Edwards Aquifer Habitat Conservation Plan
Expanded Water Quality Monitoring Report
December 2013

Introduction

The Edwards Aquifer Authority (EAA) and its predecessor agency, the Edwards Underground Water District (EUWD), in cooperation with the United States Geological Survey (USGS) and the Texas Water Development Board (TWDB) has maintained a water quality sampling program since 1968. Analyses of these data have been used by the EAA to assess aquifer water quality. This routine or historical sampling program involves the analyses of a broad spectrum of parameters in wells, springs, and streams across the region. Generally, the routine sampling program includes sampling a minimum of 80 wells, eight streams, and major springs across the region (at frequencies ranging from annually to monthly). The EAA's existing sampling program was expanded with the adoption of the Edwards Aquifer Habitat Conservation Program (EAHCP) to include collection of additional samples and sample types, in the immediate vicinity of Comal and San Marcos springs. The expanded water quality sampling program, was developed in accordance with the directives of the EAHCP and provides a means for early detection of potential impairments to water quality within the Comal River and headwaters of the San Marcos River systems. The expanded EAHCP sampling requirements are described in the *Water Quality Monitoring Program Strategy for Comal Springs and San Marcos Springs in Support of the Edwards Aquifer Habitat Conservation Plan* (EAHCP Workplan) which is included in Appendix J of this document.

Based on the requirements of the EAHCP Workplan, the expanded sampling program entails the collection of multiple sample types. Specifically, the following sample types and data collection efforts are required as part of the expanded sampling program.

1. Surface water (base flow) samples;
2. Sediment samples;
3. Real time instrument (RTI) water quality monitoring; and,
4. Storm water sampling.

Prior to the implementation of the EAHCP, the historical sampling program had not specifically addressed surface water quality, sediment quality, real time changes for basic water quality parameters, or storm water impacts along the Comal River or headwaters of the San Marcos River. Therefore, this expanded sampling program was designed to gather data specific to all of these parameters. This report provides a means of publishing that data. The data set represents only the first year of the program and is not sufficient to establish any long-term trends or patterns.

For purposes of this report, Comal River may also be referred to as Comal Springs or Comal Springs complex and the San Marcos River headwaters may also be referred to as San Marcos Springs or San Marcos Springs complex. An overview of surface water, sediment, RTI locations, and storm water sample locations for Comal and San Marcos springs are shown in Figures 1 and 2. Figures 3-6, provide detailed location data for sample points and RTIs at the Comal Springs complex. Figures 7-10, provide detailed locations for the sample points and RTIs at the San Marcos Springs complex.

Figure 1. EAA HCP expanded water quality monitoring program, Comal Springs and River.

Figure 2. EAA HCP expanded water quality monitoring program, San Marcos Springs and River.

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Surface Water (Base Flow) Samples

Surface water (base flow) samples are collected twice annually at each spring complex. The Comal Springs complex has five sample locations along the Comal system from the upstream end of Landa Lake (where Blieders Creek empties into the headwaters of Landa Lake), to the south end of the Comal River, upstream of the confluence with the Guadalupe River. In the San Marcos system, surface water samples are collected at seven locations. Sample sites begin at Sink Creek, upstream of the headwaters of Spring Lake on the north end of the system, and end downstream of Capes Dam, on the south end of the system.

Surface water sample locations are designed to provide water quality data for the majority of the surface waters of each spring system and river reach of concern. Samples are collected both above and below where each system's surface waters are influenced by springflow as well as other potential surface water inputs (such as Dry Comal Creek, or Purgatory Creek). Surface water samples are analyzed for a broad spectrum of parameters as outlined in Table 1. Year one surface water samples were collected in the spring (prior to peak contact recreation season) and in the early fall (just after peak contact recreation season).

Regulatory standards for surface water quality vary dependent upon type of use. For this report, surface water results are compared to drinking water quality standards (30 TAC, Chapter 290, Subchapter F) for detected constitutes of concern. These guidelines were selected for use since in general, they provide the most stringent quality standards. For detections of interest that do not have an established maximum contaminant level (MCL) under 30 TAC 290, the Texas Risk Reduction Program (TRRP) from 30 TAC 350 was substituted. The TRRP standards used are the Tier I, residential standards and are referred to as protective concentration levels (PCL). Other guidelines may be more useful or appropriate for particular research; however, for the scope of this report these standards provide an appropriate and applicable guideline with regard to water quality.

Sediment Samples

Collection of sediment samples within in each spring system was included in the program to help ascertain potential effects on listed species via direct or indirect exposure to sediments. Designated sediment sample locations were coincident with surface water (base flow) sample locations at each spring complex. Specifically, five sediment samples were collected from the Comal Springs area and seven locations are sampled within the San Marcos area. All sediment samples in year one were collected from the sediment surface to approximately 18-inches below the surface. Samples were then homogenized at the laboratory and analyzed for the parameters listed in Table 1. Year one sediment samples were collected on the basis of investigating general sediment quality in the uppermost 18-inches of sediment. Sediment sampling was a "screening" event, and used to assess potential contaminants in the upper 18-inches of sediment. Future sediment sample collection may be tailored to focus on more discreet intervals in order to further refine the understanding of sediment quality at each spring group.

Sediment samples were collected as close to each associated surface water sample location as possible. However, for many of the samples, collection points were moved slightly to find adequate sediment, or to avoid rocky substrates that prevented collection of adequate sample volume. Sample locations where any significant deviations from this approach occurred are discussed in Appendix G of this report.

Analytical results for sediment samples are compared to the sediment quality guidelines published , in: *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems* (MacDonald et al., 2000). These guidelines are based on determination of probable sediment toxicity in freshwater ecosystems and provide a numerical sediment quality guideline for 28 chemicals of concern. The guidance provides two basic standards for comparison: 1) Threshold effect concentration (TEC), and; 2) Probable effect concentration (PEC). Analytical results with a concentration below the TEC are predicted to have no toxic effect (on sediment dwelling organisms), while results with a concentration above the PEC are indicated as having a probable toxic effect on sediment dwelling organisms. Detected compounds with concentrations between the TEC and PEC are considered equally likely to be toxic or non-toxic. While numerous other guidelines for sediment quality exist, these guidelines provide a good reference for the scope of the current investigation. Future researchers may find other guidelines, more specific to particular concerns or interest, more applicable.

Real Time Water Quality Monitoring

The objective for implementing the use of RTI was to measure changes in basic water quality parameters in near real time. The RTIs record data at 15-minute intervals (or nearly continuous basis). As such, the instrumentation provides a mechanism for recording water quality changes related to season, time of day, weather, and various other influences. The instrumentation measures the following parameters.

- Dissolved oxygen (DO) in milligrams per liter (mg/L),
- pH (no units),
- Conductivity in micro-Siemens per centimeter (uS/cm),
- Turbidity in nephelometeric turbidity units (NTU), and;
- Temperature in degrees Celsius (°C).

The resulting data are stored locally on the instrument and also reported to and stored on a secure internet site. The data are subsequently downloaded monthly and permanently stored on the EAA computer network.

The RTIs have allowed for collection of near-continuous data since the date of installation. Generally, the instrumentation is very robust and thus far required minimal maintenance. However, occasional anomalous data do appear, especially for turbidity and conductivity readings which are easily affected by indigenous wildlife or vegetation particles that temporarily lodge on detectors. The instrumentation selected for use is the Eureka Manta 2 probe system coupled with a Measurement Specialties telemetry unit that communicates via cell phone with the secure website. The data from the RTI are provided in Appendix B.

Storm Water Samples

Storm water sampling was performed at five Comal Springs locations and at seven San Marcos Springs locations. Storm water sample collection was adopted as part of the expanded water quality monitoring effort to assess potential contaminants that may be present in surface water runoff generated by storm events. The storm water sampling effort was designed to assess what changes in water quality occur within each surface water system during a storm event. Storm samples were collected in association with various surface water inputs along each spring complex within the study area. Although storm samples were generally collected from the actual surface water channel, one Comal location was collected outside the channel for both events. Details of each storm water sample location and any deviations from the workplan are discussed in Appendix G of this report. Storm water samples were analyzed for the same parameters as surface water (base flow) samples as outlined in Table 1.

Storm water samples were collected at a minimum of three points across the storm hydrograph for each surface water sampling site. Sample collection was targeted for the rising limb, peak, and receding limb of the stream hydrograph. Timing for sample collection was generally determined using the RTI system's conductivity and turbidity parameters rather than the flow measurements from the United States Geological Survey (USGS) streamflow gauges. The USGS gauges are only updated on an hourly basis whereas the

RTIs were available on 15-minute intervals and providing more timely data. In addition, automated sample collection equipment could not be utilized for the storm sampling effort due to the parameters collected and the associated preservation, volume, and storage requirements. Therefore, sampling was performed manually by EAA sampling personnel. Each spring group was sampled twice for storm water events during calendar year 2013, per the EAHCP Workplan.

Storm water sample collection presents many inherent difficulties compared with other types of sample collection. Safety of personnel is the primary focus. Many times, sample collection occurs after multiple hours of "on-call" duty, in inclement weather, and often in the dark. Sample collection locations in some circumstances required modification in the field due to safety concerns. All deviations from any proposed sample location are noted in the results and documented in Appendix G. Detailed sample locations are shown in Figures 3-10.

As previously mentioned, standards for surface water quality vary dependent upon type of use. For this report, storm water results are compared to drinking water quality standards (30 TAC, Chapter 290, Subchapter F) for detected chemicals of concern. These guidelines were selected for use since in general, they provide the most stringent quality standards. For detections of interest that do not have an established MCL under 30 TAC 290, the TRRP from 30 TAC 350 was substituted. The TRRP standards used are the Tier I, residential standards and are referred to as PCLs. Other guidelines may be more useful or appropriate for particular research; however, for the scope of this report these standards provide an appropriate and applicable guideline with regard to water quality.

Table 1, Listing of Analytical Parameters by Sample Type

Analytical Parameter	**Surface Water (Base Flow) Samples**	**Sediment Samples**	**Storm Water Samples**
Volatile Organic Compounds (VOCs)	Yes	Yes	Yes
Semi-volatile Organic Compounds (SVOCs)	Yes	Yes	Yes
Organochlorine Pesticides	Yes	Yes	Yes
Polychlorinated Biphenyls (PCBs)	Yes	Yes	Yes
Organophosphorous Pesticides	Yes	Yes	Yes
Herbicides	Yes	Yes	Yes
Metals (Al, Sb, As, Ba, Be, Cd, Cr (total), Cu, Fe, Pb, Mn, Hg, Ni, Se, Ag, Tl, and Zn)	Yes	Yes	Yes
General Chemistry (GWQP) Total Alkalinity (as CaCO3), Bicarbonate Alkalinity (as CaCO3), Carbonate Alkalinity (as CaCO3); (Cl, Br, NO_3, SO_4, Fl, pH, TDS, TSS, Ca, Mg, Na, K, Si, Sr, CO_3,)	Yes	No: *TDS, TSS, or TKN*	Yes
Phosphorus (total)	Yes	Yes	Yes
Total Organic Carbon (TOC),	Yes	Yes	Yes
Dissolved Organic Carbon (DOC)	Yes	Yes	Yes
Total Kjeldahl Nitrogen (TKN)	Yes	Yes	Yes
Bacteria (E. Coli)	Yes	No	Yes
Field Parameters (DO, pH, Conductivity, Turbidity, Temperature)	Yes	No	Yes

Sample Location Detail

Detail of individual sample locations are provided in the Figures that follow. Figures 3, 4, and 5 show sample location details for the Comal Springs area. Figures 6, 7, and 8 provide sample location details for the San Marcos Springs area.

Figure 3. HCP Comal Springs detailed map indicating sample locations 110, 210, 310, 120, 320.

Figure 4. HCP Comal Springs detailed map indicating sample locations 130, 330, and RTIs at Spring 7, and Spring Run 3.

Figure 5. HCP Comal Springs detailed map indicating sample locations 140, 240, 340, 250, 160, 260, 360, and downstream RTI.

Figure 6. HCP Comal Springs detailed map indicating sample location 270.

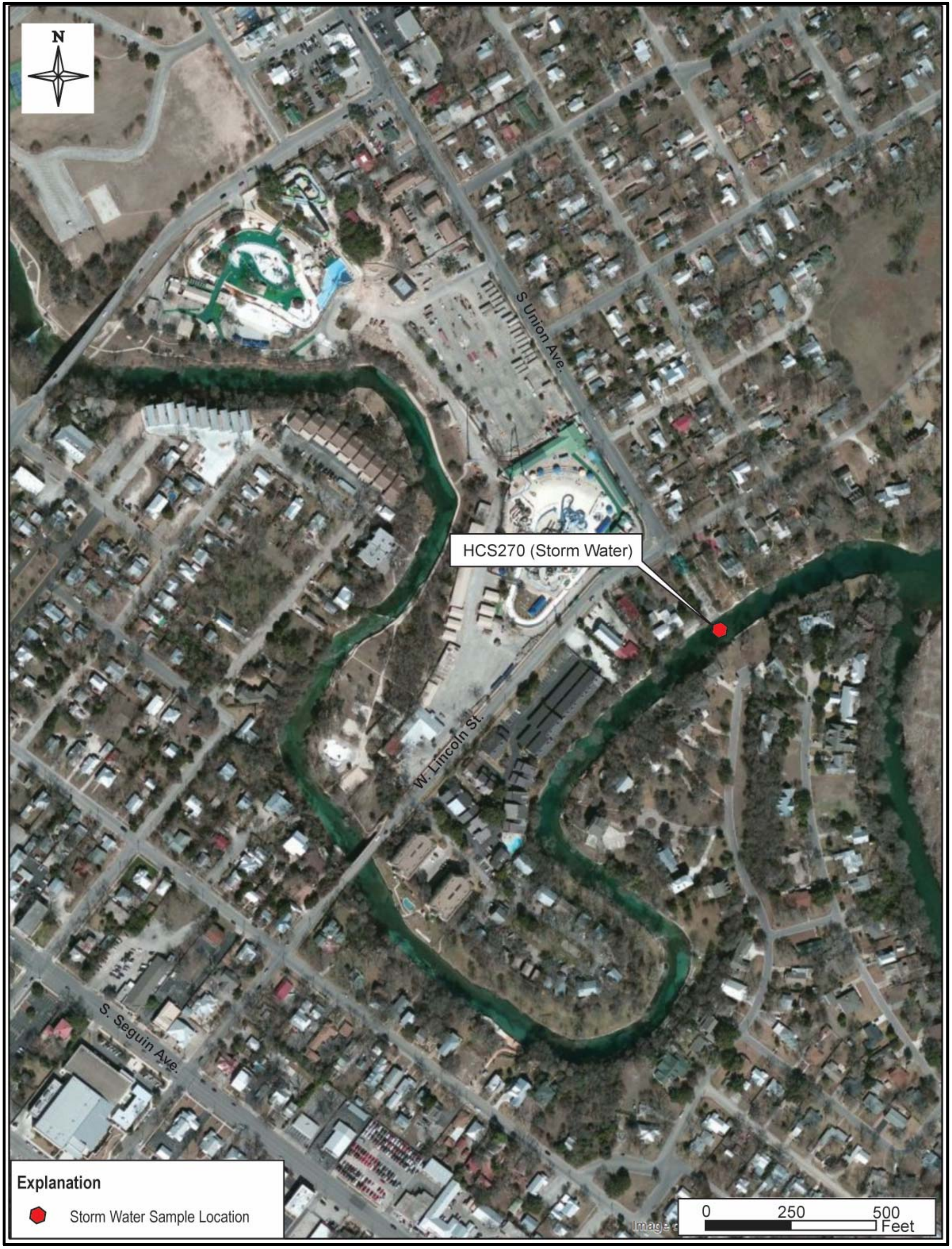


Figure 7. HCP San Marcos Springs detailed map indicating sample locations 110-320 and upstream RTI Univ. Dr.

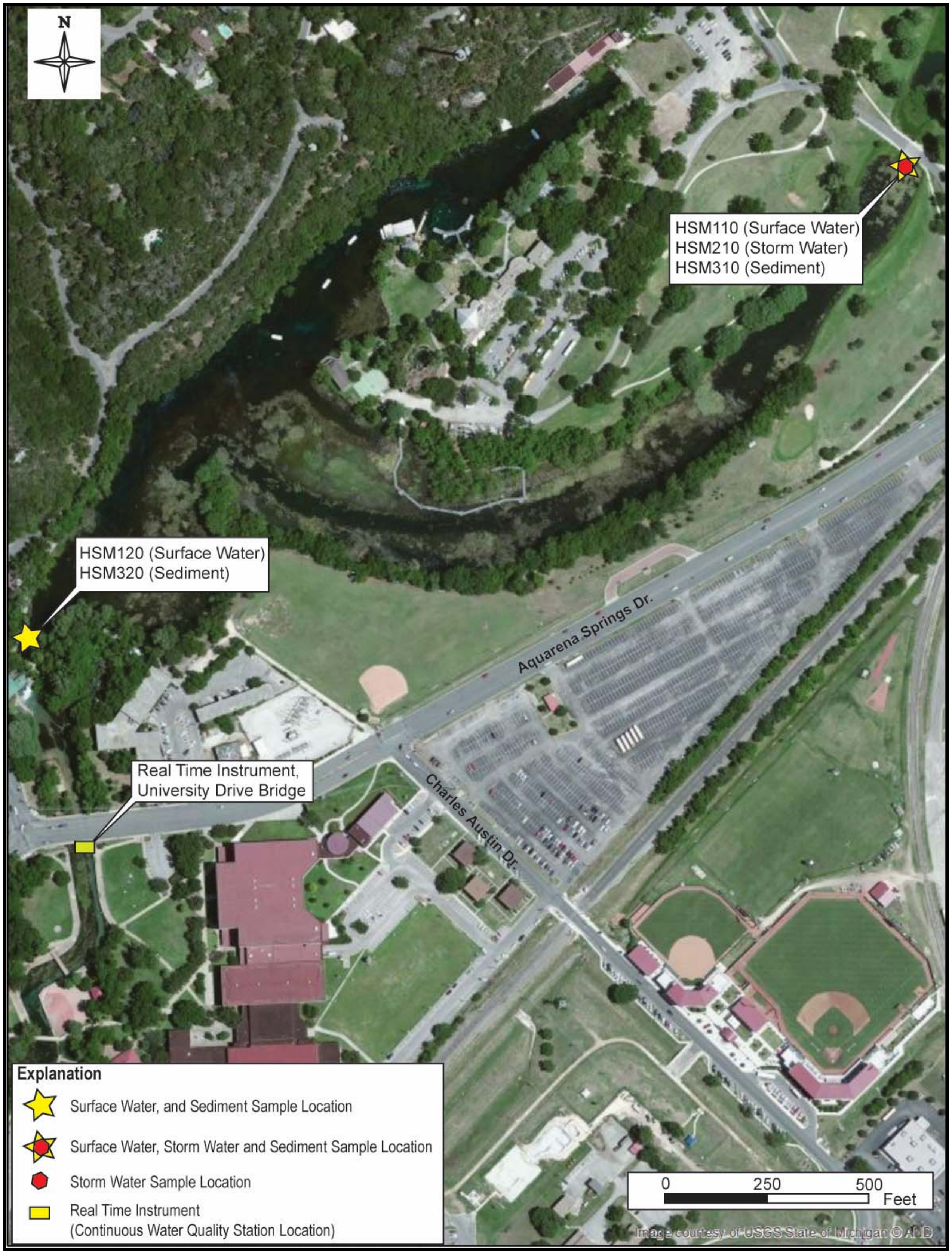


Image courtesy of USGS State of Michigan © AND

Figure 8. HCP San Marcos Springs detailed map indicating sample locations HSM130-HSM340.

Figure 9. HCP San Marcos Springs detailed map indicating sample locations HSM250-HSM350 and downstream RTI, Rio Vista.

Figure 10. HCP San Marcos Springs detailed indicating map sample locations HSM160-HSM370.

MODIFICATIONS OF ACTIVITES DUE TO DROUGHT

Sampling activities were minimally affected by the ongoing drought conditions in the area. No extreme low flow sampling was initiated at wells (Sections 6.4.3.3 and 6.4.4.3 of the Habitat Conservation Plan) as flows at Comal Springs did not drop below 30 cubic feet per second (cfs), or below 50 cfs at San Marcos Springs. However, the ongoing drought made storm water sampling exceedingly difficult to perform. Rain events were generally scattered in nature and often too small in magnitude to result in sufficient runoff to sample.

AFFECT ON COVERED SPECIES

The implementation of the HCP water quality and sediment sampling program provided base line data along the Comal River and upper reaches of the San Marcos River system. Water quality grab samples were collected twice from each river during baseflow conditions and during two storm events. Sediment samples were also collected from both systems. Three RTI water quality monitoring stations were also placed in the Comal Springs system and two RTI stations were added to the San Marcos system.

Collection and analysis of water quality and sediment samples has benefited all of the covered species by providing baseflow and storm flow water quality data throughout the habitat of the covered species. The data included water quality discharging directly from the springs, water discharging into the Comal and San Marcos rivers below the springs, and real time water quality data at five locations.

Analytical results are compared to various water quality and sediment standards as guidelines to identify any existing problems and create a body of baseline data to ascertain any long-term sediment and water quality trends.

STAFF TRAINING

Prior to initiation of field activities, the existing *EAA Groundwater Monitoring Plan* (see Appendix K) was revised to incorporate sediment and storm water sample collection methodologies. The *EAA Groundwater Monitoring Plan* also requires staff safety and procedural training on an annual basis as part of the quality assurance process. Therefore, under the guidelines of the EAA Groundwater Monitoring Plan, and the needs associated with the EAHCP, field staff were provided a significant amount of training for sample collection in calendar year 2013. Specifically the following training activities were undertaken in calendar year 2013 for staff involved in sample collection or data collection related to the EAHCP.

- **Laboratory Documentation -** March 7, 2013, two hour presentation provided by the EAA's contract laboratory (TestAmerica). Training included the significance of correctly completed sample labels and Chain of Custody (COC) forms, legality of COCs and appropriate sample custody. Other details included a refresher on the correct volumes of sample needed for various analyses.
- **San Antonio River Authority (Storm water training) -** March 9, 2013, an EAA staff member trained with the storm water sampling team at San Antonio River Authority (SARA). Although the rain event used for the training effort was not sufficient for a full sample collection suite (effort was cancelled during the process due to insufficient rainfall), the training included sample preparation, mobilization, and limited sample collection.
- **Basic Water Rescue Preparedness -** June 22, 2013, prior to EAA field staff engaging in storm water sampling activities participants were required to receive training on the dangers of swift water / flood water. Therefore, EAA field staff attended an eight hour course titled *Basic Water Rescue Preparedness*, at the Comal River. Ms. Victoria Smith, S.T.O.R.M. Rescue Team Leader, and her assistant instructed EAA field staff on the dangers of swift water and taught swift water survival skills in order to enhance the field staff's general knowledge and danger of working around swift water or flood waters (photographs of this training activity are located in Appendix F)

- **Chemistry for Environmental Professionals -** August 28 - 30, 2013, EAA staff attended a 32 hour training course titled *Environmental Chemistry Demystified*^{TM}, taught by AArcher Institute of Environmental Training, and held at the EAA offices. The course was instructed by Dr. Denise Turner and Mr. William Spain. The course covered multiple aspects of organic and some inorganic chemistry as well as material safety data sheets (or safety data sheets), laboratory analytical reports, and environmental assessment work.

LOGISTICS

In order to accommodate the needs of the EAHCP expanded water quality monitoring program, a significant number of man hours were required to obtain necessary equipment, construct housings for the RTIs, and develop sampling strategies. The EAHCP related sampling was to be conducted in addition to the existing data collection and sampling programs already underway for the EAA. Below is a short synopsis of events and tasks undertaken to accomplish the necessary logistics for the EAHCP sampling program.

- January 1, 2013, EAA expanded its water quality monitoring program to include additional surface water (and storm water), groundwater, and sediment monitoring within Comal and San Marcos Springs complexes.
- January 9, 2013, EAA field staff conducted a field inspection for Comal and San Marcos Springs complexes after a rain event in order to observe storm impacts on storm water sample locations.
- January 25, 2013, EAA field staff conducted another field inspection for surface water, sediment, and storm water locations at the San Marcos Springs complex.
- January – April, 2013, EAA's Aquifer Science Team updated the *EAA Groundwater Monitoring Plan*, to include sediment and storm water sampling.
- March 18, 2013, EAA field staff conducted field inspections at the Comal Springs complex with City of New Braunfels staff in order to discuss sampling locations, RTI locations, sampling procedures and storm water sampling notifications (notifications to include local police and fire departments) at the Comal Springs complex.
- April 17, 2013, EAA field staff conducted field inspections at the San Marcos Springs complex with City of San Marcos staff in order to discuss sampling locations, RTI locations, sampling procedures and storm water sampling notifications (notifications to include local police and fire departments) at the San Marcos Springs complex.

Surface Water Sampling Program

January - March 2013, EAA staff purchased water quality sampling supplies and fabricated certain devises to assist in storm water and surface water sample collection.

Sediment Sampling Program

May 2013 EAA field staff purchased a Shelby Sampler and other supplies necessary for collection of sediment samples.

Real Time Water Quality Instrumentation (RTI)

January 2013 through April 2013 EAA staff bench tested the RTI systems. Between April 2013 and May 2013 EAA field staff fabricated five enclosures for the RTI probes. Subsequent installations for each of the enclosures and instruments occurred as listed below:

- April 11, 2013, Comal Spring Run #3, New Braunfels, Texas.
- May 30, 2013, Comal River below the confluence with Dry Comal Creek, New Braunfels, Texas.
- May 30, 2013, USGS gauging station (University Drive Bridge area), San Marcos, Texas, and at Rio Vista Park, San Marcos, Texas.

- September 10, 2013, Comal Spring Run #7, New Braunfels, Texas.

Storm Water Program

May and June 2013, EAA field staff completed the procurement process for storm water sampling equipment (such as life vests, rain suits, head lamps, throw ropes, duffle bags, strobe lights, first aid kits, 24 foot telescopic retractable poles) in addition to fabricating equipment and receiving training for swift water environments.

SAMPLE COLLECTION METHODOLOGY

Surface water/Base flow Sampling Program

Surface water quality grab samples were collected from five sites throughout the Comal Springs complex and seven sites throughout the San Marcos Springs complexes biannually. According to the EAHCP workplan, the sample dates were to be six months apart. The preferred method for obtaining a surface water sample is to either wade to the sample location and on the upstream side of the sampler (assuming stream is flowing), obtain field parameters (pH, specific conductivity, dissolved oxygen, and temperature) then insert the sample bottle directly into the water or utilize a sample bottle and pole assembly. In April 2013, EAA field staff utilized a retractable pole in order to obtain water quality samples from the Comal and San Marcos Springs complexes. Field parameters were collected first by inserting the appropriate probe into the surface water as close to the sample location as possible. Next, EAA field staff inserted a Teflon® beaker into the telescopic retractable pole and collected water samples. This process continued until all sample bottles were properly filled. However, during the October 2013 surface water sampling event, samples were collected in their respective containers directly from the surface water body. Samples were collected in accordance with the criteria set forth in the *EAA Groundwater Monitoring Plan.*

Filtration for methods 6010B (metals), 6020 (metals), 7470A (mercury) and field alkalinity were performed at the sample location by utilizing a 0.45 micron high capacity cartridge filter inserted into a weighted single sample disposable bailer. Preservatives were placed in the bottles (as appropriate) by the contracted laboratory. Ice was placed into the cooler immediately after sampling and later shipped to the contract laboratory. When not in use or after collection, sampling equipment and/or coolers containing samples were secured inside the EAA vehicles to maintain appropriate sample custody and security.

According to the *EAA Groundwater Monitoring Plan*, one field duplicate was sampled for each spring complex per sampling event. The field duplicate was sampled after the parent water quality sample and in the same manner as the parent water quality sample. In addition, one equipment blank was taken for each spring complex per sampling event if sampling equipment was utilized during the sampling process.

Equipment blanks were collected on April 15, 2013 at the location of HCS 140, New Braunfels, Texas, and another on April 16, 2013 at the location of HSM 150, San Marcos, Texas. No equipment blanks were collected in October 2013 as EAA field staff were able to insert the sample bottle directly into the surface water. Equipment blanks were obtained by filling the Teflon® beaker with ASTM Type II water which is subsequently poured into sample bottles in the same order and manner as an environmental sample. Equipment blanks were not performed for the following analyses: field parameters, turbidity, field alkalinity, and bacteria.

EAA field staff decontaminated all equipment (Teflon® beaker and stainless steel swivels as applicable) by inserting them into a five gallon bucket which contained tap water and Liquinox®. Next, the equipment was submerged into another five gallon bucket filled with deionized water as an initial rinse. A second rinse was performed on the Teflon® beaker by submerging it into another five gallon bucket filled with deionized water.

Analyses for field alkalinity were conducted at EAA's Camden Building or in a secure location in the field. The method used for field alkalinity is discussed in detail in the *EAA Groundwater Monitoring Plan* (Appendix K).

Sediment Sampling Program

Sediment samples were collected from the surface to approximately 18" below the surface. Locations were generally coincident with surface water samples at each of the spring complexes. Sediment samples were collected at five sites for the Comal Springs complex and seven sites for the San Marcos Springs complex. Sediment samples are designated for collection once annually. Three to four samples were collected from each sample site by EAA staff in a sample tube using a Shelby sampler. Sediment samples from each site were individually homogenized at the contract laboratory prior to analysis. Sediment collection points included an area up to several feet in diameter, which varied based on the amount of available sediment at each location. The Shelby Sampler utilized one-inch diameter, 25-inch long plastic liners to contain the sediment collected within the probe. Laboratory analytical requirements dictated that a total of 48 linear inches of liner needed to be filled with sediment to have adequate volume for each sample. After extra head space was removed from the top the plastic liner and both ends were wrapped with laboratory film (Parafilm) before being capped with end pieces. Once 48-inches of sediments were collected, liners were individually labeled and bound together with Parafilm. Sample sets were immediately placed on ice and later shipped to the contract laboratory. Sediment samples were collected in accordance with the criteria set forth in the *EAA Groundwater Monitoring Plan*. When not in use or after collection, sampling equipment and/or coolers containing samples were secured inside locked EAA vehicles to maintain appropriate sample custody and security.

The *EAA Groundwater Monitoring Plan* requires one field duplicate was sampled for each spring complex. The field duplicate was sampled after the parent sediment sample and in the same manner as the parent sediment sample.

According to the *EAA Groundwater Monitoring Plan*, one equipment blank was sampled for the entire batch of plastic liners. The equipment blank was sampled on June 10, 2013, at the EAA Camden Building. An equipment blank was obtained by allowing ASTM Type II water to flow into and through the plastic liner which then flowed into the sample bottle. Herbicides and pesticides were collected first, then SVOCs, followed by VOCs, general water, nitrate/nitrite, and metals. Filtration for methods 6010B (Metals) and 6020 (Metals) was performed by pouring ASTM Type II water into a weighted single sample disposable bailer attached to a 0.45 micron high capacity cartridge filter. Preservatives were placed in the bottles (as appropriate) by the contract laboratory. Ice was placed into the cooler immediately after sampling and later shipped to the contract laboratory. An equipment blank was not performed for the following analytes: field parameters, turbidity, field alkalinity, and bacteria.

Storm water Sampling Program

Storm water samples are designated by the EAHCP Workplan (Appendix J) for collection twice annually from each spring complex. Storm water samples were collected when rainfall amounts were adequate to initiate a significant rise at the respective USGS gauging locations for each spring complex. Samples were collected across the storm-affected stream hydrograph at the rise, peak, and recession limb of the associated stream hydrograph. As with the other sample types, five locations at Comal Springs were sampled and seven locations at San Marcos Springs. In general, the turbidity and conductivity data from the RTIs at each site were utilized as a surrogate for the stream hydrograph due to immediate availability of the data.

Storm water sample collection was affected by the ongoing drought conditions across the region. Often, storms that materialized were insufficient to create adequate runoff for sample collection. As a result, members of the storm water sampling team spent many more hours on-call than were expected. In general, when rainfall probabilities exceeded 20-percent for a given time period, the team was placed on-call for sample collection. Multiple scenarios involved a mobilization that was later cancelled due to insufficient rainfall, or storms that dissipated prior to reaching the sample area. Storm team duty is summarized and documented in Appendix H of this document.

Due to the inherently unsafe conditions associated with storm water flow, EAA field staff utilized a retractable pole when needed in order to safely obtain water samples during storm water sampling events. Field parameters were collected first by inserting the YSI probe as close to the sample location as possible (the probe was affixed in some instances to the retractable pole to insert the probe into the appropriate location). Next, EAA field staff utilized the telescopic retractable pole with a 500 mL Teflon® beaker attached to a stainless steel swivel at the end of the sampling pole to collect samples. After collecting each sample, water is transferred from the beaker into the appropriate sample bottle.

Storm water sampling activities conformed to the protocols outlined in the *EAA Groundwater Monitoring Plan*, for sample collection, handling, and decontamination. After collection of field parameters, samples were collected in the following order: Herbicides and pesticides, SVOCs, VOCs, GWQP (general water quality parameters), nitrate/nitrite, turbidity, bacteria, field alkalinity, and metals. Filtration for methods 6010B (Metals), 6020 (Metals), and field alkalinity were performed at the sample location by utilizing a 0.45 micron high capacity cartridge filter inserted into a weighted single sample disposable bailer. Preservatives were placed in the bottles (as needed) by the contracted laboratory. All samples were immediately placed into coolers with ice after sampling and later shipped to the contract laboratory. When not in use or after collection, sampling equipment and/or coolers containing samples were secured inside locked EAA vehicles to maintain appropriate sample custody and security.

According to the *EAA Groundwater Monitoring Plan*, two field duplicates were to be collected for the Comal Springs complex and three field duplicates for the San Marcos Springs complex per rain event. However, due to a field oversight, only one field duplicate was sampled for the Comal Springs July 15, 2013, event, and for the San Marcos Springs event on August 15 - 16, 2013. Field duplicates were sampled after collection of the parent sample and in the same manner as the parent sample.

According to the *EAA Groundwater Monitoring Plan*, one equipment blank was sampled for each spring complex per rain event. The equipment blanks were sampled after parent sample collection, at sites HCS 260, on July 15, (Comal Springs) and at HSM 240, August 16, 2013, (San Marcos, Springs). Other equipment blanks were collected for the Comal Springs on October 13, 2013, event at EAA offices and on October 31, 2013, at the San Marcos Nature Center, for the associated San Marcos Springs rain event. Equipment blanks were obtained by filling the Teflon® beaker with ASTM Type II water which was then carefully poured into sample bottles in the same order and manner as an environmental sample. Equipment blanks were not performed for the following analytes: field parameters, turbidity, field alkalinity, and bacteria.

EAA field staff decontaminated all reusable equipment (Teflon® beaker and stainless steel swivel) by inserting into a five gallon bucket which contained tap water and Liquinox®. Next, the equipment was submerged into another five gallon bucket filled with deionized water for the initial rinse. A second rinse was performed on the equipment by submerging into another five gallon bucket filled with deionized water.

Analyses for field alkalinity were conducted concurrently with sample collection or at the EAA's Camden Building. The method used for field alkalinity is discussed in detail in the *EAA Groundwater Monitoring Plan*.

SAMPLE RESULTS

Results from the sampling efforts related to the expanded EAHCP sampling program are discussed in the paragraphs that follow. Results are discussed by sample type for Comal Springs, followed by a separate discussion by sample type for San Marcos Springs. Sample events are listed in the order of surface water (base flow) samples, sediment samples, and storm water samples. A complete record of laboratory analyses and field parameters is provided in Appendix C of this document. The laboratory data were reviewed by EAA staff with the results of that review provided as Appendix D (data validation discussion) of this document. Each sample location (latitude/longitude), name, and other location information is also summarized in Appendix E of this document.

Data sets from each RTI from the date of installation through November 2013, are provided in Appendix B of this document. In addition to the RTI data sets, Appendix A provides a record of springflow for Comal and San Marcos springs for January through November 2013.

COMAL SPRINGS SAMPLE RESULTS

The Comal Springs complex were sampled for water quality during base flow conditions in April and October of 2013. In general, few detections were noted. As discussed previously, surface water samples are compared to the drinking water standards for water quality in this report.

Sediments at the Comal Springs complex were sampled in June 2013. Sediment results are compared to the standards developed by McDonald et al., (2000). These standards are based on the probability of a detected compound having a toxic effect on sediment dwelling organisms and are referred to as the TEC and PEC. Detections below the TEC are not considered to be toxic, while detections above the PEC are considered to be toxic to sediment dwelling organisms. Detections above the TEC but less than the PEC are considered to be equally likely to be toxic or non-toxic.

Storm water events were sampled at the Comal Springs complex in July and October of 2013. Storm water results did not indicate a significant number of detections of concern. Bacteria results were perhaps the most significant detections associated with the storm water sampling.

COMAL SPRINGS SURFACE WATER / BASE FLOW SAMPLING

Surface Water / Base Flow - Bacteria

Bacteria results for surface water associated with the Comal Springs complex ranged from 26 MPN/100mL (most probable number of colony-forming units per 100 milliliters of water through 1900 MPN/100 mL for E. Coli. Because of the presence of various fauna in surface water collection sites, positive detections are not uncommon. However, some of the detections were generally higher than anticipated for spring fed surface waters. Surface water bacteria detections are summarized in Table 2.

Table 2, Summary of Bacteria Detections for Surface Water Samples Comal Springs Complex

Sample Name	Sample Date	Concentration (MPN/100 mL)
HCS 110	4/15/2013	1,900
HCS 120	4/15/2013	26
HCS 130	4/15/2013	80
HCS 140	4/15/2013	310
HCS 140FD	4/15/2013	200
HCS 160	4/15/2013	180
HCS 110	10/7/2013	650
HCS 120	10/9/2013	93
HCS 130	10/9/2013	83
HCS 140	10/9/2013	210
HCS 140FD	10/9/2013	170
HCS 160	10/9/2013	250

Surface Water / Base Flow - Volatile Organic Compounds (VOCs)

The majority of samples did not test positive for VOCs during the surface water sampling events. No VOC detections were noted for the April 2013 sampling event. However, for the October 7, 2013, event, sample site HCS 110 tested positive for four different VOC analytes. During the sample collection process, EAA field staff noted an unknown substance seeping to the surface of the stream from sediments. The substance had a solvent like odor and caused a thin milky layer of film to form at the water surface. EAA Staff notified local officials and collected a sample within the area containing the unknown substance. The detections are summarized below for HCS 110 from the October 7, sampling event.

- Ethylbenzene, detected at 19.6 micrograms per liter (µg/L) (PCL* = 700 µg/L)
- M-P-xylene, detected at 100 µg/L (PCL* = 10,000 µg/L)
- O-xylene, detected at 40.8 µg/L (PCL* = 10,000 µg/L)
- Total xylenes, detected at 141 µg/L (PCL* = 10,000 µg/L)
- Toluene, detected at 1.13 µg/L (MCL = 1,000 µg/L)

** = MCL not established, protective concentration limit (PCL) from 30 TAC 350.*

Surface Water / Base Flow - Semi-volatile Organic Compounds (SVOCs)

Generally, SVOCs are analyzed because their detection can indicate the presence of chemicals originating from anthropogenic sources which, if detected help in the evaluation of potential impacts on water quality. The only detected SVOC associated with the surface water sampling event on April 15, 2013 was di-n-octyl phthalate at site HCS 130. While it cannot be ruled out as being present in the water sample, it is also an extremely common compound used in plastics, cosmetics, and pesticides. The detected concentration of 1.67 µg/L was far below the PCL of 980 µg/L. For the October 7 and 9, 2013, sample event, bis(2-ethylhexyl)phthalate (DEPH) was noted in all the samples. The DEHP results are also noted in the laboratory blank samples and are considered likely post collection contaminants or false positive detections, as such they are not summarized below but can be reviewed in the analytical results section located in Appendix C. The April 15, 2013 di-n-octyl phthalate detection is summarized below. Phthalate compounds are generally very problematic to assess when detected.

- HCS 110 (April 15, 2013) – Di-n-octyl phthalate was detected at 1.67 J µg/L (PCL = 980 µg/L)
  Note: J = detection is above the method detection limit, but below the reporting limit.

Surface Water / Base Flow - Pesticides

Surface water samples were analyzed for pesticides because their detection can indicate the presence of chemicals originating from anthropogenic sources which, if detected help in the evaluation of potential impacts on water quality. No pesticides were detected for either the April or October 2013 sampling events at all five sites for the Comal Springs complex.

Surface Water / Base Flow - Herbicides

Surface water samples were analyzed for herbicides because their detection can indicate the presence of chemicals originating from anthropogenic sources which, if detected help in the evaluation of potential impacts on water quality. Herbicide analyses indicated no detections for both the April and October 2013 sampling events at all five sites for the Comal Springs complex.

Surface Water / Base Flow - Polychlorinated Biphenyls (PCBs)

Surface water samples were analyzed for the various Aroclor compounds that are collectively referred to as PCBs because their detection can indicate the presence of chemicals originating from anthropogenic sources which, if detected help in the evaluation of potential impacts on water quality. PCB analyses were non-detect for both the April and October 2013 sampling events at all five sites for the Comal Springs complex.

Surface Water / Base flow - Metals

Surface water samples were analyzed for metals because the detection of certain metals can indicate potential threats to water quality originating from anthropogenic sources. Although metals were detected for the April and October sampling events at all five sites for the Comal Springs complex, no metals of concern at a concentration in excess of the drinking water standards were noted. The metals arsenic, lead, mercury, and selenium were the detected metals of concern; however, none of the concentrations approached the MCL. These detections are listed below in Table 3, note all detections are “J” flagged, indicating the detected concentration is below the laboratory reporting limit, but above the method detection limit.

Table 3, Metals Detections for Surface Water Samples - Comal Springs Complex

Sample Name (Location)	Sample Date	Metal	Concentration (µg/L)	MCL (µg/L)
HCS 120	4/15/2013	Arsenic	1.40 J	10.0
HCS 110	4/15/2013	Lead	1.87 J	15.0
HCS 120	4/15/2013	Lead	1.92 J	15.0
HCS 130	4/15/2013	Lead	1.36 J	15.0
HCS 140	4/15/2013	Lead	1.51 J	15.0
HCS 140 FD	4/15/2013	Lead	1.43 J	15.0
HCS 160	4/15/2013	Lead	1.46 J	15.0
HCS 120	4/15/2013	Mercury	0.157 J	2.0
HCS 110	4/15/2013	Selenium	3.09 J	50.0
HCS 120	4/15/2013	Selenium	4.36 J	50.0
HCS 130	4/15/2013	Selenium	3.25 J	50.0
HCS 140	4/15/2013	Selenium	1.87 J	50.0
HCS 140 FD	4/15/2013	Selenium	1.31 J	50.0
HCS 160	4/15/2013	Selenium	1.70 J	50.0
HCS 140	10/9/2013	Selenium	1.4 J	50.0

Note: J = detection is above the method detection limit, but below the reporting limit.

Surface Water / Base Flow - Nitrates

Surface water samples were analyzed for nitrate-nitrite as nitrogen. Laboratory analyses indicated a limited range of nitrate-nitrite as nitrogen in surface water samples. Of the twelve surface water samples (ten environmental samples and two field duplicates) collected for the two sample events, concentrations ranged from 0.633 to 1.85 milligrams per liter (mg/L). None of the nitrate concentrations detected exceeds the MCL of 10 mg/L for drinking water. The highest nitrate concentration in surface water at the Comal Springs complex was 1.85 mg/L from HCS 130 sampled on April 15, 2013. Nitrate-nitrogen results are summarized in Table 4.

Table 4, Summary of Nitrate Detections for Surface Water Samples - Comal Springs Complex

Sample Name	Sample Date	Concentration (mg/L)
HCS 110	4/15/2013	1.22
HCS 120	4/15/2013	1.82
HCS 130	4/15/2013	1.85
HCS 140	4/15/2013	1.76
HCS 160	4/15/2013	1.74
HCS 110	10/7/2013	0.633 H
HCS 120	10/9/2013	1.68
HCS 130	10/9/2013	1.61
HCS 140	10/9/2013	1.6
HCS 160	10/9/2013	1.61
HCS 140 FD	4/15/2013	1.78
HCS 140 FD	10/9/2013	1.59

H – analyzed outside hold time, result included for comparison but not considered valid

COMAL SPRINGS SEDIMENT SAMPLING

Sediment - Volatile Organic Compounds (VOCs)

Few VOC detections were noted in the sediment samples collected at Comal Springs. Two compounds, acetone and 2-butanone were detected. Acetone was detected in four samples plus a field duplicate, while 2-butanone was only detected in one sample. Acetone is frequently suspect as a laboratory artifact due to its widespread use in the laboratory. The detection of 2-butanone (methyl ethyl ketone) is also somewhat suspect. This is a common solvent that is quite volatile. Additionally, the San Marcos sediment samples had similar detections of acetone and 2-butanone. While they cannot be ruled out as definite laboratory artifacts, these two compounds are suspected as such. Note also, all detections are “J” flagged, meaning the concentration is below the reporting limit, but above the method detection limit. The detected compounds are listed in Table 5, below for documentation, but not considered as confirmed detections. As the HCP data set grows, additional conclusions may be made regarding problematic compounds such as these.

Table 5, VOC Detections in Comal Sediment Samples

Sample Name (Location)	Sample Date	Compound	Concentration (μg/kg)	TEC/PEC
HCS 310	6/10/2013	Acetone	11.0 J	NE
HCS 320	6/10/2013	Acetone	12.8 J	NE
HCS 330	6/11/2013	Acetone	47.3 J	NE
HCS 330	6/11/2013	2-Butanone	11.6 J	NE
HCS 360	6/11/2013	Acetone	205 J	NE
HCS 330FD	6/11/2013	Acetone	29.6 J	NE

Note: J = detection is above the method detection limit, but below the reporting limit. NE indicates not established

Sediment - Semi-volatile Organic Compounds (SVOCs)
Generally, sediments are expected to contain some SVOCs if the sediments have been exposed to these compounds. In summarizing the sediment SVOC detections, any compounds suspected as laboratory artifacts are listed here in the text. Detected compounds of interest (polycyclic aromatic hydrocarbons, or PAHs) are discussed in detail. Suspected laboratory or sampling artifacts include DEHP, present in the five primary samples as well as the field duplicate. Detected concentrations of DEHP range from 25.2 µg/kg to 2,610 µg/kg. The other suspect compound detected in sediments is di-n-octyl phthalate at a concentration of 183 µg/kg, at location HCS 360.

The remaining SVOC detections are all PAH compounds. These detections are listed in Table 6 and further displayed as a graphic comparing the total PAH concentrations to the TEC and PEC values of MacDonald (2000). Note also that sample HCS 330 did not test positive for any PAH compounds; however, the field duplicate HCS 330 FD was positive for several PAH compounds. This may be due to collection of the duplicate from slightly different areas than the parent sample was collected from.

Table 6, Detected PAH Compounds Comal Springs Complex - Sediment Samples

Sample Name (Location)	Sample Date	Compound	Concentration (µg/kg)	TEC (µg/kg)	PEC (µg/kg)
HCS 310	6/10/2013	Pyrene	354 J	195	1,520
HCS 310	6/10/2013	Fluoranthene	546 J	423	2,230
HCS 310	6/10/2013	Phenanthrene	329 J	204	1,170
		Total PAH	**1,229**	**1,610**	**22,800**
HCS 320	6/10/2013	Anthracene	337 J	57.2	845
HCS 320	6/10/2013	Pyrene	2,730 J	195	1,520
HCS 320	6/10/2013	Benzo(g,h,I)perylene	829 J	NE	NE
HCS 320	6/10/2013	Indeno(1,2,3-cd)pyrene	738 J	NE	NE
HCS 320	6/10/2013	Benzo(b)fluoranthene	1,270 J	NE	NE
HCS 320	6/10/2013	Fluoranthene	2,950 J	423	2,230
HCS 320	6/10/2013	Benzo(k)fluoranthene	543 J	NE	NE
HCS 320	6/10/2013	Chrysene	1,170 J	166	1,290
HCS 320	6/10/2013	Benzo(a)pyrene	1,100 J	150	1,450
HCS 320	6/10/2013	Benzo(a)anthracene	1,150 J	108	1,050
HCS 320	6/10/2013	Phenanthrene	1,430 J	204	1,170
		Total PAH	**14,247**	**1,610**	**22,800**
HCS 360	6/10/2013	Anthracene	46.0 J	57.2	845
HCS 360	6/10/2013	Pyrene	669	195	1,520
HCS 360	6/10/2013	Benzo(g,h,I)perylene	311 J	NE	NE
HCS 360	6/10/2013	Indeno(1,2,3-cd)pyrene	259 J	NE	NE
HCS 360	6/10/2013	Benzo(b)fluoranthene	547 J	NE	NE
HCS 360	6/10/2013	Fluoranthene	754	423	2,230
HCS 360	6/10/2013	Benzo(k)fluoranthene	259 J	NE	NE
HCS 360	6/10/2013	Chrysene	437 J	166	1,290
HCS 360	6/10/2013	Benzo(a)pyrene	368 J	150	1,450
HCS 360	6/10/2013	Dibenz(a,h)anthracene	80.3 J	NE	NE
HCS 360	6/10/2013	Benzo(a)anthracene	320 J	108	1,050
HCS 360	6/10/2013	Phenanthrene	206 J	204	1,170
HCS 360	6/10/2013	Fluorene	71.2 J	77.4	536
		Total PAH	**4,327.5**	**1,610**	**22,800**

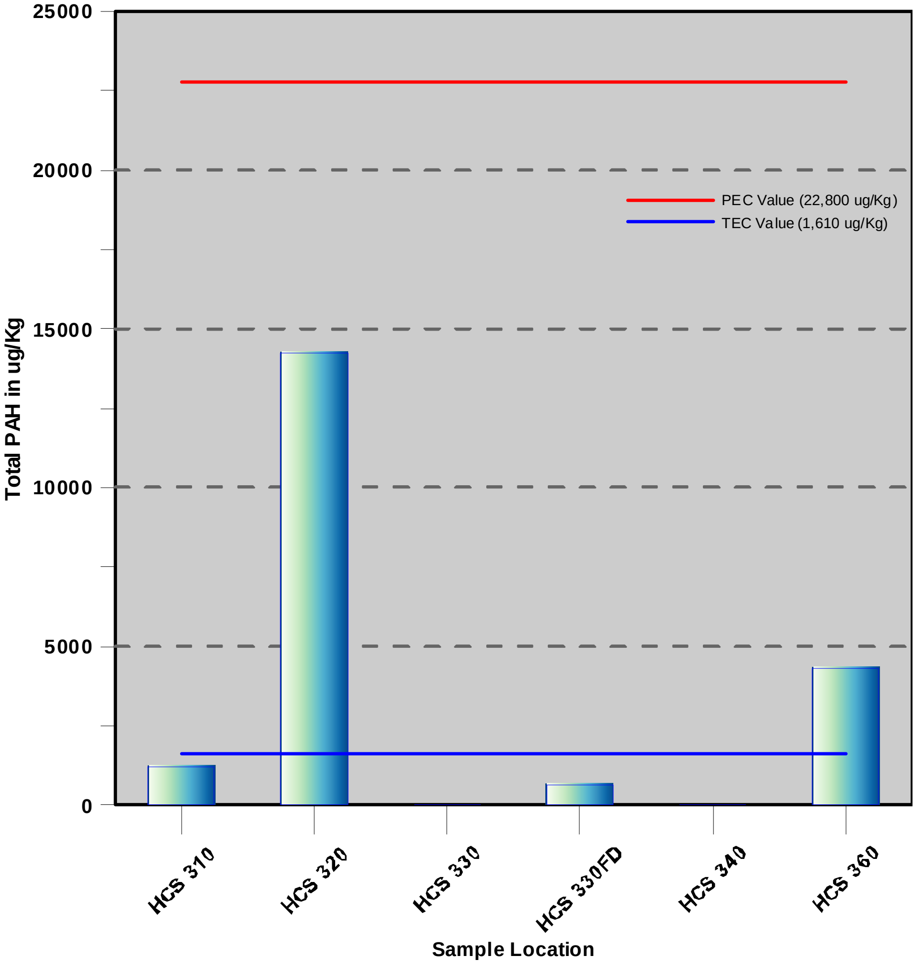
Table 6 (continued), Detected PAH Compounds Comal Springs Complex -, Sediment Samples

Sample Name (Location)	Sample Date	Compound	Concentration (µg/kg)	TEC (µg/kg)	PEC (µg/kg)
HCS 330FD	6/10/2013	Pyrene	105 J	195	1,520
HCS 330FD	6/10/2013	Benzo(g,h,I)perylene	55.9 J	NE	NE
HCS 330FD	6/10/2013	Indeno(1,2,3-cd)pyrene	44.2 J	NE	NE
HCS 330FD	6/10/2013	Benzo(b)fluoranthene	98.6 J	NE	NE
HCS 330FD	6/10/2013	Fluoranthene	109 J	423	2,230
HCS 330FD	6/10/2013	Benzo(k)fluoranthene	38.5 J	NE	NE
HCS 330FD	6/10/2013	Chrysene	77.0 J	166	1,290
HCS 330FD	6/10/2013	Benzo(a)pyrene	61.9 J	150	1,450
HCS 330FD	6/10/2013	Benzo(a)anthracene	58.6 J	108	1,050
		Total PAH	**648.7**	**1,610**	**22,800**

Note: J = detection is above the method detection limit, but below the reporting limit. NE indicates not established

PAH detections are shown below in Figure 11, where the total PAH concentrations are compared to the total TEC and PEC values for PAH concentration.

Figure 11, Comal Springs Sediment PAH Detections Compared to TEC and PEC values



Sediment - Pesticides

Sediment samples were analyzed for both organochlorine and organophosphorous pesticides. Due to the persistence of certain pesticide compounds their detection in sediment is not unusual. Pesticide detections in the Comal Springs complex sediment samples were generally low. None of the detections exceed the PEC value. Detected compounds are listed in Table 7, below and as a graph in Figure 12.

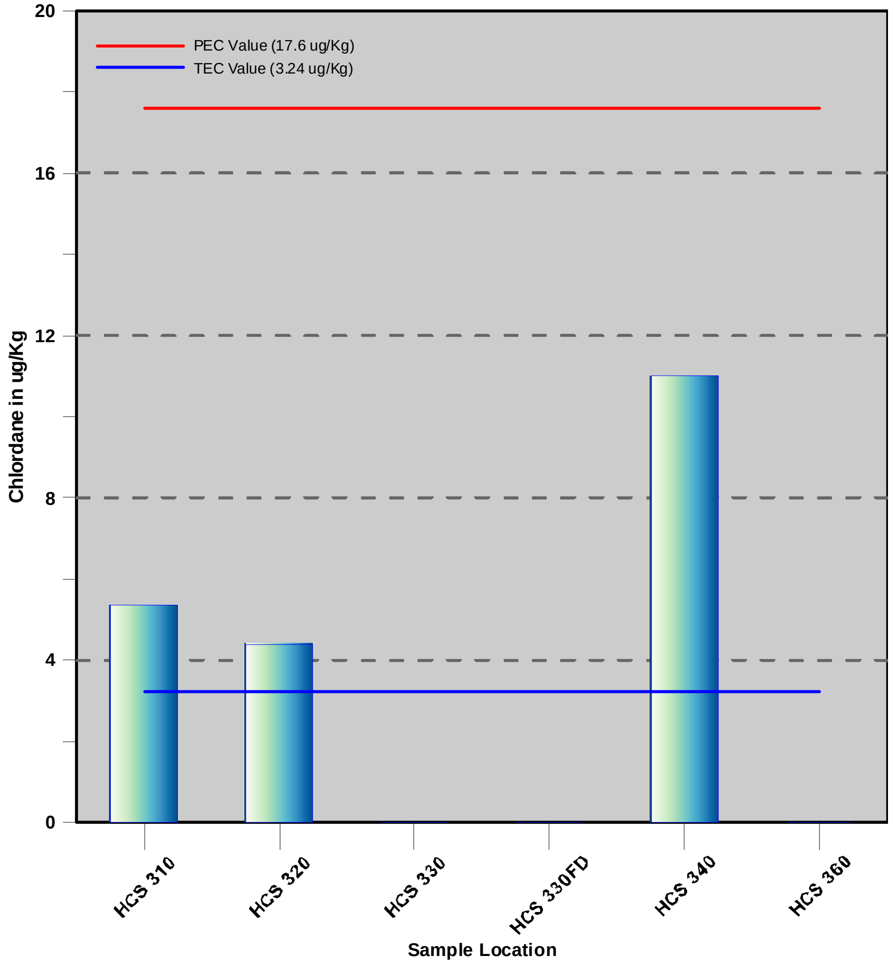
Table 7, Detected Pesticide Compounds Comal Springs Complex - Sediment Samples

Sample Name (Location)	Sample Date	Compound	Concentration (µg/kg)	TEC (µg/kg)	PEC (µg/kg)
HCS 310	6/10/2013	Chlordane (technical)	5.35 Jp	3.24	17.6
HCS 310	6/10/2013	alpha-Chlordane	0.531 J	NE	NE
HCS 310	6/10/2013	gamma-Chlordane	0.611 Jp	NE	NE
HCS 310	6/10/2013	Dieldrin	0.205 J	1.90	61.8
HCS 310	6/10/2013	4,4'-DDE	1.36 J	3.16	31.3
HCS 310	6/10/2013	4,4'-DDD	0.922 J	4.88	28.0
HCS 320	6/10/2013	alpha-Chlordane	0.0956 J	NE	NE
HCS 320	6/10/2013	Chlordane (technical)	4.39 J	3.24	17.6
HCS 320	6/10/2013	gamma-Chlordane	0.24 Jp	NE	NE
HCS 320	6/10/2013	4,4'-DDD	0.196 J	4.88	28.0
HCS 320	6/10/2013	4,4'-DDE	0.213 Jp	3.16	31.3
HCS 340	6/10/2013	Chlordane (technical)	11.0 J	3.24	17.6
HCS 340	6/10/2013	Dieldrin	0.534 J	1.90	61.8
HCS 340	6/10/2013	4,4'-DDD	0.697 J	4.88	28.0
HCS 340	6/10/2013	gamma-Chlordane	0.675 Jp	NE	NE
HCS 340	6/10/2013	4,4'-DDE	1.56 J	3.16	31.3
HCS 360	6/10/2013	gamma-Chlordane	0.466 Jp	NE	NE
HCS 360	6/10/2013	Dieldrin	0.310 Jp	1.90	61.8
HCS 360	6/10/2013	4,4'-DDE	1.14 Jp	3.16	31.3

Note: J = detection is above the method detection limit, but below the reporting limit. NE indicates not established, p indicates the lower value between the detection column and confirmation column is reported

In Figure 12 the TEC and PEC values are compared to the detected concentrations of chlordane in the sediment samples. Note, for the chlordane results, total chlordane values are used (sum of all chlordane species) for comparison to the TEC and PEC values. No specific values for alpha, beta, or gamma chlordane are listed with a TEC or PEC value, only a value for total chlordane is provided. As such, for construction of the graph all chlordane detections are summed for comparison to the standard. All other pesticide detections are below the TEC value (DDD and DDE) and are not graphed.

Figure 12, Comal Springs Sediment Chlordane Detections Compared to TEC and PEC values



Sediment - Herbicides

Sediments were analyzed for herbicide compounds to further assess sediment quality at the Comal Springs complex. No herbicides were detected from the Comal Springs complex sediment samples collected, using method SW 8151A.

Sediment - Polychlorinated Bi-phynels

Sediments were analyzed for PCB compounds to further assess sediment quality at the Comal Springs complex. The PCB compounds Aroclor 1260 and Aroclor 1254 were detected at very low concentrations in sediment sample HCS 360. Aroclor 1260 was detected at 0.0206 µg/kg, while Aroclor 1254 was detected at 0.0266 µg/kg. Total PCBs at HCS 360 were 0.0472 µg/kg. The corresponding TEC and PEC values for total PCBs in sediment are 59.8 and 676 µg/kg respectively. On the basis of sediment toxicity values derived by MacDonald et al. (2000), for the sediments sampled at the Comal Springs complex, it does not appear that any toxic effect from PCBs is present in the sediments sampled. Future sampling may indicate differently.

Sediment - Metals

Sediment samples are generally expected to exhibit higher concentrations of metals (and other compounds) than water samples. Sediment sample results for metals at the Comal Springs complex tested positive for several metals, generally at low concentrations. Metals detected above the method detection limit and subsequently evaluated in this report for potential toxic effects using the TEC and PEC standards are: arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc. Other metals detected that do not have a TEC or PEC value available are: aluminum, barium, beryllium, calcium, iron, magnesium, potassium, selenium, silicon, silver, sodium, and thallium. Of these metals, aluminum, barium, beryllium, and selenium, were compared to Texas-specific soil background concentrations (30 TAC 350). Only selenium appears above the listed background concentration of 0.3 mg/kg. The metal silver was evaluated against the New York State Department of Environmental Conservation's published standards for evaluating sediment quality (NYSDEC, 1999). Silver was detected below this published standard of 1.0 mg/kg (TEC). Metal detections are listed in Table 8 below. Metals with detections above an established TEC or PEC value are displayed graphically in Figures 13, 14, and 15, for cadmium, lead, and nickel respectively. Cadmium is the only metal detected above a PEC value, at location HCS 340.

Table 8, Detected Metal Comal Springs Complex - Sediment Samples

Sample Name (Location)	Sample Date	Compound	Concentration (mg/kg)	TEC (mg/kg)	PEC (mg/kg)
HCS 310	6/10/2013	Aluminum	532	NE	NE
HCS 310	6/10/2013	Arsenic	2.05	9.79	33.0
HCS 310	6/10/2013	Barium	6.68	NE	NE
HCS 310	6/10/2013	Beryllium	0.0675 J	NE	NE
HCS 310	6/10/2013	Cadmium	0.0773 J	0.99	4.98
HCS 310	6/10/2013	Calcium	299,000	NE	NE
HCS 310	6/10/2013	Chromium	2.17	43.4	111
HCS 310	6/10/2013	Copper	1.88	31.6	149
HCS 310	6/10/2013	Iron	1140	NE	NE
HCS 310	6/10/2013	Lead	3.99	35.8	128
HCS 310	6/10/2013	Magnesium	1730	NE	NE
HCS 310	6/10/2013	Manganese	25.7	NE	NE
HCS 310	6/10/2013	Nickel	4.17	22.7	48.6
HCS 310	6/10/2013	Silicon	256	NE	NE
HCS 310	6/10/2013	Sodium	26.0 J	NE	NE
HCS 310	6/10/2013	Strontium	146	NE	NE
HCS 310	6/10/2013	Zinc	32.5	121	459
HCS 320	6/10/2013	Aluminum	1810	NE	NE
HCS 320	6/10/2013	Arsenic	1.03 J	9.79	33.0
HCS 320	6/10/2013	Barium	26.4	NE	NE
HCS 320	6/10/2013	Calcium	162000	NE	NE
HCS 320	6/10/2013	Chromium	4.79	43.4	111
HCS 320	6/10/2013	Iron	2550	NE	NE
HCS 320	6/10/2013	Lead	5.59	35.8	128
HCS 320	6/10/2013	Magnesium	2120	NE	NE
HCS 320	6/10/2013	Manganese	45.4	NE	NE
HCS 320	6/10/2013	Mercury	0.0119 J	0.18	1.06
HCS 320	6/10/2013	Nickel	3.48 J	22.7	48.6
HCS 320	6/10/2013	Selenium	0.885 J	NE	NE

Table 8 (continued), Detected Metal Comal Springs Complex - Sediment Samples

Sample Name (Location)	Sample Date	Compound	Concentration (mg/kg)	TEC (mg/kg)	PEC (mg/kg)
HCS 320	6/10/2013	Silicon	293	NE	NE
HCS 320	6/10/2013	Sodium	334	NE	NE
HCS 320	6/10/2013	Strontium	300	NE	NE
HCS 320	6/10/2013	Zinc	12.1	121	459
HCS 330	6/11/2013	Aluminum	11600	NE	NE
HCS 330	6/11/2013	Arsenic	4.96	9.79	33.0
HCS 330	6/11/2013	Barium	61.3	NE	NE
HCS 330	6/11/2013	Beryllium	0.924	NE	NE
HCS 330	6/11/2013	Cadmium	0.643	0.99	4.98
HCS 330	6/11/2013	Calcium	156000	NE	NE
HCS 330	6/11/2013	Chromium	12.5	43.4	111
HCS 330	6/11/2013	Copper	8.20 J	31.6	149
HCS 330	6/11/2013	Iron	10000	NE	NE
HCS 330	6/11/2013	Lead	11.4	35.8	128
HCS 330	6/11/2013	Magnesium	4090	NE	NE
HCS 330	6/11/2013	Manganese	212	NE	NE
HCS 330	6/11/2013	Nickel	13.2	22.7	48.6
HCS 330	6/11/2013	Potassium	1690	NE	NE
HCS 330	6/11/2013	Selenium	1.07	NE	NE
HCS 330	6/11/2013	Silicon	352	NE	NE
HCS 330	6/11/2013	Sodium	37 J	NE	NE
HCS 330	6/11/2013	Strontium	221	NE	NE
HCS 330	6/11/2013	Thallium	0.184 J	NE	NE
HCS 330	6/11/2013	Zinc	25.0 J	121	459
HCS 330FD	6/11/2013	Aluminum	8050	NE	NE
HCS 330FD	6/11/2013	Arsenic	5.48	9.79	33.0
HCS 330FD	6/11/2013	Barium	66.6	NE	NE
HCS 330FD	6/11/2013	Beryllium	0.878	NE	NE
HCS 330FD	6/11/2013	Cadmium	0.277 J	0.99	4.98
HCS 330FD	6/11/2013	Calcium	97100	NE	NE
HCS 330FD	6/11/2013	Chromium	15.9	43.4	111
HCS 330FD	6/11/2013	Copper	8.61	31.6	149
HCS 330FD	6/11/2013	Iron	10100	NE	NE
HCS 330FD	6/11/2013	Lead	16.3	35.8	128
HCS 330FD	6/11/2013	Magnesium	2870	NE	NE
HCS 330FD	6/11/2013	Manganese	203	NE	NE
HCS 330FD	6/11/2013	Nickel	13.6	22.7	48.6
HCS 330FD	6/11/2013	Potassium	1460	NE	NE
HCS 330FD	6/11/2013	Selenium	0.859	NE	NE
HCS 330FD	6/11/2013	Silicon	525	NE	NE
HCS 330FD	6/11/2013	Silver	0.120 J	1.0	2.2

Table 8 (continued), Detected Metal Comal Springs Complex - Sediment Samples

Sample Name (Location)	Sample Date	Compound	Concentration (mg/kg)	TEC (mg/kg)	PEC (mg/kg)
HCS 330FD	6/11/2013	Sodium	121	NE	NE
HCS 330FD	6/11/2013	Strontium	145	NE	NE
HCS 330FD	6/11/2013	Thallium	0.183 J	NE	NE
HCS 330FD	6/11/2013	Zinc	24.6	121	459
HCS 340	6/10/2013	Aluminum	1940	NE	NE
HCS 340	6/10/2013	Arsenic	6.48	9.79	33.0
HCS 340	6/10/2013	Barium	34.7	NE	NE
HCS 340	6/10/2013	Cadmium	12.2	0.99	4.98
HCS 340	6/10/2013	Calcium	299000	NE	NE
HCS 340	6/10/2013	Chromium	7.10 J	43.4	111
HCS 340	6/10/2013	Copper	8.57 J	31.6	149
HCS 340	6/10/2013	Iron	4260	NE	NE
HCS 340	6/10/2013	Lead	10	35.8	128
HCS 340	6/10/2013	Magnesium	2410	NE	NE
HCS 340	6/10/2013	Manganese	55.3	NE	NE
HCS 340	6/10/2013	Mercury	0.0230 J	0.18	1.06
HCS 340	6/10/2013	Nickel	27.1	22.7	48.6
HCS 340	6/10/2013	Potassium	505	NE	NE
HCS 340	6/10/2013	Selenium	4.20 J	NE	NE
HCS 340	6/10/2013	Silicon	340	NE	NE
HCS 340	6/10/2013	Sodium	313	NE	NE
HCS 340	6/10/2013	Strontium	357	NE	NE
HCS 340	6/10/2013	Zinc	21.2	121	459
HCS 360	6/11/2013	Aluminum	5660	NE	NE
HCS 360	6/11/2013	Arsenic	3.91	9.79	33.0
HCS 360	6/11/2013	Barium	59.9	NE	NE
HCS 360	6/11/2013	Beryllium	0.571	NE	NE
HCS 360	6/11/2013	Cadmium	0.322 J	0.99	4.98
HCS 360	6/11/2013	Calcium	368000	NE	NE
HCS 360	6/11/2013	Chromium	12.5	43.4	111
HCS 360	6/11/2013	Copper	12.8	31.6	149
HCS 360	6/11/2013	Iron	6560	NE	NE
HCS 360	6/11/2013	Lead	36.7	35.8	128
HCS 360	6/11/2013	Magnesium	2460	NE	NE
HCS 360	6/11/2013	Manganese	122	NE	NE
HCS 360	6/11/2013	Nickel	8.72	22.7	48.6
HCS 360	6/11/2013	Potassium	1040	NE	NE
HCS 360	6/11/2013	Selenium	1.23	NE	NE
HCS 360	6/11/2013	Silicon	1320	NE	NE
HCS 360	6/11/2013	Silver	0.103 J	1.0	2.2
HCS 360	6/11/2013	Sodium	276	NE	NE

Table 8 (continued), Detected Metal Comal Springs Complex - Sediment Samples

Sample Name (Location)	Sample Date	Compound	Concentration (mg/kg)	TEC (mg/kg)	PEC (mg/kg)
HCS 360	6/11/2013	Strontium	200	NE	NE
HCS 360	6/11/2013	Thallium	0.207 J	NE	NE
HCS 360	6/11/2013	Zinc	71.9	121	459

Note: J = detection is above the method detection limit, but below the reporting limit. NE indicates not established, p indicates the lower value between the detection column and confirmation column is reported

Figure 13, Cadmium in Comal Springs Complex Sediments Compared to the TEC and PEC Values

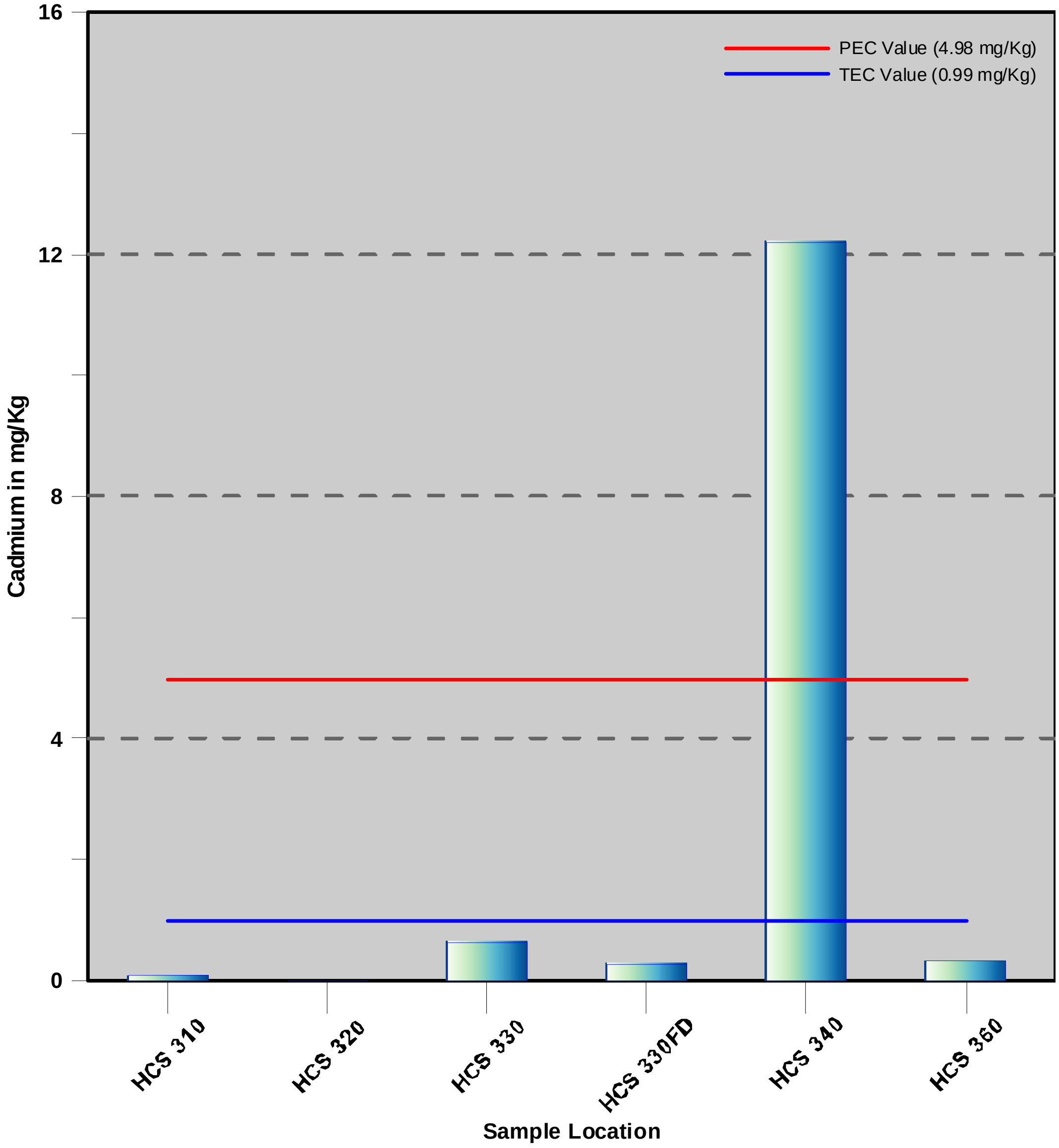


Figure 14, Lead in Comal Springs Complex Sediments Compared to the TEC and PEC Values

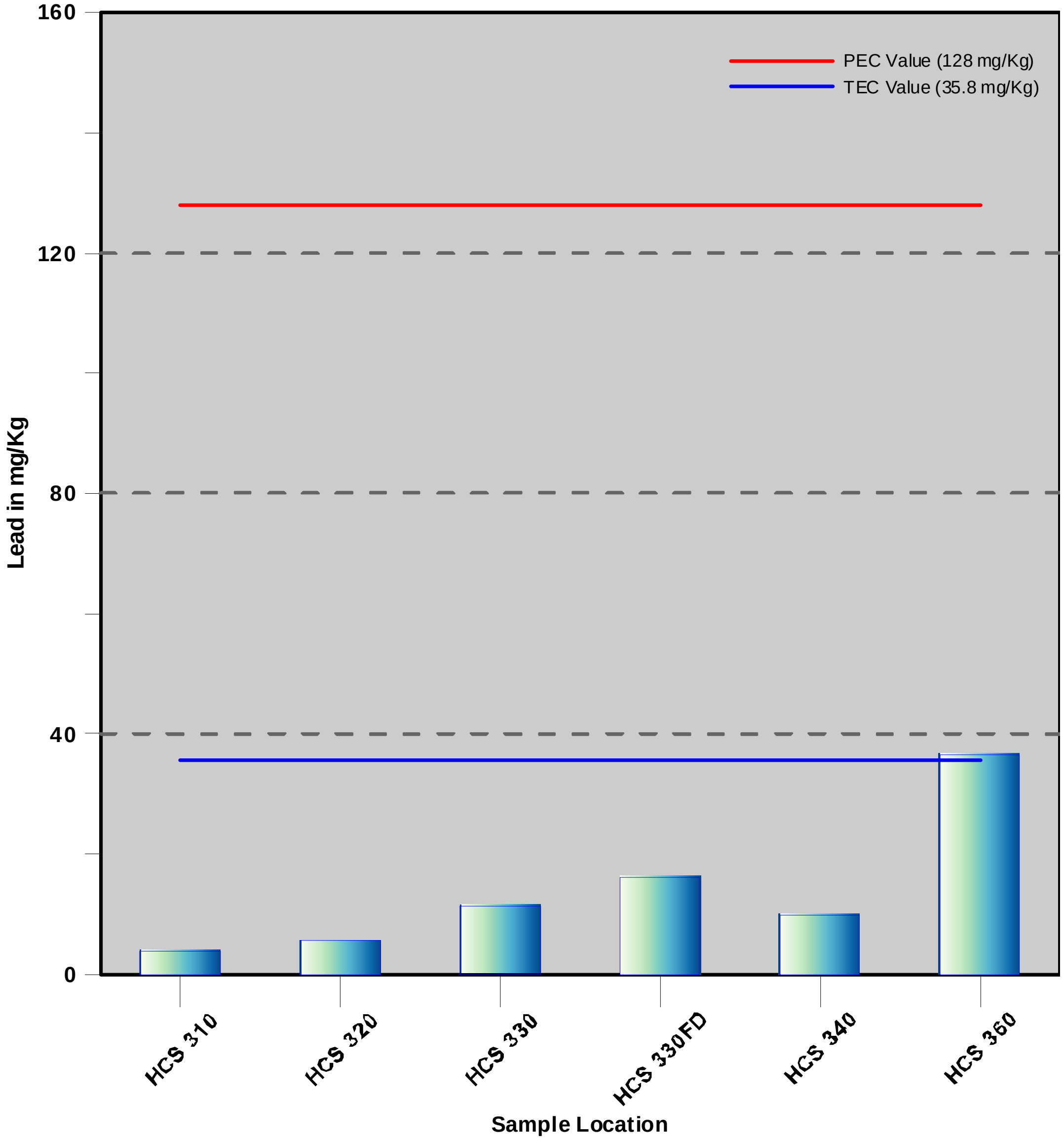
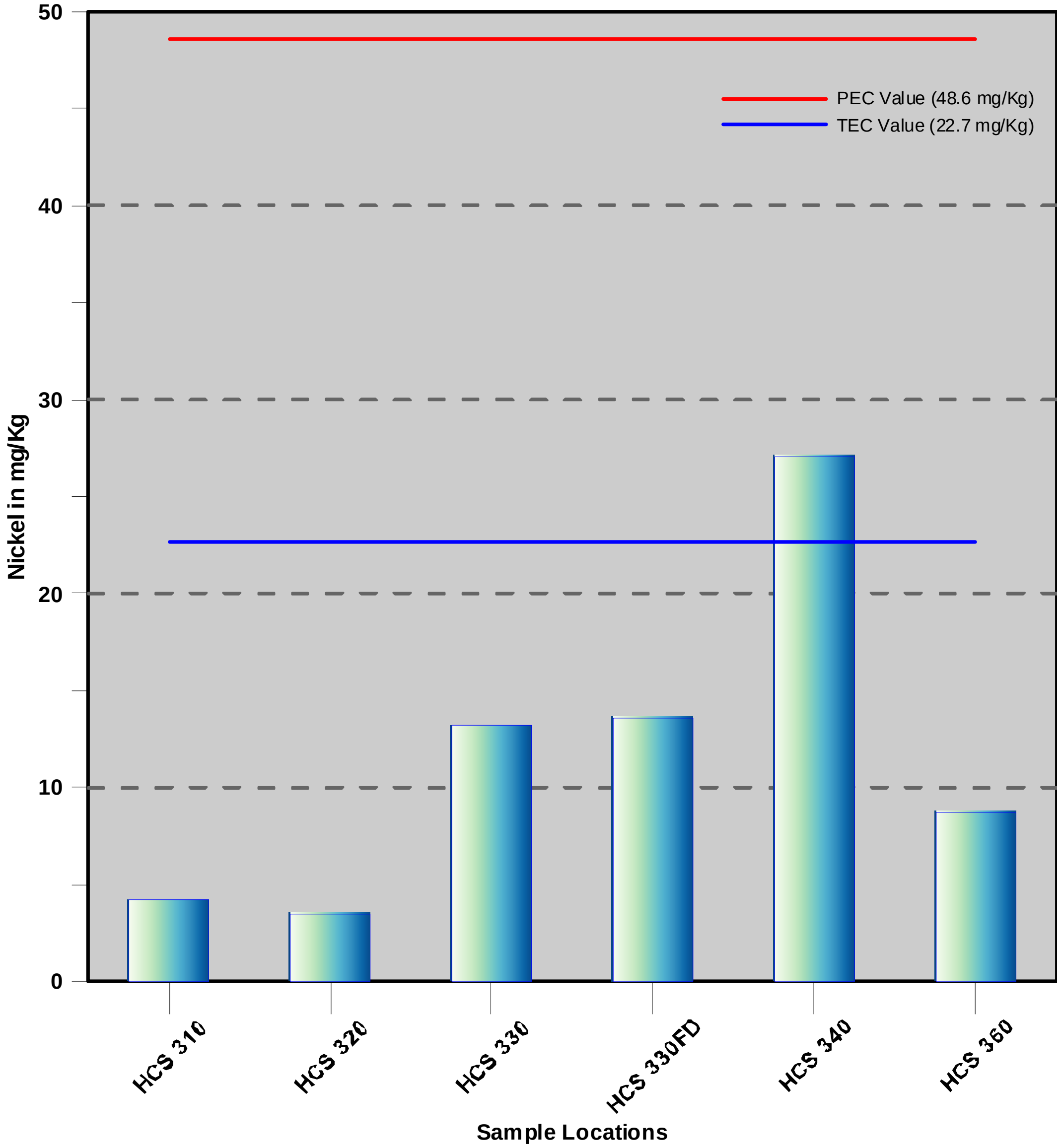


Figure 15, Nickel in Comal Springs Complex Sediments Compared to the TEC and PEC Values



COMAL SPRINGS STORM WATER SAMPLING

Storm water samples were collected during two storm events at the Comal Springs complex. Each event was sampled according to the guidelines in the EAHCP workplan. Event one occurred on July 15, 2013. Total rainfall for the first event was just below one-inch. The second event occurred on October 13, 2013, also with just under one-inch of rainfall. While both sampling events are considered minimal runoff events, given the on-going drought across the region, the decision was made that it was more preferable to obtain samples than to risk not capturing two storm water sampling events for the year.

During the July event, one sample set was destroyed by accident, sample HCS 260-3, collected 7/15/2013 was inadvertently destroyed and not analyzed. This was due to collection of sample set HCS 250 from the adjacent drainage channel rather than the actual “Comal River old channel” as the workplan indicates (see deviations from workplan in Appendix G). The intent was to destroy the incorrectly located sample; however, sample HCS 260-3 was destroyed by mistake. The result is a total of 32 Comal Springs related storm water samples (including duplicates).

Storm water - Bacteria Detections

Storm water samples collected and analyzed for bacteria analyses generally tested positive for high levels of bacteria. Bacterial analyses was performed for E. Coli, using a most probable number method. Bacteria counts ranged from 5,800 to 82,000 mpn/100 ml for the July 15, 2013 sample event, and from 98 to 20,000 mpn/100 ml for the October 13, 2013 sample event. Bacterial detections are listed below in Table 9.

Table 9, Bacteria Detections in Comal Springs Complex Storm water Samples

Location	Date Sampled	Time Sampled	E-coli MPN/100ml
HCS 210	7/15/2013	16:38	13000
HCS 210	7/15/2013	17:44	16000
HCS 210	7/15/2013	20:25	12000
HCS 210 FD	7/15/2013	21:00	12000
HCS 240	7/15/2013	16:30	82000
HCS 240	7/15/2013	17:40	9200
HCS 240	7/15/2013	21:30	13000
HCS 250	7/15/2013	17:00	73000
HCS 250	7/15/2013	18:00	20000
HCS 250	7/15/2013	22:40	12000
HCS 260	7/15/2013	17:15	18000
HCS 260	7/15/2013	18:11	33000
HCS 260	7/15/2013	22:00	5800
HCS 270	7/15/2013	17:20	77000
HCS 270	7/15/2013	18:15	31000
HCS 270	7/15/2013	23:10	24000
HCS 210-1	10/13/2013	8:10	6100
HCS 210-2	10/13/2013	10:20	9200
HCS 210-3	10/13/2013	13:30	20000
HCS 240-1	10/13/2013	8:45	770
HCS 240-2	10/13/2013	10:50	1300
HCS 240-3	10/13/2013	14:15	820
HCS 240-3FD	10/13/2013	14:45	600
HCS 250-1	10/13/2013	9:15	2000
HCS 250-2	10/13/2013	11:10	2000
HCS 250-3	10/13/2013	13:20	1600
HCS 260-1	10/13/2013	9:15	NA*
HCS 260-2	10/13/2013	10:23	14000
HCS 260-3	10/13/2013	14:10	1200
HCS 270-1	10/13/2013	8:05	14000
HCS 270-2	10/13/2013	10:35	11000
HCS 270-2FD	10/13/2013	11:00	9200
HCS 270-3	10/13/2013	14:30	98

Note: NA indicates not analyzed,

Storm Water - Volatile Organic Compounds, (VOCs)

Storm water samples collected and analyzed for VOCs were generally non-detect for these compounds. Of the 32 total samples collected for the two storm water events at Comal Springs, two sample points tested positive for a total of two VOC analytes. These particular detections are solvent compounds and are summarized below. The compound acetone was also detected in the trip blank, potentially indicating the likely hood the acetone detection is a laboratory artifact.

- HCS 250 on (7/15/2013) at 6:00 pm – 4-methyl-2-pentanone detected at 1.10 J µg/L
- HCS 250 on (7/15/2013) at 6:00 pm – acetone detected at 6.18 J µg/L
- HCS 250 on (7/15/2013) at 5:00 pm – 4-methyl-2-pentanone detected at 0.505 J µg/L
- HCS 250 on (7/15/2013) at 5:00 pm – acetone detected at 8.07 J µg/L
- HCS 270 on (7/15/2013) at 5:20 pm – acetone detected at 8.00 J µg/L

Note: J = detection is above the method detection limit, but below the reporting limit.
No MCL values are established for these compounds, the corresponding PCL value is 1,950 µg/L for 4-methyl-2-pentanone, and 22,000 µg/L for acetone.

Storm Water - Semi-volatile Organic Compounds (SVOCs)

Storm water samples collected and analyzed for SVOCs were generally non-detect for these compounds, with the exception of several phthalate detections, no SVOCs were noted in the results. The phthalate compounds DEHP, diethyl phthalate, and butyl benzyl phthalate were detected. In general these compounds are quite problematic in that they are common in plastics and other materials. Often they are categorized as laboratory or sampling artifacts. However, for the record, phthalate compounds not co-detected in the laboratory blank sample (b-flagged), are listed in Table 10.

Table 10, SVOC Detections in Comal Springs Complex Storm water Samples

Sample Name (Location)	Sample Date / Time	SVOC	Concentration (µg/L)	MCL (µg/L)
HCS 240	7/15/13 4:30 PM	bis(2-ethylhexyl)phthalate	5.45 J	6.0
HCS 210	7/15/13 4:35 PM	bis(2-ethylhexyl)phthalate	8.26 J	6.0
HCS 210	7/15/13 4:35 PM	Diethyl phthalate	0.770 J	20,000*
HCS 210	7/15/13 4:35 PM	Butyl benzyl phthalate	3.83 J	480*
HCS 260	7/15/13 5:11 PM	bis(2-ethylhexyl)phthalate	3,220	6.0
HCS 270	7/15/13 5:20 PM	bis(2-ethylhexyl)phthalate	7.92 J	6.0
HCS 210	7/15/13 5:41 PM	bis(2-ethylhexyl)phthalate	11.0 J	6.0
HCS 210	7/15/13 5:41 PM	Diethyl phthalate	0.800 J	20,000*
HCS 210	7/15/13 5:41 PM	Butyl benzyl phthalate	3.57 J	480*
HCS 250	7/15/13 6:00 PM	bis(2-ethylhexyl)phthalate	8.90 J	6.0
HCS 250	7/15/13 6:00 PM	Butyl benzyl phthalate	2.79 J	480*
HCS 260	7/15/13 6:10 PM	bis(2-ethylhexyl)phthalate	11.1 J	6.0
HCS 270	7/15/13 6:15 PM	bis(2-ethylhexyl)phthalate	24.3 J	6.0
HCS 210	7/15/13 8:25 PM	bis(2-ethylhexyl)phthalate	7.71 J	6.0

Note: J = detection is above the method detection limit, but below the reporting limit.
** = no MCL values are established for these compounds, PCL value is referenced*

Storm Water - Herbicides and Pesticides

Of the 32 samples analyzed for pesticide compounds associated with the Comal Springs complex storm water sampling, two pesticide compounds were detected, at two locations. One location tested positive for pentachlorophenol in three samples (during one event), and another location tested positive for coumaphos one time. These detections are summarized below.

- HCS 210 on (7/15/2013) at 5:41 pm, pentachlorophenol detected at 0.138 J µg/L
- HCS 210 on (7/15/2013) at 8:25 pm, pentachlorophenol detected at 0.0789 J µg/L
- HCS 210-Duplicate on (7/15/2013) at 9:00 pm, pentachlorophenol detected at 0.0723 J µg/L
- HCS 270-2 on (10/13/13) at 10:35 am, coumaphos detected at 0.111 J µg/L
  Note: J = detection is above the method detection limit, but below the reporting limit.
  Pentachlorophenol MCL = 1.0 µg/L, coumaphos PCL = 170 µg/L

Storm Water - Polychlorinated Biphynels (PCBs)

Storm water samples were analyzed for the various Aroclor compounds that are generally referred to collectively as PCBs. None of the storm water samples from the Comal Springs complex indicated positive detections of PCBs compounds.

Storm Water - Metals

Storm water samples were analyzed for metals in accordance with the EAHCP workplan. Several positive metal detections were noted in the sample set; however, only one sample detected a metal at a concentration in excess of the drinking water MCL. The metal arsenic was detected in HCS 210 (7/15/2013, 8:25 pm) at a concentration of 11.4 µg/L. The MCL for arsenic in drinking water is 10 µg/L.

Storm Water - Nitrates

Storm water samples were analyzed for nitrate-nitrite as nitrogen in accordance with the EAHCP workplan. All samples detected nitrate results below the MCL of 10 mg/L. The range of nitrate results was 0.0381 – 1.71 mg/L in the sample set. The nitrate values in storm water for both sample events average 1.19 mg/L, whereas the average nitrate in spring water samples at Comal Springs for calendar 2012 was 2.01 mg/L. Note that routine water quality data collected by the EAA in 2012 for Comal Springs is provided in Appendix I (the EA Hydrologic Data Report for 2012).

SAN MARCOS SPRINGS SAMPLE RESULTS

The surface waters associated with the San Marcos Springs complex were sampled for base flow conditions in April and October of 2013. In general, few detections were noted. As discussed previously, surface water samples are compared to the drinking water standards for water quality in this report.

Sediments at the San Marcos Springs complex were sampled in June 2013. Sediment results are compared to the standards developed by McDonald et al. (2000). These standards are based on the probability of a detected compound having a toxic effect on sediment dwelling organisms and are referred to as the TEC and PEC. Detections below the TEC are not considered to be toxic, while detections above the PEC are considered to be toxic to sediment dwelling organisms. Detections above the TEC but less than the PEC are considered to be equally likely to be toxic or non-toxic.

Storm water events were sampled at the San Marcos Springs complex in August and October of 2013. Storm water results did not indicate a significant number of detections of concern. Bacteria results were perhaps the most significant detections associated with the storm water sampling.

SAN MARCOS SPRINGS SURFACE WATER / BASE FLOW SAMPLING

The San Marcos Springs complex was sampled on April 16, May 21, and October 8, 2013 for surface water / base flow events. The odd sample date of May 21, 2013 is due to a problem at the laboratory with the original April 16, 2013 samples for sites HSM 110 and HSM 120. The decision was made to completely resample these two sites and submit them for re-analyses rather than have a partial analyses from two sample dates for these sites. As such, the original sample from April 16, 2013 was discarded and recollected for HSM 110 and HSM 120 on May 21, 2013.

Surface Water / Base flow - Bacteria

Bacteria results for surface water associated with the San Marcos Springs complex ranged from two MPN/100 mL through 150 MPN/100 mL for E. Coli. Because of the presence of various fauna in surface water collection sites, positive detections are not uncommon. Surface water bacteria detections are summarized in Table 11. Note, sites HSM 110 and HSM 120 were analyzed for bacteria prior to the resampling effort for these two sites. As such, two additional bacteria analyses are included for these two locations.

Table 11, Bacteria Detections in San Marcos Springs Complex Surface Water Samples

Location	Date Sampled	Time Sampled	E-coli MPN/100 ml
HSM 110	4/16/2013	9:35 am	2
HSM 120	4/16/2013	10:00 am	22
HSM 130	4/16/2013	10:30 am	99
HSM 140	4/16/2013	11:15 am	93
HSM 150	4/16/2013	11:50 am	63
HSM 160	4/16/2013	12:45 pm	81
HSM 160 FD	4/16/2013	12:45 pm	93
HSM 170	4/16/2013	1:40 pm	150
HSM 110	5/21/2013	2:25 pm	3
HSM 120	5/21/2013	2:55 pm	26
HSM 110	10/8/2013	9:25 am	12
HSM 130	10/8/2013	10:00 am	150
HSM 120	10/8/2013	10:25 am	32
HSM 120FD	10/8/2013	10:25 am	32
HSM 140	10/8/2013	11:20 am	96
HSM 150	10/8/2013	1:15 pm	52
HSM 160	10/8/2013	1:40 pm	45
HSM 170	10/8/2013	2:10pm	70

Surface Water / Base Flow - Volatile Organic Compounds (VOCs)

The majority of samples did not test positive for VOCs during the surface water sampling events. However, for the May 21, 2013 event, sample site HSM 110 tested positive for carbon disulfide at 1.78 J µg/L. No additional VOC detections were noted for the San Marcos surface water sampling events. Carbon disulfide does not have an MCL, however, it does have a risk based protective concentration level (PCL) for groundwater of 2,400 µg/L.

Surface Water / Base Flow - Semi-volatile Organic Compounds (SVOCs)

Generally, SVOCs are analyzed because their detection can indicate the presence of chemicals originating from anthropogenic sources which, if detected help in the evaluation of potential impacts on water quality. The only detected SVOC associated with the surface water sampling events occurred on October 8, 2013.

The compound detected was diethyl phthalate at site HSM 130. While it cannot be ruled out as being present in the water sample, it is also an extremely common compound used in plastics, cosmetics, and pesticides. The detected concentration of 2.98 J µg/L was far below the PCL value of 980 µg/L. For the October 8, 2013, sample event, bis(2-ethylhexyl)phthalate (DEHP) was noted in all the samples. These DEHP results are also noted in the laboratory blank samples and are considered likely post collection, as such they are not summarized below but can be reviewed in the analytical results section located in Appendix C. The diethyl phthalate detection is summarized below. Phthalate compounds are very problematic to assess.

- HSM 130 (October 8, 2013) – Diethyl phthalate was detected at 2.98 J µg/L (PCL = 980 µg/L)
  Note: J = detection is above the method detection limit, but below the reporting limit.

Surface Water / Base Flow - Pesticides

Surface water samples were analyzed for pesticides because their detection can indicate the presence of chemicals originating from anthropogenic sources which, if detected help in the evaluation of potential impacts on water quality. The pesticide compound gamma-BHC was detected during the April sample event. This compound is detected at a very low concentration, and is a fairly rare compound as it is no longer used as a pesticide, but still has some pharmaceutical applications. Future sampling will help to ascertain if this detection is linked to a potential source, or if it is merely a transient detection, or laboratory artifact. Note too, this compound was detected in the associated equipment blank.

- HSM 170 (April 16, 2013) – Gamma-BHC detected at 0.00124 J µg/L (PCL = 0.5 µg/L)
  Note: J = detection is above the method detection limit, but below the reporting limit

Surface Water / Base flow - Herbicides

Surface water samples were analyzed for herbicides because their detection can indicate the presence of chemicals originating from anthropogenic sources which, if detected help in the evaluation of potential impacts on water quality. Herbicide analyses were non-detect for the April, May and October, 2013 sampling events at all seven sites for the San Marcos Springs complex.

Surface Water / Base Flow - Polychlorinated Biphynels (PCBs)

Surface water samples were analyzed for the various Aroclor compounds that are generally referred to collectively as PCBs. PCBs are sampled because their detection can indicate the presence of chemicals originating from anthropogenic sources which, if detected help in the evaluation of potential impacts on water quality. PCB analyses were non-detect for the April, May and October, 2013 sampling events at all seven sites for the San Marcos Springs complex.

Surface Water / Base Flow - Metals

Surface water samples were analyzed for metals because the detection of certain metals can indicate potential threats to water quality originating from anthropogenic sources. Although metals were detected for the April, May and October sampling events at all seven sites for the San Marcos Springs complex, no metals of concern were noted at a concentration in excess of the drinking water standards. The metals arsenic, copper, lead, mercury, and selenium were the most significant detections; however, none of the concentrations were close to a regulatory standard. These detections are listed below in Table 12, note all detections except copper are “J” flagged, indicating the detected concentration is below the laboratory reporting limit, but above the method detection limit. Site HSM 110 and 120, both had arsenic detections at low levels for both sample events.

Table 12, Metals Detections for Surface Water Samples, San Marcos Springs Complex

Sample Name (Location)	Sample Date	Metal	Concentration (µg/L)	MCL (µg/L)
HSM 110	10/8/2013	Arsenic	4.64 J	10.0
HSM 120	10/8/2013	Arsenic	2.14 J	10.0
HSM 110	5/21/2013	Arsenic	1.84 J	10.0
HSM 120	5/21/2013	Arsenic	1.31 J	10.0
HSM 120	10/8/2013	Copper	97.2	1,300*
HSM 160	10/8/2013	Lead	1.46 J	15.0
HSM 140	10/8/2013	Mercury	0.13 J	2.0
HSM 130	4/16/2013	Selenium	2.07 J	50.0
HSM 140	4/16/2013	Selenium	1.59 J	50.0
HSM 150	4/16/2013	Selenium	1.47 J	50.0
HSM 160	4/16/2013	Selenium	1.15 J	50.0
HSM 160 FD	4/16/2013	Selenium	1.11 J	50.0
HSM 110	10/8/2013	Selenium	1.36 J	50.0
HSM 130	10/8/2013	Selenium	2.58 J	50.0
HSM 140	10/8/2013	Selenium	2.16 J	50.0
HSM 150	10/8/2013	Selenium	1.91 J	50.0
HSM 160	10/8/2013	Selenium	1.35 J	50.0
HSM 170	10/8/2013	Selenium	1.13 J	50.0
HSM 110	5/21/2013	Selenium	1.69 J	50.0
HSM 120	5/21/2013	Selenium	2.75 J	50.0
HSM 120 FD	10/8/2013	Selenium	1.45 J	50.0

Note: J = detection is above the method detection limit, but below the reporting limit.

** = no MCL values are established for these compounds, PCL value is referenced*

Surface Water / Base Flow - Nitrates

Surface water samples were analyzed for nitrate-nitrite as nitrogen. Laboratory analyses indicated a limited range of nitrate-nitrite as nitrogen in surface water samples. Of the 16 surface water samples (14 environmental samples and two field duplicates) collected for the two sample events, concentrations ranged from 0.191 to 1.7 mg/L. None of the nitrate concentrations detected exceed the MCL of 10 mg/L for drinking water. The highest nitrate concentration in surface water at the San Marcos Springs complex was 1.7 mg/L from HSM 130 sampled on April 16, 2013. Nitrate-nitrogen results are summarized in Table 13.

Table 13, Summary of Nitrate Detections for Surface Water Samples, San Marcos Springs Complex

Sample Name	Sample Date	Concentration (mg/L)
HSM 170	4/16/13	1.30
HSM 130	4/16/13	1.70
HSM 140	4/16/13	1.34
HSM 150	4/16/13	1.29
HSM 160	4/16/13	1.27
HSM 160 FD	4/16/13	1.28
HSM 110	5/21/13	0.229 J
HSM 120	5/21/13	1.23
HSM 110	10/8/13	0.191
HSM 130	10/8/13	1.52
HSM 120	10/8/13	1.31
HSM 120FD	10/8/13	1.31

Table 13 (continued),
Summary of Nitrate Detections for Surface Water Samples, San Marcos Springs Complex

Sample Name	Sample Date	Concentration (mg/L)
HSM 140	10/8/13	1.24
HSM 150	10/8/13	1.22
HSM 160	10/8/13	1.3
HSM 170	10/8/13	1.23

SAN MARCOS SPRINGS SEDIMENT SAMPLING

Sediment - Volatile Organic Compounds (VOCs)

Few VOC detections were noted in the sediment samples collected at San Marcos Springs. Five compounds, acetone, toluene, 2-butanone, 4-isopropyltoluene, and 1,2,4-trimethylbenzen were detected. Acetone was detected in six samples plus a field duplicate, while 2-butanone was only detected in one sample. Acetone is typically suspect as a laboratory or sampling artifact detection due to its widespread use in the laboratory. The detection of 2-butanone (methyl ethyl ketone) is also somewhat suspect. This is a common solvent that is quite volatile. Additionally, the Comal sediment samples were similar in detection of acetone and 2-butanone. While they cannot be ruled out as detections, these two compounds are suspect as laboratory artificats. Note also, most of the detections are “J” flagged, meaning the concentration is below the reporting limit, but above the method detection limit. The detected compounds are listed in Table 14, below for documentation. As the HCP data set grows additional conclusions may be made regarding problematic compounds such as these.

Table 14, VOC Detections in San Marcos Sediment Samples

Sample Name (Location)	Sample Date	Compound	Concentration (µg/kg)	TEC/PEC
HSM 310	6/11/13	Acetone	109 J	NE
HSM 320	6/12/13	Acetone	139 J	NE
HSM 330	6/12/13	Toluene	11.7 J	NE
HSM 330	6/12/13	Acetone	138 J	NE
HSM 330	6/12/13	2-Butanone	40.4	NE
HSM 330	6/12/13	1,2,4-Trimethylbenzene	1.54 J	NE
HSM 340	6/12/13	Toluene	3.51 J	NE
HSM 340	6/12/13	Acetone	62.9 J	NE
HSM 340	6/12/13	4-Isopropyltoluene	10.6 J	NE
HSM 350	6/12/13	Acetone	150 J	NE
HSM 350	6/12/13	2-Butanone	37.9 J	NE
HSM 370	6/13/13	Acetone	73.2	NE

Note: J = detection is above the method detection limit, but below the reporting limit. NE = not established.

Sediment - Semi-volatile Organic Compounds (SVOCs)

Generally, sediments would be expected to contain some SVOCs if the sediments have been exposed to these compounds. In summarizing the sediment SVOC detections, any compounds suspected as false positives are listed here in the text. Compounds of interest (primarily polycyclic aromatic hydrocarbons) are discussed in detail. Suspected laboratory artifact detections include DEHP, present in six out of seven primary samples. Detected concentrations of DEHP range from 23.6 µg/kg to 1,670 µg/kg. The other suspect compounds detected in sediments are di-n-octyl phthalate at a concentration of 1040 µg/kg, at location HSM 350 and di-n-butyl phthalate at location HSM 340, at 50.2 µg/kg. As the HCP data set grows additional conclusions may be made regarding problematic compounds such as these.

The remaining SVOC detections are all PAH compounds. These detections are listed in Table 15 and further displayed as a graphic comparing the total PAH concentrations to the TEC and PEC values of MacDonald (2000). A total of 16 different PAH compounds are noted as detected in the San Marcos Springs complex sediments.

Table 15, Detected PAH Compounds San Marcos Springs Complex, Sediment Samples

Sample Name (Location)	Sample Date	Compound	Concentration (µg/kg)	TEC (µg/kg)	PEC (µg/kg)
HSM 320	06/12/13	Pyrene	103 J	195	1,520
HSM 320	06/12/13	Benzo(g,h,I)perylene	52.2 J	NE	NE
HSM 320	06/12/13	Indeno(1,2,3-cd)pyrene	46.6 J	NE	NE
HSM 320	06/12/13	Benzo(b)fluoranthene	112 J	NE	NE
HSM 320	06/12/13	Fluoranthene	105 J	423	2,230
HSM 320	06/12/13	Chrysene	79.0 J	166	1,290
HSM 320	06/12/13	Benzo(a)pyrene	70.5 J	150	1,450
HSM 320	06/12/13	Benzo(a)anthracene	68.3 J	108	1,050
		Total PAH	**636.6**	**1,610**	**22,800**
HSM 330	06/12/13	Anthracene	499	57.2	845
HSM 330	06/12/13	Dibenzofuran	76.4	NE	NE
HSM 330	06/12/13	Benzo(g,h,I)perylene	2,170	NE	NE
HSM 330	06/12/13	Indeno(1,2,3-cd)pyrene	2,180	NE	NE
HSM 330	06/12/13	Benzo(b)fluoranthene	7,430	NE	NE
HSM 330	06/12/13	Benzo(k)fluoranthene	2,830	NE	NE
HSM 330	06/12/13	Acenaphthylene	40.4 J	NE	NE
HSM 330	06/12/13	Chrysene	5,790	166	1,290
HSM 330	06/12/13	Benzo(a)pyrene	4,140	150	1,450
HSM 330	06/12/13	Dibenz(a,h)anthracene	628	NE	NE
HSM 330	06/12/13	Benzo(a)anthracene	4,180	108	1,050
HSM 330	06/12/13	Acenaphthene	140 J	NE	NE
HSM 330	06/12/13	Phenanthrene	4,110	NE	NE
HSM 330	06/12/13	Fluorene	175 J	77.4	536
HSM 330	06/12/13	Pyrene	7,830	195	1,520
HSM 330	06/12/13	Fluoranthene	10,000	423	2,230
		Total PAH	**52218.8**	**1,610**	**22,800**
HSM 340	06/12/13	Anthracene	644	57.2	845
HSM 340	06/12/13	Dibenzofuran	92.4 J	NE	NE
HSM 340	06/12/13	Benzo(g,h,I)perylene	2340	NE	NE
HSM 340	06/12/13	Indeno(1,2,3-cd)pyrene	2310	NE	NE
HSM 340	06/12/13	Benzo(b)fluoranthene	8450	NE	NE

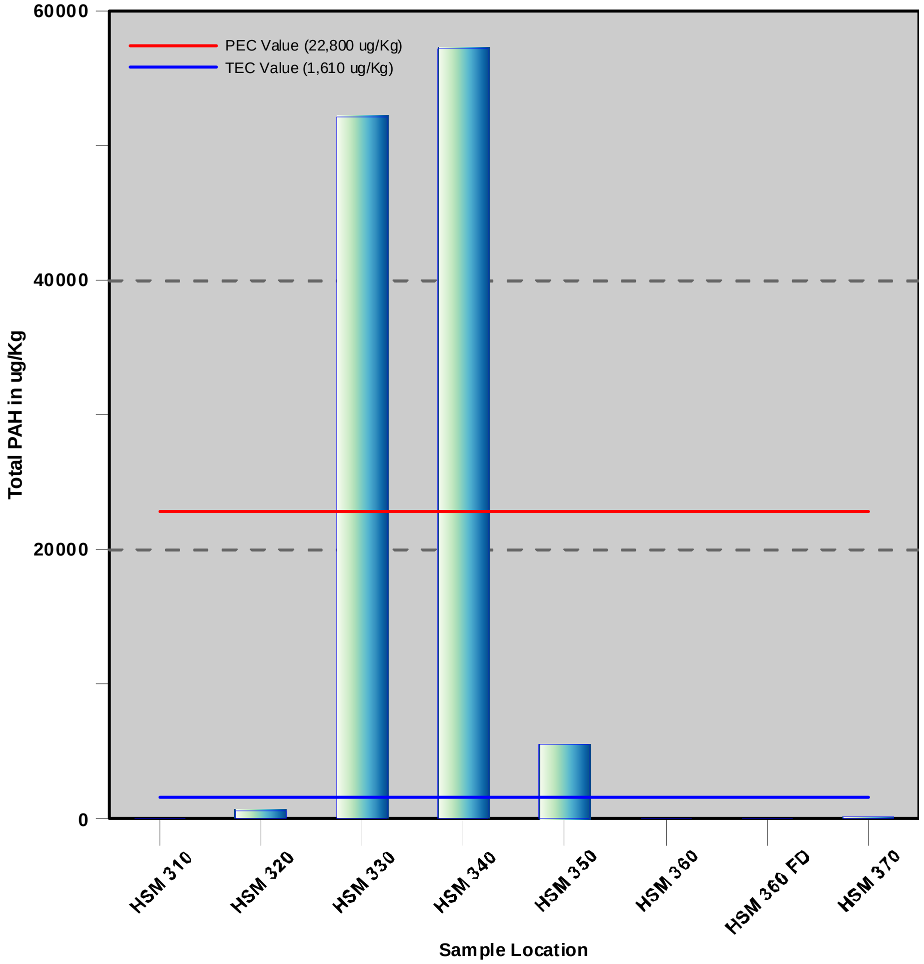
Table 15 (continued), Detected PAH Compounds San Marcos Springs Complex, Sediment Samples

Sample Name (Location)	Sample Date	Compound	Concentration (µg/kg)	TEC (µg/kg)	PEC (µg/kg)
HSM 340	06/12/13	Benzo(k)fluoranthene	2,780	NE	NE
HSM 340	06/12/13	Acenaphthylene	68.9 J	NE	NE
HSM 340	06/12/13	Chrysene	6,500	166	1,290
HSM 340	06/12/13	Benzo(a)pyrene	4,630	150	1,450
HSM 340	06/12/13	Dibenz(a,h)anthracene	630	NE	NE
HSM 340	06/12/13	Benzo(a)anthracene	4,700	108	1,050
HSM 340	06/12/13	Acenaphthene	169 J	NE	NE
HSM 340	06/12/13	Phenanthrene	4,620	NE	NE
HSM 340	06/12/13	Fluorene	195 J	77.4	536
HSM 340	06/12/13	Pyrene	8700	195	1,520
HSM 340	06/12/13	Fluoranthene	10,500	423	2,230
		Total PAH	**57,329**	**1,610**	**22,800**
HSM 350	06/12/13	Anthracene	75.2 J	57.2	845
HSM 350	06/12/13	Pyrene	929	195	1,520
HSM 350	06/12/13	Benzo(g,h,I)perylene	304 J	NE	NE
HSM 350	06/12/13	Indeno(1,2,3-cd)pyrene	279 J	NE	NE
HSM 350	06/12/13	Benzo(b)fluoranthene	1,020	NE	NE
HSM 350	06/12/13	Fluoranthene	745	423	2,230
HSM 350	06/12/13	Benzo(k)fluoranthene	306 J	NE	NE
HSM 350	06/12/13	Acenaphthylene	39.2 J	NE	NE
HSM 350	06/12/13	Chrysene	603 J	166	410
HSM 350	06/12/13	Benzo(a)pyrene	490 J	150	1,450
HSM 350	06/12/13	Dibenz(a,h)anthracene	70.0 J	NE	NE
HSM 350	06/12/13	Benzo(a)anthracene	380 J	108	1,050
HSM 350	06/12/13	Acenaphthene	42.4 J	NE	NE
HSM 350	06/12/13	Phenanthrene	248 J	NE	NE
		Total PAH	**5,530.8**	**1,610**	**22,800**
HSM 370	06/13/13	Pyrene	27.0 J	195	1,520
HSM 370	06/13/13	Benzo(b)fluoranthene	28.8 J	NE	NE
HSM 370	06/13/13	Fluoranthene	26.3 J	423	2,230
HSM 370	06/13/13	Chrysene	27.6 J	166	1,290
		Total PAH	**109.7**	**1,610**	**22,800**

Note: J = detection is above the method detection limit, but below the reporting limit. NE=not established.

PAH detections are shown below in Figure 16, where the total PAH concentrations (sum of all detected concentrations for each sample point) are compared to the total TEC and PEC values for PAH concentration. Sample locations HSM 330 and HSM 340 exceed the allowable total for PAH concentrations, based on the PEC value established by MacDonald et al. (2000).

Figure 16, San Marcos Springs Sediment PAH Detections Compared to TEC and PEC values



Sediment - Pesticides

Sediment samples were analyzed for both organochlorine and organophosphorous pesticides. Due to the persistence of certain pesticide compounds their detection in sediment is not unusual. Pesticide detections in the San Marcos Springs complex sediment samples were generally low. Some compounds did exceed either a TEC or PEC value. Specifically, dieldrin, was detected just above the TEC value at location HSM 330 while chlordane was detected at a concentration in excess of the PEC value. Detected compounds are listed in Table 16, below and as graphs in Figures 17 and 18.

Table 16, Detected Pesticide Compounds San Marcos Springs Complex - Sediment Samples

Sample Name (Location)	Sample Date	Compound	Concentration (µg/kg)	TEC (µg/kg)	PEC (µg/kg)
HSM 310	06/11/13	Dieldrin	0.684 J	1.9	61.8
HSM 310	06/11/13	Endrin ketone	1.60 J	2.22	207
HSM 320	06/12/13	4,4'-DDD	0.643 J	4.88	28
HSM 320	06/12/13	4,4'-DDE	1.21 J	3.16	31.3
HSM 320	06/12/13	gamma-Chlordane	0.388 J	3.24	17.6
HSM 330	06/12/13	Aldrin	0.397 Jp	NE	NE

Table 16 (continued), Detected Pesticide Compounds San Marcos Springs Complex - Sediment Samples

Sample Name (Location)	Sample Date	Compound	Concentration (µg/kg)	TEC (µg/kg)	PEC (µg/kg)
HSM 330	06/12/13	alpha-Chlordane	0.354 J	3.24	17.6
HSM 330	06/12/13	Dieldrin	2.04 J	1.9	61.8
HSM 340	06/12/13	4,4'-DDD	1.52 J	4.88	28
HSM 340	06/12/13	Aldrin	0.391 Jp	NE	NE
HSM 340	06/12/13	alpha-Chlordane	1.28 J	3.24	17.6
HSM 340	06/12/13	Chlordane (technical)	72.7	3.24	17.6
HSM 340	06/12/13	gamma-Chlordane	1.87 J	3.24	17.6
HSM 350	06/12/13	4,4'-DDE	1.03 J	3.16	31.3
HSM 350	06/12/13	gamma-Chlordane	0.264 J	3.24	17.6
HSM 370	06/13/13	4,4'-DDE	0.166 Jp	3.16	31.3

Note: J indicates the result is above the method detection limit and below the laboratory reporting limit, p indicates the lower value between the detection column and confirmation column is reported. NE=not established.

In Figures 17 and 18, below the TEC and PEC values are compared to the detected concentrations of dieldrin and chlordane in the sediment samples. Note, for the chlordane results, total chlordane values are used (sum of all chlordane species) for comparison to the TEC and PEC values. No specific values for alpha, beta, or gamma chlordane are listed with a TEC or PEC value, only a total value for chlordane is provided. As such, for construction of the graph all chlordane detections are summed for comparison to the standard. All other pesticide detections are below the TEC value and are not graphed.

Figure 17, San Marcos Springs Sediment Dieldrin Detections Compared to TEC and PEC values

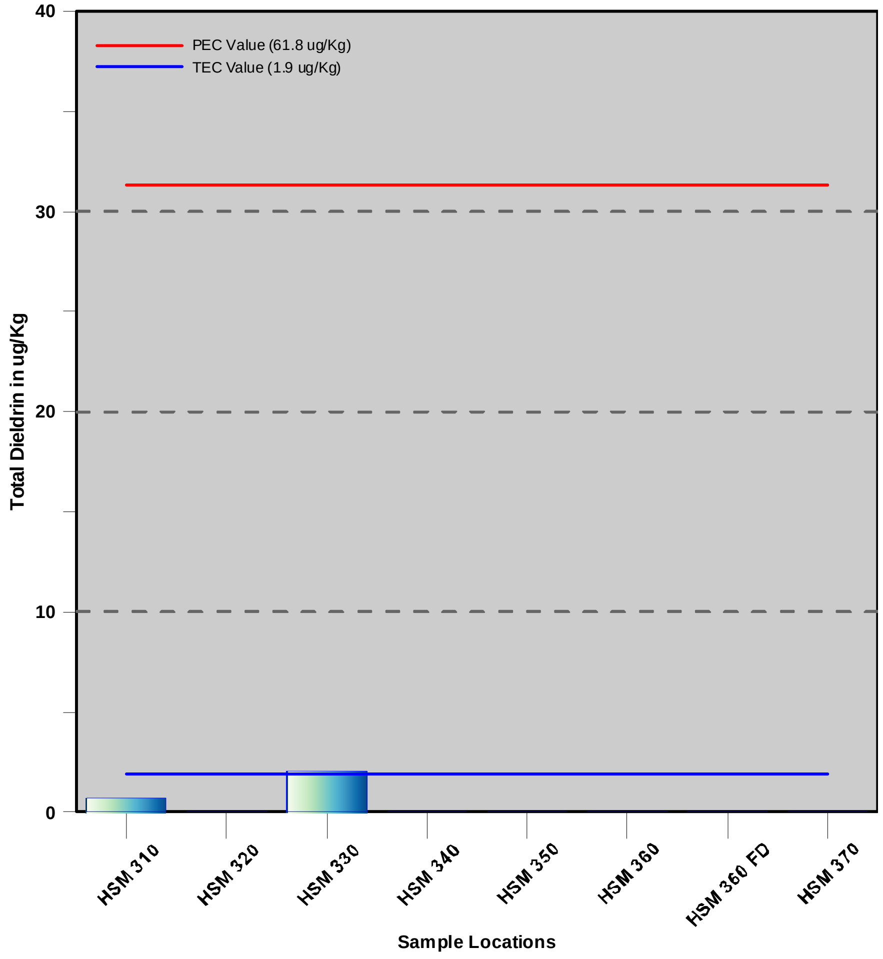
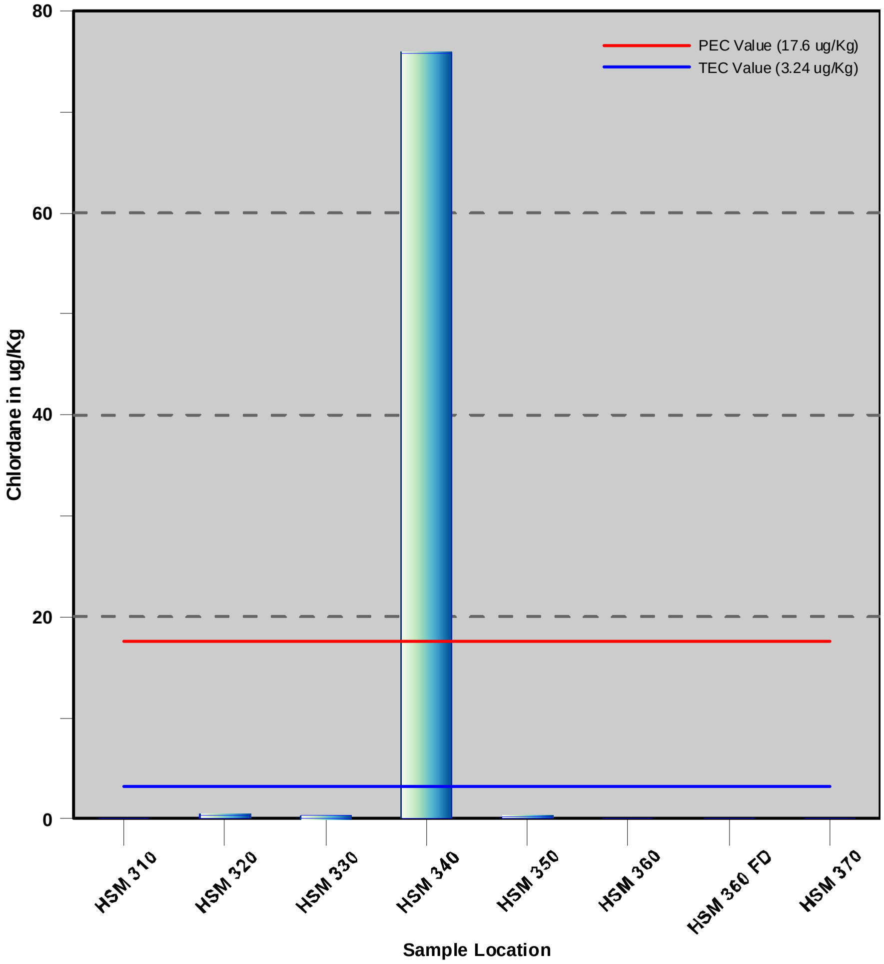


Figure 18, San Marcos Springs Sediment Chlordane Detections Compared to TEC and PEC values



Sediment - Herbicides

Sediments were analyzed for herbicide compounds to further assess sediment quality at the San Marcos Springs complex. No herbicides were detected from the San Marcos Springs complex sediment samples collected, using method SW 8151A.

Sediment - Polychlorinated Bi-phynels

Sediments were analyzed for PCB compounds to further assess sediment quality at the San Marcos complex. The PCB compounds Aroclor 1268, Aroclor 1260 and Aroclor 1254 were detected at very low concentrations in sediment samples. Sample locations HSM 330, HSM 340, HSM 350, and HSM 370 tested positive for PCB compounds. The total PCBs at all sample sites were well below the TEC value. Detected PCBs are summarized in Table 17. On the basis of sediment toxicity values derived by MacDonald et al. (2000), for the sediments sampled at the San Marcos Springs complex, it does not appear that any toxic effect from PCBs is present in sediments sampled.

Table 17, Detected PCB Compounds San Marcos Springs Complex, Sediment Samples

Sample Name (Location)	Sample Date	Compound	Concentration (µg/kg)	TEC (µg/kg)	PEC (µg/kg)
HSM 330	06/12/13	Aroclor 1260	0.0965 J	59.8	676
HSM 330	06/12/13	Aroclor 1254	0.125 J	59.8	676
HSM 340	06/12/13	Aroclor 1260	0.0242 J	59.8	676
HSM 350	06/12/13	Aroclor 1260	0.0938	59.8	676
HSM 370	06/13/13	Aroclor 1268	0.00888 J	59.8	676

Note: J indicates the result is above the method detection limit, but below the laboratory reporting limit,

Sediment - Metals

Sediment samples are generally expected to exhibit higher concentrations of metals (and other compounds) than water samples. Sediment sample results for metals at the San Marcos Springs complex tested positive for several metals, generally at low concentrations. Metals detected above the method detection limit and subsequently evaluated in this report for potential toxic effects using the TEC and PEC standards are: arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc. Other metals detected that do not have a TEC or PEC value available are: aluminum, barium, beryllium, calcium, iron, magnesium, potassium, selenium, silicon, silver, sodium, and thallium. Of these metals, aluminum, barium, beryllium, and selenium, were compared to Texas-specific soil background concentrations (30 TAC 350). Only selenium appears above the listed background concentration of 0.3 mg/kg. The metal silver was evaluated against the New York State Department of Environmental Conservation’s published standards for evaluating sediment quality (NYSDEC, 1999). Silver was detected below this published standard of 1.0 mg/kg (TEC). Metal detections are listed in Table 18 below.

Table 18, Detected Metals San Marcos Springs Complex - Sediment Samples

Sample Name (Location)	Sample Date	Compound	Concentration (mg/kg)	TEC (mg/kg)	PEC (mg/kg)
HSM 310	06/11/13	Aluminum	9540	NE	NE
HSM 310	06/11/13	Arsenic	13.9	9.79	33.0
HSM 310	06/11/13	Barium	113	NE	NE
HSM 310	06/11/13	Beryllium	1.08	NE	NE
HSM 310	06/11/13	Cadmium	0.466	0.99	4.98
HSM 310	06/11/13	Calcium	64000	NE	NE
HSM 310	06/11/13	Chromium	26.2	43.4	111
HSM 310	06/11/13	Copper	14.0	31.6	149
HSM 310	06/11/13	Iron	17500	NE	NE
HSM 310	06/11/13	Lead	17.7	35.8	128
HSM 310	06/11/13	Magnesium	2150	NE	NE
HSM 310	06/11/13	Manganese	304	NE	NE
HSM 310	06/11/13	Nickel	19.6	22.7	48.6
HSM 310	06/11/13	Potassium	1540	NE	NE
HSM 310	06/11/13	Selenium	1.49	NE	NE
HSM 310	06/11/13	Silicon	266	NE	NE

Table 18 (continued), Detected Metals San Marcos Springs Complex - Sediment Samples

Sample Name (Location)	Sample Date	Compound	Concentration (mg/kg)	TEC (mg/kg)	PEC (mg/kg)
HSM 310	06/11/13	Silver	0.119 J	1.0	2.2
HSM 310	06/11/13	Sodium	117	NE	NE
HSM 310	06/11/13	Strontium	98.0	NE	NE
HSM 310	06/11/13	Thallium	0.221 J	NE	NE
HSM 310	06/11/13	Zinc	36.7	120	460
HSM 320	06/12/13	Aluminum	7000	NE	NE
HSM 320	06/12/13	Arsenic	9.82	9.79	33
HSM 320	06/12/13	Barium	60.9	NE	NE
HSM 320	06/12/13	Beryllium	0.843	NE	NE
HSM 320	06/12/13	Cadmium	0.495	0.99	4.98
HSM 320	06/12/13	Calcium	75500	NE	NE
HSM 320	06/12/13	Chromium	19.4	43.4	111
HSM 320	06/12/13	Copper	37.2	31.6	149
HSM 320	06/12/13	Iron	20300	NE	NE
HSM 320	06/12/13	Lead	34.8	35.8	128
HSM 320	06/12/13	Magnesium	1850	NE	NE
HSM 320	06/12/13	Manganese	298	NE	NE
HSM 320	06/12/13	Mercury	0.0682 J	0.18	1.06
HSM 320	06/12/13	Nickel	20.6	22.7	48.6
HSM 320	06/12/13	Potassium	1560	NE	NE
HSM 320	06/12/13	Selenium	1.61	NE	NE
HSM 320	06/12/13	Silicon	298	NE	NE
HSM 320	06/12/13	Silver	0.122 J	1.0	2.2
HSM 320	06/12/13	Sodium	136	NE	NE
HSM 320	06/12/13	Strontium	83.7	NE	NE
HSM 320	06/12/13	Thallium	0.213 J	NE	NE
HSM 320	06/12/13	Zinc	66.1	121	459
HSM 330	06/12/13	Aluminum	1060	NE	NE
HSM 330	06/12/13	Arsenic	3.37	9.79	33
HSM 330	06/12/13	Barium	17.1	NE	NE
HSM 330	06/12/13	Beryllium	0.149 J	NE	NE
HSM 330	06/12/13	Cadmium	0.160 J	0.99	4.98
HSM 330	06/12/13	Calcium	528000	NE	NE
HSM 330	06/12/13	Chromium	10.1	43.4	111
HSM 330	06/12/13	Copper	5.91	31.6	149
HSM 330	06/12/13	Iron	4190	NE	NE
HSM 330	06/12/13	Lead	26.9	35.8	128
HSM 330	06/12/13	Magnesium	1880	NE	NE
HSM 330	06/12/13	Manganese	143	NE	NE
HSM 330	06/12/13	Mercury	0.0644 J	0.18	1.06
HSM 330	06/12/13	Nickel	4.98	22.7	48.6
HSM 330	06/12/13	Potassium	223	NE	NE
HSM 330	06/12/13	Selenium	0.321	NE	NE

Table 18 (continued), Detected Metals San Marcos Springs Complex - Sediment Samples

Sample Name (Location)	Sample Date	Compound	Concentration (mg/kg)	TEC (mg/kg)	PEC (mg/kg)
HSM 330	06/12/13	Silicon	174	NE	NE
HSM 330	06/12/13	Sodium	107	NE	NE
HSM 330	06/12/13	Strontium	144	NE	NE
HSM 330	06/12/13	Zinc	33.2	121	459
HSM 340	06/12/13	Aluminum	2730	NE	NE
HSM 340	06/12/13	Arsenic	3.80	9.79	33
HSM 340	06/12/13	Barium	35.8	NE	NE
HSM 340	06/12/13	Beryllium	0.271	NE	NE
HSM 340	06/12/13	Cadmium	0.210 J	0.99	4.98
HSM 340	06/12/13	Calcium	288000	NE	NE
HSM 340	06/12/13	Chromium	14.2	43.4	111
HSM 340	06/12/13	Copper	6.34	31.6	149
HSM 340	06/12/13	Iron	4920	NE	NE
HSM 340	06/12/13	Lead	56.0	35.8	128
HSM 340	06/12/13	Magnesium	2170	NE	NE
HSM 340	06/12/13	Manganese	218	NE	NE
HSM 340	06/12/13	Mercury	0.0165 J	0.18	1.06
HSM 340	06/12/13	Nickel	5.87	22.7	48.6
HSM 340	06/12/13	Potassium	484	NE	NE
HSM 340	06/12/13	Selenium	0.519	NE	NE
HSM 340	06/12/13	Silicon	342	NE	NE
HSM 340	06/12/13	Sodium	108	NE	NE
HSM 340	06/12/13	Strontium	119	NE	NE
HSM 340	06/12/13	Zinc	34.8	121	459
HSM 350	06/12/13	Aluminum	4470	NE	NE
HSM 350	06/12/13	Arsenic	5.51	9.79	33
HSM 350	06/12/13	Barium	40.7	NE	NE
HSM 350	06/12/13	Beryllium	0.571	NE	NE
HSM 350	06/12/13	Cadmium	0.410	0.99	4.98
HSM 350	06/12/13	Calcium	200000	NE	NE
HSM 350	06/12/13	Chromium	15.5	43.4	111
HSM 350	06/12/13	Copper	14.3	31.6	149
HSM 350	06/12/13	Iron	7010	NE	NE
HSM 350	06/12/13	Lead	57.0	35.8	128
HSM 350	06/12/13	Magnesium	2350	NE	NE
HSM 350	06/12/13	Manganese	122	NE	NE
HSM 350	06/12/13	Mercury	0.0860 J	0.18	1.06
HSM 350	06/12/13	Nickel	8.6	22.7	48.6
HSM 350	06/12/13	Potassium	850	NE	NE
HSM 350	06/12/13	Selenium	1.57	NE	NE
HSM 350	06/12/13	Silicon	387	NE	NE
HSM 350	06/12/13	Silver	0.205 J	1.0	2.2
HSM 350	06/12/13	Sodium	169	NE	NE

Table 18 (continued), Detected Metals San Marcos Springs Complex - Sediment Samples

Sample Name (Location)	Sample Date	Compound	Concentration (mg/kg)	TEC (mg/kg)	PEC (mg/kg)
HSM 350	06/12/13	Strontium	157	NE	NE
HSM 350	06/12/13	Thallium	0.135 J	NE	NE
HSM 350	06/12/13	Zinc	62.8	121	459
HSM 360	06/13/13	Aluminum	4280	NE	NE
HSM 360	06/13/13	Arsenic	1.62	9.79	33
HSM 360	06/13/13	Barium	26.1	NE	NE
HSM 360	06/13/13	Beryllium	0.476	NE	NE
HSM 360	06/13/13	Cadmium	0.258	0.99	4.98
HSM 360	06/13/13	Calcium	189000	NE	NE
HSM 360	06/13/13	Chromium	12.7	43.4	111
HSM 360	06/13/13	Copper	5.48	31.6	149
HSM 360	06/13/13	Iron	3110	NE	NE
HSM 360	06/13/13	Lead	6.98	35.8	128
HSM 360	06/13/13	Magnesium	1370	NE	NE
HSM 360	06/13/13	Manganese	52.9	NE	NE
HSM 360	06/13/13	Nickel	5.60	22.7	48.6
HSM 360	06/13/13	Potassium	747	NE	NE
HSM 360	06/13/13	Selenium	0.834	NE	NE
HSM 360	06/13/13	Silicon	1620	NE	NE
HSM 360	06/13/13	Silver	0.0687 J	1.0	2.2
HSM 360	06/13/13	Sodium	182	NE	NE
HSM 360	06/13/13	Strontium	159	NE	NE
HSM 360	06/13/13	Thallium	0.121 J	NE	NE
HSM 360	06/13/13	Zinc	17.5	121	459
HSM 360FD	06/13/13	Aluminum	4030	NE	NE
HSM 360FD	06/13/13	Arsenic	1.61	9.79	33
HSM 360FD	06/13/13	Barium	22.6	NE	NE
HSM 360FD	06/13/13	Beryllium	0.450	NE	NE
HSM 360FD	06/13/13	Cadmium	0.196 J	0.99	4.98
HSM 360FD	06/13/13	Calcium	177000	NE	NE
HSM 360FD	06/13/13	Chromium	11.3	43.4	111
HSM 360FD	06/13/13	Copper	4.94	31.6	149
HSM 360FD	06/13/13	Iron	2910	NE	NE
HSM 360FD	06/13/13	Lead	7.18	35.8	128
HSM 360FD	06/13/13	Magnesium	1200	NE	NE
HSM 360FD	06/13/13	Manganese	45	NE	NE
HSM 360FD	06/13/13	Nickel	4.20	22.7	48.6
HSM 360FD	06/13/13	Potassium	665	NE	NE
HSM 360FD	06/13/13	Selenium	0.936	NE	NE
HSM 360FD	06/13/13	Silicon	1080	NE	NE
HSM 360FD	06/13/13	Silver	0.0643 J	1.0	2.2
HSM 360FD	06/13/13	Sodium	140	NE	NE
HSM 360FD	06/13/13	Strontium	134	NE	NE

Table 18 (continued), Detected Metals San Marcos Springs Complex - Sediment Samples

Sample Name (Location)	Sample Date	Compound	Concentration (mg/kg)	TEC (mg/kg)	PEC (mg/kg)
HSM 360FD	06/13/13	Thallium	0.104 J	NE	NE
HSM 360FD	06/13/13	Zinc	14.5	121	459
HSM 370	06/13/13	Aluminum	6340	NE	NE
HSM 370	06/13/13	Arsenic	8.24	9.79	33
HSM 370	06/13/13	Barium	86.2	NE	NE
HSM 370	06/13/13	Beryllium	0.662	NE	NE
HSM 370	06/13/13	Cadmium	0.295	0.99	4.98
HSM 370	06/13/13	Calcium	260000	NE	NE
HSM 370	06/13/13	Chromium	11.1	43.4	111
HSM 370	06/13/13	Copper	7.38	31.6	149
HSM 370	06/13/13	Iron	9340	NE	NE
HSM 370	06/13/13	Lead	14.1	35.8	128
HSM 370	06/13/13	Magnesium	2320	NE	NE
HSM 370	06/13/13	Manganese	374	NE	NE
HSM 370	06/13/13	Mercury	0.0400 J	0.18	1.06
HSM 370	06/13/13	Nickel	9.90	NE	NE
HSM 370	06/13/13	Potassium	962	NE	NE
HSM 370	06/13/13	Selenium	1.14	NE	NE
HSM 370	06/13/13	Silicon	824	NE	NE
HSM 370	06/13/13	Silver	0.0863 J	1.0	2.2
HSM 370	06/13/13	Sodium	159	NE	NE
HSM 370	06/13/13	Strontium	178	NE	NE
HSM 370	06/13/13	Thallium	0.124 J	NE	NE
HSM 370	06/13/13	Zinc	24.5	121	459

Note: J indicates the result is above the method detection limit, but below the laboratory reporting limit, NE indicates not established.

Metals with detections above an established TEC and PEC value are displayed graphically in Figures 19, 20, and 21, for arsenic, copper, and lead respectively.

Figure 19, San Marcos Springs Sediment Arsenic Detections Compared to TEC and PEC values

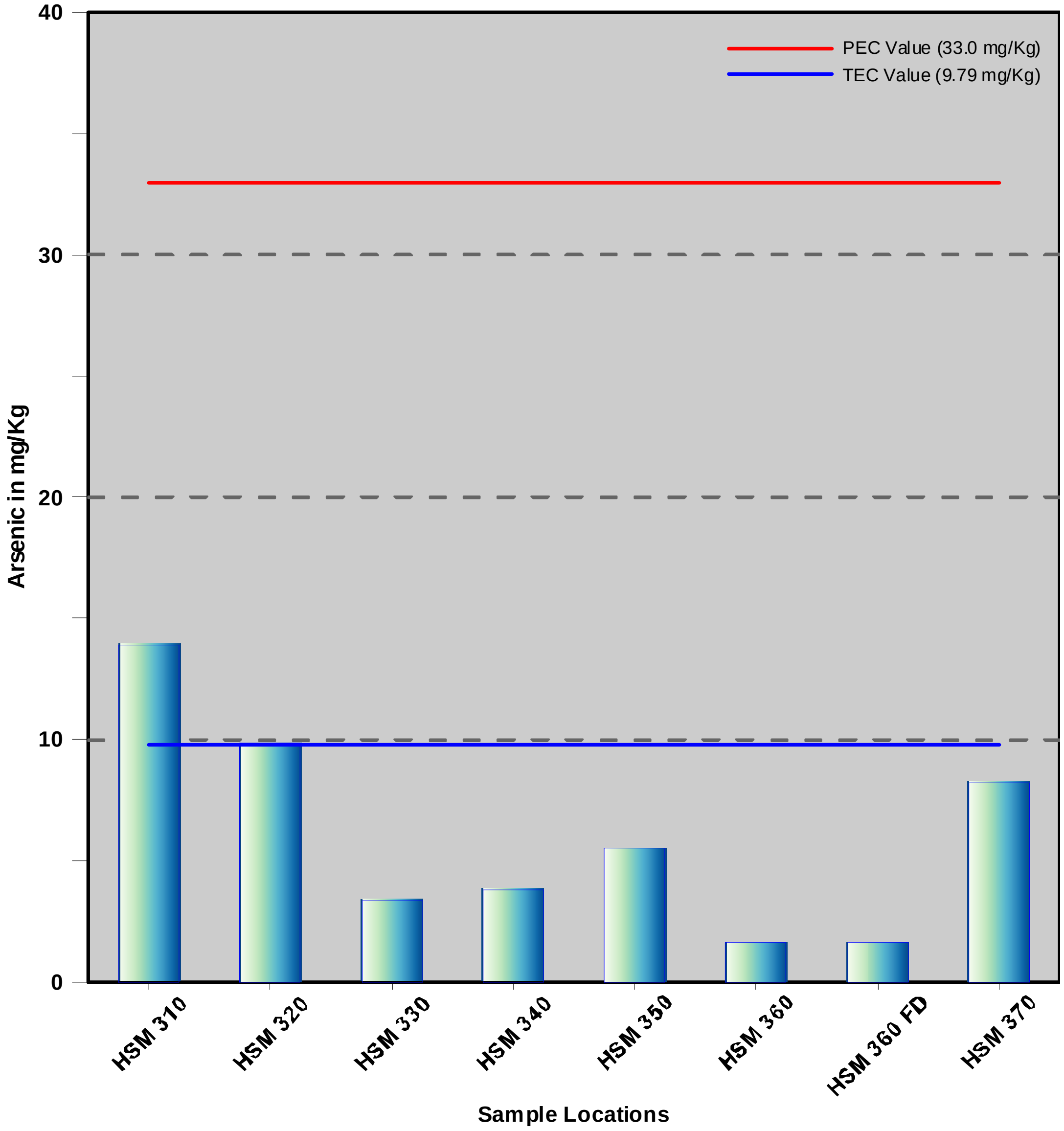


Figure 20, San Marcos Springs Sediment Copper Detections Compared to TEC and PEC values

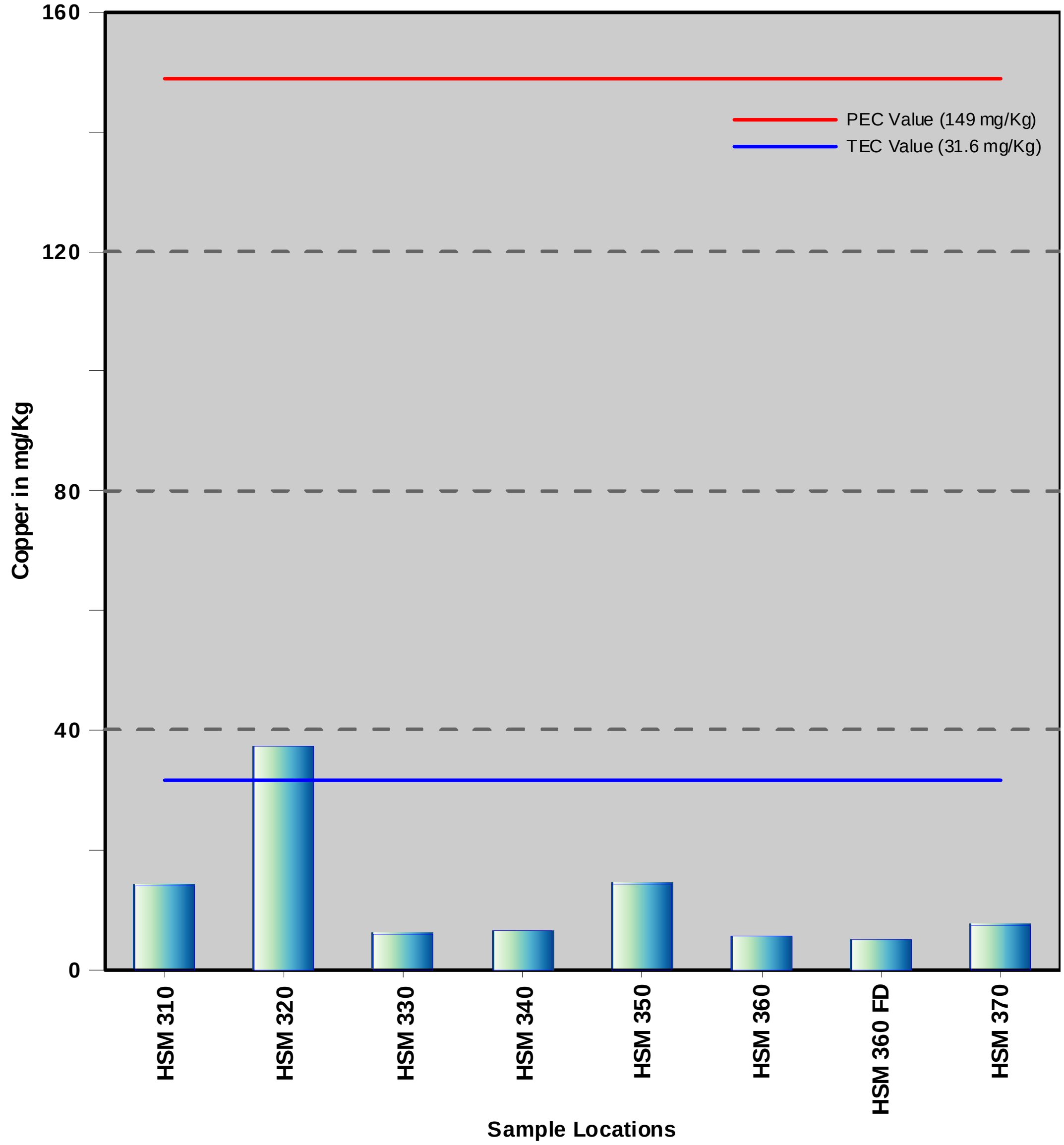
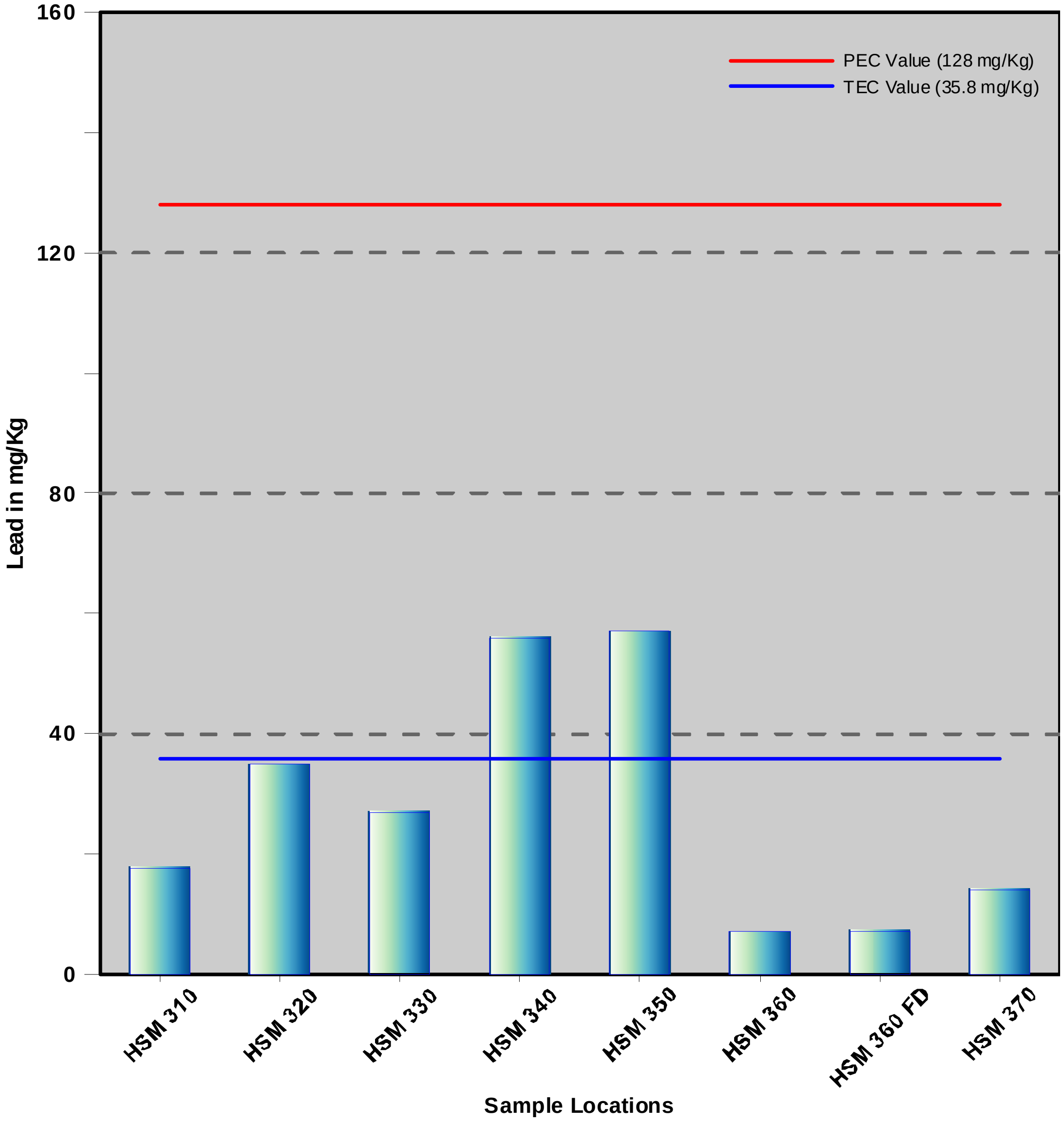


Figure 21, San Marcos Springs Sediment Lead Detections Compared to TEC and PEC values



SAN MARCOS SPRINGS STORM WATER SAMPLING

Storm water samples were collected during two storm events at the San Marcos Springs complex. Each event was sampled according to the guidelines in the EAHCP workplan. Event one occurred on August 15, 2013. Total rainfall for the first event was approximately 0.5-inch. The second event occurred on October 31, 2013, with approximately 4-inches of rainfall locally and more than 10-inches upstream.

The August event is considered a minimal runoff event, whereas the October event captured a significant flood. As such, the sample regime was modified for the October event to capture the unique runoff circumstances associated with the flood. A fourth set of storm water samples was collected and analyzed under the EAA routine sampling program with the results included herein for the record. The total number of storm water samples collected (including duplicates) for San Marcos storm water sampling is 52.

Storm water - Bacteria Detections

Storm water samples collected and analyzed for bacteria analyses generally tested positive for high levels of bacteria. Samples were analyzed for E. Coli, MPN. Bacteria counts ranged from 150 to 20,000 MPN/100 ml for the August 15, sample event, and from 110 to 240,000 MPN/100 ml for the October 31, sample event. Bacterial detections are listed below in Table 19.

Table 19, Bacteria Detections in San Marcos Springs Complex Storm water Samples

Location	Date Sampled	Time Sampled	E-coli MPN/100ml
HSM 210-1	8/15/2013	9:10 pm	160
HSM 260-1	8/15/2013	9:25 pm	1,400
HSM 240-1	8/15/2013	9:45 pm	9,800
HSM 230-1	8/15/2013	10:00 pm	11,000
HSM 270-1	8/15/2013	10:05 pm	4,900
HSM 250-1	8/15/2013	10:30 pm	20,000
HSM 231-1	8/15/2013	10:30 pm	12,000
HSM 260-2	8/15/2013	10:45 pm	3,900
HSM 270-2	8/15/2013	11:15 pm	4,900
HSM 210-2	8/15/2013	11:20 pm	150
HSM 240-2	8/15/2013	11:30 pm	610
HSM 230-2	8/15/2013	11:40 pm	4,400
HSM 260-3	8/15/2013	11:45 pm	6,500
HSM 260-3FD	8/15/2013	11:45 pm	6,900
HSM 231-2	8/16/2013	12:10 am	2,000
HSM 250-2	8/16/2013	12:20 am	12,000
HSM 270-3	8/16/2013	12:30 am	5,200
HSM 210-3	8/16/2013	1:00 am	NA*
HSM 230-3	8/16/2013	1:15 am	1,700
HSM 240-3	8/16/2013	1:20 am	210
HSM 250-3	8/16/2013	1:40 am	11,000
HSM 231-3	8/16/2013	1:45 am	1,600
HSM 260-1	10/31/2013	1:15 am	1,100
HSM 210-1	10/31/2013	1:25 am	110
HSM 240-1	10/31/2013	1:25 am	120,000
HSM 270-1	10/31/2013	1:45 am	1,000
HSM 230-1	10/31/2013	1:55 am	38,000
HSM 250-1	10/31/2013	2:25 am	120,000
HSM 231-1	10/31/2013	2:30 am	100,000
HSM 210-2	10/31/2013	3:20 am	96,000
HSM 260-2	10/31/2013	3:25 am	200,000
HSM 250-2	10/31/2013	3:45 am	140,000
HSM 230-2	10/31/2013	3:50 am	73,000
HSM 270-2	10/31/2013	4:00 am	49,000
HSM 231-2	10/31/2013	4:15 am	20,000
HSM 240-2	10/31/2013	4:45 am	17,000
HSM 250-3	10/31/2013	8:20 am	72,000
HSM 260-3	10/31/2013	8:25 am	240,000
HSM 210-3	10/31/2013	8:35 am	24,000
HSM 260-3FD	10/31/2013	8:45 am	170,000
HSM 210-3FD	10/31/2013	9:01 am	160,000

Table 19 (continued), Bacteria Detections in San Marcos Springs Complex Storm water Samples

Location	Date Sampled	Time Sampled	E-coli MPN/100ml
HSM 270-3	10/31/2013	9:15 am	17,000
HSM 240-3	10/31/2013	9:25 am	140,000
HSM 231-3	10/31/2013	9:45 am	98,000
HSM 240-3FD	10/31/2013	9:50 am	69,000
HSM 230-3	10/31/2013	10:15 am	9,200
HSM 250-4	11/1/2013	10:30 am	12,000
HSM 231-4	11/1/2013	10:45 am	8,700
HSM 260-4	11/1/2013	10:45 am	10,000
HSM 230-4	11/1/2013	10:15 am	1,300
HSM 270-4	11/1/2013	11:15 am	8,700
HSM 210-4	11/1/2013	11:35 am	9,200
HSM 240-4	11/1/2013	11:45 am	8,200

Storm Water - Volatile Organic Compounds (VOCs)

Storm water samples collected and analyzed for VOCs were generally non-detect for these compounds. Of the 52 total samples collected for the two storm water events at San Marcos Springs, four sample locations tested positive for a total of three VOC analytes. These particular detections are summarized below.

- HSM 240-1 on (8/15/2013) at 9:45 pm – toluene detected at 0.681 J µg/L
- HSM 250-1 on (8/15/2013) at 10:30 pm – acetone detected at 5.68 J µg/L
- HSM 230-1 on (8/15/2013) at 11:00 pm – acetone detected at 5.92 J µg/L
- HSM 250-2 on (10/31/2013) at 3:45 am – chloromethane detected at 0.446 J µg/L
- HSM 250-3 on (10/31/2013) at 8:20 am – chloromethane detected at 0.483 J µg/L
- HSM 270-1 on (10/31/2013) at 1:45 am – chloromethane detected at 0.492 J µg/L

Note: J indicates the result is above the method detection limit, but below the laboratory reporting limit.
MCL for toluene is 1,000 µg/L. No MCL values are established for the remaining compounds, the corresponding PCL value is 22,000 µg/L for acetone and 70 µg/L for chloromethane.

Storm Water, Semi-volatile Organic Compounds (SVOCs)

Storm water samples collected and analyzed for SVOCs were generally non-detect for these compounds. With the exception of several detections of DEHP, no SVOCs were noted in the results. In general these phthalate compounds are quite problematic in that they are common in plastics and other materials. Often they are categorized as sampling or laboratory artifacts. However, for the record, DEHP detections not co-detected in the laboratory blank sample (b-flagged), are listed in Table 20.

Table 20, SVOC Detections in San Marcos Springs Complex Storm water Samples

Sample Name (Location)	Sample Date / Time	SVOC	Concentration (µg/L)	MCL (µg/L)
HSM 270-2	8/15/13 11:15 PM	bis(2-ethylhexyl)phthalate	14.4 J	6.0
HSM 270-3	8/16/13 12:30 AM	bis(2-ethylhexyl)phthalate	6.60 J	6.0
HSM 260 FD	8/15/13 11:45 PM	bis(2-ethylhexyl)phthalate	6.29 J	6.0
HSM 240-3	10/31/13 9:25 AM	bis(2-ethylhexyl)phthalate	5.06 J	6.0
HSM 260-2	10/31/13 3:25 AM	bis(2-ethylhexyl)phthalate	107	6.0
HSM 270-1	10/31/13 1:45 AM	bis(2-ethylhexyl)phthalate	5.06 J	6.0

Note: J indicates the result is above the method detection limit, but below the laboratory reporting limit.

Storm Water - Herbicides and Pesticides

Of the 52 samples analyzed for herbicide and pesticide compounds associated with the San Marcos Springs complex storm water sampling, one herbicide and two pesticide compounds were detected, at five locations. These detections are summarized below in Table 21.

Table 21, Herbicide and Pesticide Detections in San Marcos Springs Complex Storm water Samples

Sample Name (Location)	Sample Date / Time	SVOC	Concentration (µg/L)	MCL (µg/L)
HSM 210-1	10/31/13 1:25 AM	alpha-Chlordane	0.0206 J	2.6*
HSM 210-1	10/31/13 1:25 AM	gamma-Chlordane	0.0310 J	2.6*
HSM 210-2	10/31/13 3:20 AM	alpha-Chlordane	0.0221 J	2.6*
HSM 230-1	8/15/13 10:00 PM	2,4-D	0.922	70.0
HSM 230-1	10/31/13 1:55 AM	Dieldrin	0.0212 J	0.57*
HSM 230-1	10/31/13 1:55 AM	2,4-D	0.0660 JP	70.0
HSM 230-2	8/15/13 11:40 PM	2,4-D	0.281	70.0
HSM 230-3	10/31/13 10:15 AM	2,4-D	0.0830 J	70.0
HSM 231-2	10/31/13 4:15 AM	gamma-Chlordane	0.0193 J	2.6*
HSM 250-1	10/31/13 2:25 AM	2,4-D	0.195 J	70.0
HSM 260-2	10/31/13 3:25 AM	2,4-D	0.0499 JP	70.0

** Indicates a PCL value, J indicates the result is above the method detection limit, but below the laboratory reporting limit, p indicates the lower value between the detection column and confirmation column is reported.*

Storm Water - Polychlorinated Biphynels

Storm water samples were analyzed for the various aroclor compounds that are generally referred to collectively as PCBs. None of the storm water samples from the San Marcos Springs complex indicated positive detections of PCBs compounds.

Storm Water - Metals

Storm water samples were analyzed for metals in accordance with the EAHCP workplan. Several positive metal detections were noted in the sample set; however, only one sample detected a metal at a concentration in excess of the drinking water MCL. The metal antimony was detected in HSM 231-1 (10/31/2013, 2:30 am) at a concentration of 10.3 µg/L. The MCL for antimony in drinking water is 6.0 µg/L.

Storm water - Nitrates

Storm water samples were analyzed for nitrate-nitrite as nitrogen in accordance with the EAHCP workplan. All samples detected nitrate results below the MCL of 10 mg/L. The range of nitrate results was 0.246 – 3.19 mg/L in the sample set. The nitrate values in storm water for both sample events average 0.90 mg/L whereas the average nitrate in spring water samples at San Marcos Springs for calendar 2012 was 1.44 mg/L. Note that routine water quality data collected by the EAA in 2012 for San Marcos Springs is provided in Appendix I (the EA Hydrologic Data Report for 2012).

Summary of Results

Edwards Aquifer Authority staff collected baseline, stormwater, and sediment samples from Comal Springs and River and San Marcos Springs and the headwaters of the San Marcos River. The sampling events meet the requirements of the EAHCP and provides background data for these two systems. The limited number of detections above any of the comparative standards is indicative of generally high water quality. However, the results of a few analyses were of concern. Continued sampling will be helpful in assessing if these detected compounds are repeated and may have a long term impact on list species. Specific detections of interest, such as compounds detected above an MCL (for water) or PEC (for sediment) are listed below.

Comal Sediment

HCS 340,	June 10,	Cadmium	12.2 mg/kg (PEC = 4.98)

Comal Storm Water

HCS 210, 8:25 pm	July 15	Arsenic	11.4 µg/L (MCL =10 µg/L)

San Marcos Sediment

HSM 330,	June 10,	Total PAH	52,218.8 mg/kg (PEC = 22,800)
HSM 340,	June 10,	Total PAH	57,329 mg/kg (PEC = 22,800)
HSM 340,	June 10	Chlordane (total)	75.85 mg/kg (PEC = 17.6)

San Marcos Storm Water

HSM 231-1, 2:30 am	October 31	Antimony	10.3 µg/L (MCL = 6.0 µg/L)

Other detections were noted for particular anthropogenic compounds, but at concentrations below a comparative standard. Those detections are detailed in the body of the report, and listed in Appendix C, with the full set of laboratory results.

Based on the data collected for this report combined with completion of several sample events, a few points worth consideration in future years are suggested. Although this initial data set essentially initiates a baseline for future data sets, currently the data set is not adequate to make significant assessments regarding water or sediment quality. The current data set is extremely important for use in developing a baseline such that in the future, additional information can be added to it, allowing interested parties to better understand the surface water quality, storm water impacts, and sediment quality trends of each system. In addition, the RTIs are very valuable for gathering basic water quality data and tracking any changes to basic water quality over time.

Based on this initial year of work, a few minor changes should be considered for the 2015 EAHCP Workplan. Specific changes include the following.

- Sediment samples should be collected at a more discreet interval. Rather than the long interval of zero to 18-inches below the surface, consideration should be given to collecting the uppermost three inches of sediment in 2015, with future sampling years (beyond 2015) having another modified interval based on the additional sample results.
- Addition of a downstream RTI at the San Marcos complex is recommended. It would be helpful with regard to timing storm water sample collection, as well as informative with regard to changes in basic water quality within the system. The distance from the Rio Vista RTI to the downstream end of the sampled portion of the San Marcos complex is roughly three quarters of a mile. Within this stretch, there are surface water inputs from IH-35, and Willow Springs Creek. The addition of a downstream RTI on the San Marcos Complex would be of value in establishing improved sample

collection for storm water samples as well as assessing potential impacts from the IH-35 (runoff) and Willow Springs Creek surface water inputs.

DEFINITIONS

Alkalinity	The capacity of water to neutralize acids, a property imparted by the water’s content of carbonate, bicarbonate, hydroxide, and on occasion borate, silicate, and phosphate. It is expressed in milligrams per liter of equivalent calcium carbonate (mg/l $CaCO_3$).
Aquifer	Underground geological formation or group of formations containing water; source of groundwater for wells and springs.
ASTM	Abbreviation for American Society for Testing and Materials. A nonprofit organization that develops and publishes approximately 12,000 technical standards, covering the procedures for testing and classification of materials of every sort.
Bacteria	Microscopic living organisms that can aid in pollution control by metabolizing organic matter in sewage, oil spills, or other pollutants. However, certain bacteria in soil, water, or air can also cause human, animal, and plant health problems.
Basin	Any area draining to a point of interest.
Baseline data	Initial data generated by consistent monitoring of the same sites over time.
Channel	A long, narrow excavation or surface feature that conveys surface water and is open to the air.
Deionized water	Water with all ions removed.
Detection limit	The lowest concentration of a given pollutant that an analytical method or equipment can detect and still report as greater than zero. Generally, as readings approach the detection limit, they become less and less reliable quantitatively.
Digital titrator	A titrator unit having a counter that displays numbers. As the regent is dispensed, the counter changes in proportion to the amount of reagent used.
Dissolved solids	The total amount of dissolved material, organic, and inorganic, contained in water or wastewater. Measurements are expressed as ppm or mg/L.

DO	Abbreviation for dissolved oxygen. Oxygen molecules that are dissolved in water and available for living organisms to use for respiration. Usually expressed in milligrams per liter or percent of saturation. The concentration of DO is an important environmental parameter contributing to water quality.
DOC	Abbreviation for dissolved organic carbon, a broad classification of organic molecules of varied origin and composition within aquatic systems. Organic carbon compounds are a result of decomposition processes from dead organic matter, such as plants.
DQO	Abbreviation for data quality objectives, a process used to develop performance and acceptance criteria or data quality objectives that clarify study objectives, define the appropriate type of data, and specify tolerable levels of data needed to support decisions.
Drainage	The collection, conveyance, containment, and/or discharge of surface and storm water runoff.
EARIPHCP	Abbreviation for Edwards Aquifer Recovery Implementation Program Habitat Conservation Plan.
Endpoint	That state in titration at which an effect, such as a color change, occurs, indicating that a desired point in the titration has been reached.
Equipment blank	Sample used to assess the effectiveness of the decontamination process on sampling equipment. The equipment blank is prepared by pouring reagent-grade water over/through sampling equipment and analyzing for parameters of concern (to match the sampling routine applicable to the site).
Field duplicate	Second sample collected simultaneously from the same source as the parent sample, but which is submitted and analyzed as a separate sample. This sample should generally be identified such that the laboratory is unaware that it is a field duplicate.
Filtration	The process of separating solids from a liquid by means of a porous substance (filter) through which only the liquid can pass.
Groundwater	Water found beneath Earth’s surface that fills pores between materials, such as sand, soil, or gravel.

Habitat	The specific area of environment in which a particular type of plant or animal lives and grows.
HCP	Abbreviation for Habitat Conservation Plan. A planning document that is required by the United States Fish and Wildlife Service as part of their enforcement of the Endangered Species Act.
LCS/LCSD	Abbreviation for Laboratory control samples and laboratory control sample duplicate. LCS/LSD are evaluated to assess overall method performance and are the primary indicators of laboratory performance. In general, laboratory control samples are similar in composition as the environmental samples, contain known concentrations of all the analytes of interest, and undergo the same preparatory and determinative procedures as the environmental samples. A LCS/LCSD may be analyzed to provide information on the precision of the analytical method.
MS/MSD	Abbreviation for matrix spike/matrix spike duplicate. MS/MSD results are examined to evaluate the impact of matrix effects on overall analytical performance and potential usability of the data. A matrix spike is a representative environmental sample that is spiked with target analytes of interest prior to being taken through the entire analytical process in order to evaluate analytical bias for an actual matrix. A matrix duplicate is a collected (e.g., a VOC soil sample) or a homogenized sample that is processed through entire analytical procedure in order to evaluate overall precision for an actual matrix.
MDL	Abbreviation for method detection limit, minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero, as determined from analysis of a sample containing the analyte in a given matrix.
MPN	Abbreviation for most probable number. An analytical method used to detect the presence of coliforms in a water sample and estimate their numbers.
PCBs	Abbreviation for polychlorinated biphenyls. Group of more than two hundred chlorinated toxic hydrocarbon compounds that can be biomagnified.
PCL	Abbreviation for protective concentration levels which is established to protect human health.

Peak	Maximum instantaneous flow at a specific location resulting from a given storm condition.
pH	A measure of the alkalinity or acidity of a substance. Also defined as “the negative logarithm of the hydrogen ion concentration (-log10[H^+]) where H^+ is the hydrogen ion concentration in moles per liter. The pH of a substance is neutral at 7.0, acidic below 7.0, and alkaline above 7.0.
PQL	Abbreviation for practical quantitation limit, which is the smallest concentration of the analyte that can be reported with a specific degree of confidence.
Precipitation	The discharge of water, in liquid or solid state, out of the atmosphere, generally upon a land or water surface. Precipitation includes rainfall, snow, hail, and sleet.
Precision	The ability of a measurement to be consistently reproduced.
QA/QC	Abbreviation for quality assurance/quality control. The total integrated program for assuring reliability of monitoring and measurement data.
Recession	End of runoff event, which is defined as the point in time when the recession limb of the hydrograph is <2% of the peak or is within 10% of the prestorm base flow, whichever is greater.
RPD	Abbreviation for relative percent difference. The RPD provide a measure of precision.
Representative	Said of samples collected that are similar to those of groundwater in its in situ condition.
RL	Abbreviation for reporting limit, the smallest concentration of an analyte reported by the laboratory to a customer. The RL is never less than the PQL and is generally twice the MDL.
Runoff	Precipitation, snow melt, or irrigation water that runs off the land into surface water. Runoff can carry pollutants from the air and land into the receiving waters.

Sediment	Fragmental material that originates from weathering of rocks and is transported by, suspended in, or deposited by water or air.
Shelby Sampler	A thin-walled tube with a cutting edge at the toe. A sampler head attaches the tube to the drill rod and pressure vents. Generally used in cohesive soils. Soil or sediment sampled from this sampler is considered undisturbed.
Spring	Water coming naturally out of the ground.
Storm water	Storm water is the water that runs off surfaces such as rooftops, paved streets, highways, and parking lots. It can also come from hard grassy surfaces such as lawns, play fields, graveled roads, and parking lots.
Surface water (Base flow)	That which forms and remains above ground, such as lakes, ponds, rivers, streams, bays, and oceans.
SVOC	Abbreviation for semi-volatile organic compounds, which is a group of chemicals composed primarily of carbon and hydrogen that have a tendency to evaporate (volatilize) into the air from water or soil. Some of the compounds that make up asphalt are examples of SVOCs.
TDS	Abbreviation for total dissolved solids, or the total amount of all inorganic and organic substances, including minerals, salts, metal, cations, or anions that are dispersed within a volume of water.
Temporal	Over a period of time.
TKN	Abbreviation for total kjeldahl nitrogen, which is the total concentration of organic and ammonia nitrogen in wastewater.
TOC	Abbreviation for total organic carbon, which is the gross amount of organic matter found in natural water. Suspended-particulate, colloidal, and dissolved organic matter are part of the TOC measurement. Settable solids consisting of inorganic sediments and some organic particulate are not transferred from the sample by the lab analyst and are not part of the TOC measurement.
Turbidimeter	An instrument for measuring turbidity in which a standard suspension is used for reference.

Turbidity	A measure of how clear the water is; how much the suspended material in water results in the scattering and absorption of light rays. An analytical quantity is usually reported in turbidity units and determined by measurements of light diffraction. Material that can increase turbidity (reduce clarity of water) are suspended clay, silt, sand, algae, plankton, microbes, and other substances.
Trip blank	Sample known to be free of contamination (for target analytes) that is prepared in the laboratory and treated as an environmental sample after receipt by the sampler. Trip blank samples are applicable to VOC analysis only.
TSS	Abbreviation for total suspended solids, which are the nonfilterable residue retained on a glass-fiber disk filter mesh measuring 1.2 micrometers after filtration of a sample of water or wastewater.
USGS	Abbreviation for Unites States Geological Services. USGS is a science which provides impartial information on health of ecosystems and environment, natural hazards which may threaten us, natural resources, impacts of climate and land use change, and core science systems which provide timely, relevant, and useable information.
VOC	Abbreviation for volatile organic compounds, which are often used as solvents in industrial processes and are either known or suspected carcinogens or mutagens. The five most toxic are vinyl chloride, tetrachloroethylene, trichloroethylene, 1,2-dichloroethane, and carbon tetrachloride.
Whirl-Pak®	Sterilized, clear polyethylene bag used to collect water samples for analysis.
WQAL	Abbreviation for a list of parameters defined as the following: pH, conductivity, temperature, dissolved oxygen, turbidity, and alkalinity in the field. Other parameters submitted for laboratory analysis include cations, anions, nutrients, metals, VOCs, SVOCs, herbicides and pesticides, bacteria, TOC, PCBs and phosphorous.

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NYSDEC. 1999. Technical guidance for screening contaminated sediments. Division of Fish, Wildlife and Marine Resources, New York State Department of Environmental Conservation, Albany, NY. 39:20-31

Edwards Aquifer Authority

INTERNET RESOURCES

MCL Information and Tables:
http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=5&ti=30&pt=1&ch=290&sch=F&rl=Y

TRRP Rules and PCL Tables:
http://www.tceq.state.tx.us/assets/public/remediation/trrp/trrptbls1_5_042308.xls

Texas Specific Soil Background Metals Concentrations
http://info.sos.state.tx.us/fids/200700768-1.html