cave, and was initially detected at Barton Springs within 18 days after injection. This arrival time contrasts with 2.5 days during a 2007 trace under similar conditions**.** The percentage recovery of dye mass injected at Wildflower Cave was 22% in 2007 and 5% in 2010. The arrival delay and lower recovery in 2010 is likely attributed to the dye being retained in the vadose zone, until a sufficient rain event flushed it into the water table. Because intensive sampling was limited a few weeks after injection, short-term, rain-driven pulses may have later discharged that were missed, causing percent recovery to be underestimated. The overall results from this phase have enhanced our conceptual model of groundwater flow to help avoid spills and prepare for accidental spills that may occur.

Acknowledgments

We appreciate the support of well users and property owners who allowed access for injection and monitoring. Preparation and injection of the 2007 traces was assisted by Brian Cowan, Scott Hiers, Sylvia Pope, David Johns, Chris Herrington (City of Austin Watershed Protection Dept. or CoA WP), Julie Jenkins (Barton Springs/Edwards Aquifer Conservation District or BSEACD), and William Russell (Texas Cave Management Association or TCMA). In 2007, the tracers were mixed by Scott Hiers (CoA WP) and Julie Jenkins (BSEACD). For the 2010 repeat trace at 10D Wildflower Cave, the SRB dye was mixed by Nico Hauwert (CoA WP). Chad Peddy and Stan Tindell of CoA WP and Joe Beery of BSEACD assisted Nico Hauwert in the 2010 injection at 10D Wildflower Cave.

For the 2007 injections, BSEACD staff (Brian Hunt, Joe Beery, and Guy Rials) generally monitored wells while CoA WP staff (Brian Cowan and Nico Hauwert) monitored Barton Springs, although both agencies assisted in monitoring both sets of locations. 2007 Flint Ridge Cave monitoring was conducted by Brian Cowan, William Russell, Julie Jenkins, and Nico Hauwert. Justin Camp (CoA WP) monitored well sites and Barton Springs for the 2010 trace. Mark Sanders of City of Austin Water Utility Balcones Canyonland Preserve program (CoA BCP) monitored Blowing Sink Cave with assistance from Heather Tuček, Devra Heyer, Sandi Calhoun of TCMA and UT Grotto. Dr. Steve Windhager of the Lady Bird Johnson Wildflower Center graciously provided access to Wildflower Cave for both the 2007 and 2010 injections. The Shady Hollow Municipal Utility District provided water for the 10B Sandbur Cave trace. The supplies and laboratory costs associated with this study were paid for through a City of Austin Capital Improvement Project. Access to some injection and monitoring sites in 2007 were made possible through access permits administered by Kevin Thuesen, Ph.D. and Lisa O'Donnell of CoA Wildlands Conservation Dept. of Austin Water Utility.

Keith Heuss (Texas Speleological Survey) conducted the cave radio survey of Flint Ridge Cave on behalf of the City of Austin. A subsurface cave radio team included Mark Sanders (CoA); William Russell (Travis County project manager for Texas Speleological Survey), and Julie Jenkins (BSEACD). Permanent surface monuments were cemented over the cave radio locations by Parc Smith and volunteers from the Austin Environmental Corps. Bill Mixon of the University of Texas Grotto and National Speleological Society assisted in calculating the cave depths for the Flint Ridge Cave radio survey.

Detailed review and comment on drafts of this report were provided by BSEACD hydrogeologist Brian Hunt, P.G. and CoA WP Groundwater Team leader David Johns, P.G. This report was also reviewed by technical editor Mary-Love Bigony, CoA WP Environmental Resource Management supervising engineer Ed Peacock, P.E., BSEACD Chief Operating Officer W.F. (Kirk) Holland, P.G., and BSEACD Research Team leader Brian Smith, Ph.D., P.G.

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1. Introduction

1.1 Setting

The Barton Springs Segment of the Edwards Aquifer (hereafter called Barton Springs Segment) is a prolific karst aquifer developed in faulted and fractured Cretaceous-age limestones and dolostones. The aquifer system lies within the Miocene-age Balcones Fault Zone that forms the Balcones Escarpment of Central Texas. The Barton Springs Segment is bounded to the north by the Colorado River, by a groundwater divide to the south that shifts between Onion Creek and the Blanco River, by the interface between the fresh- and saline-water zones to the east, and by the outcrop and saturated thickness of the Edwards Group to the west (Figure 1). The largest natural discharge point is Barton Springs, which consists of four major outlets. The primary Main Barton Springs discharges directly into Barton Springs pool, a major recreational attraction of the City of Austin. The other spring outlets of Barton Springs include Eliza Springs, which discharges to Barton Creek just north of Barton Springs pool, Old Mill Springs, which discharges from the south side of Barton Creek downstream of Barton Springs pool, Upper Barton Springs and High Barton Springs, which discharges from the south bank of Barton Creek 600 feet (200 m) upstream of Barton Springs pool. High Barton Springs flows only under high aquifer discharge conditions at the base of a bluff about 230 feet (70 m) southwest of Upper Barton Springs. Cold Springs is another major spring issuing from the Barton Springs Segment, which discharges directly into the Colorado River from the south "Deep Eddy" bluff and is partially submerged below Lady Bird Lake (Figure 1).

The Barton Springs Segment is a federally-designated sole source aquifer south of the Williamson Creek watershed. It provides water for about 60,000 people with about 7,800 acre-feet/yr (2.5 billion gallons/yr; 11 ft^3/s; 0.31 m^3/s) of authorized pumping. Barton Springs is the only known habitat for the federally listed endangered aquatic salamander, *Eurycea sosorum*, and another candidate, the blind salamander, *Eurycea waterlooensis*. A number of caves in the Barton Springs Segment, including Flint Ridge Cave, are designated as Balcones Canyonland Preserve (BCP) sites in order to ensure that a number of rare cave invertebrate species are protected and do not become endangered. Flint Ridge Cave is located adjacent to proposed State Highway 45 Southwest (SH45 SW) extension and Blowing Sink Cave, located a mile east of MoPac South (also known as Loop 1). Adequate protection of 62 caves listed on a federal BCP permit held by the City of Austin and Travis County facilitates smoother infrastructure growth across the county.

The U.S. Environmental Protection Agency (EPA) has identified karst aquifers as one of the aquifer types most vulnerable to pollution (Schindel et al., 1996). Karst aquifers are noted for their rapid groundwater velocities and limited ability to filter contaminants. Groundwater tracing studies of the Barton Springs Segment began in 1996 as a cooperative project between the Barton Springs/Edwards Aquifer Conservation District and City of Austin, with 319(h) grant funding from EPA through the Texas Commission on Environmental Quality (TCEQ). The tracing studies revealed that groundwater in the Barton Springs Segment generally flows west to east across the recharge zone, converging with preferential groundwater flow paths subparallel to major faulting, and then flowing northward toward Barton Springs. Rates of groundwater flow along preferential flow paths, determined from dye tracing, can be as fast as 4 to 7 mi/day (6 to 11 km/day) under high aquifer discharge conditions or about 1 mi/day (1.6 km/day) under low aquifer discharge conditions (Hauwert et al., 2004a/2004b; Hunt et al., 2006). The tracing study continues to characterize groundwater flow though the aquifer, through Capital Improvement Project (6660.027) funding through the City of Austin, designed to simulate the impacts of accidental spills from specific potential contaminant sources and areas, for the purposes of protecting Barton Springs. The SH45 SW and Mopac South area was selected for Phase 10 as a continuation of the overall tracing study.

1.2 Background: SH45 SW and MoPac South

1.2.1 Initial History of SH45 SW and MoPac South

Disturbance associated with population growth can alter or impact the natural environment (Sharp, 2010). The Austin area has experienced tremendous population growth over the past 50 years, bringing about large development and infrastructure projects. Many of those projects have occurred over the recharge zone of the Edwards Aquifer. A major highway system known as SH45 SW and MoPac South was proposed in the 1980s to cross the middle of the recharge zone of the Barton Springs Segment (Figure 1). The proposed roadway generated concern regarding the potential impacts on a karst aquifer that is a sole-source water supply, habitat for karst invertebrates and aquatic life such as the Barton Springs salamander, and a cherished recreational facility at Barton Springs. A lawsuit was filed against the Texas Department of Transportation (TxDOT) by Save Our Springs (SOS) and Save Barton Creek Association (SBCA). The Barton Springs/Edwards Aquifer Conservation District (BSEACD), a groundwater district tasked by the state to manage and protect water supplies, intervened on the lawsuit. Through a settlement consent decree TxDOT agreed to measures that mitigate the potential effects of the proposed highway. Those measures included the construction of hazardous material traps and filtration ponds, placing signs educating the public about the location of the recharge zone along the highways, limiting highway access points and their associated secondary impacts, and implementing a study of roadway runoff contamination by the Center for Research for Water Resources (Barrett et al., 1995a-d; Irish et al., 1995). TxDOT (1989) noted that activities associated with the presence of the highway, such as adjacent development, commercial sites, utility lines, and petroleum stations, could potentially change the rural nature of the area and create secondary impacts beyond the construction and operation of the proposed highway itself.

1.2.2 TxDOT: Environmental Impact Statement and Recent Studies

Earlier reports considered the possible effects of accidental spills from the SH45 SW area. A final Environmental Impact Statement (EIS) was prepared that discussed potential spills from SH45 SW between MoPac South and Bear Creek (TxDOT, 1989):

"A final indirect impact on groundwater that should be addressed is the possible effects that the road may have on Barton Springs. Barton Springs lies about 10 straight-line miles north of the route's crossing of Bear Creek. Even if unfiltered runoff were allowed to enter the aquifer without mitigation, the distance of flow and the mixing of this recharge water with the total volume of transient wedge flowing toward Barton Springs would decrease the concentrations to well within drinking water standards. If the entire ROW contributed runoff at a rate described by Moe and others (1979), an annual input of water at these concentrations would total 1,720 acre feet. Only a fraction of this pavement wash will actually contribute to recharge, but for purposes of creating a worst-case scenario, it is assumed that this road wash flows into the aquifer undiluted. This water would move to Barton Springs, probably via a somewhat circuitous route, at a rate of about 51 feet per day (Slade, personal communication, 1988). Assuming that the water flowed directly to the springs, the travel time would be at least 1,035 days. During that time, the road wash would mix with the "transient flow" described by Slade and others (1986); the volumes generated from the entire ROW, assuming 100 percent runoff would be only 5 percent of the groundwater at the spring after almost 3 years. The concentrations of contaminants would be reduced to only five percent of the initial values. Even allowing for no initial or in-transit water-quality mediation, the groundwater at the springs would still meet public health criteria for drinking water."

MoPac South and a small west-to-east portion of SH45 SW joining MoPac South and FM 1826 were completed by TxDOT in 1995. As of the date of this report, SH45 SW connecting MoPac South and FM 1626 has not been built. However, the right-of-way for this portion of the highway has been determined, and has been the focus of intense scrutiny and negotiation since this portion of SH45 SW crosses very near many significant environmental features, such as Flint Ridge Cave and Bear Creek.

For this area of SH45 SW, the EIS (TxDOT, 1989) states that fluid entering the most obvious sinkhole draining the Highway 45 site does not directly recharge the aquifer:

"Furthermore, geologic maps of the area show that Flint Ridge Cave does not lie within a contiguous part of the outcropping Edwards aquifer. Instead, it lies near the base of the Edwards Limestone, within a faulted area where the bottom of the Edwards

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is exposed. Because of this geometry, any recharging waters would
probably discharge via seeps or ephemeral springs and contribute
to surface runoff before entering the contiguous aquifer recharge
zone farther east."
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Recent studies by TxDOT consultants have focused on the recharge potential and significance of Flint Ridge Cave. The TxDOT consultants hypothesized that the flow of a discrete drip near the lowest extent of Flint Ridge Cave (Flint Ridge Drip Pit) originates from nearby Bear Creek, rather than from the overlying surface (Paulson et al., 2004). This assessment is largely based on the fact that the elevation of Flint Ridge Drip Pit is significantly lower than nearby Bear Creek and that soil infiltration studies in the vicinity of the cave encountered clay-rich "aquitards" that limited the infiltration of brilliant blue dye. A study utilizing soil tensiometers, piezometers, and microcatchment gauges reported that little infiltration reached the bedrock surface to infiltrate to the water table (Wilding and Dill, 2007). From the infiltration studies it was estimated that only 0 to 4% of infiltrating surface runoff was able to reach the bedrock surface (Paulson et al., 2004). The EIS and associated studies suggest that roadway runoff and accidental spill materials from SH45 SW would not be expected to recharge the Edwards Aquifer unless they reached Bear Creek. Furthermore, these hypotheses suggest that federally permitted (under BCP) Flint Ridge Cave is relatively immune to surface impacts except from Bear Creek.

1.3 Purpose

Since 1996, numerous dye traces have shown relatively rapid groundwater flow rates across the aquifer and close surface-subsurface connections (Hauwert et al., 2004a, 2004b, Hunt et al., 2006; Cowan et al., 2007; Hauwert, 2009). A spill plan incorporating recent dye trace results has been developed for the purpose of protecting Barton Springs from the effects of an accidental spill (COA, 2006.) On the basis of the previous tracings, it was estimated that a spill from the SH45 SW and MoPac South intersection could be expected to reach Barton Springs within three days. However, site-specific data from the SH45 SW and MoPac South areas are needed to reconcile the different viewpoints (see section 1.2.2) regarding recharge, groundwater flow rates, and the fate of hazardous material spills. Therefore, the purpose of this study was to design tests to answer a number of questions including:

1) Does infiltrating water from the SH45 SW/MoPac South study area actually recharge the Edwards Aquifer?
2) What are the flow paths and travel times of the simulated spill material (dye) to wells, federally permitted cave preserve sites, and Barton Springs?
3) Is Bear Creek the sole source for cave drips in Flint Ridge Cave?
4) What mass recovery and concentration of dye arrives at Barton Springs?
5) Can the attenuation of dye flowing through the aquifer be quantified in other ways?

This phase of the spill preparation study uses dyes to simulate accidental spills in the area of the SH45 SW/ MoPac South intersection. This study is intended to be used for preparing for, and mitigating the effects of, an accidental spill that might affect Barton Springs and water-supply wells utilizing the Edwards Aquifer. Although the study targets the SH 45 SW and MoPac South area, it is not necessarily intended solely for spills from highways. Additionally, the groundwater flow paths traced as a result of this study may help locate sources of chronic water-quality problems. In 2010, an actual wastewater spill occurred near one of the injection sites (10D Wildflower Cave) just east of MoPac South Expressway. A reinjection of tracer at the 10D Wildflower Cave site in response to the spill provided additional data used to study contaminate transport and refine locations of groundwater flow paths. This report focuses on groundwater flow from creek channel and solution features and does not directly measure the infiltration of runoff through upland soils.

2. Methodology

2.1. Preparation

A proposal that describes the purpose, hypothesis, tracer safety, and sampling plan was prepared January 26, 2007, and revised February 28, 2007. This proposal was submitted for approval by the research review committee of the City of Austin Water Quality Protection Lands. The proposal was also submitted on January 30, 2007, to the BSEACD for approval under their rule 3.1-2 regarding groundwater tracing in their jurisdiction and to request the cooperative assistance of BSEACD staff for a major part of the study involving the monitoring of wells and injections. The BSEACD approved the proposal on March 7, 2007. The Texas Natural Resource Conservation Commission (now TCEQ) Region 11 field office was notified of the injections to coordinate response to any reports of dye observations. The proposal also included a component of soil tracing to characterize cave drips, to better understand soil attenuation of contaminants that was conducted by University of Texas Jackson School of Geosciences graduate student Brian Cowan in cooperation with the City of Austin Watershed Protection Department. The soil tracing component is not yet completed and will be reported under a separate report, although initial results are reported by Cowan et al., (2007) and Cowan (2010).

2.2. Cave Radio Survey

A cave radio survey of Flint Ridge Cave was conducted in order to locate points on the surface corresponding to specific points in the underlying cave. Delineating the cave footprint using cave radio is a step toward examining potential source areas for cave drips and any role the cave may play in the local hydrogeology. The survey also allowed the comparison of elevations of Bear Creek, where tracers were injected, with cave drips in Flint Ridge cave that were monitored for the tracer. A cave radio that transmits low frequency waves capable of penetrating the bedrock was taken into Flint Ridge Cave on April 4, 2006. A receiver was walked over the surface to detect transmissions from specific cave locations and measure the approach angle of the radio waves. The cave radio locations were located with a Trimble XH global positioning (GPS) unit, and the GPS results were post-processed to a horizontal and vertical accuracy of 3 feet (1 m). Permanent surface monuments were cemented over the cave radio locations. In order to measure the depth of the transmitter, six to 13 readings were collected at varying distances from the monuments directly overlying the transmitter. Based on the angle and horizontal distance to the transmitter, the range of individual transmitter depth measurements varied between 1 and 8 feet (0.3 and 2.4 m), once outliers were eliminated. The cave radio results are presented in Appendix C.

2.3. Injections

Four sites were selected for injection of organic dye tracers (Table 1). The sites selected were three caves and a portion of Bear Creek upstream of the proposed SH45 SW crossing. After injection, the three caves were flushed with about 10,000 gallons (38 m^3 or kl) of chlorinated municipal water in order to carry the dyes roughly 200 feet (60 m) to the water table. The natural flow of Bear Creek inundated about a mile stretch of Bear Creek beyond the injection point, closest to Flint Ridge Cave, so no flush water was required. The four injections were conducted under high Barton Springs discharge conditions of 96 to 98 ft^3/s (2.72 to 2.78 m^3/s). The surface geology of the study area is mapped in Figure 2 from a geodatabase modified from Small et al. (1996) and Hauwert (2009).

The dyes used are sodium fluorescein (fluorescein, 75% mixture color index 73), eosine (75% mixture acid red 87), Rhodamine WT (RWT, 20% acid red 388), and sulforhodamine b (SRB, 75% mixture acid red 52). All dyes used were provided by Ozark Underground Labs (OUL) in Protem, Missouri. The dye concentrations referenced in this report are OUL mixtures rather than pure dye concentrations to allow injected and recovered amounts to be readily compared. The dyes used were selected on the basis of their safety, their ability to be detected and recovered from charcoal receptors, and their proven ability to be recovered miles away in the Barton Springs Segment (Smart, 1984; Field et al., 1995; Hauwert et al., 2004a). A description of the dyes and the effects of tracer properties on their recovery are summarized by Aley (2002) and Hauwert (2009; Appendix I). The tracers were mixed by staff not immediately involved in the monitoring in order to prevent cross contamination.

The dyes were poured into caves and Bear Creek channel and flushed with water, rather than poured on random areas of ground as an actual accidental spill might be introduced. This was necessary because low masses of the type of tracers we utilize (organic dyes) are readily sorbed by soil unless a sufficiently large mass of tracer and flush liquid is used to saturate and penetrate the soil, reach and utilize macropores in the soil, or flow to a downstream recharge feature such as a cave or sinkhole. Recharge features and other macropores are extremely common within the study area. For this simulation we assume that a small mass (on the order of 5 to 45 pounds or 2 to 20 kg) of a spilled material is able to reach a recharge feature or creek and become flushed with at least 10,000 gallons (38 m^3) of runoff or other liquid constituents in the spilled material. A separate report of the spill tracing study will focus on the movement and storage of materials into the shallow subsurface using suitable chemical soil tracers and different methodology.

Table 1. Summary of Injections

Injection Site	Injection Date Time	Barton Spr. Flow (ft3/s)	(m3/s)	Tracer	Mass (OUL mixt.) (lbs)	(kg)	Flush Vol. (gal)
10A Hangtree	4/10/07 9:10	96	2.72	Eosine	30	13.6	7,030
10B Sandbur	4/11/07 11:00	96	2.72	RWT	45	20.4	16,000
10C Bear Creek Dam	5/1/07 13:30	96	2.72	Fl	5	2.3	creekflow
10D Wildflower Cave	4/9/07 10:00	96	2.72	SRB	30	13.6	7,163
10D Wildflower Cave	5/24/10 10:30	98	2.77	SRB	33.5	15.2	10,300

10A Hangtree Cave is an open cave shaft located north of and adjacent to an existing portion of SH45 SW, and west of MoPac South Expressway. This cave is currently obstructed with boulders and debris and is located within a fenced enclosure between SH45 SW and a housing subdivision. Hangtree Cave is likely developed within the Dolomitic Member of the Edwards Group, based on previous local geological mapping (Figure 2).

10B Sandbur Cave is located about 1,200 feet (365 m) from proposed SH45 SW and about 1,600 feet (488 m) from Flint Ridge Cave on CoA Water Quality Protection Lands. This cave was selected in place of Flint Ridge Cave as an injection site since Sandbur Cave is near Flint Ridge Cave but is not a BCP permit preserve site. Sandbur Cave does not have significant mapped cave passage beyond about 15 feet (5 m). The cave appears to be developed within the Kirschberg Member of the Edwards Group, near its contact with the overlying Grainstone Member, based on the *cladophyllia*-bearing siliceous remnants found nearby (Hauwert, 2009; Figure 2).

City of Austin staff (Chris Herrington, Scott Hiers, and David Johns) injecting RWT into 10B Sandbur Cave.

10C Bear Creek Dam was selected to simulate the effects of a spill reaching Bear Creek as well as testing a hypothesized source for drips in Flint Ridge Cave (see Section 1.2). An existing dam on Tabor WQPL is located about 1 mile upstream of the proposed SH45

SW crossing, although the proposed highway right-of-way is only about 1,800 feet (550 m) directly east. The dam overlies the Dolomitic Member of the Edwards Group. As the creek flow continues east, midway toward the proposed SH45 SW crossing, it crosses a fault that places the creek channel in the Kirschberg Member of the Edwards Group.

The stretch of Bear Creek between the Tabor dam and proposed SH45 SW is directly west of Flint Ridge Cave and was identified as the most likely portion to contribute flow to Flint Ridge Cave if it was the primary source of flow to the observed drips in Flint Ridge Cave. Infiltration from Bear Creek downstream of SH45 SW is unlikely to reach Flint Ridge Cave because creek channel infiltration would need to flow in the opposite direction of down-dropping fault blocks and observed southeast bedding dip in Bear Creek near Marbridge. Bear Creek infiltration upstream of the Bear Creek Tabor WQPL dam would have to pass beneath the tested stretch of Bear Creek in order to reach Flint Ridge Cave. The creek channel consists of bedrock and sediment substrate. A few swallets were identified in this stretch of Bear Creek on the basis of channel bedrock depressions and measured flow loss, although no swallets here are known to have open apertures.

10D Wildflower Cave is located on the Lady Bird Johnson Wildflower Center grounds just north of a small tributary to Slaughter Creek and about 800 feet (244 m) east of MoPac South Expressway. Wildflower Cave is an upland collapsed sinkhole that receives overland sheet flow from the north. The roof and sinkhole entrance to Wildflower Cave is developed within the massive, resistant Grainstone Member of the Edwards Group, while its cave passages extend through the underlying Kirschberg Member of the Edwards Group. The cave is utilized for educational programs, such as the City of Austin Earth Camp program, to inform the public about caves, the Edwards Aquifer, and its karst species. Two injections, in 2007 and 2010, were conducted at this location.

View looking at the entrance to Wildflower Cave.

Photographs of the fire hose used in 2010 to flush the SRB Dye into a fissure in the rear of Wildflower Cave.

2.4. Monitoring

Wells, springs, or creek segments likely to receive dye from the injection sites were monitored during this study. The chance of recovering dye from any well or cave stream is not very high, since groundwater flow paths in the Barton Springs Segment are relatively narrow (Hauwert et al., 2004a; Hauwert, 2009), although recharge pulses may spread dye some distance away from the discrete groundwater flow paths.

Sites were monitored for the presence of dye using charcoal receptors and periodic water (grab) samples. Some of the monitored sites are characterized as active sites, consisting of pumping wells or flowing springs or cave streams. A portion of the monitored sites are passive well sites, where charcoal receptors are lowered on strings below the water table. Although tracer hits have been detected at passive well sites in previous tracer phases, their success at detecting a tracer flowing nearby is lower since there may be limited flow through the well, or the receptor is placed at the depth where flow is stagnant. Some monitoring sites have an irregular or periodic sample record because these wells had access problems or were added late as a new monitoring site. Over the 2007 and 2010 injections, 33 wells and two deep caves were monitored. The sites monitored for Phase 10 are shown in Figures 3 and 4.

Monitoring intervals varied among the monitoring locations. In general, well charcoal receptors were replaced on roughly three week intervals from mid-March 2007 to mid-June 2007. Charcoal receptors left too long at a monitoring site may become saturated with organics and fail to adsorb tracers that pass through or by it.

Since the study involved pouring dye in a one-mile portion of Bear Creek adjacent to many water wells, particular effort was made to contact well owners in that area. A line of wells was present along the south side of Bear Creek downstream of the injection site between Bear Creek and Bliss Spillar Road, so notices were hand-delivered to residences adjacent to the portion of Bear Creek where tracer might extend. These notices provided information on the proposed trace, request for access to monitor their well, and contact information in case tracers were observed in the well water. No response was received through the notices, however, so the study was limited to a few previously known wells where the well owner was directly contacted for access permission. Access to four wells was obtained for monitoring just south of the Bear Creek between Bear Creek dam and the extent of creek flow.

Cave monitoring sites, such as Flint Ridge Cave and Blowing Sink Cave, required a specially trained team, and typically required an entire day to access. Monitoring in Blowing Sink involved descending over 240 feet (73 m) to the water table in Eileen's River cave stream and a sump at the end of air-filled passage within the Dark Side of the Moon cave passage. Charcoal receptors were placed in the cave stream and sump and replaced roughly each month. Flint Ridge Cave was monitored by placing charcoal receptors in the Drip Pit and shallower Balcony Room. Flint Ridge Cave Drip Pit was monitored using charcoal receptors for 42 days after the Bear Creek injection of tracer 10C. A receptor placed from 42 to 114 days after injection was reported to be recovered from the cave but the sample could not be located for shipment to the laboratory. The last receptor was placed 116 to 172 days after the Bear Creek injection.

Photograph of Heather Tuček replacing a charcoal receptor in the Dark Side of the Moon passage of Blowing Sink Cave by Mark Sanders.

Monitoring was conducted at Barton Springs so that the arrival times and concentration of dye (and therefore breakthrough mass) can be calculated. For the 2007 tracing, automatic samplers collected water samples at Main Barton Springs at four-hour intervals between April 12 and April 17, continuing at six-hour intervals between April 20 and April 23. Automatic sampling continued at Main Barton Springs for four-hour intervals between May 3 and May 8, 2007. Eliza Springs was auto-sampled at four-hour intervals from April 11 to April 20 and May 1 to May 8, 2007, and at six-hour intervals from April 21 to April 24, 2007.

For the 2010 trace, dye loading at Main and Old Mill Springs was based on Eliza Springs tracer concentrations. ISCO automatic samplers collected water samples at four-hour intervals from May 25 to June 1, 2010, eight-hour intervals from June 3 to June 16 and a single grab sample on June 2, 2010. Sampling was repeated after a rain event at four-hour intervals from June 30 to July 1 and July 8 to 10, 2010. Main Barton Springs was infrequently sampled in 2010 on May 25, May 27, June 16, June 25, June 30, and July 27.

2.5. Data Analysis

The charcoal receptors and water samples collected for dye analysis were analyzed by Ozark Underground Labs in Protem, Missouri (http://www.ozarkundergroundlab.com/). The procedures and criteria used in analyzing the dye samples are described by Aley (2008). The dyes provided by OUL are dye mixtures and dye mixture concentrations reported rather than pure dye concentrations. The detection limits for receptors and water samples are shown in Table 2.

Water sample dye concentrations are used along with measured spring discharge to calculate the mass of tracer discharging from a spring. To calculate the percentage of tracer recovery, the mass of tracer recovered is divided by the mass of tracer injected. However, cumulative concentrations from charcoal receptors are not directly comparable to water concentrations because the charcoal concentrations vary with the amount of flow passing through the charcoal, and the ability of charcoal to absorb dye over time. In order to derive a daily average charcoal concentration, charcoal receptor concentrations are divided by the placement interval. The variation in the daily average charcoal concentrations can help define breakthroughs of dye when the concentrations are below water sample detection limits. The percentage of material moving through the aquifer depends on the properties of the material and the mass injected, in addition to the hydraulic properties of the aquifer. Higher recoveries can be expected with higher injection masses. Consequently, the percentage of material reaching Barton Springs from a large mass of spilled material is expected to be larger than a smaller injection of the same material.

The tracing results were analyzed for mean residence time, mean velocity, longitudinal dispersion, and Péclet number as described in detail by Field (2002). Mean residence time represents the mean interval the tracer pulse is stored in the aquifer until it discharges from a spring. Mean velocity is the flow rate of a tracer pulse through the aquifer. Longitudinal dispersion is the rate of lateral spread of an injected pulse as it moves through the aquifer (Mull et al., 1988). Field (2002) notes that longitudinal dispersion "is relevant to the analysis of karst conduits because it provides an indication of the amount of possible spreading of a pollutant mass in terms of increasing persistence and decreasing concentration over time." The Péclet number is the ratio between advective transport versus diffusion and dispersion. It essentially describes the importance of movement through open conduits compared to slow flow through small pores along the tracer flow paths. Péclet numbers below indicate a flow system dominated by molecular diffusion, values of 0.4 to 6 indicate a flow system with similar mechanical dispersion and molecular diffusion, and values over 6 indicate an advection-dominated system.

Variations in tracer breakthrough concentrations and water quality constituent concentrations suggest that Main Barton, Eliza, Old Mill, and Upper Barton Springs are fed by different source mixtures (Hauwert et al., 2004b; Hauwert, 2009). The dye and geochemical composition of the Manchaca flow route is most represented in Eliza Springs, while Main Barton Springs receives additional but relatively small contribution from Sunset Valley and Saline-Line flow routes. However, the dilution from smaller flowpaths is sufficiently small that the concentrations at Eliza and Main Barton Springs are similar enough to use corresponding time data from one spring to fill missing data for the other spring. Old Mill Springs is geochemically influenced by the Saline-Line flow route to a greater extent than Eliza and Main Barton springs, but also shows varying geochemical influence from the Manchaca flow route. In this phase, dye concentrations from Old Mill Spring compared closely to corresponding concentrations in Eliza and Main Barton springs. This is likely because under high aquifer discharge conditions of this phase, the additional contribution from the Saline-Line flow route is relatively low.

In order to mass calculate loading breakthrough of the dyes at Barton Springs, the dye concentrations and springflows are necessary measurements. The USGS-reported Barton Springs discharge was used as a basis for total Barton Springs flow, using periodic individual measurements of Main Barton, Eliza, and Old Mill springs by the City of Austin to determine the proportion of discharge at each spring. The loading of dye at Main Barton and Old Mill springs was based on the concentration measured at Eliza Springs and the discharge proportion of Main Barton, Eliza, and Old Mill springs measured. On May 11, 2007, the CoA WP measured the discharge of Main Barton Springs to be 104 ft^3/s (80% or 2.9 m^3/s), Eliza Springs at 15 ft^3/s (11% or 0.42 m^3/s), and Old Mill Springs discharge of 12 ft^3/s (9% or 0.34 m^3/s). On May 5, 2010 Main Barton Springs discharge was 65 ft^3/s (68% or 1.84 m^3/s), Eliza Springs discharge was 15 ft^3/s (16% or 0.42 m^3/s), and Old Mill Springs discharge was 16 ft^3/s (17% or 0.45 m^3/s), respectively. During the breakthrough period of June 11 through July 1, 2010, USGS reported total Main, Barton, Eliza, and Old Mill Spring flows to vary from 100 ft^3/s (2.83 m^3/s) to 94 ft^3/s (2.66 m^3/s), within 4% of the 96 ft^3/s (2.72 m^3/s) measured on May 5, 2010.

Data gaps occur as part of any tracer monitoring and were corrected in this study as described below. From 4 p.m. on May 3, 2007 to 9:10 a.m. on May 4, 2007, as the fluorescein peak was arriving at Barton Springs, five water sample results measured at Eliza Springs were used to estimate breakthrough concentrations at Main Barton Springs during a sampling gap. Also on May 4 and 5, 2007 a second pulse of SRB dye breakthrough was missed at Eliza Springs, due to an autosampler failure, although the corresponding pulse was documented discharging from Main Barton Springs based on four-hour sampling intervals. In this case, concentrations of SRB measured at Main Barton Springs were assumed identical at Eliza Springs for five samples. For the 2010 Wildflower Center trace, continuous sampling of the dye breakthrough pulse was conducted only at Eliza Springs. The measured concentrations of SRB in Eliza during the 2010 repeat trace were assumed to be identical at Main Barton and Old Mill springs for the purposes of calculating total loading of Barton Springs.

Table 2. Tracer Wavelengths and Detection Limits

Tracer	Normal Acceptable Emission Wavelength Range (nanometers)	Detection Limit (parts per billion)	Practical Quantity Limits (PQL) (ppb)	Precision Limits (RPD) (%)
Elutant Extractions from Charcoal Receptors				
Fluorescein	510.7 to 515.0	0.01	0.03	26-34
Eosine	533.0 to 539.6	0.035	0.0105	29-36
Rhodamine WT	561.7 to 568.9	0.275	0.825	37-49
Sulforhodamine B	567.5 to 577.5	0.15	0.45	35-46
Water Samples				
Fluorescein	505.6 to 510.5	0.0005	0.0015	1.7-2.7
Eosine	529.6 to 538.4	0.008	0.024	3-4.5
Rhodamine WT	569.4 to 574.8	0.05	0.15	4.5-6
Sulforhodamine B	576.2 to 579.7	0.04	0.12	4.2-5.5

Values provided by Ozark Underground Labs, 2007.

3. Results

The results from traces at the four injection sites are summarized in Table 3 below. The results compiled from OUL lab reports are presented in Appendices A and B.

Based on the results of these traces integrated into previous traces (described by Hauwert et al., 2004a; Hauwert et al., 2004b; Hunt et al., 2006; and Hauwert, 2009), maps of the interpreted locations of primary and secondary flow paths are shown in Figures 5 and 6.

Table 3. Phase 10 Tracing Results

Injection Site		10A	10B	10C	10D	10D
Feature Name		**Hangtree**	**Sandbur**	**Bear Creek Dam**	**Wildflower Cave 2007**	**Wildflower Cave 2010**
Distance to Barton Springs	(km)	23	18	19	16	16
Dye		Eosine	RWT	Fl	SRB	SRB
Mass	(lbs)	30	45.0	5.0	30.0	33.5
	(kg)	13.6	20.4	2.3	13.6	15.2
Inj Date/Time		4/10/11 9:10	4/11/2007 11:00	5/1/2007 13:30	4/9/2007 10:00	5/24/2010 10:30
Initial Detection (Barton Springs)	(days)	3-4	2.9	2.0	2.5	17.7
Mean Residence Time	(days)	---	4.7	5.0	8.1	30.8
MeanTracer Velocity	km/day	---	3.77	3.86	1.99	0.52
Time to Peak	(days)	---	2.9	2.6	3	37.9
Barton Springs Flow (USGS)	(cfs)	96	96	96	96	98
Mass Recovered	(kg)		0.73	1.01	3.0	0.8
Main Barton	(kg)	---	0.44	0.78	2.3	0.5
Eliza	(kg)	---	0.28	0.17	0.5	0.1
Old Mill	(kg)	---	0.013	0.06	0.22	0.1
Upper Barton	(kg)	---	0	0	0	0
Total Barton Springs	(%)	**<4%**	**4%**	**45%**	**22%**	**5%**
Chatwin Value	($s^{1/2}$)	---	16,000	3,570	5,550	75,000
Longitudinal Dispersion (Chatwin)	(m^2/s)	---	0.3	7.3	2.1	0.01
Peclét Number		---	60,520	2,832	4,225	202,922

3.1. 10A Hangtree Cave

Thirty pounds (13.6 kg) of eosine mixture was injected in Hangtree Cave by Scott Hiers and David Johns, both hydrogeologists with CoA WP on April 10, 2007. Eosine dye injected in Hangtree Cave was detected in three well receptors (58-50-7DT, 58-50-745, and 58-50-703) 4.5 miles east and a well (58-50-751) six miles east within six hours after injection, and initially arrived at Barton Springs within three to four days (Figures 5 and 7).

Eosine arrived at Main Barton, Eliza, and Old Mill Springs 78 to 102 hours, or 3.2 to 4.3 days, after injection (Figure 8). Eosine concentrations at Barton Springs were detected in charcoal receptors only and not detected in water samples. The estimated recovery of eosine from 10A Hangtree Cave was <4%. Since the tracer was recovered in charcoal receptors below the detection limit for water samples, the longitudinal dispersion and Péclet number were not calculated. Eosine was also measured in background and post injection monitoring of Cold Springs and Upper Barton Springs (Figures 9 and 10).

3.2. 10B Sandbur

On April 11, 2007, 45 pounds (20 kg) of RWT mixture was poured into 10B Sandbur by Chris Herrington, Scott Hiers, Sylvia Pope, David Johns, and Nico Hauwert, all of the CoA WP. RWT dye injected in Sandbur Cave was not detected in any monitored wells during the monitoring interval that did not already have background RWT. RWT from 10B Sandbur arrived at Main Barton, Eliza, and Old Mill springs within 2.7 days after injection (Figures 11 and 12). The dye discharge at Barton Springs revealed a mean residence time of 4.7 days, a mean velocity of 3.8 km/day, and a Péclet number of 60,520. RWT concentrations peaked at 2 parts per billion at Main Barton and Eliza springs.

3.3. 10C Bear Creek Dam

Five pounds (2.3 kg) of 75% sodium fluorescein mixture was poured in Bear Creek at Tabor WQPL dam by William Russell (TCMA) and Julie Jenkins (BSEACD) on May 1, 2007. This dye injection into a limited flowing portion of Bear Creek helped simulate the effects of a spill reaching this creek channel. A relatively small mass of tracer injected along a flowing stretch of Bear Creek on Tabor WQPL was not detected in nearby Flint Ridge Cave or any monitored well, but an estimated 45% of the dye was recovered from Barton Springs.

Prior to injection, flow was measured along Bear Creek to quantify flow loss in specific stretches. A compilation of flow loss measurements along Bear Creek, including the 2007 flow surveys between Bear Creek dam (28,000 feet downstream) and proposed SH45 SW crossing (35,000 feet downstream) is presented in a separate report on stream flow loss (Hauwert, 2012). Flow crossing the Tabor Dam on Bear Creek was measured to be 3.9 ft^3/s (0.1 m^3/s) on May 1, 2007 at 1:30 pm. On May 1, 2007 creek flow completely recharged within a 1 mile stretch of Bear Creek before reaching the proposed SH45 SW crossing. The flow loss measured between Tabor Dam injection site and the proposed SH45 SW crossing is varies between 5 ft^3/s (0.14 m^3/s) on March 20, 2007; 10 ft^3/s (0.28 m^3/s) on April 3, 2007; 4 ft^3/s (0.11 m^3/s) on April 18, 2007; and 4 ft^3/s (0.11 m^3/s) on April 30, 2007.

The traced portion of Bear Creek was about 1,500 feet (450 m) west and south of the Drip Pit in Flint Ridge Cave (Figure 2). No fluorescein, RWT, SRB, or eosine dye was detected in Flint Ridge Drip Pit within 42 days after injection or 116 to 172 days after injection.

Fluorescein initially arrived at Main Barton and Eliza Springs within 1.9 to 2.1 days after injection and within 2.2 days at Old Mill Springs, moving at velocities of about 6 miles per day (Figures 13 and 14). Even though only five pounds (2.3 kg) of fluorescein was poured into Bear Creek, a 45% recovery was measured at Barton Springs, with peak instantaneous water concentrations approaching 4 ppb. A Péclet number of 2,832 was calculated for the fluorescein breakthrough at Barton Springs. No fluorescein was detected at Upper Barton, High Barton, or Cold Springs during the monitored intervals.

3.4. 10D Wildflower Cave

Thirty pounds (13.6 kg) of SRB was injected in Wildflower Cave at 10 a.m. on April 9, 2007 by Nico Hauwert and Sylvia Pope (both CoA WP). The SRB was not detected in any of the monitored well sites during 2007, but arrived at Main, Eliza, and Old Mill Springs, but not at Upper Barton or Cold Springs. The first detection at Main Barton Springs on April 11, 2007 at 9:00 pm, occurred 59 hours or 2.5 days after injection were mirrored at Eliza Springs about four hours later (Figures 11 and 12). While one breakthrough peak was observed at Main Barton Springs, multiple peaks were measured at Eliza Springs. A peak of 8.4 parts per billion was measured 3 days after injection, and a second peak of 9.7 parts per billion was measured 25 days after injection or 3 days after a 2-inch (5 cm) rain. A Péclet number of 4,225 was calculated from the tracer breakthrough at Barton Springs.

On Sunday, May 9, 2010, a wastewater spill was discovered flowing into a tributary crossing MoPac South. It was reported that the wastewater approached within 200 feet (60 m) of injection site 10D Wildflower Cave. Well sampling commenced on May 11, 2010 but it was unclear from the water-quality sampling results alone if the well sites were downgradient of the spill site. On May 24, 2010, 33.5 pounds (15.2 kg) of SRB was reinjected in 10D Wildflower Cave by Nico Hauwert, Stan Tindel, and Chad Petty of CoA WP and Joe Beery of BSEACD. During this second injection, SRB was detected on several samples from the Dark Side of the Moon passage in Blowing Sink Cave, located 1.3 miles (2.2 km) east of 10D Wildflower Cave (see Figure 6). SRB was not detected in any of the monitored wells during either the 2007 or 2010 traces. SRB was measured in Eliza Springs for a short duration beginning 17.7 days after the May 24, 2010 injection, or 2 days after a 2-inch (5 cm) rainfall, peaking at 2.7 parts per billion. This 2010 arrival was significantly later than 2.5 days observed in the 2007 trace under very similar conditions (Figure 15). A second peak of 4.2 parts per billion was measured at Eliza Springs 38 days after injection and 1.5 days after a 4-inch rainfall.

4. Discussion

The four tracer injections spaced across a two square-mile (5 km^2) area, showed surprisingly similar travel times to Barton Springs and other hydrogeologic parameters indicating prominence of conduits in the flow system. Because flow through karst aquifers is focused along relatively narrow pathways, it is difficult to locate monitoring sites directly on the downgradient flowpath (relevant monitoring sites, Quinlan, 1989). Monitoring every well, spring, and cave in the Barton Springs Segment was not possible within the scope of this project. However, additional data from each tracing phase provide new information to locate relevant monitoring sites.

4.1. 10A Hangtree

The potentiometric surface is relatively steep between 10A Hangtree Cave and the Marbridge area where eosine was detected in wells shortly after injection. Hunt et al., (2007) prepared potentiometric-surface maps that included the study area under a similar high flow condition at Barton Springs discharge rates of 103 to 105 ft^3/s (2.9 to 3 m^3/s). This map shows the potentiometric surface decline from about 800 feet msl in the vicinity of Hangtree Cave to about 600 feet msl near the Marbridge area where eosine was recovered in three wells (58-50-751, 58-50-745, and 58-50-703). The results indicate groundwater flow rates of about a mile (1.6 km) per hour west to east across the recharge zone, but also indicate the presence of groundwater below Hangtree Cave capable of transporting the dye under the tested high flow conditions.

Eosine was also detected in background and post injections samples from Cold Springs, Upper Barton Springs, and High Barton Springs. Eosine was detected in background receptors at Upper Barton Springs, but increased four times average daily concentrations within 3 to 15 days after the eosine injection at 10A Hangtree (see Figure 9). Cold Springs showed an increase in receptor and grab water concentrations two to three weeks after the 10A Hangtree injection. Notably Cold Springs has had similar concentration increases through the 2010 tracer monitoring (see Figure 10). Due to the high background and insufficient number of samples these results are inconclusive as to whether or not the 10A Hangtree area also contributes to Cold Springs. However, the hypothesis that the western edge of the recharge zone may also contribute to Cold Springs should continue to be tested by monitoring Upper Barton and Cold springs for future tracing injections along the western side of the Barton Springs Segment recharge zone. Previous works have estimated that the site of 10A Hangtree Cave is located outside the Cold Springs and Sunset Valley Groundwater Basins (Hauwert, 2009). However, as more tracing is conducted it could be discovered that some groundwater flows along the western boundary of the Mt. Bonnell Fault extension that discharges at the Colorado River, Cold Springs, or into the Sunset Valley Groundwater Basin. Pre-injection eosine measured at Upper, High, and particularly Cold springs, is attributed to residual dye from a 50 pound injection of eosine at 9C Seismic Wall, just downstream of Loop 360 in Barton Creek channel, on March 6, 2006, during previous spill simulation testing (Phase 9). This injection occurred at what is currently thought to be the boundary of the Cold Springs and Sunset Valley Groundwater basins, and accordingly the dye may be periodically flushed by Barton Creek channel infiltration.

Persistent eosine has also been observed near other past eosine injections sites. Some residual eosine was also measured in well 58-50-402 during 2010 monitoring of the 10D Wildflower Cave trace. It is possible this eosine is residual from an injection of 7 pounds (3.2 kg) of eosine mixture injected only 500 feet (150 m) to the south on April 27, 1999, at site H Brodie Sink during previous dye tracing The persistence of eosine for 11 years is surprising and unprecedented in the Barton Springs Segment. Although not related to Phase 10, similar dye persistence has been observed in the vicinity of site L Dahlstrom Cave in Hays County as recently as Nov 2, 2006, following the injection of 10 pounds (4.5 kg) of eosine mixture on Sept. 28, 1999.

4.2. 10B Sandbur

Sandbur Cave lies near the extrapolated flowpath from 10A Hangtree Cave, from which eosine dye was detected in numerous wells. We interpret that the RWT injected in Sandbur Cave followed a different flow path than the eosine injected in Hangtree Cave, because both dyes were not detected together in monitored wells. One possibility is that the flowpath from 10B Sandbur is to the northeast and joins the Manchaca Flow Route at a point downgradient of wells where eosine was detected.

The breakthrough curve of RWT at Barton Springs was not a typical bell-shaped curve. The breakthrough of both SRB from trace 10D Wildflower Cave and RWT from 10B Sandbur at relatively high concentrations within days of each other may have caused unexpected interference between the two dyes of similar wavelength. Consequently, both RWT and SRB concentrations are both shown together on the breakthrough curves in Figures 11 and 12.

RWT was detected in background 2007 samples through the 2010 trace at 10D Wildflower Cave in wells 58-50-407 and 58-50-421. The RWT detected in these wells are attributed to a May 5, 2005, injection of 30 pounds (14 kg) of RWT mixture in site U Headquarters Flat Cave, located half a mile west of these wells (Hauwert et al., 2004a). The local persistence of this dye five years after injection may indicate flushing of dye stored in the vadose zone and/or some local storage in the phreatic zone.

4.3. 10C Bear Creek Dam

As a result of this test, Bear Creek does not appear to contribute to the Flint Ridge Drip Pit, even though this drip has a lower elevation than Bear Creek. The elevation of Bear Creek descends from about 750 feet msl at the Tabor Dam, about 3,000 feet (915 m) northwest of the Flint Ridge Drip Pit, to about 730 feet msl near the proposed SH45 SW crossing, about 1,500 feet (450 m) south of Flint Ridge Drip Pit. The Drip Pit cave radio station in Flint Ridge has an elevation of 653 feet msl, which about 80 to 100 feet lower than Bear Creek channel immediately to the west. The hydrostratigraphic properties of the Dolomitic Member are such that it has been observed to perch groundwater at a low hydraulic gradient between fissured shafts that breach the perching beds (Small et al., 1996; Hauwert, 2009). However, the tracer poured into Bear Creek immediately west of Flint Ridge Drip Pit was not detected in Flint Ridge Cave. Also measured flow losses on the stretch of Bear Creek between Tabor Dam and proposed SH45 SW, at 4 to 10 ft^3/s

(see section 3.3) are much larger than the drip rate observed in the Flint Ridge Drip Pit. It is interpreted that recharge from Bear Creek either flows in a different direction than Flint Ridge or descends below the elevation of the observed Drip Pit flows.

Water flows can be observed throughout Flint Ridge Cave and are common at elevations higher than nearby Bear Creek. Ceiling drips are observed a short distance from the cave entrance at elevations of about 750 to 775 feet msl in the Formation Pit and Balcony Rooms. Water flows are observed on the floor of the First Trimester passage of Culvert Crawl passage at about 720 feet msl. A continuous stream of drips flows from the ceiling into the floor at an elevation of about 653 feet msl down to the Drip Pit. It is reasonable from cave observations that the water observed in Flint Ridge Cave is completely derived from the overlying surface through the combination of storm runoff into the entrance and through soil macropores, and slow drainage of the soil and epikarst/vadose pools. This type of recharge through soil macropores is well documented in shallow caves on the Tabor Tract by Cowan et al., (2007) and Cowan (2010).

The fluorescein dye was not detected in any well sites, even though its flowpath likely shares common flowpaths with the other three injections prior to reaching Barton Springs. The lack of fluorescein detection in nearby wells where eosine was detected may be explained by either insufficient concentrations of fluorescein at monitored sites or that the dye took a separate flow path that was not monitored. The concentration of fluorescein may be low near the injection area due to possible bifurcation of flow paths from Bear Creek and/or the lower mass of injected fluorescein (5 pounds, 2.3 kg) compared to the eosine (30 pounds, 13.6 kg) that was detected in area wells. Because fluorescein injected in 10C Bear Creek at Tabor was not also detected in wells in the Shady Hollow area where eosine was detected, it is possible that the fluorescein and Bear Creek recharge flowed southeast along a separate groundwater flow path(s) than flow paths utilized by the eosine injected in 10A Hangtree. One assumption made is that groundwater flow paths from the four injection sites do not cross. Additional injections using more well monitoring sites and larger injection masses in Bear Creek or nearby cave injection sites are necessary to refine the location of groundwater flow paths with high confidence.

Fluorescein poured into Bear Creek just west of Flint Ridge had a relatively large calculated recovery of 45% fluorescein was measured at Barton Springs. The relatively large recovery of fluorescein from the Bear Creek injection was surprising considering low injection mass of 5 lbs (2.3 kg).

4.4. 10D Wildflower Cave

The successful dye tracing of a groundwater flow path across Slaughter Creek to Blowing Sink Cave (trace 10D Wildflower Cave) corroborates the results of previous sediment source analyses. A sediment sample collected by Nico Hauwert from Eileen's River in Blowing Sink was analyzed by Leo Lynch of University of Texas Geological Sciences (now at Mississippi State University) as part of a sediment source water study by Barbara Mahler, currently of U.S. Geological Survey (Mahler, 1997; Lynch et al., 2004). Those studies associated specific clays in the Blowing Sink sediment sample to clays unique to the Glen Rose Formation. The closest and likeliest source of Glen Rose-derived sediment is Slaughter Creek, which drains the upstream contributing area where the upper Glen Rose Formation is widely exposed. In this case, creek flow and a cave appear to contribute water to a flowing cave stream that can be physically accessed and observed.

Initial arrival at Barton Springs of the SRB tracer from 10D Wildflower Cave varied from 2.5 days in 2007 to 17 days in 2010 (Figure 15). The injection masses, flush volumes, and aquifer discharge conditions were very similar for both injections. The reason for the differences in travel times and recoveries is not known, although there are possible explanations.

1. Epikarst/Vadose storage of dye. The first arrival of the 2010 injection at Barton Springs occurred two days after a rain of about 2 inches (5 cm) in magnitude, the first rain greater than a half inch in magnitude since the injection. For both the 2007 and 2010 injections, pulse arrivals of tracer repeatedly occurred about 2 days after rain events greater than 1 inch (2.5 cm; Figure 15). Dye pulses associated with rain events may be interpreted as a result of storage of dye in the vadose zone, requiring sufficient rain events to carry dye to the water table. Under these conditions, low recovery of dye commonly can be expected, as the dye may continue to flush with rains after the intensive monitoring interval and not be detected.

2. Data gaps during intensive monitoring interval. A second possibility could be data gaps from insufficient sampling frequency. There are data gaps from autosampler failures in 2010 from 5 to 6 days, 8 to 9 days, 13.5 to 16 days after injection where dye may have arrived at Barton Springs, but was not detected.

3. Dye deterioration from residual wastewater. A third possibility could be biological and chemical breakdown of the dye. In 2010 the dye was injected near the leading edge of a wastewater spill weeks before. It is possible that the diluted residual wastewater affected the dye due to higher bacterial activity or chemical breakdown that inhibited tracer transport rate and recovery.

4. Variations in hydrogeological response. Finally, while hydrologic conditions were similar, they were not identical. 2007 was the third wettest year on record and the injections occurred on the rising limb of the spring hydrograph, while 2010 injections occurred at the plateau of the spring hydrograph. The vagaries of these two hydrologic regimes are poorly understood, but they could have been a factor in the differences in results displayed in this study. Only one other injection site in the Barton Springs Segment was traced a second time under nearly identical conditions to test for variability between traces. Crippled Crawfish Cave on Onion Creek was traced on August 8, 2002 under Barton Springs flows of 99 ft^3/s (2.8 m^3/s) and repeated on May 4, 2005 at Barton Springs flows of 104 ft^3/s (2.9 m^3/s). In the case of these repeated Crippled Crawfish Cave traces, the first arrivals of <3.5 and 2.4 days and recoveries of 1% versus 5 % were essentially identical.

4.5. Flow Path Interpretation

Variations in the arrival times and dye concentrations at the various Barton Springs outlets during the same trace interval suggests differences in flow paths. Dye concentrations at Eliza Springs were consistently slightly higher than Main Barton or Old Mill Springs. This result is consistent with the interpretation that Eliza Springs primarily receives its flow from the Manchaca Flow Route, while Main Barton and Old Mill springs receive additional sources (such as the Saline-Line flow route or Sunset Valley flow route) that would dilute flow from the Manchaca flow route.

The lack of measurable RWT (from 10B Sandbur), fluorescein (from 10C Bear Creek Tabor), and SRB (from 10D Wildflower Cave) in Upper Barton Springs is interpreted to indicate that these dyes arrived at Barton Springs through the Manchaca flow route in the Manchaca groundwater basin and did not measurably enter the Sunset Valley groundwater basin under the tested conditions. Similarly wells in Sunset Valley where dye was previously detected in earlier traces (Phase 2, site C Dry Fork Sink, Hauwert, et al., 2004a) did not detect the SRB injected at 10D Wildflower Cave in 2010. Whether some eosine from 10A Hangtree arrived at Cold, Upper, and High Barton Springs is not clear due to residual background eosine at these sites. A future tracing phase simulating pipeline spills may help further test the flow routes from the Manchaca, Sunset Valley, and Cold Springs groundwater basin divides.

4.6. Dye Recovery in Wells and Cave Streams

Tracers were detected in only 5 of the 33 wells monitored and in one of two deep caves. As noted in Section II.4, the groundwater flow paths are relatively narrow and the chance of recovering tracers in a well or cave is very low. During most periods, flow from the aquifer drains to local preferential groundwater flow paths, and even a well near a preferential flow path where dye is flowing may not receive measureable amounts of the dye except during recharge conditions when flow from the preferential flow paths fills matrix storage (Hauwert, 2009). Only in trace 10A Hangtree was dye recovered in downgradient wells. Tracer detected from 10D Wildflower in Blowing Sink Cave only after this site was added for the 2010 injection. The likelihood of recovering dye in wells can be increased by including more wells, although it is possible there are no existing wells directly located along some traced groundwater flow paths.

4.7. Hydrogeologic Parameters

The initial arrival and mean residence times of the tracers from SH45 SW and MoPac South study area to Barton Springs were relatively rapid. Initial arrivals of four injection sites to Barton Springs varied from 2 to 4 days. Dye reinjected into one of these four sites in 2010 required 18 days to initially arrive at Barton Springs. This directly traced velocity is significantly faster than the 1,035 day minimum travel time from SH45 SW to Barton Springs calculated by TxDOT (1989).

The amount of dye recovered in this phase was highly variable. The amount of SRB poured into 10D Wildflower Cave that was calculated to discharge from Main Barton, Eliza, and Old Mill Springs was 22% of the injected mass, which is indicative of an overall strong recovery from a small injection mass. About 5% of SRB reinjected under similar conditions in 2010 was recovered. About 4% of the RWT dye injected into 10D Sandbur was calculated to discharge from the three major Barton Springs outlets. Even though eosine from 10A Hangtree Cave was detected in more wells than the other dyes and rapidly measured in charcoal receptors at Barton Springs, it was not detected above the detection limit for water samples at Barton Springs, and thus only a minor amount (<4%) of dye mass is calculated to have discharged. About 45% of the 5 lbs (2.3 kg) in 10C Bear Creek at Tabor was recovered at Barton Springs.

Measurement of dye mass recovery may be subject to various potential errors, most of which tend to underestimate actual recovery:

- The loading calculation error is directly related to the accuracy of discharge measurement of the individual Barton Springs.
- Aliasing biases from insufficient sampling frequency are more likely to cause underestimation of mass loading (Quinlan, 1989; Quinlan, 1990)
- All of the dyes used are not as conservative as water and tend to sorb on fine-grained organic-rich soils and plant debris, although eosine and fluorescein tend to sorb much less than RWT and SRB.
- Because SRB and RWT dyes are detected at similar wavelengths, it is possible that since SRB water concentrations were relatively high at Barton Springs during the 2007 injections, peaking near 10 ppb, and both dyes arrived within several days of each other, some dye interference may well have occurred. The effect of this interference could be that some calculated SRB loading might have actually been RWT, and vice versa.
- It is possible, but unlikely, that some of the dye loading to Barton Springs is low because some of the dye discharged somewhere other than Barton Springs.

Using relatively small tracer mass (5 to 45 lbs) of four organic dyes used in this study, a range in estimated tracer recoveries from <4% (detection only in charcoal at concentrations too low to detect in water samples) to 45% were calculated. The dyes used in this study are not completely conservative, as they must sorb sufficiently onto organic material like charcoal in order to continuously detect them (Tom Aley, 2007 personal communication). Consequently, the percent mass recoveries observed from injection masses of 5 to 45 lbs are likely to be significantly smaller than injection of a large mass (such as hundreds or thousands of pounds) of the same material. It may be possible to examine the effect of injection mass loading on breakthrough recovery by combining results from many tracing phases of this study. However, as seen with the two injections of similar mass and hydrologic conditions at 12D Wildflower Cave, that at the relatively low masses used in tracing studies that other factors other than injection mass may have an overriding effect on percent recovery.

The very low longitudinal dispersion values of less than 7.3 m^2/s and high Péclet numbers ranging from about 2,000 to 20,000 m^2/day indicate a strongly conduit-dominated system of rapid flow with low natural retention by the aquifer. Péclet numbers below 0.4 indicate a strong diffuse system. These values based on injections of relatively small tracer masses indicate a contaminant spill generally would experience relatively low attenuation in contaminant loading as it moves to Barton Springs once it reaches a creek or cave. The values also suggest that the retention or storage of a contamination plume within the aquifer is relatively low and that the aquifer (excluding the soil and epikarst) have the ability to flush contaminants over time.

Other factors, such as the properties of spill constituents, dilution, and soil sorption/desorption can influence the timing, concentration, and loading of spilled contaminants across the aquifer. While this study uses tracers as an estimate of a contaminant spill response, different materials will have different properties that the tracer surrogates. For example, some ammonia nitrogen may convert to nitrate nitrogen. Some materials may breakdown into constituents that can be more harmful to life. Prediction of complex geochemical fates of potential spill materials is beyond the scope of this report. Also, while the total load of a contaminant arriving at Barton Springs may approach the total mass of spilled materials, concentrations arriving at Barton Springs may be diluted by groundwater. The ability of the soil to both sorb and release contaminants are not tested in this phase of the study.

The tracer breakthroughs indicated a high component of advection (flow through open conduits) versus dispersion and diffusion. The implication of this result is that in the phreatic zone, groundwater flow is rapid and natural attenuation is limited to dilution for many conservative constituents. Cleanup of spilled materials that have entered the aquifer is very improbable, except by natural flushing over time. The nature of advective flow in the phreatic zone itself may allow faster flushing of spilled materials than from a diffuse-storage aquifer such that it eventually may recover if the spill masses are sufficiently small. A large mass spill of hazardous materials within the SH45 SW and MoPac South study area could pose a serious threat to human health and safety at wells and Barton Springs Pool and to the habitat of aquatic species in the aquifer's outlets.

5. Conclusions

All four tracers injected along the SH45 SW and MoPac South study area appeared to follow the Manchaca flow route to arrive first at Main Barton, then Eliza, and finally Old Mill springs. These flow path results are consistent with flow paths and groundwater basins defined in previous investigations (Hauwert, 2009). This study defined a flow path from SH45 SW west of MoPac South through Shady Hollow, crossing Bear Creek to Marbridge, then turning north subparallel to Brodie Lane and Manchaca Roads to Barton Springs. A repeat trace of 10D Wildflower Cave recovered the SRB tracer in Blowing Sink cave stream, one mile directly east of the injection site. Two other tracer injection sites (10B Sandbur and 10C Bear Creek Tabor) were not recovered in wells, so their flow paths were estimated using previous tracing and other data (Hauwert, 2009).

Spilled material will travel through the aquifer at rates that vary with the spill constituent properties, groundwater flow conditions, and the groundwater flow rates. In this simulation, the groundwater flow rates are measured with dye injections under high groundwater flow conditions (Barton Springs discharge of 96 to 98 ft^3/s or 2.7 to 2.8 m^3/s). An accidental spill from the SH45 SW and MoPac South intersection area can be expected to recharge into the Edwards Aquifer and initially arrive at Barton Springs within two to four days under high aquifer discharge conditions. Slower initial arrival times of about three weeks can be expected under drought conditions, on the basis of previous studies (Hauwert et al., 2004a). The previous estimate in the TxDOT (1989) EIS study of a travel time of 1,045 days for a spill from SH45 SW to reach Barton Springs grossly underestimated actual travel velocities.

Storage of spilled materials and simulation dyes in the soil, epikarst, and vadose zones can account for delays in initial arrivals and result in pulse-driven longer term contamination sources, as observed in the 2010 injection at 10D Wildflower. Variation in the properties and mass of spilled constituents may also serve to affect the groundwater transport of the constituents.

The Flint Ridge Drip Pit is about 134 feet (40.8 m) below proposed SH45 SW, as measured by cave radio survey. The cave drip does not appear to be recharged by nearby Bear Creek. Additional studies involving cave drip monitoring and soil tracing are recommended to further investigate the drip's sources.

6. Figures

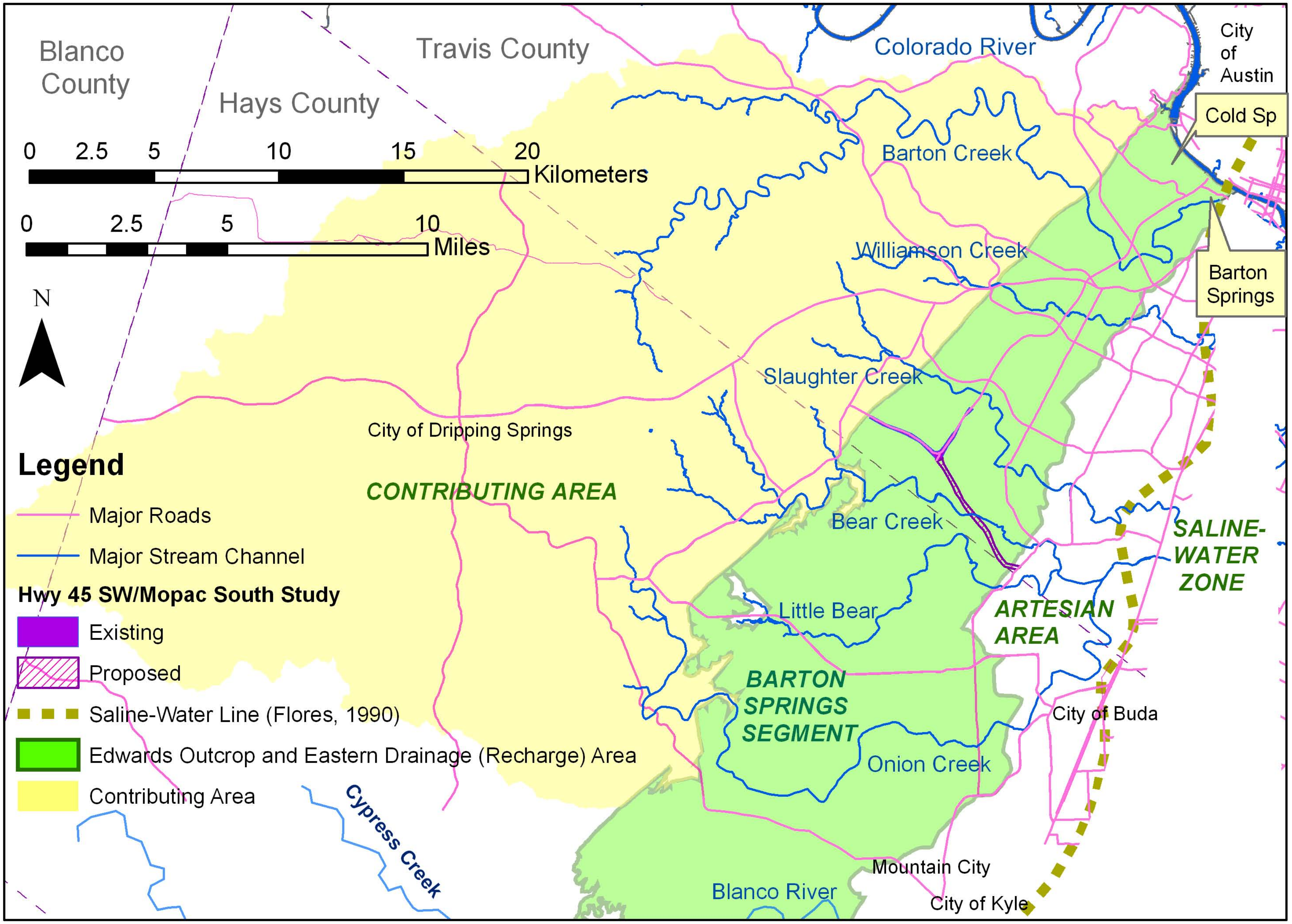
Blanco County
Travis County
Hays County
Colorado River
City of Austin
Cold Sp
Barton Creek
Williamson Creek
Barton Springs
Slaughter Creek
City of Dripping Springs
CONTRIBUTING AREA
Bear Creek
Little Bear
ARTESIAN AREA
SALINE-WATER ZONE
BARTON SPRINGS SEGMENT
City of Buda
Onion Creek
Cypress Creek
Mountain City
Blanco River
City of Kyle
0 2.5 5 10 15 20 Kilometers
0 2.5 5 10 Miles
N
Legend
Major Roads
Major Stream Channel
Hwy 45 SW/Mopac South Study
Existing
Proposed
Saline-Water Line (Flores, 1990)
Edwards Outcrop and Eastern Drainage (Recharge) Area
Contributing Area

Figure 2. Phase 10 Surface Geology

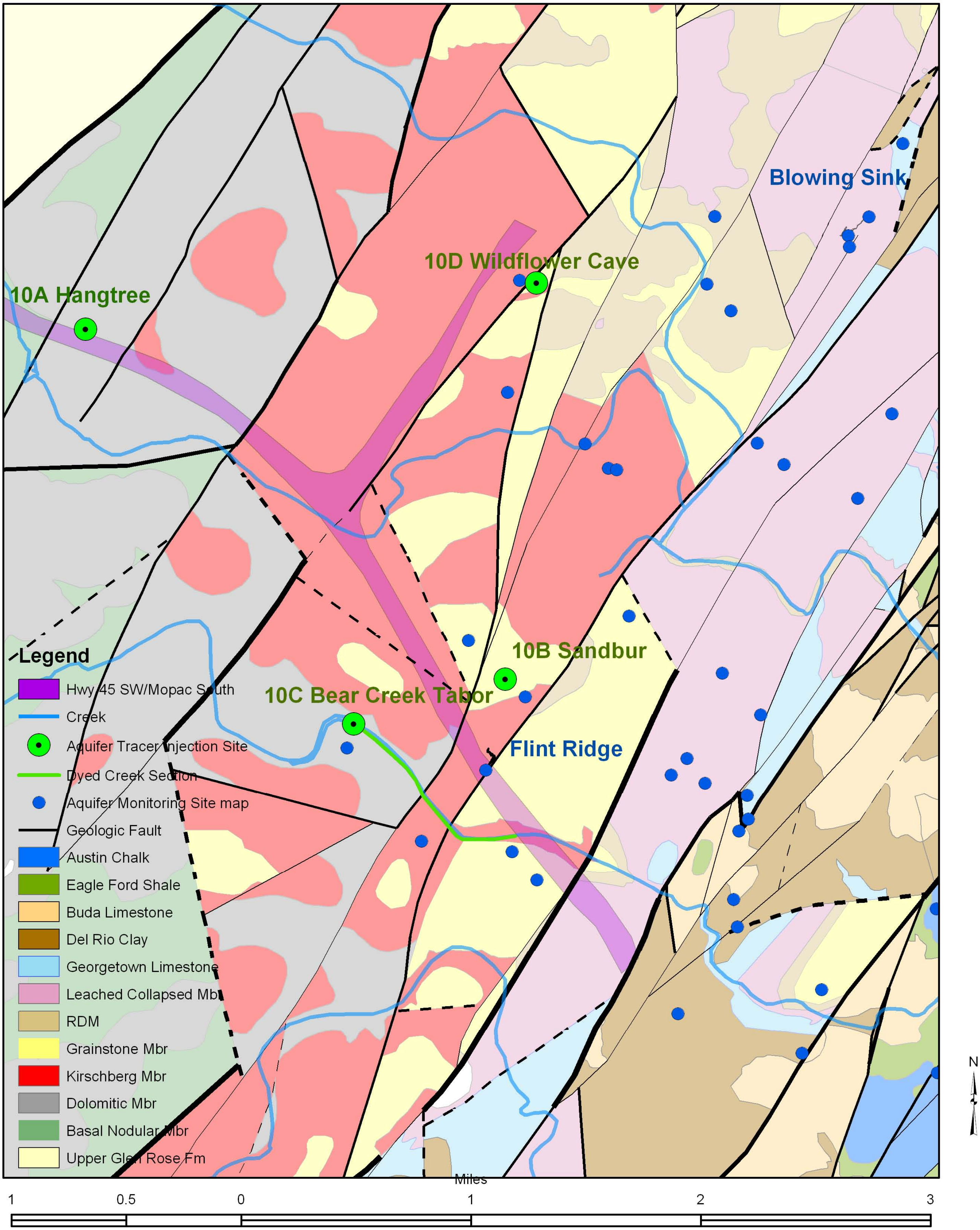

Figure 3. Injection and Aquifer Monitoring Sites

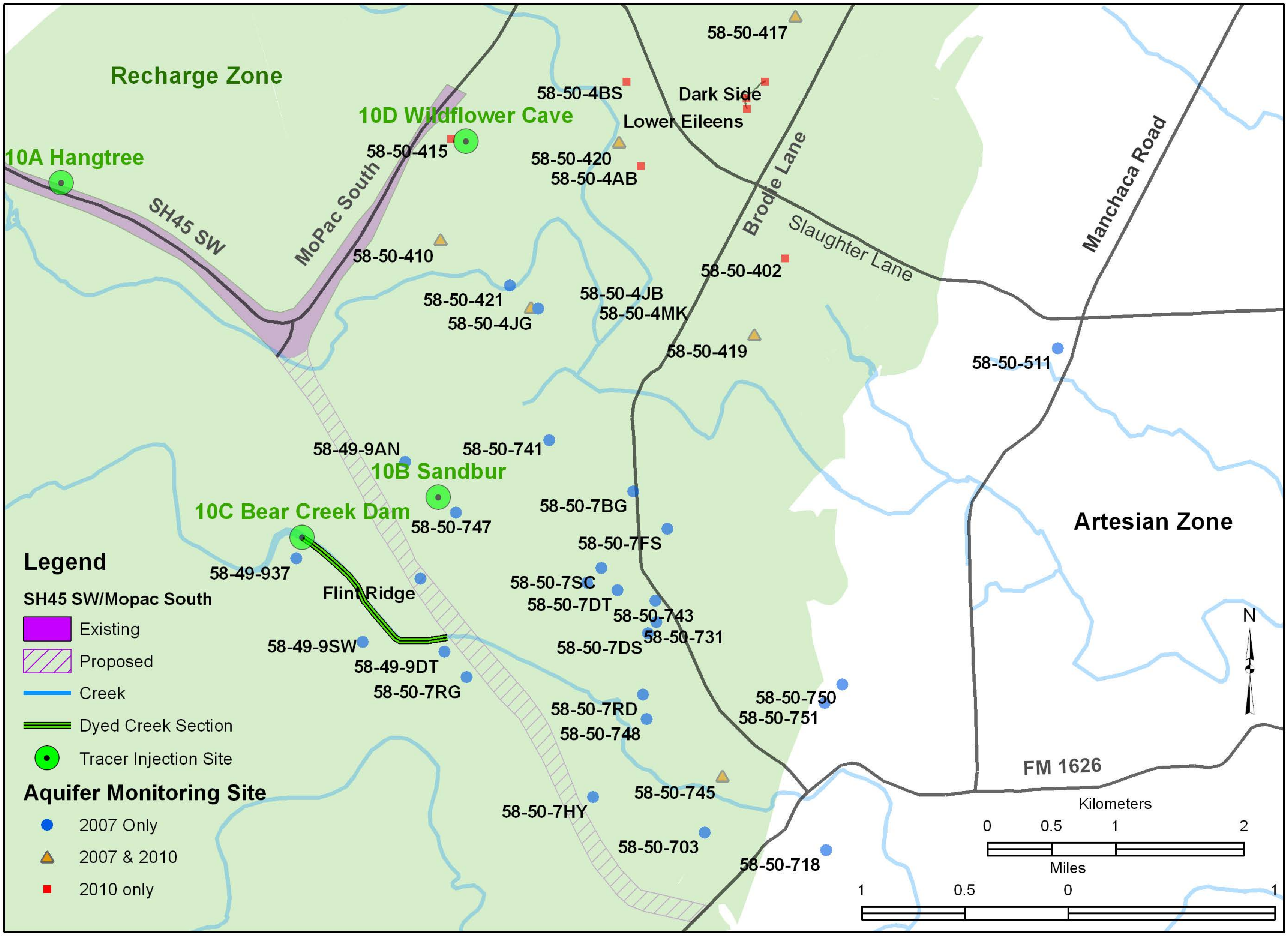

Figure 4. North Aquifer Monitoring Sites

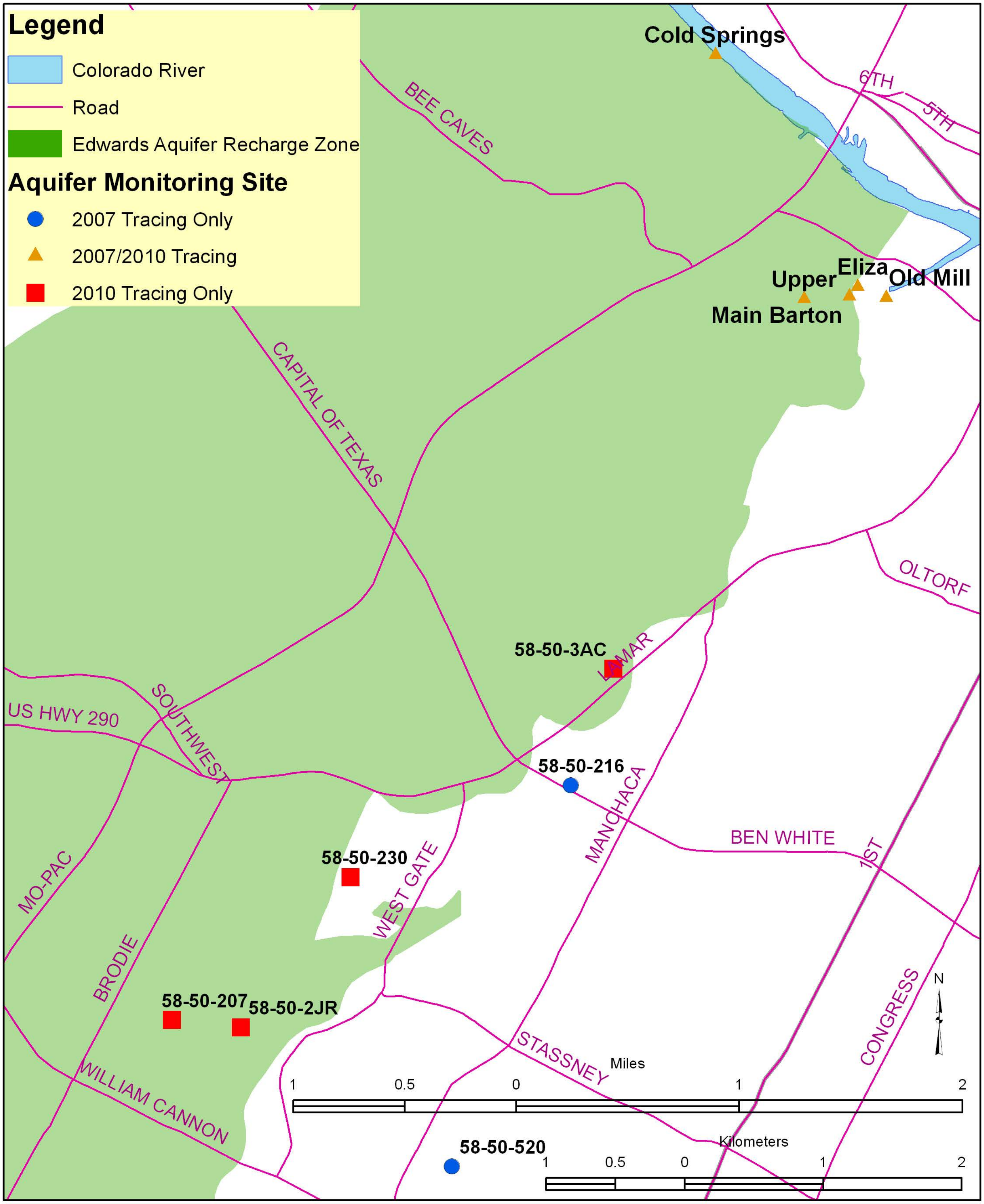

Figure 5. Map Showing Well Recovery of 2007 Groundwater Traces

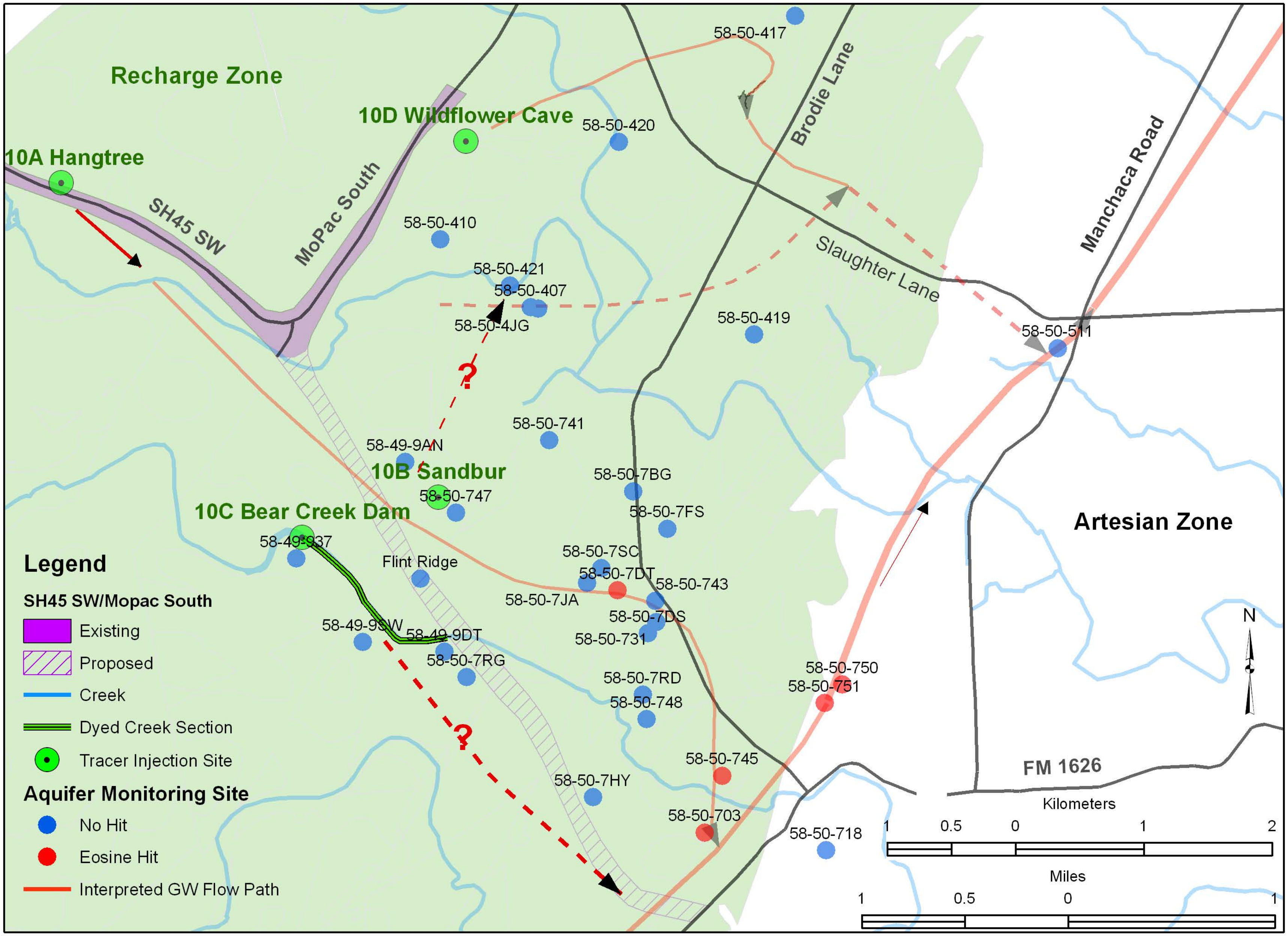

Figure 6. Map Showing 2010 10D Wildflower Trace Results

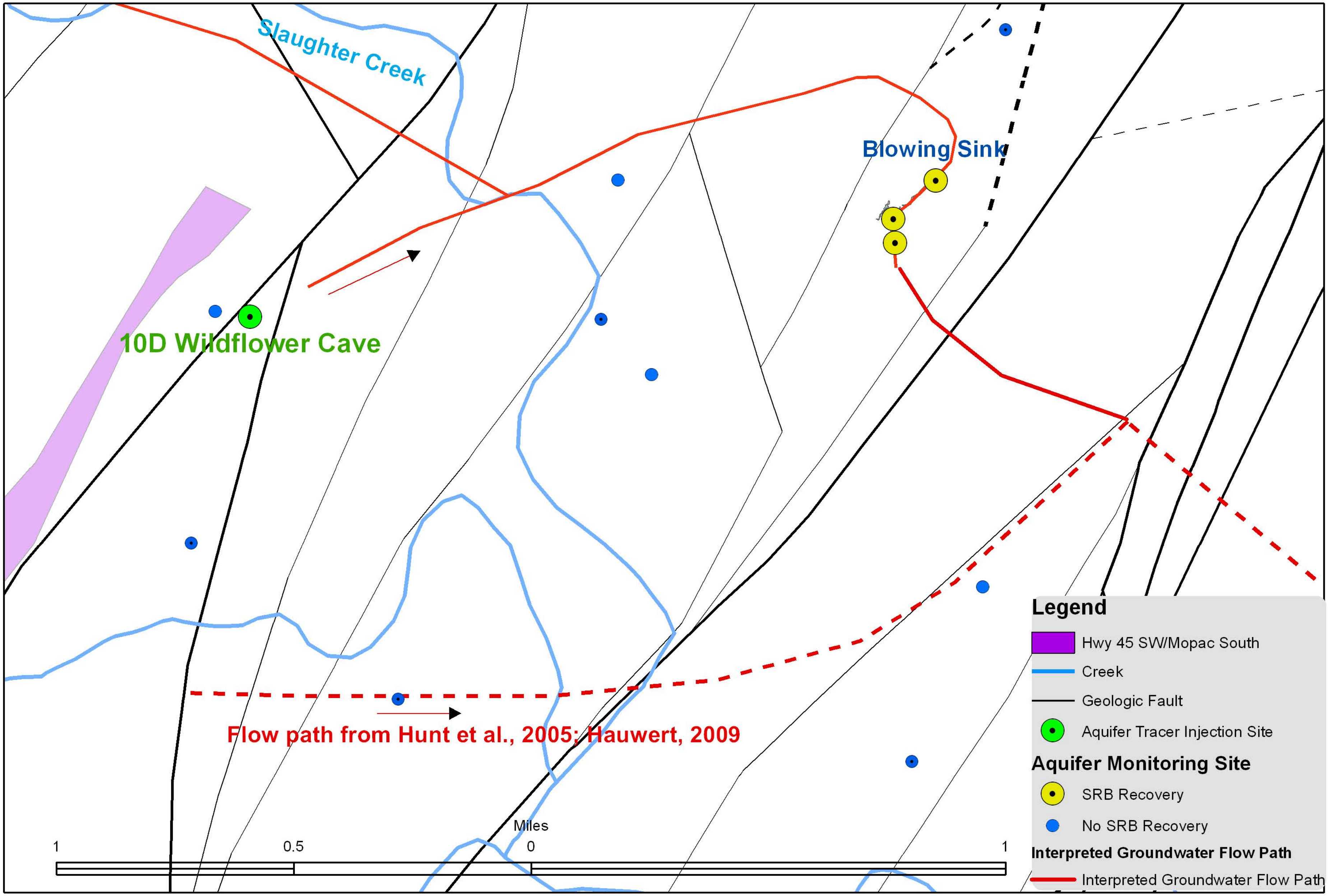

Figure 7. 2007 Eosine Detection in Wells Following 10A Hangtree Injection

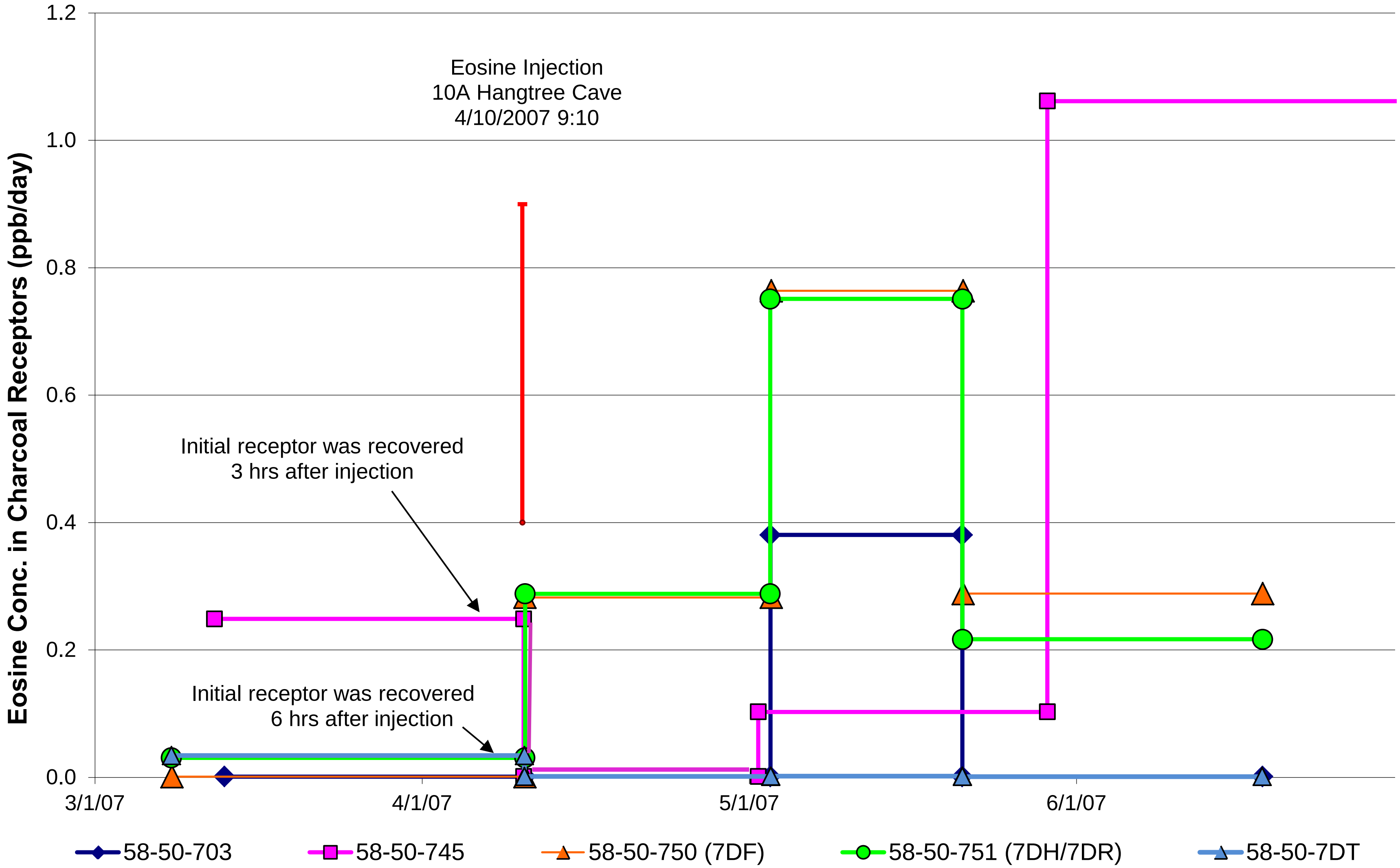

Figure 8. 2007 Eosine Breakthrough at Barton Springs

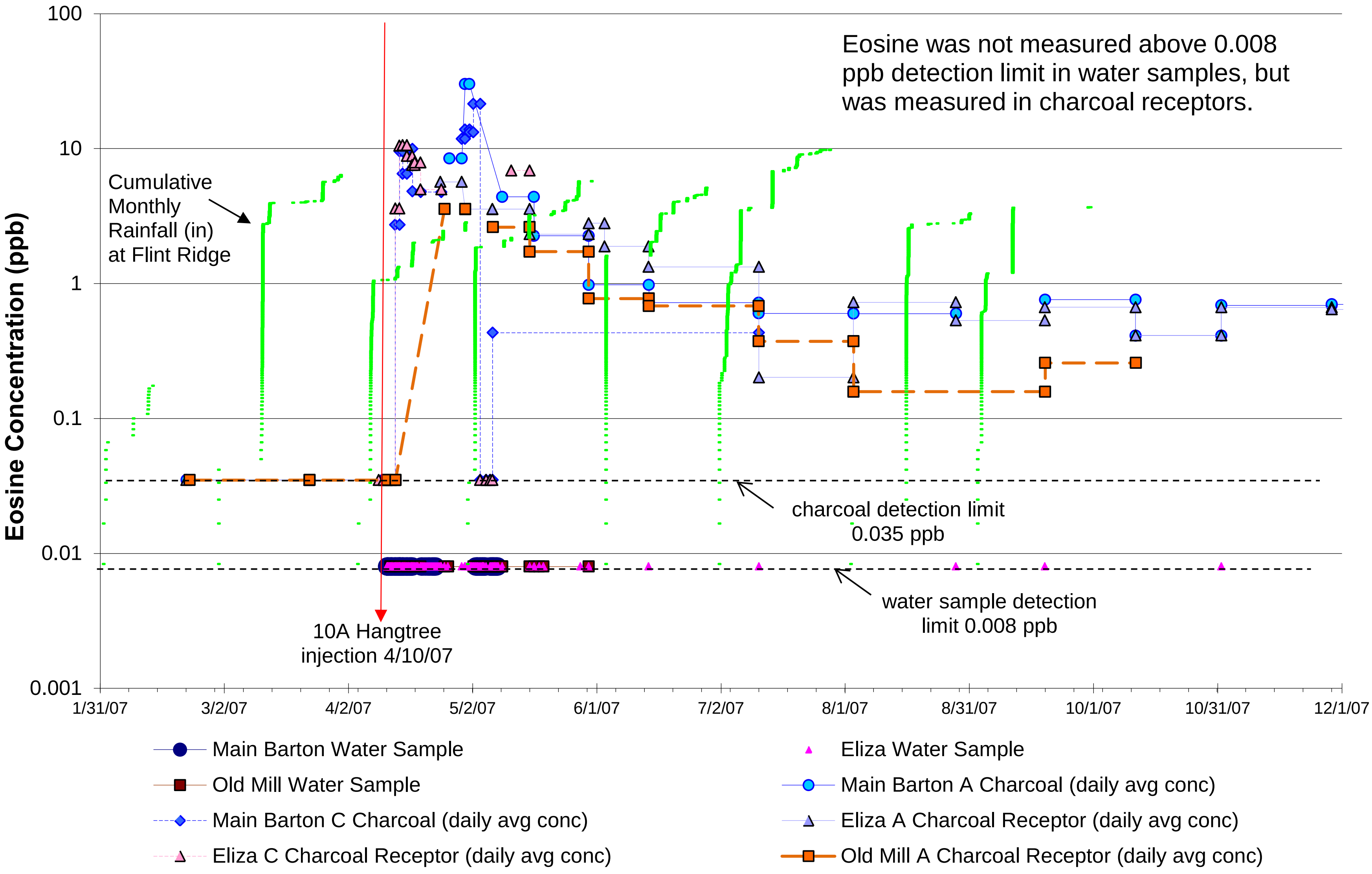

Figure 9. 2007 Eosine Detection Upstream of Barton Springs Pool

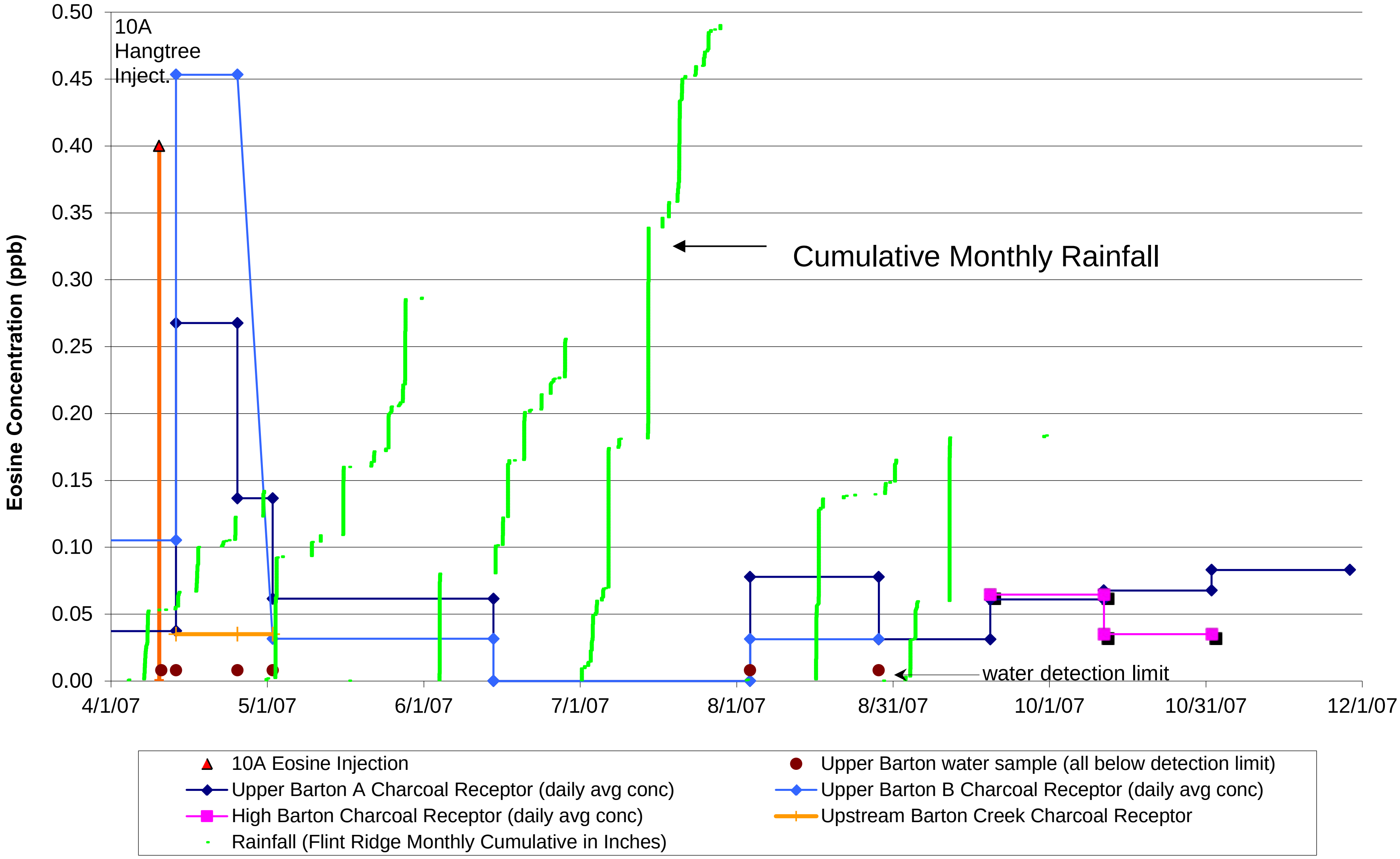

Figure 10. 2007 Eosine Detection at Cold Springs

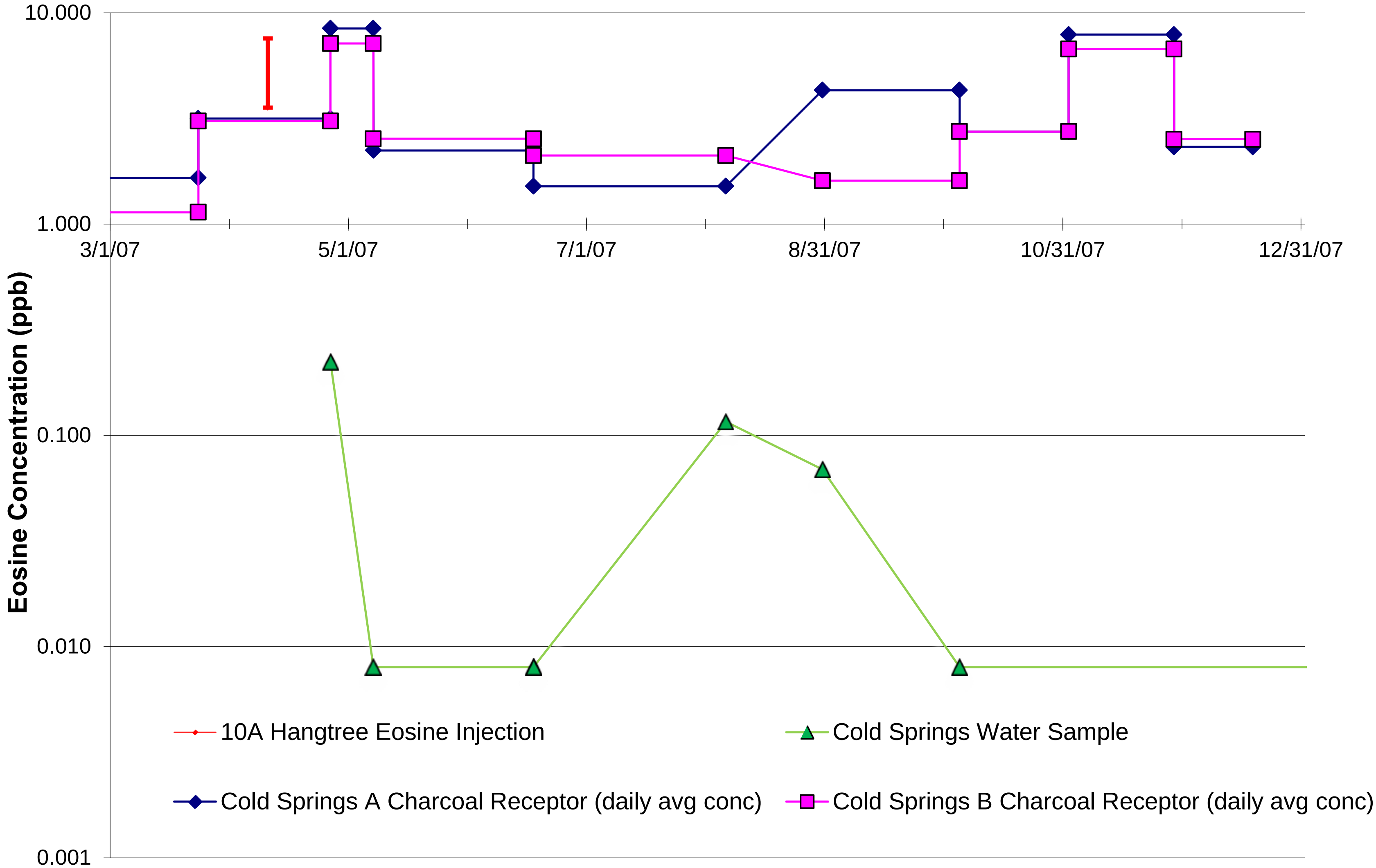

Figure 11. 2007 Breakthrough of SRB and RWT at Barton Springs

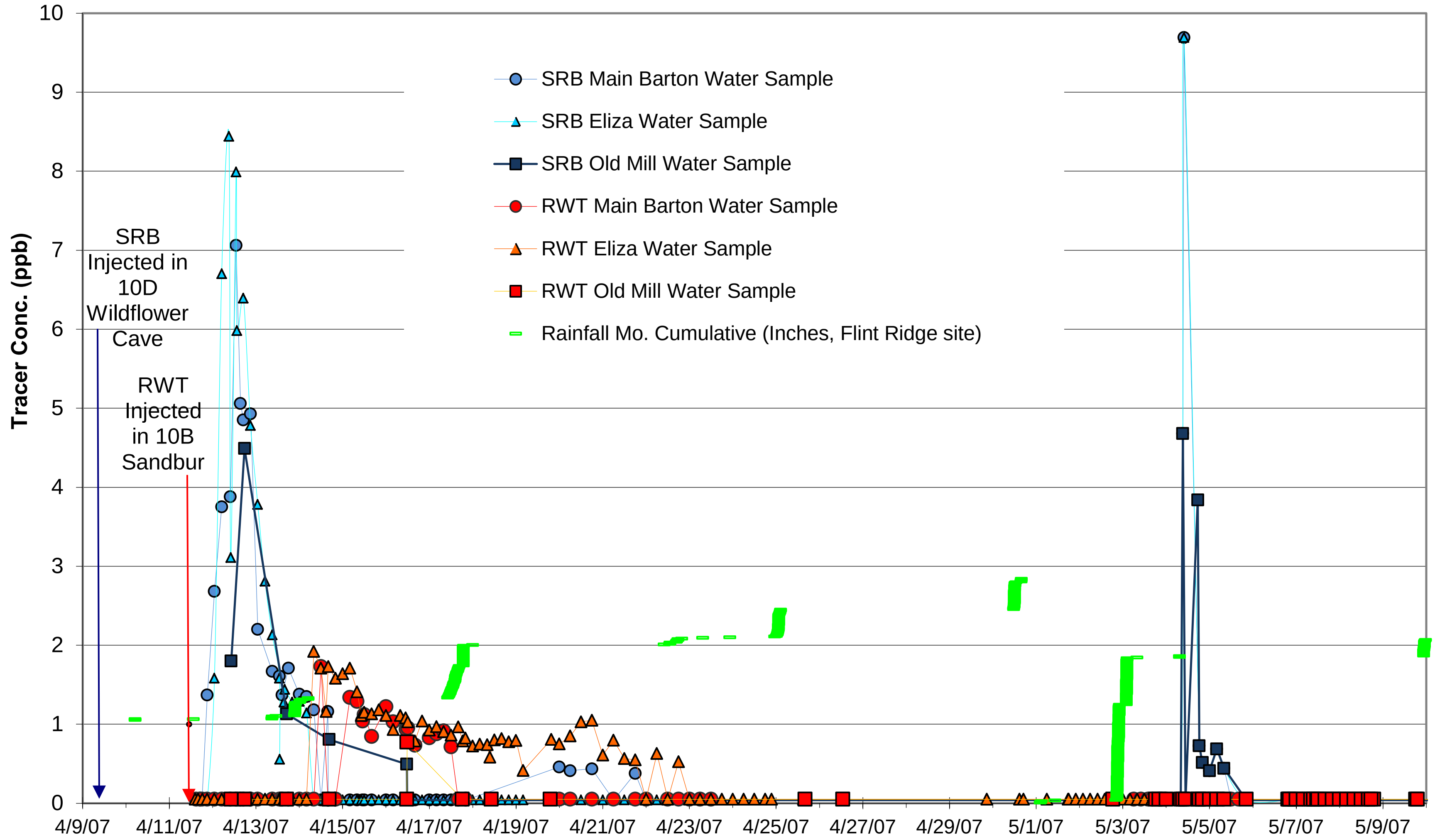

Figure 12. Detail of 2007 Breakthrough of SRB and RWT at Barton Springs

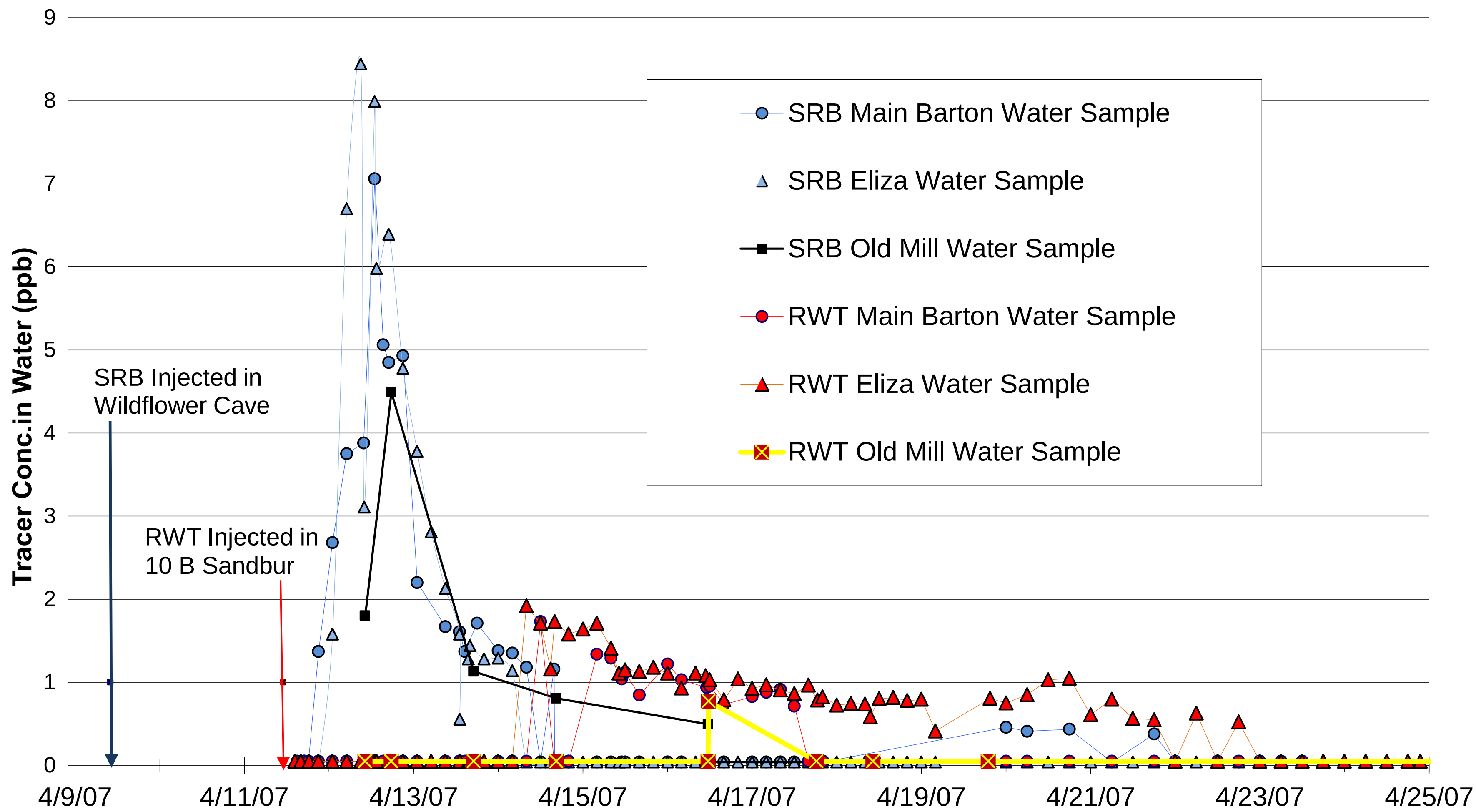

Figure 13. Extended 2007 Breakthrough of Fluorescein From Springs Following 10C Bear Creek Dam Injection

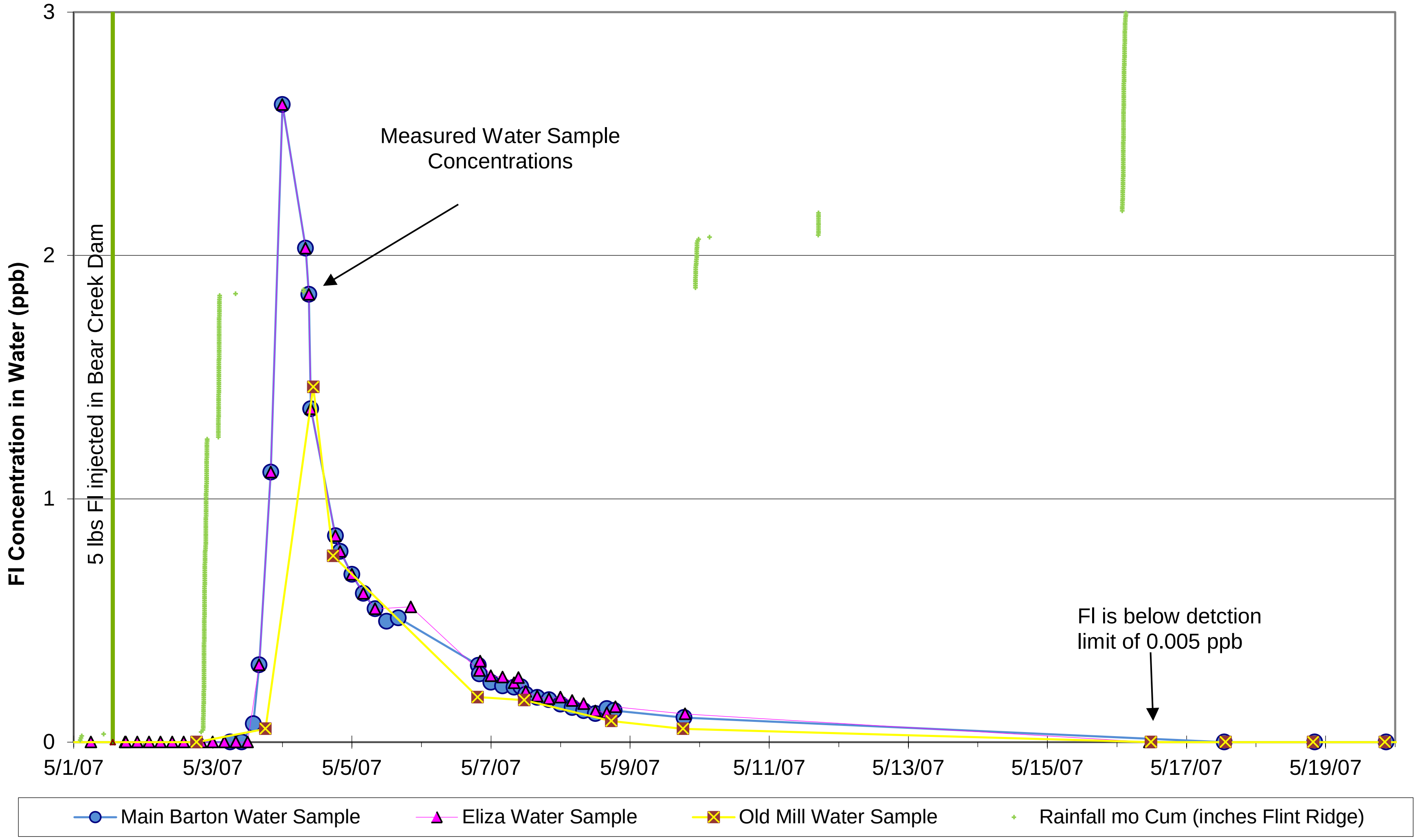

Figure 14. Detail Fluorescein Breakthough From Barton Springs Following 10C Bear Creek Dam Injection

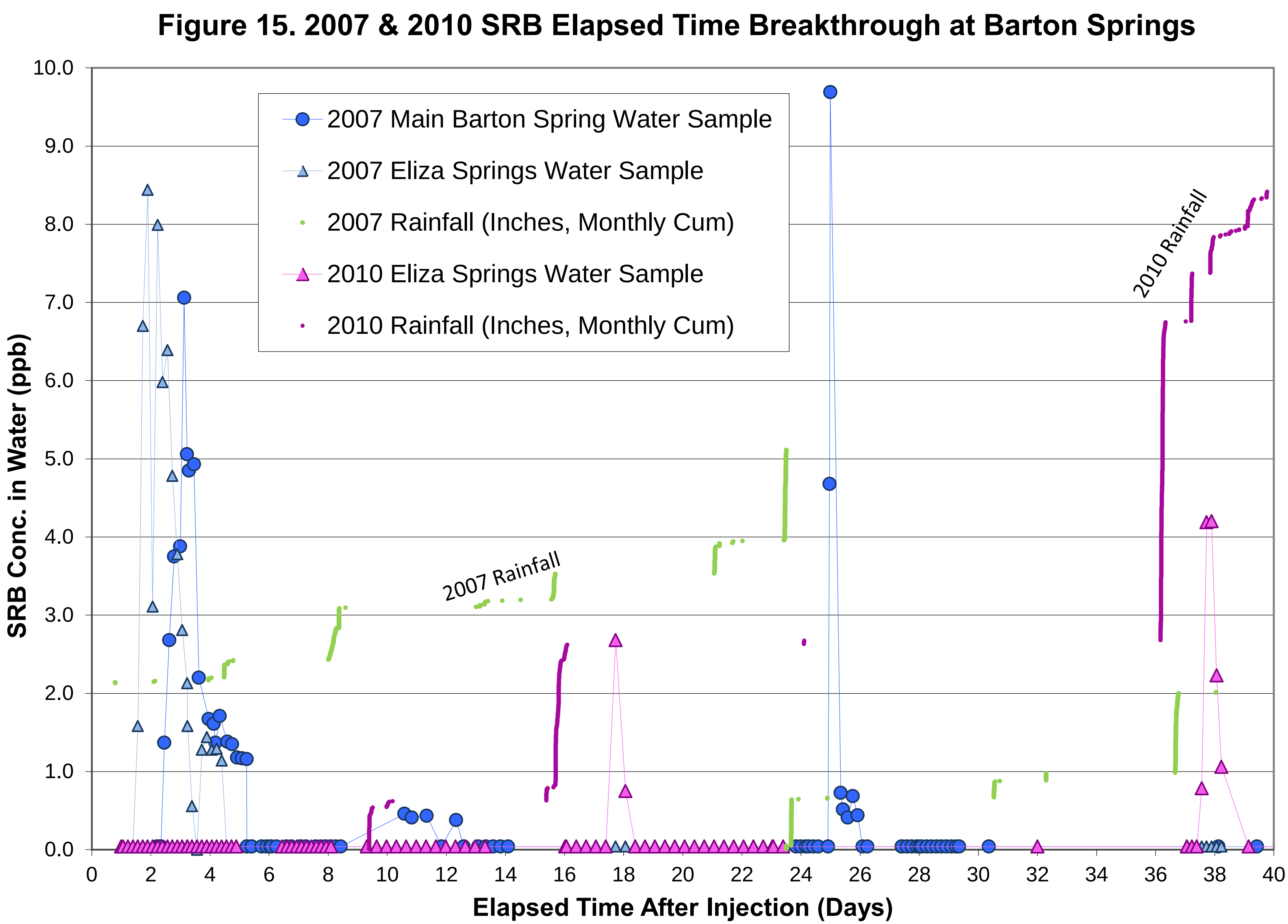
Figure 15. 2007 & 2010 SRB Elapsed Time Breakthrough at Barton Springs
SRB Conc. in Water (ppb)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Elapsed Time After Injection (Days)
2007 Main Barton Spring Water Sample
2007 Eliza Springs Water Sample
2007 Rainfall (Inches, Monthly Cum)
2010 Eliza Springs Water Sample
2010 Rainfall (Inches, Monthly Cum)
2007 Rainfall
2010 Rainfall

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Appendices

Appendix A Charcoal Receptor Results

2007 Spring Sites

COA Station Number and Name	Date/Time Placed	Date/Time Recovered	Placement (days)	Fluorescein Peak nm		Fluorescein Conc. ppb	Eosine Peak nm		Eosine Conc. ppb	RWT Peak nm		RWT Conc. ppb	SRB Peak nm		SRB Conc. ppb
42914A Main Barton	2/21/07 14:40	3/23/07 16:00	30.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
42914A Main Barton	3/23/07 16:00	4/10/07 19:10	18.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
42914A Main Barton	4/10/07 19:10	4/13/07 14:30	2.8	ND	<	0.01	ND	<	0.035	ND	<	0.275	578.8		166
42914A Main Barton	4/26/07 21:00	4/29/07 21:15	3.0	ND	<	0.01	541.3		25.4	568.1		75.1	ND	<	0.15
42914A Main Barton	4/30/07 16:45	5/1/07 18:00	1.1	ND	<	0.01	542.9		31.7	569.7		396	ND	<	0.15
42914A Main Barton	5/9/07 18:50	5/17/07 13:00	7.8	515.5		63.7	538.8		34.1	568.0		56.9	ND	<	0.15
42914A Main Barton	5/17/07 13:00	5/30/07 21:35	13.4	517.8		4.38	540.6		30.2	569.4 (3)		25.1	ND	<	0.15
42914A Main Barton	5/30/07 21:35	6/14/07 14:50	14.7	ND	<	0.01	541.1		14.4	ND	<	0.275	ND	<	0.15
42914A Main Barton	6/14/07 14:50	7/11/07 11:45	26.9	ND	<	0.01	541.3		19.4	ND	<	0.275	ND	<	0.15
42914A Main Barton	7/11/07 11:45	8/3/07 15:00	23.1	ND	<	0.01	540.8		13.9	ND	<	0.275	ND	<	0.15
42914A Main Barton	8/3/07 11:45	8/28/07 16:30	25.2	ND	<	0.01	541.5		15.1	ND	<	0.275	ND	<	0.15
42914A Main Barton	9/19/07 10:45	10/11/07 13:50	22.1	ND	<	0.01	541.4		16.8	ND	<	0.275	ND	<	0.15
42914A Main Barton	10/11/07 13:50	11/1/07 13:00	21.0	ND	<	0.01	541.3		8.63	ND	<	0.275	ND	<	0.15
42914A Main Barton	11/1/07 13:00	11/28/07 12:45	27.0	ND	<	0.01	541.5		18.6	ND	<	0.275	ND	<	0.15
42914A Main Barton	11/28/07 12:45	12/19/07 15:00	21.1	ND	<	0.01	541.3		14.8	ND	<	0.275	ND	<	0.15
42914B Main Barton	2/21/07 14:42	3/23/07 16:03	30.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
42914B Main Barton	3/23/07 16:03	4/10/07 19:15	18.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
42914B Main Barton	4/10/07 19:15	4/13/07 14:32	2.8	ND	<	0.01	ND	<	0.035	ND	<	0.275	578.6		178
42914B Main Barton	4/30/07 16:47	5/1/07 18:02	1.1	ND	<	0.01	542.5		35.3	569.6		399	ND	<	0.15
42914B Main Barton	5/9/07 18:52	5/17/07 13:02	7.8	515.0		65.7	539.4		38.4	566.6		60.6	ND	<	0.15
42914B Main Barton	5/17/07 13:02	5/30/07 21:37	13.4	515.8		4.06	541.0		29.6	567.2 (3)		21.9	ND	<	0.15
42914B Main Barton	5/30/07 21:37	6/14/07 14:52	14.7	ND	<	0.01	540.9		14.7	ND	<	0.275	ND	<	0.15
42914C Main Barton	3/23/07 16:05	4/10/07 19:17	18.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
42914C Main Barton	4/10/07 19:20	4/11/07 15:00	0.8	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
42914C Main Barton	4/11/07 15:00	4/12/07 15:25	1.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	578.7		146
42914C Main Barton	4/12/07 15:25	4/13/07 14:35	1.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	578.9		105
42914C Main Barton	4/13/07 14:35	4/14/07 16:00	1.1	ND	<	0.01	540.4		2.89	ND	<	0.275	573.2		66.1
42914C Main Barton	4/14/07 16:00	4/15/07 11:00	0.8	ND	<	0.01	541.4		7.56	570.1		135	ND	<	0.15
42914C Main Barton	4/15/07 11:00	4/16/07 11:10	1.0	ND	<	0.01	540.8		6.55	569.3		126	ND	<	0.15
42914C Main Barton	4/16/07 21:00	4/17/07 20:25	1.0	ND	<	0.01	540.0		9.73	568.8		181	ND	<	0.15
42914C Main Barton	4/17/07 20:25	4/19/07 20:30	2.0	ND	<	0.01	540.4		9.66	568.3		131	ND	<	0.15
42914C Main Barton	4/19/07 20:30	4/24/07 22:15	5.1	ND	<	0.01	542.0		24.2	569.0		264	ND	<	0.15
42914C Main Barton	4/29/07 21:15	4/30/07 16:45	0.8	ND	<	0.01	541.2		9.62	569.7		18.4	ND	<	0.15
42914C Main Barton	4/30/07 16:50	5/1/07 18:05	1.1	ND	<	0.01	541.3		14.6	568.2		36.8	ND	<	0.15
42914C Main Barton	5/1/07 18:05	5/2/07 17:30	1.0	ND	<	0.01	541.2		12.9	567.6		24.5	ND	<	0.15
42914D Main Barton	5/2/07 17:30	5/4/07 9:50	1.7	515.3		114	540.2 (1)		36.1	569.3		285	ND	<	0.15
42914D Main Barton	5/4/07 9:50	5/5/07 19:40	1.4	516.7		500	ND	<	0.035	ND	<	0.275	578.5		103
42914D Main Barton	5/5/07 19:40	5/6/07 19:40	1.0	515.1		84.1	ND	<	0.035	ND	<	0.275	572.8 *		6.55
42914D Main Barton	5/6/07 19:40	5/7/07 10:20	0.6	515.1		43.6	ND	<	0.035	572.0 *		9.07	ND	<	0.15
42914D Main Barton	7/11/07 11:50	8/3/07 15:05	23.1	ND	<	0.01	541.4		10.0	ND	<	0.275	ND	<	0.15

COA Station Number and Name	Date/Time Placed	Date/Time Recovered	Placement (days)	Fluorescein			Eosine			RWT			SRB		
				Peak nm		Conc. ppb	Peak nm		Conc. ppb	Peak nm		Conc. ppb	Peak nm		Conc. ppb
42921A Eliza	2/21/07 14:15	3/23/07 15:10	30.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
42921A Eliza	3/23/07 15:10	4/11/07 14:30	19.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
42921A Eliza	4/11/07 14:30	4/13/07 15:00	2.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	579.0		223
42921A Eliza	4/24/07 15:10	4/29/07 20:45	5.2	ND	<	0.01	542.0		29.7	569.9		502	ND	<	0.15
42921A Eliza	4/30/07 17:00	5/7/07 9:30	6.7	517.1		328	540.4 (1)		23.8	ND	<	0.275	573.8		52.7
42921A Eliza	5/7/07 9:20	5/16/07 11:15	9.1	515.5		142	540.4 (1)		32.4	567.4		70.7	ND	<	0.15
42921A Eliza	5/16/07 11:15	5/30/07 21:45	14.4	516.2		6.13	541.2		33.5	569.2 (3)		22.5	ND	<	0.15
42921A Eliza	5/30/07 21:45	6/3/07 18:15	3.9	ND	<	0.01	541.3		10.8	ND	<	0.275	ND	<	0.15
42921A Eliza	6/3/07 18:15	6/14/07 13:40	10.8	ND	<	0.01	540.9		20.4	ND	<	0.275	ND	<	0.15
42921A Eliza	6/14/07 13:40	7/11/07 12:15	26.9	ND	<	0.01	541.2		35.8	ND	<	0.275	ND	<	0.15
42921A Eliza	7/11/07 12:15	8/3/07 14:40	23.1	ND	<	0.01	541.9		4.66	ND	<	0.275	ND	<	0.15
42921A Eliza	8/3/07 14:40	8/28/07 16:10	25.1	ND	<	0.01	541.4		18.2	ND	<	0.275	ND	<	0.15
42921A Eliza	8/28/07 16:10	9/19/07 10:10	21.8	ND	<	0.01	541.3		11.6	ND	<	0.275	ND	<	0.15
42921A Eliza	9/19/07 10:10	10/11/07 13:30	22.1	ND	<	0.01	541.5		14.8	ND	<	0.275	ND	<	0.15
42921A Eliza	10/11/07 13:30	11/1/07 12:30	21.0	ND	<	0.01	541.3		8.64	ND	<	0.275	ND	<	0.15
42921A Eliza	11/1/07 12:30	11/28/07 13:15	27.0	ND	<	0.01	541.5		18.0	ND	<	0.275	ND	<	0.15
42921A Eliza	11/28/07 13:15	12/19/07 15:45	21.1	ND	<	0.01	541.5		13.6	ND	<	0.275	ND	<	0.15
42921B Eliza	3/23/07 15:12	4/11/07 14:32	19.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
42921B Eliza	4/11/07 14:32	4/13/07 15:03	2.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	578.7		167
42921B Eliza	4/24/07 15:12	4/29/07 20:47	5.2	ND	<	0.01	542.4		30.5	570.0		496	ND	<	0.15
42921B Eliza	4/30/07 17:02	5/7/07 9:32	6.7	517.0		382	541.0 (1)		27.3	ND	<	0.275	572.6 **		60.3
42921B Eliza	5/7/07 9:22	5/16/07 11:17	9.1	515.4		140	540.4 (1)		38.3	567.8		78.0	ND	<	0.15
42921B Eliza	5/16/07 11:17	5/30/07 21:47	14.4	516		6.20	540.7		34.3	569.2 (3)		27.3	ND	<	0.15
42921B Eliza	5/30/07 21:47	6/3/07 18:15	3.9	516.0 (3)		1.50	540.9		10.2	ND	<	0.275	ND	<	0.15
42921B Eliza	6/3/07 18:15	6/14/07 13:42	10.8	ND	<	0.01	541.1		18.7	ND	<	0.275	ND	<	0.15
42921B Eliza	6/14/07 13:42	7/11/07 12:17	26.9	ND	<	0.01	541.2		35.8	ND	<	0.275	ND	<	0.15
42921B Eliza	8/3/07 14:42	8/28/07 16:12	25.1	ND	<	0.01	541.5		14.6	ND	<	0.275	ND	<	0.15
42921C Eliza	4/9/07 14:15	4/10/07 18:30	1.2	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
42921C Eliza	4/10/07 18:30	4/11/07 14:20	0.8	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
42921C Eliza	4/11/07 14:20	4/12/07 15:30	1.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	578.7		154
42921C Eliza	4/12/07 15:30	4/13/07 15:05	1.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	578.5		143
42921C Eliza	4/13/07 15:05	4/14/07 15:10	1.0	ND	<	0.01	538.8		3.61	ND	<	0.275	573.2		79.9
42921C Eliza	4/14/07 15:10	4/15/07 10:15	0.8	ND	<	0.01	540.8		8.36	569.3		169	ND	<	0.15
42921C Eliza	4/15/07 10:15	4/16/07 10:50	1.0	ND	<	0.01	540.6		10.9	569.2		244	ND	<	0.15
42921C Eliza	4/16/07 10:50	4/17/07 18:35	1.3	ND	<	0.01	540.6		11.7	568.7		184	ND	<	0.15
42921C Eliza	4/17/07 18:35	4/18/07 9:30	0.6	ND	<	0.01	540.4 *		4.71	568.5		93.7	ND	<	0.15
42921C Eliza	4/18/07 9:30	4/19/07 19:30	1.4	ND	<	0.01	540.2		11.2	568.9		176	ND	<	0.15
42921C Eliza	4/19/07 19:30	4/24/07 21:45	5.1	ND	<	0.01	542.8		25.4	568.9		250	ND	<	0.15
42921C Eliza	5/2/07 18:00	5/4/07 9:10	1.6	516.7		344	ND (2)	<	0.035	569.3		30.6	ND	<	0.15
42921C Eliza	5/4/07 9:10	5/5/07 20:00	1.5	516.9		486	ND	<	0.035	ND	<	0.275	578.3		157
42921C Eliza	5/5/07 20:00	5/6/07 20:00	1.0	515.0		98.8	ND	<	0.035	ND	<	0.275	573.9 *		7.06
42921C Eliza	5/6/07 20:00	5/7/07 9:35	0.6	515.0		53.0	ND	<	0.035	ND	<	0.275	573.6		6.49
42921C Eliza	5/12/07 0:01	5/16/07 11:20	4.5	515.4		74.0	538.8		30.8	567.3		61.2	ND	<	0.15

COA Station Number and Name	Date/Time Placed	Date/Time Recovered	Placement (days)	Fluorescein			Eosine			RWT			SRB		
				Peak nm		Conc. ppb	Peak nm		Conc. ppb	Peak nm		Conc. ppb	Peak nm		Conc. ppb
42922A Old Mill	2/22/07 9:40	3/23/07 17:00	29.3	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
42922A Old Mill	3/23/07 17:00	4/11/07 15:40	18.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
42922A Old Mill	4/11/07 15:40	4/13/07 17:00	2.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	578.5		138
42922A Old Mill	4/11/07 15:43	4/13/07 17:03	2.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	578.7		130
42922A Old Mill	4/25/07 16:00	4/30/07 17:30	5.1	ND	<	0.01	541.1		18.1	568.3		54.8	ND	<	0.15
42922A Old Mill	5/1/07 18:00	5/7/07 11:30	5.7	515.2		181	ND (2)	<	0.035	ND	<	0.275	574.6		41.2
42922A Old Mill	5/7/07 11:30	5/16/07 11:45	9.0	515.6		102	540.4 (1)		23.6	567.4		46.9	ND	<	0.15
42922A Old Mill	5/16/07 11:45	5/30/07 21:15	14.4	516.2		4.53	540.7		24.8	567.2 (3)		17.6	ND	<	0.15
42922A Old Mill	5/30/07 21:15	6/14/07 14:45	14.7	ND	<	0.01	541.1		11.4	ND	<	0.275	ND	<	0.15
42922A Old Mill	6/14/07 14:45	7/11/07 11:00	26.8	ND	<	0.01	541.3		18.3	ND	<	0.275	ND	<	0.15
42922A Old Mill	7/11/07 11:00	8/3/07 15:50	23.2	ND	<	0.01	541.6		8.66	ND	<	0.275	ND	<	0.15
42922A Old Mill	8/3/07 15:50	9/19/07 11:45	46.8	ND	<	0.01	541.7		7.40	ND	<	0.275	ND	<	0.15
42922A Old Mill	9/19/07 11:45	10/11/07 15:00	22.1	ND	<	0.01	541.5		5.71	ND	<	0.275	ND	<	0.15
42922B Old Mill	2/22/07 9:42	3/23/07 17:02	29.3	515.6 *		0.999	ND	<	0.035	ND	<	0.275	ND	<	0.15
42922B Old Mill	3/23/07 17:03	4/11/07 15:43	18.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
42922B Old Mill	4/25/07 16:02	4/30/07 17:32	5.1	ND	<	0.01	540.9		17.1	568.4		51.3	ND	<	0.15
42922B Old Mill	5/1/07 18:02	5/7/07 11:32	5.7	515.2		151	ND (2)	<	0.035	ND	<	0.275	574.6		40.1
42922B Old Mill	5/7/07 11:32	5/16/07 11:47	9.0	515.4		94.4	540.4 (1)		21.8	568.1		53.0	ND	<	0.15
42922B Old Mill	5/16/07 11:47	5/30/07 21:17	14.4	516.2		4.58	540.8		26.5	570.0 (3)		19.6	ND	<	0.15
42922B Old Mill	5/30/07 21:17	6/14/07 14:47	14.7	ND	<	0.01	540.9		9.83	ND	<	0.275	ND	<	0.15
42922B Old Mill	6/14/07 14:47	7/11/07 11:02	26.8	ND	<	0.01	541.1		21.1	ND	<	0.275	ND	<	0.15
42922B Old Mill	7/11/07 11:02	8/3/07 15:52	23.2	ND	<	0.01	541.6		9.12	ND	<	0.275	ND	<	0.15
42922C Old Mill	4/11/07 15:40	4/12/07 17:30	1.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	578.5		43.4
42922C Old Mill	4/12/07 17:30	4/13/07 17:05	1.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	578.6		161
42922C Old Mill	4/13/07 17:05	4/14/07 16:30	1.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	575.5		58.2
42922C Old Mill	4/14/07 16:30	4/15/07 11:30	0.8	ND	<	0.01	541.0		6.11	570.1		133	ND	<	0.15
42922C Old Mill	4/15/07 11:30	4/16/07 11:40	1.0	ND	<	0.01	540.4		4.93	569.2		105	ND	<	0.15
42922C Old Mill	4/16/07 11:40	4/17/07 18:15	1.3	ND	<	0.01	540.0 *		4.88	568.6		98.4	ND	<	0.15
42922C Old Mill	4/17/07 18:15	4/18/07 10:15	0.7	ND	<	0.01	538.8 *		3.47	568.2		86.8	ND	<	0.15
42922C Old Mill	4/18/07 10:15	4/19/07 19:00	1.4	ND	<	0.01	540.6 *		3.00	569.1		58.5	ND	<	0.15
42922C Old Mill	4/19/07 19:00	4/25/07 16:05	5.9	ND	<	0.01	540.8		11.4	568.9		136	ND	<	0.15
42922C Old Mill	5/12/07 0:01	5/16/07 11:50	4.5	515.5		28.4	538.4 (1)		10.6	568.3 (3)		23.5	ND	<	0.15
42920A Upper Barton	3/23/07 16:30	4/13/07 16:30	21.0	ND	<	0.01	542.0 *		0.785	ND	<	0.275	ND	<	0.15
42920A Upper Barton	4/13/07 16:30	4/25/07 15:30	12.0	ND	<	0.01	541.4		3.20	ND	<	0.275	ND	<	0.15
42920A Upper Barton	4/25/07 15:30	5/2/07 12:40	6.9	ND	<	0.01	543.6 *		0.940	ND	<	0.275	ND	<	0.15
42920A Upper Barton	5/2/07 12:40	6/14/07 14:00	43.1	ND	<	0.01	541.6		2.65	ND	<	0.275	ND	<	0.15
42920A Upper Barton	8/3/07 15:20	8/28/07 17:00	25.1	ND	<	0.01	542.0		1.95	ND	<	0.275	ND	<	0.15
42920A Upper Barton	8/28/07 17:00	9/19/07 11:10	21.8	ND	<	0.01	542.2 *		0.679	ND	<	0.275	ND	<	0.15
42920A Upper Barton	9/19/07 11:10	10/11/07 14:30	22.1	ND	<	0.01	542.3		1.35	ND	<	0.275	ND	<	0.15
42920A Upper Barton	10/11/07 14:30	11/1/07 14:20	21.0	ND	<	0.01	540.4		1.42	ND	<	0.275	ND	<	0.15
42920A Upper Barton	11/1/07 14:20	11/28/07 14:00	27.0	ND	<	0.01	541.2		2.24	ND	<	0.275	ND	<	0.15
42920B Upper Barton	3/23/07 16:32	4/13/07 16:32	21.0	ND	<	0.01	541.4		2.21	ND	<	0.275	ND	<	0.15
42920B Upper Barton	4/13/07 16:32	4/25/07 15:32	12.0	ND	<	0.01	541.1		5.42	ND	<	0.275	ND	<	0.15
42920B Upper Barton	5/2/07 12:42	6/14/07 14:02	43.1	ND	<	0.01	544.0 *		1.36	ND	<	0.275	ND	<	0.15
42920B Upper Barton	8/3/07 15:22	8/28/07 17:02	25.1	ND	<	0.01	543.0		0.785	ND	<	0.275	ND	<	0.15

COA Station Number and Name	Date/Time Placed	Date/Time Recovered	Placement (days)	Fluorescein			Eosine			RWT			SRB		
				Peak nm		Conc. ppb	Peak nm		Conc. ppb	Peak nm		Conc. ppb	Peak nm		Conc. ppb
429BC Bypass	2/21/07 14:17	3/23/07 16:40	30.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
429UB A Barton Creek Upst. Upper Barton	4/13/07 16:40	4/25/07 15:40	12.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
429UB A Barton Creek Upst. Upper Barton	4/25/07 15:40	5/2/07 12:50	6.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
429UB B Barton Creek Upst. Upper Barton	4/13/07 16:42	4/25/07 15:42	12.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
High Barton	9/19/07 11:20	10/11/07 14:20	22.1	ND	<	0.01	541.6		1.43	ND	<	0.275	ND	<	0.15
High Barton	10/11/07 14:20	11/1/07 14:30	21.0	ND	<	0.01	ND			ND	<	0.275	ND	<	0.15
42916A Cold Springs	2/27/07 14:30	3/23/07 14:20	24.0	ND	<	0.01	541.3		39.7	566.8		19.3	ND	<	0.15
42916A Cold Springs	3/23/07 14:20	4/26/07 11:00	33.9	ND	<	0.01	540.9		107	ND	<	0.275	ND	<	0.15
42916A Cold Springs	4/26/07 11:00	5/7/07 9:40	10.9	ND	<	0.01	540.8		92.3	ND	<	0.275	ND	<	0.15
42916A Cold Springs	5/7/07 11:32	6/17/07 10:36	41.0	ND	<	0.01	540.8		91.4	ND	<	0.275	ND	<	0.15
42916A Cold Springs	6/17/07 10:36	8/5/07 17:13	49.3	ND	<	0.01	541.2		74.4	ND	<	0.275	ND	<	0.15
42916B Cold Springs dup	6/17/07 10:38	8/5/07 17:10	49.3	ND	<	0.01	541.2		104	ND	<	0.275	ND	<	0.15
42916A Cold Springs	8/30/07 10:30	10/4/07 13:00	35.1	ND	<	0.01	541.2		151	ND	<	0.275	ND	<	0.15
42916A Cold Springs	10/4/07 13:00	11/1/07 12:00	28.0	ND	<	0.01	541.1		76.5	ND	<	0.275	ND	<	0.15
42916A Cold Springs	11/1/07 12:00	11/28/07 11:30	27.0	ND	<	0.01	541.1		213	ND	<	0.275	ND	<	0.15
42916A Cold Springs	11/28/07 11:30	12/18/07 15:30	20.2	ND	<	0.01	541.3		46.8	ND	<	0.275	ND	<	0.15
42916B Cold Springs	2/27/07 14:32	3/23/07 14:22	24.0	ND	<	0.01	541.1		27.3	566.8	<	0.275	ND	<	0.15
42916B Cold Springs	3/23/07 14:22	4/26/07 11:02	33.9	ND	<	0.01	541.0		104	ND	<	0.275	ND	<	0.15
42916B Cold Springs	4/26/07 11:02	5/7/07 9:42	10.9	ND	<	0.01	540.8		78.4	ND	<	0.275	ND	<	0.15
42916B Cold Springs	5/7/07 9:40	6/17/07 10:36	41.0	ND	<	0.01	540.9		104	ND	<	0.275	ND	<	0.15
42916B Cold Springs	8/30/07 10:32	10/4/07 13:02	35.1	ND	<	0.01	540.9		56.4	ND	<	0.275	ND	<	0.15
42916B Cold Springs	10/4/07 13:02	11/1/07 12:02	28.0	ND	<	0.01	541.1		76.6	ND	<	0.275	ND	<	0.15
42916B Cold Springs	11/1/07 12:02	11/28/07 11:32	27.0	ND	<	0.01	541.3		182	ND	<	0.275	ND	<	0.15
42916B Cold Springs	11/28/07 11:32	12/18/07 15:32	20.2	ND	<	0.01	541.2		50.8	ND	<	0.275	ND	<	0.15

2007 Well, Cave, and Creek Sites

COA Station Number and Name	Date/Time Placed	Date/Time Recovered	Placement (days)	Fluorescein			Eosine			RWT			SRB		
				Peak nm		Conc. ppb	Peak nm		Conc. ppb	Peak nm		Conc. ppb	Peak nm		Conc. ppb
4102 Flint Ridge Drip Pit	5/8/07 16:15	6/11/07 11:30	33.8	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
4102 Flint Ridge Drip Pit	6/11/07 11:30	8/25/07 13:00	75.1	missing											
4102 Flint Ridge Drip Pit	8/25/07 13:00	10/19/07 15:00	55.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
4102A Flint Ridge Drip Pit	4/5/07 18:05	5/8/07 16:15	32.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
4102B Flint Ridge Drip Pit	4/5/07 18:07	5/8/07 16:17	32.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-49-937 Tabor Well	4/20/07 11:15	5/10/07 13:15	20.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-49-937 Tabor Well	5/10/07 13:15	6/5/07 16:40	26.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-49-9AN Andrewartha	4/10/07 11:30	5/2/07 11:05	22.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-49-9AN Andrewartha	5/2/07 11:05	5/29/07 12:20	27.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-49-9AN Andrewartha	5/29/07 12:20	7/2/07 13:10	34.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-49-9DT Tomlinson	3/8/07 12:55	4/10/07 15:50	33.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-49-9DT Tomlinson	4/10/07 15:50	5/3/07 13:35	22.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-49-9DT Tomlinson	5/3/07 13:35	5/21/07 12:15	17.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-49-9DT Tomlinson	5/21/07 12:15	6/18/07 14:00	28.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-49-9SH Andrewartha	3/13/07 11:10	4/10/07 11:30	28.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-49-9SW Shierlows	4/20/07 10:30	5/18/07 12:15	28.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-49-9SW Shierlows	5/18/07 12:15	7/13/07 13:30	56.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-216 Target	4/24/07 12:15	7/3/07 12:22	70.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-407 Callahan	4/10/07 10:00	5/3/07 14:40	23.2	ND	<	0.01	ND	<	0.035	568.3		172	ND	<	0.15
58-50-407 Callahan	5/3/07 14:40	5/21/07 14:00	18.0	ND	<	0.01	ND	<	0.035	567.7		84.2	ND	<	0.15
58-50-407 Callahan	5/21/07 14:40	6/18/07 12:50	27.9	ND	<	0.01	ND	<	0.035	567.1		483	ND	<	0.15
5850410 J-17 Barn	3/12/07 12:45	4/10/07 10:00	28.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850410 J-17 Barn	4/10/07 10:00	5/2/07 11:45	22.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850410 J-17 Barn	5/2/07 11:45	5/29/07 13:10	27.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850410 J-17 Barn	5/29/07 13:10	7/2/07 14:37	34.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-417 Zumwald	3/12/07 10:30	4/9/07 11:00	28.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-417 Zumwald	4/9/07 11:00	5/2/07 12:10	23.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-417 Zumwald	5/2/07 12:10	5/29/07 13:35	27.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-417 Zumwald	5/29/07 13:35	7/3/07 11:30	34.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-419 Baurle NAWQ	3/13/07 9:45	4/9/07 12:45	27.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-419 Baurle NAWQ	4/9/07 12:45	5/2/07 11:15	22.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-419 Baurle NAWQ	5/2/07 11:15	5/29/07 12:30	27.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-419 Baurle NAWQ	5/29/07 12:30	7/2/07 14:00	34.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-420 Bowie HS	3/12/07 10:50	4/9/07 11:30	28.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-420 Bowie HS	4/9/07 11:30	5/2/07 12:00	23.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-420 Bowie HS	5/2/07 12:00	5/29/07 13:25	27.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-420 Bowie HS	5/29/07 13:25	7/3/07 11:10	34.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-421 J-17 NAWQA	3/12/07 12:01	4/10/07 10:30	28.9	ND	<	0.01	ND	<	0.035	569.0 *		6.53	ND	<	0.15
58-50-421 J-17 NAWQA	4/10/07 10:30	5/2/07 11:36	22.0	ND	<	0.01	ND	<	0.035	569.8		14.2	ND	<	0.15
58-50-421 J-17 NAWQA	5/2/07 11:36	5/29/07 13:00	27.1	ND	<	0.01	ND	<	0.035	568.4		22.1	ND	<	0.15
58-50-421 J-17 NAWQA	5/29/07 13:00	7/2/07 14:17	34.1	ND	<	0.01	ND	<	0.035	569.4		11.0	ND	<	0.15
58-50-421a J17NAWQA	10/19/07 17:50	11/30/07 11:00	41.7	ND	<	0.01	ND	<	0.035	568.7		19.2	ND	<	0.15
58-50-421b J17NAWQA	10/19/07 17:52	11/30/07 11:02	41.7	ND	<	0.01	ND	<	0.035	568.3		8.29	ND	<	0.15
58-50-4JG Guttierez	3/13/07 9:35	4/10/07 10:35	28.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-4JG Guttierez	4/10/07 10:35	5/2/07 11:28	22.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-4JG Guttierez	5/2/07 11:28	5/29/07 12:45	27.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-4JG Guttierez	5/29/07 13:00	7/7/07 14:05	39.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15

COA Station Number and Name	Date/Time Placed	Date/Time Recovered	Placement (days)	Fluorescein			Eosine			RWT			SRB		
				Peak nm		Conc. ppb	Peak nm		Conc. ppb	Peak nm		Conc. ppb	Peak nm		Conc. ppb
58-50-511 Johnson	3/12/07 9:59	4/9/07 10:45	28.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-511 Johnson	4/9/07 10:45	5/2/07 12:30	23.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-511 Johnson	5/2/07 12:30	5/29/07 14:00	27.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-511 Johnson	5/29/07 14:00	7/3/07 10:40	34.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-703 Marbridge	3/13/07 12:42	4/10/07 15:30	28.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-703 Marbridge	4/10/07 15:30	5/3/07 13:50	22.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-703 Marbridge	5/3/07 13:50	5/21/07 12:30	17.9	ND	<	0.01	541.5		6.83	ND	<	0.275	ND	<	0.15
58-50-703 Marbridge	5/21/07 12:30	6/18/07 14:20	28.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-707 McCoys	4/16/07 10:30	5/2/07 10:15	16.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-707 McCoys	5/2/07 10:15	5/29/07 9:25	27.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-707 McCoys	5/29/07 9:25	7/2/07 11:00	34.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-718 Bear Creek	3/14/07 12:40	4/17/07 11:40	34.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-718 Bear Creek	4/17/07 11:40	5/4/07 10:40	17.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-718 Bear Creek 1	5/4/07 10:50	6/11/07 10:15	38.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-718 Bear Creek 1	6/11/07 10:15	6/22/07 13:30	11.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-731 Shady Hollow #1	3/14/07 12:10	4/17/07 11:20	34.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-731 Shady Hollow #1	4/17/07 11:20	5/4/07 10:22	17.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-731 Shady Hollow #1	5/4/07 10:30	6/11/07 10:00	38.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-731 Shady Hollow #1	6/11/07 10:00	6/22/07 14:00	11.2	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-733 Bear Creek	3/14/07 12:50	4/17/07 11:45	34.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-733 Bear Creek	4/17/07 12:40	5/4/07 10:44	16.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-733 Bear Creek 2	5/4/07 11:00	6/11/07 10:20	38.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-733 Bear Creek 2	6/11/07 10:20	6/22/07 13:40	11.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-741 Wiley	3/14/07 15:10	4/10/07 13:15	26.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-741 Wiley	4/10/07 13:15	5/3/07 14:20	23.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-741 Wiley	5/3/07 14:20	5/21/07 13:15	18.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-741 Wiley	5/21/07 14:20	6/18/07 13:15	28.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-743 Shady Hollow #2	3/14/07 12:20	4/17/07 11:30	34.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-743 Shady Hollow #2	4/17/07 11:30	5/4/07 10:30	17.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-743 Shady Hollow #2	5/4/07 10:30	6/11/07 10:05	38.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-743 Shady Hollow #2	6/11/07 10:05	6/22/07 13:50	11.2	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850745Lancaster	3/12/07 14:15	4/10/07 12:00	28.9	ND	<	0.01	540.6		7.19	ND	<	0.275	ND	<	0.15
5850745Lancaster	4/10/07 12:00	5/2/07 10:45	21.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850745Lancaster	5/2/07 10:45	5/29/07 11:30	27.0	ND	<	0.01	540.8		2.78	ND	<	0.275	ND	<	0.15
5850745Lancaster	5/29/07 11:30	7/2/07 11:40	34.0	ND	<	0.01	540.9		36.1	ND	<	0.275	ND	<	0.15
58-50-747 Green Emerald	3/13/07 10:45	4/10/07 10:50	28.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-747 Green Emerald	4/10/07 10:50	5/2/07 10:55	22.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-747 Green Emerald	5/2/07 10:55	5/29/07 12:12	27.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-747 Green Emerald	5/29/07 12:12	7/2/07 12:45	34.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-748 Lancaster	3/12/07 14:35	4/10/07 12:15	28.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-748 Lancaster	4/10/07 12:15	5/2/07 10:40	21.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-748 Lancaster	5/2/07 10:40	5/29/07 11:50	27.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-748 Lancaster	5/29/07 11:50	7/2/07 11:28	34.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7BG Galle	3/8/07 14:05	4/10/07 13:30	33.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7BG Galle	4/10/07 13:30	5/3/07 14:10	23.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7BG Galle	5/3/07 14:10	5/21/07 14:10	18.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7BG Galle	5/21/07 14:10	6/18/07 13:02	28.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-750/7DF Debbie	3/8/07 14:55	4/10/07 15:00	33.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-750/7DF Debbie	4/10/07 15:00	5/3/07 16:00	23.0	ND	<	0.01	540.9		6.51	ND	<	0.275	ND	<	0.15

COA Station Number	Date/Time	Date/Time	Placement	Fluorescein			Eosine			RWT			SRB		
and Name	Placed	Recovered	(days)	Peak nm		Conc. ppb	Peak nm		Conc. ppb	Peak nm		Conc. ppb	Peak nm		Conc. ppb
58-50-750/7DF Debbie	5/3/07 16:00	5/21/07 14:30	17.9	ND	<	0.01	541.1		13.7	ND	<	0.275	ND	<	0.15
58-50-750/7DF Debbie	5/21/07 14:30	6/18/07 14:50	28.0	ND	<	0.01	540.9		8.08	ND	<	0.275	ND	<	0.15
58-50-751/7DH Hanshaw	3/8/07 13:40	4/10/07 15:10	33.1	ND	<	0.01	540.4 *		1.01	ND	<	0.275	ND	<	0.15
58-50-751/7DH Hanshaw	4/10/07 15:10	5/3/07 13:24	22.9	ND	<	0.01	540.8		6.61	ND	<	0.275	ND	<	0.15
58-50-751/7DH Hanshaw	5/1/07 13:24	5/21/07 12:43	20.0	ND	<	0.01	540.8		15.0	ND	<	0.275	ND	<	0.15
58-50-751/7DH Hanshaw	5/21/07 12:43	6/18/07 14:34	28.1	ND	<	0.01	541.3		6.09	ND	<	0.275	ND	<	0.15
58-50-7DT Tidwell	3/8/07 13:55	4/10/07 13:50	33.0	ND	<	0.01	539.3 *		1.13	ND	<	0.275	ND	<	0.15
58-50-7DT Tidwell	4/10/07 13:50	5/3/07 14:50	23.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7DT Tidwell	5/3/07 14:50	5/21/07 13:00	17.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7DT Tidwell	5/21/07 13:00	6/18/07 13:45	28.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7FS Sheldon	3/8/07 14:05	4/10/07 13:40	33.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7FS Sheldon	4/10/07 13:40	5/3/07 14:30	23.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7FS Sheldon	5/3/07 14:30	5/21/07 13:20	18.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7FS Sheldon	5/21/07 13:20	6/18/07 13:28	28.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7HY Henry Well	5/1/07 15:10	6/5/07 17:00	35.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7HY Henry Well Dupl.	5/1/07 15:12	6/5/07 17:02	35.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7HYa Henry Well	6/5/07 17:00	7/13/07 14:00	37.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7HYb Henry Well Dupl.	6/5/07 17:02	7/13/07 14:02	37.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7JA Anderson, J	3/14/07 11:20	4/10/07 15:20	27.2	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7JA Anderson, J	4/10/07 15:20	5/3/07 14:00	22.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7JA Anderson, J	5/3/07 14:00	5/21/07 13:50	18.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7JA Anderson, J	5/21/07 13:50	6/18/07 13:40	28.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7RD Rev. Davis	3/13/07 12:10	4/10/07 11:45	28.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7RD Rev. Davis	4/10/07 11:45	5/2/07 10:30	21.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7RD Rev. Davis	5/2/07 10:30	5/29/07 12:00	27.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7RD Rev. Davis	5/29/07 12:00	7/2/07 11:17	34.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7RG Glowka	3/8/07 12:40	4/10/07 15:40	33.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7SC Trisha Sims	4/18/07 15:50	5/4/07 11:10	15.8	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7SC Trisha Sims	5/4/07 11:10	5/21/07 13:33	17.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58-50-7SC Trisha Sims	5/21/07 13:33	6/18/07 13:30	28.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
Bear Creek at LWX	5/25/07 16:30	6/3/07 15:00	8.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15

2010 Spring Sites

COA Station Number and Name	Date/Time Placed	Date/Time Recovered	placement length (days)	escein Results Peak nm		Conc. ppb	Eosine Results Peak nm		Conc. ppb	RWT Results Peak nm		Conc. ppb	SRB Results Peak nm		Conc. ppb
183A Upper Barton Spring	5/27/10 15:00	6/16/10 12:40	19.9	ND	<	0.01	541.6		1.41	ND	<	0.275	ND	<	0.15
183A Upper Barton Spring	6/16/10 12:40	6/25/10 11:40	9.0	ND	<	0.01	540.4		0.786	ND	<	0.275	ND	<	0.15
183A Upper Barton Spring	6/25/10 11:40	6/30/10 12:50	5.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
183A Upper Barton Spring	6/30/10 12:50	7/27/10 13:55	27.0	ND	<	0.01	540.8		1.87	ND	<	0.275	ND	<	0.15
183B Upper Barton Spring	6/16/10 12:42	6/25/10 11:42	9.0	ND	<	0.01	542.0		0.471	ND	<	0.275	ND	<	0.15
183B Upper Barton Spring	6/25/10 11:42	6/30/10 12:52	5.0	ND	<	0.01	ND		0.035	ND	<	0.275	ND	<	0.15
183B Upper Barton Spring	6/30/10 12:52	7/27/10 13:57	27.0	ND	<	0.01	541.0		1.47	ND	<	0.275	ND	<	0.15
42914A Main Barton	5/4/10 13:45	5/25/10 11:10	20.9	ND	<	0.01	541.0		2.18	ND	<	0.275	ND	<	0.15
42914A Main Barton	5/25/10 11:10	6/16/10 12:15	22.0	514.0 *		0.553	541.0		1.56	ND	<	0.275	577.8		10.3
42914A Main Barton	6/16/10 12:15	6/25/10 11:00	8.9	ND	<	0.01	541.0		2.09	ND	<	0.275	576.2 *		3.19
42914A Main Barton	6/25/10 11:00	6/30/10 12:25	5.1	ND	<	0.01	541.0		1.78	ND	<	0.275	ND	<	0.15
42914A Main Barton	6/30/10 12:25	7/27/10 13:30	27.0	ND	<	0.01	541.0		1.95	ND	<	0.275	577.4		17.8
42914B Main Barton	5/4/10 13:47	5/25/10 11:12	20.9	ND	<	0.01	541.0		1.81	ND	<	0.275	ND	<	0.15
42914B Main Barton	5/25/10 11:12	6/16/10 12:17	22.0	515.0 *		0.696	541.0		2.00	ND	<	0.275	577.8		13.2
42914B Main Barton	6/16/10 12:17	6/25/10 11:02	8.9	ND	<	0.01	541.0		2.81	ND	<	0.275	577.0		3.98
42914B Main Barton	6/25/10 11:02	6/30/10 12:27	5.1	ND	<	0.01	541.0		1.13	ND	<	0.275	ND	<	0.15
42914B Main Barton	6/30/10 12:27	7/27/10 13:32	27.0	ND	<	0.01	541.0		2.58	ND	<	0.275	577.0		21.6
42914C Main Barton fissure	5/4/10 13:50	5/25/10 11:15	20.9	ND	<	0.01	541.0		1.48	ND	<	0.275	ND	<	0.15
42914C Main Barton fissure	5/25/10 11:15	6/16/10 12:20	22.0	515.0 *		0.516	541.0		1.26	ND	<	0.275	577.2		11.5
42914C Main Barton fissure	6/16/10 12:20	6/25/10 11:05	8.9	ND	<	0.01	541.0		2.58	ND	<	0.275	578.4 *		4.02
42914C Main Barton fissure	6/25/10 11:05	6/30/10 12:30	5.1	ND	<	0.01	541.0		1.25	ND	<	0.275	ND	<	0.15
42914C Main Barton fissure	6/30/10 12:30	7/27/10 13:35	27.0	ND	<	0.01	541.0		2.01	ND	<	0.275	577.0		17.3
42916A Cold Spring	5/27/10 13:00	6/25/10 10:00	28.9	ND	<	0.01	541.0		151	ND	<	0.275	ND	<	0.15
42916A Cold Spring	6/25/10 10:00	8/11/10 11:30	47.1	ND	<	0.01	541.0		167	ND	<	0.275	ND	<	0.15
42916B Cold Spring	5/27/10 13:02	6/25/10 10:02	28.9	ND	<	0.01	541.0		152	ND	<	0.275	ND	<	0.15
42916B Cold Spring	6/25/10 10:02	8/11/10 11:32	47.1	ND	<	0.01	541.0		193	ND	<	0.275	ND	<	0.15
42921A Eliza	2/25/10 10:30	5/4/10 13:20	68.1	ND	<	0.01	541.0		2.00	ND	<	0.275	ND	<	0.15
42921A Eliza	5/4/10 13:20	5/25/10 10:30	20.9	ND	<	0.01	541.0		0.702	ND	<	0.275	ND	<	0.15
42921A Eliza	5/25/10 10:30	6/16/10 11:15	22.0	514.4 *		0.396	541.0		1.22	ND	<	0.275	578.0		10.7
42921A Eliza	6/16/10 11:15	6/25/10 10:30	9.0	ND	<	0.01	541.0		0.763	ND	<	0.275	578.2 *		1.75
42921A Eliza	6/25/10 10:30	6/30/10 12:00	5.1	ND	<	0.01	541.0		0.299	ND	<	0.275	ND	<	0.15
42921A Eliza	6/30/10 12:00	7/27/10 13:10	27.0	ND	<	0.01	541.0		0.582	ND	<	0.275	ND	<	0.15
42921B Eliza	2/25/10 10:32	5/4/10 13:22	68.1	ND	<	0.01	541.0		2.76	ND	<	0.275	ND	<	0.15
42921B Eliza	5/4/10 13:22	5/25/10 10:32	20.9	ND	<	0.01	541.0		1.81	ND	<	0.275	ND	<	0.15
42921B Eliza	5/25/10 10:32	6/16/10 11:17	22.0	ND	<	0.01	541.0		0.719	ND	<	0.275	576.6		6.68
42921B Eliza	6/16/10 11:17	6/25/10 10:32	9.0	ND	<	0.01	541.0		0.564	ND	<	0.275	580.6 *		1.98
42921B Eliza	6/25/10 10:32	6/30/10 12:02	5.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
42921B Eliza	6/30/10 12:02	7/27/10 13:12	27.0	ND	<	0.01	541.0		1.07	ND	<	0.275	577.8		25.3
42922A Old Mill	2/25/10 10:10	5/4/10 14:50	68.2	ND	<	0.01	541.0		1.71	ND	<	0.275	ND	<	0.15
42922A Old Mill	5/4/10 14:50	5/25/10 11:40	20.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
42922A Old Mill	5/25/10 11:40	6/16/10 13:05	22.1	512.8 *		0.536	541.0		1.42	ND	<	0.275	576.6		12.3
42922A Old Mill	6/16/10 13:05	6/25/10 12:15	9.0	ND	<	0.01	541.0		1.33	ND	<	0.275	578.0 *		2.45
42922A Old Mill	6/25/10 12:15	6/30/10 13:10	5.0	ND	<	0.01	541.0		0.517	ND	<	0.275	577.0		17.8
42922A Old Mill	6/30/10 13:10	7/27/10 12:35	27.0	ND	<	0.01	541.0		2.30	ND	<	0.275	577.0		22.3
42922B Old Mill	2/25/10 10:12	5/4/10 14:52	68.2	ND	<	0.01	541.0		1.69	ND	<	0.275	ND	<	0.15
42922B Old Mill	5/4/10 14:52	5/25/10 11:42	20.9	ND	<	0.01	541.0		0.413	ND	<	0.275	ND	<	0.15
42922B Old Mill	5/25/10 11:42	6/16/10 13:07	22.1	514.2 *		0.473	541.0		1.35	ND	<	0.275	577.8		12.5
42922B Old Mill	6/16/10 13:07	6/25/10 12:17	9.0	ND	<	0.01	541.0		1.26	ND	<	0.275	577.0 *		3.47
42922B Old Mill	6/25/10 12:17	6/30/10 13:12	5.0	ND	<	0.01	541.0		0.491	ND	<	0.275	ND	<	0.15
42922B Old Mill	6/30/10 13:12	7/27/10 12:37	27.0	ND	<	0.01	541.0		1.97	ND	<	0.275	577.6		27.0

2010 Well and Cave Sites

COA Station Number and Name	Date/Time Placed	Date/Time Recovered	Placement length (days)	Fluorescein Results Peak nm		Fluorescein Results Conc. ppb	Eosine Results Peak nm		Eosine Results Conc. ppb	RWT Results Peak nm		RWT Results Conc. ppb	SRB Results Peak nm		SRB Results Conc. ppb
5850207 Ashbaugh	5/20/10 14:30	5/24/10 12:35	3.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850207 Ashbaugh	5/24/10 12:35	6/3/10 9:30	9.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850207 Ashbaugh	6/3/10 9:30	6/23/10 8:55	20.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850207 Ashbaugh	6/23/10 8:55	7/26/10 14:50	33.2	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850230 Picard	5/19/10 11:00	5/24/10 14:30	5.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850230 Picard	5/24/10 14:30	6/3/10 10:00	9.8	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850230 Picard	6/3/10 10:00	6/10/10 8:50	7.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850230 Picard	6/10/10 8:50	6/17/10 9:50	7.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850230 Picard	6/17/10 9:50	6/23/10 9:25	6.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850230 Picard	6/23/10 9:25	7/26/10 15:30	33.3	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58502JR Jenkins	5/19/10 11:30	5/24/10 13:00	5.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58502JR Jenkins	5/24/10 13:00	6/3/10 9:55	9.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58502JR Jenkins	6/3/10 9:55	6/10/10 8:25	6.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58502JR Jenkins	6/10/10 8:25	6/17/10 9:20	7.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58502JR Jenkins	6/17/10 9:20	6/23/10 8:30	6.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58502JR Jenkins	6/23/10 8:30	7/26/10 15:15	33.3	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58503AC Abandoned	5/20/10 15:00	5/24/10 14:45	4.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58503AC Abandoned	5/24/10 14:45	6/3/10 11:00	9.8	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58503AC Abandoned	6/3/10 11:00	8/6/10 11:20	64.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850402 Hackmore	5/19/10 9:30	5/24/10 12:15	5.1	ND	<	0.01	541.0		61.4	ND	<	0.275	ND	<	0.15
5850402 Hackmore	5/24/10 12:15	5/26/10 12:30	2.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850402 Hackmore	5/26/10 12:30	6/1/10 15:35	6.1	ND	<	0.01	541.0		7.22	ND	<	0.275	ND	<	0.15
5850407 Callahan	5/20/10 13:30	5/24/10 10:00	3.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850407 Callahan	5/24/10 10:00	6/3/10 8:10	9.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850407 Callahan	6/3/10 8:10	6/10/10 9:30	7.1	ND	<	0.01	ND	<	0.035	570.2 *		3.79	ND	<	0.15
5850407 Callahan	6/10/10 9:30	6/17/10 11:00	7.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850407 Callahan	6/17/10 11:00	6/23/10 12:20	6.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850407 Callahan	6/23/10 12:20	7/26/10 13:50	33.1	ND	<	0.01	ND	<	0.035	566.6		9.73	ND	<	0.15
5850410 J-17 Barn	5/20/10 13:00	5/24/10 10:15	3.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850410 J-17 Barn	5/24/10 10:15	6/3/10 7:50	9.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850410 J-17 Barn	6/3/10 7:50	6/10/10 9:50	7.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850410 J-17 Barn	6/10/10 9:50	6/17/10 11:25	7.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850410 J-17 Barn	6/17/10 11:25	6/23/10 12:45	6.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850410 J-17 Barn	6/23/10 12:45	8/6/10 12:00	44.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850415 Wildflower	5/24/10 10:35	6/3/10 7:30	9.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850415 Wildflower	6/3/10 7:30	6/23/10 13:25	20.2	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850415 Wildflower	6/23/10 13:25	8/6/10 12:30	44.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850415 Wildflower	5/19/10 13:00	5/24/10 10:35	4.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15

COA Station Number and Name	Date/Time Placed	Date/Time Recovered	placement length (days)	escein Results Peak nm		Conc. ppb	Eosine Results Peak nm		Conc. ppb	RWT Results Peak nm		Conc. ppb	SRB Results Peak nm		Conc. ppb
5850417 Blowing Sink well	5/20/10 9:00	5/24/10 14:05	4.2	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850417 Blowing Sink well	5/24/10 14:05	5/26/10 14:00	2.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850417 Blowing Sink well	5/26/10 15:55	6/1/10 16:40	6.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850417 Blowing Sink well	6/1/10 16:40	6/10/10 10:30	8.7	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850417 Blowing Sink well	6/10/10 10:30	6/17/10 12:25	7.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850417 Blowing Sink well	6/17/10 12:25	6/23/10 17:00	6.2	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850417 Blowing Sink well	6/23/10 17:00	8/6/10 14:15	43.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850419 Bauerly	5/19/10 12:00	5/24/10 12:00	5.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850419 Bauerly	5/24/10 12:00	6/3/10 8:30	9.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850419 Bauerly	6/3/10 8:30	6/23/10 11:50	20.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850419 Bauerly	6/23/10 11:50	8/6/10 13:05	44.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850420 USGS Bowie	5/19/10 12:30	5/24/10 11:25	5.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850420 USGS Bowie	5/24/10 11:25	6/3/10 8:40	9.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850420 USGS Bowie	6/3/10 8:40	6/23/10 10:00	20.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850420 USGS Bowie	6/23/10 10:00	8/6/10 12:50	44.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58504AB Bricker	5/19/10 9:00	5/24/10 11:45	5.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58504AB Bricker	5/24/10 11:45	5/26/10 10:40	2.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58504AB Bricker	5/26/10 10:40	6/1/10 15:55	6.2	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58504AB Bricker	6/1/10 15:55	6/10/10 9:10	8.7	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58504AB Bricker	6/10/10 9:10	6/17/10 10:20	7.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58504AB Bricker	6/17/10 10:20	6/23/10 11:35	6.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58504AB Bricker	6/23/10 11:35	7/26/10 14:15	33.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58504BS Bowie 4H	5/19/10 10:00	5/24/10 11:00	5.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58504BS Bowie 4H	5/24/10 11:00	5/26/10 12:55	2.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58504BS Bowie 4H	5/26/10 12:55	6/1/10 16:05	6.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58504BS Bowie 4H	6/1/10 16:05	6/10/10 10:20	8.8	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58504BS Bowie 4H	6/10/10 10:20	6/17/10 12:00	7.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58504BS Bowie 4H	6/17/10 12:00	6/23/10 14:25	6.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
58504BS Bowie 4H	6/23/10 14:25	7/26/10 14:35	33.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850745Lancaster	5/19/10 10:30	5/24/10 9:45	5.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850745Lancaster	5/24/10 9:45	5/26/10 11:15	2.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850745Lancaster	5/26/10 11:15	6/1/10 14:40	6.1	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
5850745Lancaster	6/1/10 14:40	6/10/10 11:00	8.8	ND	<	0.01	541.0		1.77	ND	<	0.275	ND	<	0.15
5850745Lancaster	6/10/10 11:00	6/17/10 12:50	7.1	ND	<	0.01	541.0		2.26	ND	<	0.275	ND	<	0.15
5850745Lancaster	6/17/10 12:50	6/23/10 14:50	6.1	ND	<	0.01	541.0		1.68	ND	<	0.275	ND	<	0.15
5850745Lancaster	6/23/10 14:50	7/26/10 13:25	32.9	ND	<	0.01	541.0		9.08	ND	<	0.275	ND	<	0.15
Blowing Sink Dark Side	5/26/10 14:20	6/23/10 15:30	28.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	579.2		4.51
Blowing Sink Dark Side A	6/23/10 15:30	7/18/10 12:40	24.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	578.6 *		4.56
Blowing Sink Dark Side B	6/23/10 15:32	7/18/10 12:42	24.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
Blowing Sink Eileen's River	5/26/10 14:00	6/23/10 14:12	28.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
Blowing Sink Eileen's River	6/23/10 14:12	7/18/10 12:12	24.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	577.6 *		3.46
Blowing Sink Eileen's River	6/23/10 14:14	7/18/10 12:14	24.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
Blowing Sink Eileen's River	5/26/10 14:10	6/23/10 14:30	28.0	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
Blowing Sink Eileen's River	6/23/10 14:30	7/18/10 11:40	24.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15
Blowing Sink Eileen's River	6/23/10 14:32	7/18/10 11:42	24.9	ND	<	0.01	ND	<	0.035	ND	<	0.275	ND	<	0.15

Appendix B Water Sample Results

CoA Station # and Name	Date/Time Sampled	CoA Estm Flow (ft^3/s)	Fluorescein Results			Eosine Results			RWT Results			SRB Results		
			Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb
42914 Main Barton	4/11/07 15:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	4/11/07 17:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	4/11/07 17:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	4/11/07 18:10	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	4/11/07 21:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	582.0		1.37
42914 Main Barton	4/12/07 1:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.9		2.68
42914 Main Barton	4/12/07 5:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.6		3.75
42914 Main Barton	4/12/07 9:50	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.9		3.88
42914 Main Barton	4/12/07 13:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.8		7.06
42914 Main Barton	4/12/07 15:25	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.9		5.06
42914 Main Barton	4/12/07 17:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.9		4.85
42914 Main Barton	4/12/07 21:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.9		4.93
42914 Main Barton	4/13/07 1:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.7		2.20
42914 Main Barton	4/13/07 9:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	581.6		1.67
42914 Main Barton	4/13/07 13:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	581.4		1.61
42914 Main Barton	4/13/07 14:30	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	582.4		1.37
42914 Main Barton	4/13/07 18:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.7		1.71
42914 Main Barton	4/14/07 0:01	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.7		1.38
42914 Main Barton	4/14/07 4:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	579.4 (1)		1.35
42914 Main Barton	4/14/07 8:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	579.4 (1)		1.18
42914 Main Barton	4/14/07 12:00	70	ND	<	0.0005	ND	<	0.008	577.6		1.73	ND	<	0.04
42914 Main Barton	4/14/07 15:50	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	579.0 (1)		1.16
42914 Main Barton	4/14/07 16:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	4/14/07 16:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	4/14/07 20:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	4/14/07 20:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	4/15/07 4:00	70	ND	<	0.0005	ND	<	0.008	577.4		1.34	ND	<	0.04
42914 Main Barton	4/15/07 8:00	70	ND	<	0.0005	ND	<	0.008	578.4 **		1.29	ND	<	0.04
42914 Main Barton	4/15/07 11:00	70	ND	<	0.0005	ND	<	0.008	577.0 **		1.04	ND	<	0.04
42914 Main Barton	4/15/07 12:00	70	ND	<	0.0005	ND	<	0.008	578.6 **		1.12	ND	<	0.04
42914 Main Barton	4/15/07 16:00	70	ND	<	0.0005	ND	<	0.008	577.6 **		0.846	ND	<	0.04
42914 Main Barton	4/16/07 0:01	70	ND	<	0.0005	ND	<	0.008	578.4 **		1.22	ND	<	0.04
42914 Main Barton	4/16/07 4:00	70	ND	<	0.0005	ND	<	0.008	578.6 **		1.03	ND	<	0.04
42914 Main Barton	4/16/07 11:10	70	ND	<	0.0005	ND	<	0.008	576.6 **		0.936	ND	<	0.04
42914 Main Barton	4/16/07 12:00	70	ND	<	0.0005	ND	<	0.008	575.2 **		0.954	ND	<	0.04

CoA Station # and Name	Date/Time Sampled	CoA Estm Flow (ft^3/s)	Fluorescein Results			Eosine Results			RWT Results			SRB Results		
			Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb
42914 Main Barton	4/16/07 16:00	70	ND	<	0.0005	ND	<	0.008	576.8 **		0.733	ND	<	0.04
42914 Main Barton	4/17/07 0:01	70	ND	<	0.0005	ND	<	0.008	575.8 **		0.828	ND	<	0.04
42914 Main Barton	4/17/07 4:00	70	ND	<	0.0005	ND	<	0.008	576.2 **		0.879	ND	<	0.04
42914 Main Barton	4/17/07 8:00	70	ND	<	0.0005	ND	<	0.008	576.6 **		0.914	ND	<	0.04
42914 Main Barton	4/17/07 12:00	70	ND	<	0.0005	ND	<	0.008	574.5 **		0.712	ND	<	0.04
42914 Main Barton	4/17/07 16:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	4/17/07 20:10	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	4/20/07 0:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.4 (1)		0.459
42914 Main Barton	4/20/07 6:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	579.4 (1)		0.411
42914 Main Barton	4/20/07 18:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.0 (1)		0.435
42914 Main Barton	4/21/07 6:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	4/21/07 18:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	579.6 (1)		0.378
42914 Main Barton	4/22/07 0:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	4/22/07 12:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	4/22/07 18:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	4/23/07 0:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	4/23/07 6:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	4/23/07 12:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/3/07 6:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/3/07 10:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/3/07 14:00	70	507.6		0.08	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/4/07 9:50	70	508.5		1.37	ND	<	0.008	ND	<	0.05	580.7		9.69
42914 Main Barton	5/4/07 20:00	70	508.5		0.78	ND	<	0.008	ND	<	0.05	580.6		0.514
42914 Main Barton	5/4/07 4:00	70	508.2		3.77	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/5/07 0:00	70	508.2		0.69	ND	<	0.008	ND	<	0.05	581.6		0.410
42914 Main Barton	5/5/07 4:00	70	508.3		0.61	ND	<	0.008	ND	<	0.05	582.6		0.687
42914 Main Barton	5/5/07 8:00	70	508.5		0.55	ND	<	0.008	ND	<	0.05	582.8		0.442
42914 Main Barton	5/5/07 12:00	70	508.5		0.50	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/5/07 16:00	70	508.5		0.51	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/6/07 19:40	70	508.5		0.32	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/6/07 20:00	70	507.6		0.28	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/7/07 0:00	70	508.7		0.25	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/7/07 4:00	70	507.8		0.23	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/7/07 8:00	70	508.7		0.23	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/7/07 10:20	70	508.8		0.23	ND	<	0.008	ND	<	0.05	ND	<	0.04

CoA Station # and Name	Date/Time Sampled	CoA Estm Flow (ft^3/s)	Fluorescein Results			Eosine Results			RWT Results			SRB Results		
			Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb
42914 Main Barton	5/7/07 12:00	70	508.7		0.20	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/7/07 16:00	70	508.7		0.18	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/7/07 20:00	70	508.7		0.17	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/8/07 0:00	70	508.4		0.16	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/8/07 4:00	70	508.5		0.14	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/8/07 8:00	70	509.1		0.13	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/8/07 12:00	70	508.6		0.12	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/8/07 16:00	70	509.0		0.14	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/8/07 18:30	70	509.3		0.130	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/9/07 18:40	70	508.3		0.101	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/17/07 13:00	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/18/07 20:15	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/19/07 20:55	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/27/07 21:15	70	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	5/30/07 21:35		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42916 Cold Spring	4/26/07 11:00	27	ND	<	0.0005	534.8		0.223	ND	<	0.05	ND	<	0.04
42916 Cold Spring	5/7/07 9:40	27	ND	<	0.0005	ND		0.008	ND	<	0.05	ND	<	0.04
42916 Cold Spring	8/5/07 17:10		ND	<	0.0005	535.2		0.116	ND	<	0.05	ND	<	0.04
42916 Cold Spring	8/30/07 10:30		ND	<	0.0005	536.0		0.069	ND	<	0.05	ND	<	0.04
42916 Cold Spring	10/4/07 13:02		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42916 Cold Spring	3/20/08 13:30		ND		0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42916A Cold Springs	6/17/07 10:45		ND		0.0005	ND		0.008	ND	<	0.05	ND	<	0.04
42916B Cold Springs	6/17/07 10:48		ND		0.0005	ND		0.008	ND	<	0.05	ND	<	0.04
42920 Upper Barton	4/10/07 20:15	2	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42920 Upper Barton	4/13/07 16:30	2	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42920 Upper Barton	4/25/07 15:30	2	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42920 Upper Barton	5/2/07 12:40	2	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42920 Upper Barton	8/3/07 15:20		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42920 Upper Barton	8/28/07 16:50		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	1/16/07 12:00		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	4/11/07 14:20	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	4/11/07 16:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	4/11/07 18:20	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	4/11/07 21:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	4/12/07 1:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.4		1.58

CoA Station # and Name	Date/Time Sampled	CoA Estm Flow (ft^3/s)	Fluorescein Results Peak nm	</>	Conc. ppb	Eosine Results Peak nm	</>	Conc. ppb	RWT Results Peak nm	</>	Conc. ppb	SRB Results Peak nm	</>	Conc. ppb
42921 Eliza Spring	4/12/07 5:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.7		6.70
42921 Eliza Spring	4/12/07 9:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.4		8.44
42921 Eliza Spring	4/12/07 10:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.6		3.11
42921 Eliza Spring	4/12/07 13:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.7		7.99
42921 Eliza Spring	4/12/07 13:30	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.7		5.98
42921 Eliza Spring	4/12/07 17:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	581.0		6.39
42921 Eliza Spring	4/12/07 21:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.8		4.78
42921 Eliza Spring	4/13/07 1:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.7		3.78
42921 Eliza Spring	4/13/07 5:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	581.1		2.81
42921 Eliza Spring	4/13/07 9:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.9		2.13
42921 Eliza Spring	4/13/07 13:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	581.1		1.58
42921 Eliza Spring	4/13/07 13:05	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	581.2 **		0.555
42921 Eliza Spring	4/13/07 15:30	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	581.2		1.28
42921 Eliza Spring	4/13/07 16:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	581.5		1.44
42921 Eliza Spring	4/13/07 20:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.5		1.28
42921 Eliza Spring	4/14/07 0:01	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.0 (1)		1.29
42921 Eliza Spring	4/14/07 4:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	579.4 (1)		1.14
42921 Eliza Spring	4/14/07 8:00	15	ND	<	0.0005	ND	<	0.008	577.8		1.92	ND	<	0.04
42921 Eliza Spring	4/14/07 12:00	15	ND	<	0.0005	ND	<	0.008	577.4		1.71	ND	<	0.04
42921 Eliza Spring	4/14/07 14:52	15	ND	<	0.0005	ND	<	0.008	576.4		1.16	ND	<	0.04
42921 Eliza Spring	4/14/07 16:00	15	ND	<	0.0005	ND	<	0.008	576.8		1.73	ND	<	0.04
42921 Eliza Spring	4/14/07 20:00	15	ND	<	0.0005	ND	<	0.008	577.3		1.58	ND	<	0.04
42921 Eliza Spring	4/15/07 0:01	15	ND	<	0.0005	ND	<	0.008	576.2		1.64	ND	<	0.04
42921 Eliza Spring	4/15/07 4:00	15	ND	<	0.0005	ND	<	0.008	576.6		1.71	ND	<	0.04
42921 Eliza Spring	4/15/07 8:00	15	ND	<	0.0005	ND	<	0.008	577.0		1.41	ND	<	0.04
42921 Eliza Spring	4/15/07 10:15	15	ND	<	0.0005	ND	<	0.008	575.0		1.11	ND	<	0.04
42921 Eliza Spring	4/15/07 12:00	15	ND	<	0.0005	ND	<	0.008	577.4		1.15	ND	<	0.04
42921 Eliza Spring	4/15/07 16:00	15	ND	<	0.0005	ND	<	0.008	577.1		1.13	ND	<	0.04
42921 Eliza Spring	4/15/07 20:00	15	ND	<	0.0005	ND	<	0.008	576.1		1.18	ND	<	0.04
42921 Eliza Spring	4/16/07 0:01	15	ND	<	0.0005	ND	<	0.008	575.4 **		1.11	ND	<	0.04
42921 Eliza Spring	4/16/07 4:00	15	ND	<	0.0005	ND	<	0.008	576.0		0.932	ND	<	0.04
42921 Eliza Spring	4/16/07 8:00	15	ND	<	0.0005	ND	<	0.008	576.9		1.11	ND	<	0.04
42921 Eliza Spring	4/16/07 10:50	15	ND	<	0.0005	ND	<	0.008	576.6		1.08	ND	<	0.04
42921 Eliza Spring	4/16/07 12:00	15	ND	<	0.0005	ND	<	0.008	577.2		1.03	ND	<	0.04
42921 Eliza Spring	4/16/07 16:00	15	ND	<	0.0005	ND	<	0.008	577.1		0.788	ND	<	0.04

CoA Station # and Name	Date/Time Sampled	CoA Estm Flow (ft^3/s)	Fluorescein Results			Eosine Results			RWT Results			SRB Results		
			Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb
42921 Eliza Spring	4/16/07 20:00	15	ND	<	0.0005	ND	<	0.008	575.7		1.04	ND	<	0.04
42921 Eliza Spring	4/17/07 0:01	15	ND	<	0.0005	ND	<	0.008	575.9		0.926	ND	<	0.04
42921 Eliza Spring	4/17/07 4:00	15	ND	<	0.0005	ND	<	0.008	577.5		0.968	ND	<	0.04
42921 Eliza Spring	4/17/07 8:00	15	ND	<	0.0005	ND	<	0.008	575.6 **		0.907	ND	<	0.04
42921 Eliza Spring	4/17/07 12:00	15	ND	<	0.0005	ND	<	0.008	576.7		0.862	ND	<	0.04
42921 Eliza Spring	4/17/07 16:00	15	ND	<	0.0005	ND	<	0.008	577.0 **		0.965	ND	<	0.04
42921 Eliza Spring	4/17/07 18:35	15	ND	<	0.0005	ND	<	0.008	576.6 **		0.786	ND	<	0.04
42921 Eliza Spring	4/17/07 20:00	15	ND	<	0.0005	ND	<	0.008	577.4 **		0.825	ND	<	0.04
42921 Eliza Spring	4/18/07 0:01	15	ND	<	0.0005	ND	<	0.008	578.0 (1)		0.725	ND	<	0.04
42921 Eliza Spring	4/18/07 4:00	15	ND	<	0.0005	ND	<	0.008	576.8 (1)		0.746	ND	<	0.04
42921 Eliza Spring	4/18/07 8:00	15	ND	<	0.0005	ND	<	0.008	577.0 (1)		0.739	ND	<	0.04
42921 Eliza Spring	4/18/07 9:30	15	ND	<	0.0005	ND	<	0.008	576.4 (1)		0.583	ND	<	0.04
42921 Eliza Spring	4/18/07 12:00	15	ND	<	0.0005	ND	<	0.008	576.6 (1)		0.802	ND	<	0.04
42921 Eliza Spring	4/18/07 16:00	15	ND	<	0.0005	ND	<	0.008	574.2 (1)		0.818	ND	<	0.04
42921 Eliza Spring	4/18/07 20:00	15	ND	<	0.0005	ND	<	0.008	577.4 (1)		0.779	ND	<	0.04
42921 Eliza Spring	4/19/07 0:00	15	ND	<	0.0005	ND	<	0.008	575.6 (1)		0.795	ND	<	0.04
42921 Eliza Spring	4/19/07 4:00	15	ND	<	0.0005	ND	<	0.008	579.0 (1)		0.414	ND	<	0.04
42921 Eliza Spring	4/19/07 19:30	15	ND	<	0.0005	ND	<	0.008	576.0 (1)		0.807	ND	<	0.04
42921 Eliza Spring	4/20/07 0:00	15	ND	<	0.0005	ND	<	0.008	577.0 (1)		0.750	ND	<	0.04
42921 Eliza Spring	4/20/07 6:00	15	ND	<	0.0005	ND	<	0.008	579.0 (1)		0.851	ND	<	0.04
42921 Eliza Spring	4/20/07 12:00	15	ND	<	0.0005	ND	<	0.008	577.0 (1)		1.03	ND	<	0.04
42921 Eliza Spring	4/20/07 18:00	15	ND	<	0.0005	ND	<	0.008	576.4 (1)		1.05	ND	<	0.04
42921 Eliza Spring	4/21/07 0:00	15	ND	<	0.0005	ND	<	0.008	579.4 (1)		0.610	ND	<	0.04
42921 Eliza Spring	4/21/07 6:00	15	ND	<	0.0005	ND	<	0.008	578.0 (1)		0.797	ND	<	0.04
42921 Eliza Spring	4/21/07 12:00	15	ND	<	0.0005	ND	<	0.008	579.4 (1)		0.565	ND	<	0.04
42921 Eliza Spring	4/21/07 18:00	15	ND	<	0.0005	ND	<	0.008	579.0 (1)		0.550	ND	<	0.04
42921 Eliza Spring	4/22/07 0:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	4/22/07 6:00	15	ND	<	0.0005	ND	<	0.008	578.6 (1)		0.628	ND	<	0.04
42921 Eliza Spring	4/22/07 12:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	4/22/07 18:00	15	ND	<	0.0005	ND	<	0.008	577.0 (1)		0.524	ND	<	0.04
42921 Eliza Spring	4/23/07 0:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	4/23/07 6:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	4/23/07 12:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	4/23/07 18:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	4/24/07 0:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04

CoA Station # and Name	Date/Time Sampled	CoA (ft^3/s)	Fluorescein Results			Eosine Results			RWT Results			SRB Results		
			Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb
42921 Eliza Spring	4/24/07 6:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	4/24/07 12:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	4/24/07 18:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	4/24/07 21:30	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	4/25/07 15:10	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	4/26/07 12:30	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	4/29/07 20:45	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	4/30/07 14:45	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	4/30/07 17:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/1/07 6:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/1/07 17:45	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/1/07 18:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/1/07 22:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/2/07 6:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/2/07 10:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/2/07 14:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/2/07 18:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/2/07 20:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/3/07 0:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/3/07 4:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/3/07 8:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/3/07 12:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/4/07 4:00	15	508.2		3.77	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/3/07 16:00	70	508.4		0.32	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/3/07 16:00	15	508.4		0.32	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/3/07 20:00	70	508.2		1.11	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/3/07 20:00	15	508.2		1.11	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/3/07 20:00	15	508.2		1.11	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/4/07 0:00	70	509.2		2.62	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/4/07 0:00	15	509.2		2.62	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/4/07 0:00	15	509.2		2.62	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/4/07 8:00	70	509.1		2.03	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/4/07 8:00	15	509.1		2.03	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/4/07 8:00	15	509.1		2.03	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/4/07 9:10	70	508.4		1.84	ND	<	0.008	ND	<	0.05	581.2		4.68
42921 Eliza Spring	5/4/07 9:10	15	508.4		1.84	ND	<	0.008	ND	<	0.05	581.2		4.68
42921 Eliza Spring	5/4/07 9:10	15	508.4		1.84	ND	<	0.008	ND	<	0.05	581.2		4.68

CoA Station #	Date/Time	CoA Estm Flow	Fluorescein Results			Eosine Results			RWT Results			SRB Results		
and Name	Sampled	(ft^3/s)	Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb
42921 extr. fom Main	5/4/07 9:50	15	508.5		1.37	ND	<	0.008	ND	<	0.05	580.7		9.69
42921 extr. fom Main	5/4/07 18:20	15	508.6		0.85	ND	<	0.008	ND	<	0.05	581.0		0.728
42921 extr. fom Main	5/4/07 18:20	15	508.6		0.85	ND	<	0.008	ND	<	0.05	581.0		0.728
42921 extr. fom Main	5/4/07 20:00	15	508.5		0.78	ND	<	0.008	ND	<	0.05	580.6		0.514
42921 extr. fom Main	5/4/07 20:00	15	508.5		0.78	ND	<	0.008	ND	<	0.05	580.6		0.514
42921 extr. fom Main	5/5/07 0:00	15	508.2		0.69	ND	<	0.008	ND	<	0.05	581.6		0.410
42921 extr. fom Main	5/5/07 0:00	15	508.2		0.69	ND	<	0.008	ND	<	0.05	581.6		0.410
42921 extr. fom Main	5/5/07 4:00	15	508.3		0.61	ND	<	0.008	ND	<	0.05	582.6		0.687
42921 extr. fom Main	5/5/07 4:00	15	508.3		0.61	ND	<	0.008	ND	<	0.05	582.6		0.687
42921 extr. fom Main	5/5/07 8:00	15	508.5		0.55	ND	<	0.008	ND	<	0.05	582.8		0.442
42921 extr. fom Main	5/5/07 8:00	15	508.5		0.55	ND	<	0.008	ND	<	0.05	582.8		0.442
42921 Eliza Spring	5/5/07 20:20	15	508.3		0.56	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/5/07 20:20	15	508.3		0.56	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/6/07 20:00	15	508.5		0.29	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/6/07 20:00	15	508.5		0.29	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/6/07 20:15	15	508.8		0.33	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/6/07 20:15	15	508.8		0.33	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/7/07 0:00	15	508.8		0.27	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/7/07 0:00	15	508.8		0.27	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/7/07 4:00	15	508.7		0.27	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/7/07 4:00	15	508.7		0.27	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/7/07 8:00	15	508.4		0.24	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/7/07 8:00	15	508.4		0.24	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/7/07 9:30	15	508.3		0.27	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/7/07 9:30	15	508.3		0.27	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/7/07 12:00	15	508.6		0.21	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/7/07 12:00	15	508.6		0.21	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/7/07 16:00	15	508.7		0.19	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/7/07 16:00	15	508.7		0.19	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/7/07 20:00	15	509.1		0.18	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/7/07 20:00	15	509.1		0.18	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/8/07 0:00	15	508.9		0.19	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/8/07 0:00	15	508.9		0.19	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/8/07 4:00	15	508.6		0.17	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/8/07 8:00	15	508.9		0.16	ND	<	0.008	ND	<	0.05	ND	<	0.04

CoA Station # and Name	Date/Time Sampled	CoA Estm Flow (ft^3/s)	Fluorescein Results Peak nm	</>	Conc. ppb	Eosine Results Peak nm	</>	Conc. ppb	RWT Results Peak nm	</>	Conc. ppb	SRB Results Peak nm	</>	Conc. ppb
42921 Eliza Spring	5/8/07 8:00	15	508.9		0.16	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/8/07 12:00	15	509.1		0.13	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/8/07 12:00	15	509.1		0.13	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/8/07 16:00	15	508.8		0.12	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/8/07 16:00	15	508.8		0.12	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/8/07 19:00	15	508.7		0.145	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/8/07 19:00	15	508.7		0.145	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/9/07 19:00	15	509.7		0.116	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/9/07 19:00	15	509.7		0.116	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/4/07 4:00	15	508.2		3.77	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/16/07 11:15	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/17/07 13:15	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/18/07 20:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/19/07 20:45	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/28/07 21:30	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	5/30/07 21:45	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	6/14/07 13:40	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	7/11/07 12:15	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	8/28/07 16:10	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	9/19/07 10:10	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	11/1/07 12:30	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	3/19/08 14:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	3/20/08 14:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	4/10/08 18:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	4/11/08 9:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	4/19/08 9:30	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza Spring	4/19/08 16:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill Spring	4/10/07 20:40	11	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill Spring	4/11/07 15:40	11	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill Spring	4/12/07 10:15	11	ND	<	0.0005	ND	<	0.008	ND	<	0.05	581.2		1.80
42922 Old Mill Spring	4/12/07 17:40	11	ND	<	0.0005	ND	<	0.008	ND	<	0.05	581.0		4.49
42922 Old Mill Spring	4/13/07 17:00	11	ND	<	0.0005	ND	<	0.008	ND	<	0.05	581.0		1.13
42922 Old Mill Spring	4/14/07 16:30	11	ND	<	0.0005	ND	<	0.008	ND	<	0.05	579.6 (1)		0.807
42922 Old Mill Spring	4/16/07 11:30	11	ND	<	0.0005	ND	<	0.008	ND	<	0.05	579.4 (1)		0.495
42922 Old Mill Spring	4/16/07 11:40	11	ND	<	0.0005	ND	<	0.008	576.6 **		0.773	ND	<	0.04

CoA Station # and Name	Date/Time Sampled	CoA Estm Flow (ft^3/s)	Fluorescein Results			Eosine Results			RWT Results			SRB Results		
			Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb
42922 Old Mill Spring	4/17/07 18:15	11	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill Spring	4/18/07 10:15	11	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill Spring	4/19/07 19:00	11	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill Spring	4/25/07 16:00	11	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill Spring	4/26/07 13:00	11	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill Spring	5/2/07 18:25	11	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill Spring	5/3/07 18:10	11	509.4		0.06	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill Spring	5/4/07 10:40	11	508.4		1.46	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill Spring	5/4/07 17:30	11	508.3		0.77	ND	<	0.008	ND	<	0.05	580.6		3.84
42922 Old Mill Spring	5/6/07 19:25	11	509.0		0.19	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill Spring	5/7/07 11:30	11	508.4		0.17	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill Spring	5/8/07 17:30	11	509.4		0.087	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill Spring	5/9/07 18:15	11	509.1		0.055	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill Spring	5/16/07 11:45	11	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill Spring	5/17/07 13:30	11	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill Spring	5/18/07 19:45	11	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill Spring	5/19/07 20:25	11	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill Spring	5/30/07 21:15	11	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill Spring	6/14/07 14:45		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
429RW Rollingwood Spri	3/20/08 13:40		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
DOWN Sarah &Mike Do	11/02/06 1200		ND	<	0.0005	535.5		0.614	ND	<	0.05	ND	<	0.04
499DP FR Pond below	5/8/07 15:50		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
499FR Flint Ridge Drip	5/8/07 16:20		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
58-50-4CA Callahan	5/3/07 14:40		ND	<	0.0005	ND	<	0.008	576.6 (2)		0.426	ND	<	0.04
58-50-4CA Callahan	6/18/07 12:50		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
58-50-4CA Callahan	5/21/07 14:00		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
58-50-703 Marbridge	6/18/07 14:20		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
58-50-703 Marbridge	5/21/07 12:30		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
58-50-7DF Debbie	5/3/07 16:00		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
58-50-7DH Hanshaw	5/1/07 13:24		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
58-50-7DH Hanshaw	5/21/07 12:43		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
58-50-7DT Tidwell	5/3/07 14:50		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
58-50-7DT Tidwell	6/18/07 13:45		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04

CoA Station # and Name	Date/Time Sampled	CoA Estm Flow (ft^3/s)	Fluorescein Results			Eosine Results			RWT Results			SRB Results		
			Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb
183 Upper Barton Spring	6/16/10 12:40		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
183 Upper Barton Spring	6/25/10 11:40		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
183 Upper Barton Spring	6/30/10 12:50		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
183 Upper Barton Spring	7/27/10 13:55		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
183 Upper Barton Spring	8/11/10 12:30		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton Fissur	5/25/10 11:10		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton Fissur	5/27/10 16:10		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton Fissur	6/16/10 12:15		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton Fissur	6/25/10 11:00		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	6/30/10 12:25		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42914 Main Barton	7/27/10 13:30		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42916 Cold Spring	5/27/10 13:00		ND	<	0.0005	536.0		0.115	ND	<	0.05	ND	<	0.04
42916 Cold Spring	6/25/10 10:00		ND	<	0.0005	533.8		0.165	ND	<	0.05	ND	<	0.04
42916 Cold Spring	8/11/10 11:30		ND	<	0.0005	534.4		0.202	ND	<	0.05	ND	<	0.04
42921 Eliza	5/25/10 10:30	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/25/10 12:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/25/10 16:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/25/10 20:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/26/10 0:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/26/10 4:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/26/10 8:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/26/10 12:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/26/10 16:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/26/10 20:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/27/10 0:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/27/10 4:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/27/10 8:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/27/10 12:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/27/10 16:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/27/10 16:20	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/27/10 20:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/28/10 0:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/28/10 4:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/28/10 8:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/28/10 12:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04

2010 Water Samples

CoA Station # and Name	Date/Time Sampled	CoA Estm Flow (ft^3/s)	Fluorescein Results			Eosine Results			RWT Results			SRB Results		
			Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb
42921 Eliza	5/28/10 16:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/28/10 20:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/29/10 0:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/29/10 4:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/29/10 8:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/30/10 21:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/31/10 1:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/31/10 5:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/31/10 9:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/31/10 13:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/31/10 17:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	5/31/10 21:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/1/10 1:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/1/10 5:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/1/10 9:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/1/10 13:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/2/10 18:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/3/10 2:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/3/10 10:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/3/10 18:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/4/10 2:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/4/10 10:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/4/10 18:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/5/10 2:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/5/10 10:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/5/10 18:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/6/10 2:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/6/10 10:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/6/10 18:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/9/10 11:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/9/10 12:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/9/10 20:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/10/10 4:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04

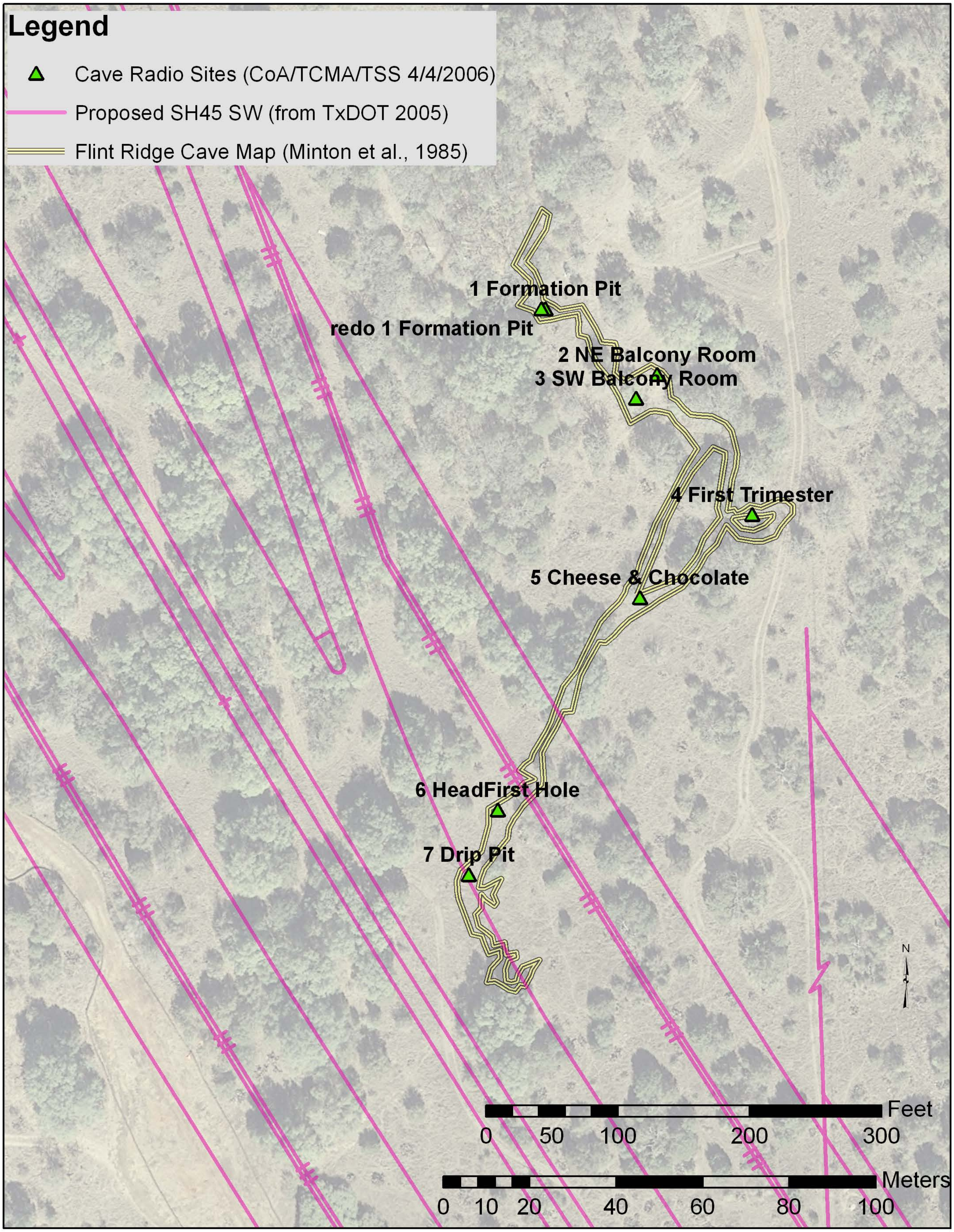
CoA Station # and Name	Date/Time Sampled	CoA Estm Flow (ft^3/s)	Fluorescein Results			Eosine Results			RWT Results			SRB Results		
			Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb
42921 Eliza	6/10/10 12:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/10/10 20:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/11/10 4:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.2		2.68
42921 Eliza	6/11/10 12:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	508.2		0.75
42921 Eliza	6/11/10 20:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/12/10 4:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/12/10 12:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/12/10 20:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/13/10 4:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/13/10 12:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/13/10 20:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/14/10 4:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/14/10 12:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/14/10 20:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/15/10 4:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/15/10 12:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/15/10 20:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/16/10 4:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/16/10 11:15	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/16/10 12:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/16/10 20:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/25/10 10:30	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/30/10 12:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/30/10 12:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/30/10 16:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	6/30/10 20:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	7/1/10 0:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	581.0		0.786
42921 Eliza	7/1/10 4:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	579.2 **		4.19
42921 Eliza	7/1/10 8:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	579.2 **		4.20
42921 Eliza	7/1/10 12:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.0 **		2.23
42921 Eliza	7/1/10 16:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	580.4		1.06
42921 Eliza	7/2/10 14:00	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	7/8/10 6:00		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	7/8/10 14:00		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	7/8/10 22:00		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04

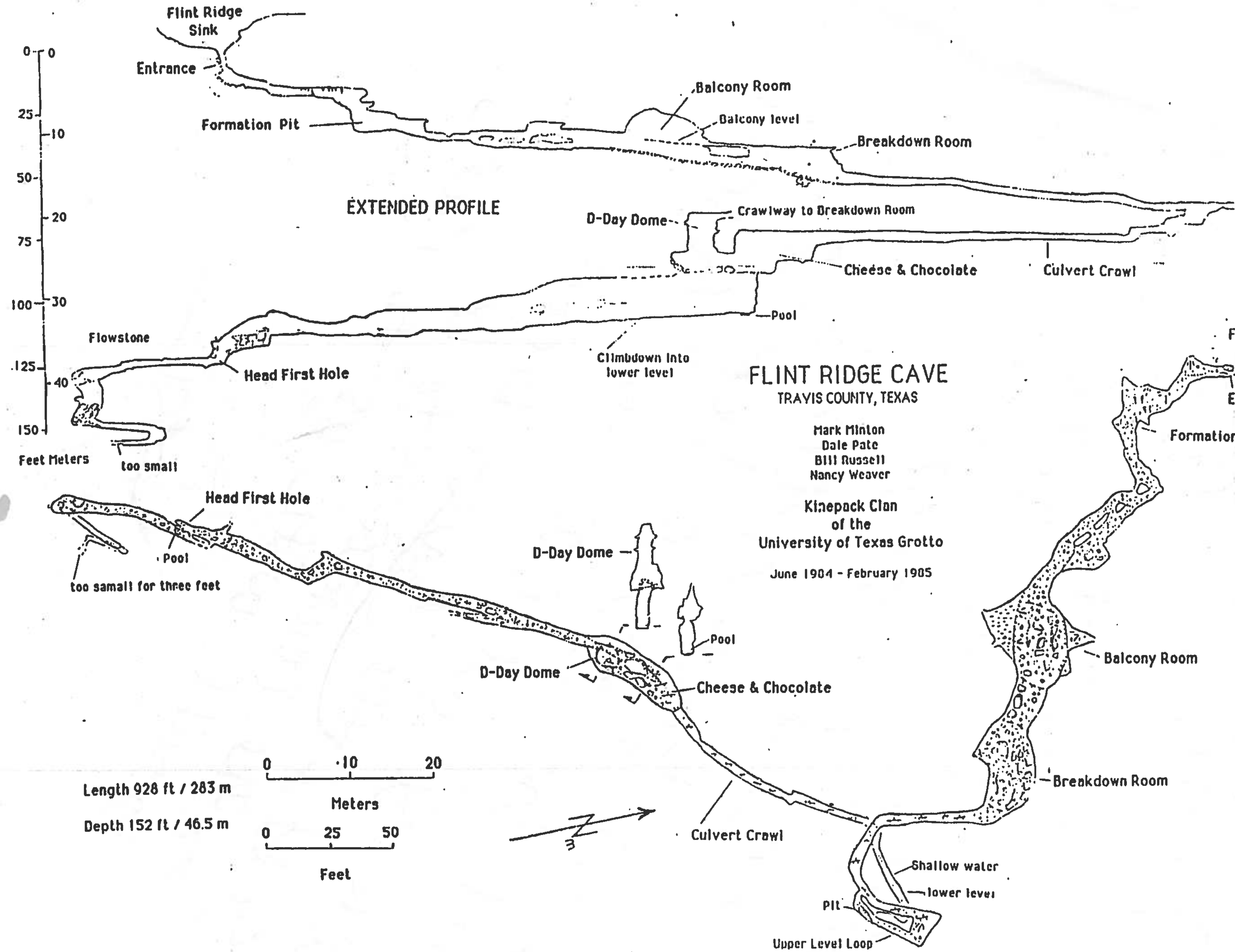
CoA Station # and Name	Date/Time Sampled	CoA Estm Flow (ft^3/s)	Fluorescein Results			Eosine Results			RWT Results			SRB Results		
			Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb	Peak nm	</>	Conc. ppb
42921 Eliza	7/9/10 6:00		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	7/9/10 14:00		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	7/9/10 22:00		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	7/10/10 6:00		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42921 Eliza	7/27/10 13:10	15	ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill	5/25/10 11:40		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill	5/27/10 16:30		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill	6/16/10 13:05		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill	6/25/10 12:15		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill	6/30/10 13:10		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
42922 Old Mill	7/27/10 12:37		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
Blowing Sink Eileens Riv	10/14/10 14:00		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
Blowing Sink Dnst Eileen	10/14/10 14:30		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04
Blowing Sink Dark Side	10/14/10 15:00		ND	<	0.0005	ND	<	0.008	ND	<	0.05	ND	<	0.04

Appendix C Flint Ridge Cave Radio Survey

Site	Horiz. Dist. (feet)	Inclination (degrees)	Angle From Vert. (degrees)	Site Depth (feet)	Arithm. Mean (ft)	+/-	Elevation ft msl
1 Formation Pit	16	44	46	30	30	1	771
	11	58	32	30			
	8	67	23	31			
	20	36	54	30			
2 NE Balcony Room	8	74	16	48	47	2	740
	20	54	36	46			
	26	43	47	45			
	42	23	67	47			
3 SW Balcony Room	8	70	20	35	34	2	749
	12	61	29	34			
	16	51	39	35			
	20	42	48	33			
	24	36	54	35			
4 First Trimester	~~8~~	~~80~~	10	~~70~~	66	3	720
	14	71.5	18.5	65			
	20	65	25	67			
	26	56	34	65			
	30	51	39	65			
	40	44	46	70			
5 Cheese & Chocolate	8	83	7	86	82	8	706
	~~14~~	~~81~~	9	~~130~~			
	20	71	19	80			
	25	65.5	24.5	82			
	30	64	26	74			
	~~35~~	~~64~~	26	~~63~~			
	40	56	34	~~96~~			
	50	44	46	87			
6 HeadFirst Hole	~~10~~	~~82~~	~~8~~	~~95~~	126	8	660
	~~15~~	~~81~~	~~9~~	~~135~~			
	20	77	13	134			
	25	74	16	135			
	30	70	20	128			
	35	67	23	133			
	~~40~~	~~70~~	~~20~~	~~167~~			
	45	60	30	125			
	50	58	32	125			
	55	54	36	125			
	60	55	35	140			
	65	48	42	125			
	70	45	45	124			
7 Drip Pit	~~20~~	~~74~~	~~16~~	~~106~~	134	2	653
	~~30~~	~~70~~	~~20~~	~~126~~			
	40	65	25	133			
	50	58	32	133			
	60	53	37	135			
	~~70~~	~~44~~	~~46~~	~~120~~			
	~~80~~	~~45~~	~~45~~	~~140~~			

Appendix 3. Map of Flint Ridge Cave Radio Locations and Subsurface Footprint




FLINT RIDGE CAVE
TRAVIS COUNTY, TEXAS
Mark Minton
Dale Pate
Bill Russell
Nancy Weaver
Kinepack Clan
of the
University of Texas Grotto
June 1984 - February 1985
EXTENDED PROFILE
Flint Ridge Sink
Entrance
Formation Pit
Balcony Room
Balcony level
Breakdown Room
D-Day Dome
Crawlway to Breakdown Room
Cheese & Chocolate
Culvert Crawl
Pool
Climbdown into lower level
Flowstone
Head First Hole
too small
0
25
50
75
100
125
150
Feet Meters
10
20
30
40
Pool
too samall for three feet
Shallow water
lower level
Pit
Upper Level Loop
Length 928 ft / 283 m
Depth 152 ft / 46.5 m
Meters
Feet