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Sorption measurements and behavior of monosodium methanearsonate and arsenic (+5) in aqueous suspensions of floridian soil fractions

George William Di Carlo
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FLORIDA INTERNATIONAL UNIVERSITY

Miami, Florida

SORPTION MEASUREMENTS AND BEHAVIOR OF MONOSODIUM
METHANEARSONATE AND ARSENIC (+5) IN AQUEOUS SUSPENSIONS OF
FLORIDIAN SOIL FRACTIONS

A thesis submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE

in

ENVIRONMENTAL ENGINEERING

by

George William Di Carlo

1999

To: Dean Gordon R. Hopkins
College of Engineering

This thesis, written by George Di Carlo, and entitled Sorption Measurements and Behavior of Monosodium Methanearsonate and Arsenic (+5) in Aqueous Suspensions of Floridian Soil Fractions, having been approved in respect to style and intellectual content, is referred to you for judgement.

We have read this thesis and recommend that it be approved.

Yong Cai

Walter Z. Tang

Héctor R. Fuentes, Major Professor

Date of Defense: August 27, 1998

The thesis of George Di Carlo is approved.

Dean Gordon R. Hopkins
College of Engineering

Dean Richard L. Campbell
Division of Graduate Studies

Florida International University, 1999

DEDICATION

I would like to dedicate this thesis to my mother, Georgia Belle Di Carlo, and my father, John Joseph Di Carlo. After my mother lost her battle with lung cancer, my father was faced with raising a 12 year-old by himself. I cannot begin to understand what he went through. By dedicating this work to my parents, I hope that I can show just how much I appreciate all their hard work, love, and support.

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I would like to express my deepest thanks to Dr. Héctor R. Fuentes for his unparalleled guidance and support during my graduate studies and the completion of this thesis. Dr. Fuentes provided me the unique opportunity to work on a subject that holds great potential for further research important to the quality of Florida's environment.

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ABSTRACT OF THE THESIS

SORPTION MEASUREMENTS AND BEHAVIOR OF MONOSODIUM METHANEARSONATE AND ARSENIC (+5) IN AQUEOUS SUSPENSIONS OF FLORIDIAN SOIL FRACTIONS

by

George William Di Carlo

Florida International University, 1999

Miami, Florida

Professor Héctor R. Fuentes, Major Professor

Adsorption experiments using both monosodium methanearsonate (MSMA) and its inorganic degradation by-product species As(+5), as sodium arsenate Na_2AsO_4 , were conducted to evaluate the sorptivity of these constituents to various fractions of soil samples taken from the West Palm Beach Country Club. Adsorption data were analyzed with common isotherm equations (i.e., Linear, Freundlich, Langmuir) to determine K_d for each arsenic (As) species/soil fraction. Simulations using a one-dimensional pesticide transport model, PRZM 2.0, were completed to evaluate possible dissolved concentrations of arsenic at the water table interface under 8 different application scenarios for the soil profile found at the sample site.

All contaminant/soil systems displayed a linear sorptivity relationship (R^2 ranging from 0.8262 to 0.9779) with K_d values (units of L/g) ranging from 0.0102 to 0.2295. Results also indicate As(+5) had a higher affinity for the soil fractions than MSMA. PRZM-2.0 predicted concentrations of dissolved arsenic at the water table interface from 0.04 to 1018 ppb within 1 month from only 1 application. Florida's MCL for dissolved As in groundwaters is 50 ppb.

It is recommended that the registration and use of MSMA be re-evaluated as it may impact ground water quality at golf courses or other sandy aquifer systems.

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1.0 INTRODUCTION

The application of herbicides to turf grass is common at golf courses throughout the United States. Most golf courses follow an Integrated Pest Management (IPM) program - a multidisciplinary, ecologically-based pest management system that uses all available methods to keep pests at acceptable levels while minimizing effects on people, the environment, and turf (Bruneau *et al.*, 1995). Thus, the IPM program is a method that reduces reliance on herbicides and pesticides in an effort to manage golf course water quality. However, IPM programs must be tailored to accommodate each unique environmental condition and circumstance. Effective IPM programs established in one geographical area may not be environmentally acceptable in others.

The state of Florida regulates herbicide usage through the Department of Agriculture & Consumer Services (FDACS) by establishing a Ranking Index (RI) to evaluate every new herbicide. The RI is part of the Florida Pesticide Registration Guideline. Some herbicides registered before FDACS' use of the RI are still in the process of being re-evaluated with the RI. The RI is an indicator of the active ingredient's (ai) leaching potential and is calculated using the following chemodynamic parameters: vapor pressure, molecular weight, temperature (K), solubility, Henry's constant, partition coefficient, and degradation half-life in soils. These values are entered into a computer program using a reference Tavares soil, 10 meters (m) depth to ground water table, and 28 centimeters (cm) recharge rate. If the RI value is calculated above 499, then the department may decide to grant full registration of the active ingredient. If the RI is 499 or below, the department requires the registrant to submit additional information for further evaluation of the active ingredient. In the case of the organic arsenical herbicide monosodium methanearsonate (MSMA), FDACS has

estimated a RI of 935.02 and granted registration without additional restrictions other than those stated on the label. MSMA is primarily used at golf courses for the post-emergence control of grassy weeds and is typically sprayed onto turf grasses and various agricultural crops spatially at 0.5 - 2.2 kg ai/hectare (ha).

The Florida Department of Environmental Protection has initiated a study on arsenic and its occurrence in the Biscayne aquifer as a result of organic arsenical herbicide use at golf courses. The state of Florida limits the concentration of As in groundwaters at 50 $\mu\text{g/L}$ (Florida Statutes, FAC, 62-550). Recent characterizations undergone in Dade County, Florida, found dissolved arsenic concentrations up to 12 mg/L in the groundwater at certain golf courses (Buckner *et al.*, 1997). This high arsenic concentration is believed to be attributed to the following:

- South Florida has a very porous subsurface environment consisting mostly of sands and limestone;
- The average depth to the ground water table is approximately less than 10 feet; and
- MSMA is a highly soluble herbicide (104 g/100 mL) (Farm Chemicals Handbook 1997).

1.1 Background

The phenomenon of pollutant fixation (i.e., MSMA) from solution onto soil particles is a direct function of the pollutant's affinity towards the soil fraction (Valsaraj *et al.*, 1995). As one of the many factors that control pollutant fate and transport, sorption (i.e., adsorption and/or sorption) is a measure of this affinity for the solid phase. Pollutant sorption

characteristics, vital to predicting fate and transport, can be expressed by the variable K_d . This study focuses on the K_d of MSMA to soil fractions found at golf courses and uses a one-dimensional solute transport code to estimate dissolved As levels at the vadose zone/water table interface.

1.2 Objectives

The main objective of this work is to:

- Experimentally determine the K_d values of both MSMA and its expected predominant inorganic by-product, arsenate ($\text{As}(+5)$), to Floridian soil fractions sampled from the West Palm Beach Country Club (WPBCC).

A secondary objective is to also:

- Illustrate the potential impact that MSMA usage on drinking water aquifers in southern Florida, using a simple analytical water model to estimate dissolved concentrations at the vadose zone/water table interface.

2.0 LITERATURE REVIEW

Extensive literature searches were conducted on the adsorption of chemicals to soils and sediments, one-dimensional analytical pesticide transport codes, arsenical herbicides, and environmental arsenic chemistry. Adsorption mechanisms, mathematics, in addition to environmental arsenic chemistry are important components of this study and emphasized in this review.

2.1 Adsorption

In the unsaturated zone, soil and sediments can be generally characterized by a solid phase composed mainly of mineral matter, organic macromolecules (i.e., humic and fulvic acids) attached to the minerals, and sedimentary porewater. Minerals typically consist of oxides of Al, Si, Fe, and other metals (Valsaraj, 1995). In southern Florida, especially in engineered strata found at golf courses, sand is the predominant fraction with less than 1% attributed to total organic matter. The various components of a soil column can accumulate contaminants which are controlled mainly by the contaminants' affinity for the physical/chemical makeup of the sediments. Valsaraj (1995) confirms that the most important process involving the fate and transport of organics and metal ion species in the subsurface is the process called sorption. Sorption can include both the adsorption to the surface of a solid (chemical) or absorption within the solid (Pignattelo *et al.*, 1996) through molecular diffusion into micro pores or cavities (physical).

Sediments such as sands can accumulate coatings of dissolved organic matter or Fe and Al oxides which greatly enhance the sorptive capacities of an otherwise relatively inert component (Lindsay, 1979; Valsaraj, 1995). These "enhanced" sands will establish

sorptive equilibria with any organic or inorganic contaminant which are controlled by various diffusion rates through the macro and micropores. However, diffusion into the sand particle itself is not expected to be a major influential factor.

2.1.1 Adsorption Mechanisms

Stumm *et al.* (1987) states that adsorption of a contaminant to a soil or sediment fraction occurs through various mechanisms. Each mechanism operates independently of each other and the energy involved can be quantified by:

$$\Delta G_{\text{ads}} = \sum_i \Delta G_i \quad (1)$$

Where ΔG_i is the energy associated with each mechanism. Valsaraj (1995) categorizes the various mechanisms:

- (i) interactions with the electrical double layer,
- (ii) ion exchange including protonation followed by ion exchange,
- (iii) coordination with surface metal cations,
- (iv) ion-dipole interactions,
- (v) hydrogen bonding, and
- (vi) hydrophobic interactions.

For adsorption of MSMA and arsenate, the first two mechanisms may apply as they relate

to ionizable species. However, the first mechanism, stated by Roy *et al.*, (1987) as the coulombic-electrostatic-chemical mechanism, is the most important. In this mechanism, an electrostatic force results from a surface charge (due to protonation of surface oxygen or OH groups) and an oppositely charged species, which maintains the electro-neutrality of the surface. Since these substitutions are usually done by lower valence cations, a net negative excess charge results. This excess charge creates a second diffuse layer of positively charged atoms or molecules. This type of reaction is important in adsorption of inorganic ions and ionized organic molecules.

2.1.2 Adsorption Models and Mathematics

Sorption is a partitioning from the soluble/insoluble phase in solution onto the solid sediment phase for which there are many partitioning descriptors. In studies concerned with the adsorption of gases by solids, more than 40 equations have been used to describe the data (Krapac *et al.*, 1987). However, most of these gas/solid derived sorption equations can be easily applied towards liquid/solid sorption (Sparks *et al.*, 1986). Mathematical representations of adsorption traditionally have been accomplished using isotherms, such as Langmuir and Freundlich (Fuentes *et al.*, 1993).

2.1.2.1 Langmuir

Initially, the Langmuir equation was derived to explain the adsorption of gases on solid surfaces (Sparks, 1986). The most commonly used Langmuir isotherm can be mathematically expressed as:

$$\frac{x}{m} = \frac{K_L MC}{1 + K_L C} \quad (2)$$

where x is the mass of the solute adsorbed (μg), m is the mass of the adsorbent (g), if C is the equilibrium concentration of the solute as $\mu\text{g/L}$, then the constants K_L and M have units of $\text{L}/\mu\text{g}$ and $\mu\text{g/g}$ respectively (Krapac *et al.*, 1987). The Langmuir constant K_L is related to the bonding energy between the adsorbed ion and the adsorbent, whereas M represents the maximum monolayer adsorption (Gutierrez *et al.*, 1993). Sparks (1986) states that the Langmuir equation is based on the following assumptions:

- 1) The adsorbed entity is attached to the surface at definite, homogeneous, localized sites forming a monolayer.
- 2) The heat of adsorption, Q is constant over the entire monolayer.
- 3) There is no lateral interaction between the adsorbed species.
- 4) Equilibrium is reached.
- 5) The volume of a monolayer and the energy of adsorption are independent of temperature.

Two linearized expressions of equation (2) can be used to calculate the constants after a simple linear regression is performed:

$$\frac{C}{x/m} = \frac{1}{K_L M} + \frac{C}{M} \quad (3)$$

$$\frac{1}{x/m} = \frac{1}{K_L M C} + \frac{1}{M} \quad (4)$$

From these equations, the distribution coefficient, K_d , can be determined by dividing x/m by the corresponding C . Since equations (3) and (4) imply linear behavior, the following relationship can be used to find K_d for either of the two equations; as $C \rightarrow 0$, then

$$\frac{C}{x/m} \rightarrow \frac{1}{K_L M} \quad (5)$$

Thus, K_d (L/g) can be found as the product of $K_L M$ (L/ μ g)(μ g/g). Langmuir isotherm equations have been successfully used to describe the adsorption characteristics of arsenate/sandy soil systems (Lindsay, 1979; Aly *et al.*, 1983; Stumm *et al.*, 1987, 1981; Krapac *et al.*, 1987; Masscheleyn *et al.*, 1991; Patrick *et al.*, 1991; Allen, 1995).

2.1.2.2 Freundlich

Krapac (1987) states that the Freundlich equation is the most widely used one for solid-liquid systems. This equation was first developed as an empirical expression without a theoretical foundation. Later, some investigators referred to the Freundlich constant K_f as a relation to the affinity of a contaminant to the adsorbent. The Freundlich equation can be expressed as:

$$\frac{x}{m} = K_f C^{1/n} \quad (6)$$

where $1/n$ is also a constant that describes how the capacity of the adsorbent varies with the equilibrium solute concentration (Krapac *et al.*, 1987). The simplicity of this equation is shown with a simple linear regression in the following logarithmic form:

$$\log(x/m) = \log K_f + 1/n \log C \quad (7)$$

When using equation (6), the constant K_f and the exponent $1/n$ can be solved for by using a power regression. However, the simplest case is where the adsorption of the solute conforms to a Freundlich equation isotherm and the $1/n$ term is unity,

$$x/m = S = K_f C^{1/n} = K_f C \quad (8)$$

This isotherm equation should produce a linear plot, where the slope K_f is numerically equal to K_d with units of L/g if x/m is expressed as $\mu\text{g/g}$ and C as $\mu\text{g/L}$ (Sparks *et al.*, 1986; Krapac *et al.*, 1987; Fuentes *et al.*, 1988).

2.2 Arsenic Chemistry

Arsenic is a naturally occurring element that ranks 20th in abundance in the earth's crust. Both inorganic and methylated forms can be found in soil/sediment and aquatic systems. However, the inorganic form is the most abundant of the two species. Cullen

et al. (1989) states that As is associated mostly with igneous and sedimentary rocks, particularly with iron, copper, cobalt and sulfidic ores, and coal. Natural and anthropogenic release of As into the environment occurs through the weathering, burning or smelting of these materials and may be deposited in soils, fresh and salt water, and in sediments (Onken *et al.*, 1995). Therefore, the presence of As in a sample is almost considered to be insignificant, unless it is compared with a value normally expected for that sample and found to be excessive. In the state of Florida, arsenic is limited to 50 ppb in groundwaters (FAC 62-550).

2.2.1 Organoarsenical Herbicides

For the past 35 years, organic arsenical herbicides have been used extensively. Hiltbold (1974) states that the more commonly used compounds are sodium and ammonium salts of methanearsonic acid (MAA), monosodium methanearsonate (MSMA), disodium methanearsonate (DSMA), and monoammonium methanearsonate (MAMA). Unlike the inorganic orthoarsenate compounds, methanearsonates have a methyl substitution of one of the hydroxyl groups linked to the arsenic atom. Addition of a second methyl group produces methylarsinic or cacodylic acid (See Figure 1).

2.2.1.1 MSMA

Monosodium methanearsonate ($(\text{CH}_3)_2\text{AsO}_2\text{Na}$; CAS No. 2163-80-6), commonly referred to as MSMA, is known as an organic arsenical because it contains a methyl group ($-\text{CH}_3$) (U.S. EPA *et al.*, 1995). MSMA is a highly water soluble crystalline solid and is used as an herbicide for the postemergent control of grassy weeds in cotton, sugarcane,

nonbearing orchards, citrus groves, lawns, turf, and in noncrop areas. Applications to turf grass at golf courses range from 0.5 kg ai/ha to 2.2 kg ai/ha (0.45 lbs MSMA/acre - 1.96 lbs MSMA/acre).

Figure 1. Formulae of organic arsenical herbicides (Hiltbold, 1974).

Hiltbold (1974) states that MSMA is typically applied to foliage as a spray. Much of the spray that is not intercepted by foliage is deposited directly onto the soil. In addition, a fraction of the MSMA that is intercepted by the foliage does reach the soil via washoff from plant surfaces. This is referred to as the foliar washoff extract coefficient, where the suggested typical value is 0.10 (Carsel *et al.*, 1984). In the environment, MSMA will undergo chemical and biochemical transformations that include oxidation, reduction, and methylation. All of these transformations are largely controlled by microbial, soil, and sediment adsorption/desorption processes which affect the overall environmental distribution of arsenic-containing constituents (U.S. EPA *et al.*, 1995). However, when considering the predominant species of As over time, the issue of understanding the fate

and transport of MSMA transforms into understanding the fate of the inorganic species.

Monosodium methanearsonate can bind, reversibly, to ferrous and aluminum oxides which may be contained on the surfaces of clay particles and sand. While unbound, MSMA may undergo oxidative demethylation to arsenate (H_2AsO_4^-), an inorganic form of arsenic, and reductive methylation to cacodylic acid (U.S. EPA *et al.*, 1995), all of which are reversible (See Figure 2). MSMA is considered to be a possible carcinogen to humans (U.S. EPA *et al.*, 1995). Table 1 illustrates some of the physiochemical properties of MSMA.

2.2.1 Inorganic Arsenate

In most environments, As occurs in an inorganic form in aqueous systems as a result of the dissolution of solids phases such as $\text{As}_2\text{O}_{3(s)}$ (arsenolite), and $\text{As}_2\text{O}_{5(s)}$ (arsenic anhydride) and $\text{AsS}_{2(s)}$ (realgar)(Aly *et al.*, 1993). Aly (1983) comments that the two predominant aqueous forms are weak acids: arsenic acid (i.e., arsenate, +5 oxidation state), and arsenious acid (i.e., arsenite, +3 oxidation state). Table 2 illustrates the acid-base pH dependent equilibria.

The oxides of Table 2 are all very soluble. As a result, As is found mostly in the anionic form which is dependent upon the pH of the water. Microbial activity, in conjunction with the right pH and redox potential, can produce naturally occurring methylated As forms. However, most aquatic systems in Florida are oxidizing conditions which do not allow a stable environment for the methylated forms to remain for very long. Figure 3 shows the effect of redox potential and pH has on the prevailing species of As in a given soil system. Masscheleyn *et al.*, (1991) found that the solubility,

Figure 2. Transformational Pathways for MSMA in the Natural Environment (U.S. E.P.A. ,1995; and Hiltbold (1974).

TABLE 1. KNOWN PHYSICAL, CHEMICAL, AND TOXICOLOGICAL PROPERTIES OF MSMA (FEDERAL REGISTER, 4/20/95; FARM CHEMICALS HANDBOOK, 1997).

Property	MSMA
Molecular Formula/Weight	CH ₄ AsO ₃ Na/ 161.95 grams
Water Solubility	104 g/ 100ml water
Vapor Pressure/Henry's Constant	<7.5E-08 mm Hg/ 6.2E-15
Color	White crystalline solid
Melting Point /Boiling Point	132 - 139°C/110°C
Density	1.55 g/ml
Herbicide Use	Postemergent control of grassy weeds in turf. Preplant in cotton, non- bearing orchards.
Half-life DT ₅₀ (days)	~100
Binding Substrate	Aluminum oxide (clay) Ferrous oxide (coating)
SDWA limits in drinking water	0.05 mg/L

TABLE 2. PH BASED EQUILIBRIA OF ARSENIC ACID AND ARSENIOUS ACID
(ALY *ET.AL.*, 1983).

Reaction	log Ka
+3	
$\text{AsO}^+ + \text{H}_2\text{O} = \text{HAsO}_2 + \text{H}^+$	0.34
$\text{HAsO}_2 = \text{AsO}_2^- + \text{H}^+$	-9.21
+5	
$\text{H}_3\text{AsO}_4 = \text{H}_2\text{AsO}_4^- + \text{H}^+$	-3.60
$\text{H}_2\text{AsO}_4^- = \text{HAsO}_4^{2-} + \text{H}^+$	-7.26
$\text{HAsO}_4^{2-} = \text{AsO}_4^{3-} + \text{H}^+$	-12.47

Figure 3. Eh-pH diagram for the As- H_2O system (Masscheleyn *et al.*, 1991).

mobility, bioavailability, and toxicity of arsenic depends on its oxidation state and pH. His studies indicate that under higher soil redox levels (+200 to +500mV) with pH values ranging from 5 to 7.5, the solubility of arsenic was low and the major species present (up to 87%) in solution was As(+5). Another study concluded that the solubility of arsenate was controlled by the adsorption to soils rather than precipitation of arsenate compounds (Raven *et al.*, 1998).

In southern Florida the subsurface is very porous, aerated, with soil pH ranging from 6.5-7.5. As a result, the predominant species of inorganic arsenic would be expected to be of the +5 valence state. Thus, arsenate (As(+5)) would not be expected to be as mobile as would arsenite (As(+3)). This is significant when determining which As species to conduct sorption studies on. Masscheleyn (1991) also found that amorphous Fe and Al hydroxides, clay content, and pH are the soil properties most related to As sorption.

2.3 PRZM-2.0

Herbicides and pesticides that leach from agricultural fields as nonpoint sources can lead to groundwater contamination. Non-point source contamination can be described as highly variable in terms of loadings. Parameters such as rainfall and irrigation events control the timing and magnitude of the herbicides leaching below the root zone (the root zone is the uppermost layer of soil where the roots of the crop or, in this case, the roots of the turf grass penetrate). Non-point sources are widespread by nature and, as a result, are very difficult to remediate. However, efforts must be made to prevent this type of contamination since herbicide use has affected Florida's Biscayne

aquifer (DERM *et al.*, 1997). The first, and most important, step in preventing groundwater contamination is understanding the relationships between chemical properties, soil system properties, and the climatic and turf management variables that combine to induce leaching.

According to Carsel *et al.* (1994), many investigators have shown that chemical solubility in water, sorptive properties, volatility, formulation, and soil persistence determine the tendency of pesticides to leach through soil. In addition, the hydrologic cycle interacts with the chemical characteristics to transform and transport pesticides within and out of the root zone.

There are many numerical models available that predict contaminant movement in porous media for steady-state, transient, homogenous, and multi-layered components. These models require large amounts of detailed data since modelers generally use what is called finite segment modeling (finite differences). This is where site specific data is entered into smaller segments of known finite volume and characteristics, within the desired area, instead of using field averages found over the whole area. Mass balances are then performed about each segment assuming homogeneity (or "pseudo-homogeneity") (Thomann *et al.*, 1987). Thus, finite element modeling allows more accurate predictions in highly variable (heterogeneous) areas that do not share the same characteristics throughout. Unfortunately, as Carsel (1994) points out, each spatial segment modeled must be properly characterized - a task which is sometimes either too expensive to perform or too overwhelming to accomplish within a project's time limits. Therefore, the use of modeling for this work should be viewed as the possibility or potential of groundwater contamination via use of MSMA at typical golf course

environments in southern Florida, and not as a modeled scenario that has undergone extensive (and expensive) verification and calibration of model parameters and conditions.

Once the critical components necessary to reasonably simulate modeling scenarios have been determined, a suitable unsaturated flow and transport computer code will be used to predict the fate and transport of MSMA and its predominant degradation product, arsenate, in the vadose zone. The computer code will estimate concentration profiles as a function of depth and time. Unsaturated zone transport models include:

- ⇒ VLEACH
- ⇒ VS2D/T
- ⇒ SESOIL
- ⇒ CHEMFLO
- ⇒ ONE - D
- ⇒ PESTRUN
- ⇒ PESTAN
- ⇒ PRZM 1.0 - 3.0

PRZM-2.0, an EPA approved computer code, was designed to address the above problems and was chosen for this study. PRZM-2.0 is available through the U.S. EPA Center for Environmental Assessment Modeling internet website, and is free to the public. It has been used by investigators for over 10 years with some success. For the

purposes of estimating the impact of MSMA use at golf courses, this model is acceptable despite its' development for agronomic systems. However, the author also recognizes that this model has limitations which will be discussed later in this chapter.

2.3.1 Theory

PRZM-2.0 is a one-dimensional, dynamic, compartmental model that is able to estimate chemical movement in unsaturated soil systems within and immediately below the plant root zone (see Figure 4) (Carsel *et al.*, 1994). PRZM-2.0 allows the consideration of pulse loads, prediction of peak events, and estimation of time-varying concentration profiles, which overcomes the limitations in steady-state models. Time-dependent transport by both advective and dispersive mechanisms in the dissolved phase or diffusion in the gas phase are also estimated in this program.

PRZM's two major components are hydrology and chemical transport. The hydrologic component estimates runoff and erosion and is based on the Soil Conservation Service curve number technique and the Universal Soil Loss Equation (Carsel *et al.*, 1994). Water movement is simulated through use of the following soil parameters including field capacity, wilting point, and saturation water content. Evapotranspiration is estimated from pan evaporation data, or by an empirical formula if input pan data are unavailable. Evapotranspiration is divided among evaporation from crop interception, evaporation from soil, and transpiration by the crop. Irrigation may also be considered.

All three phases of the MSMA/As(+5) system (dissolved, adsorbed, and gaseous) are moderated by plant uptake, surface runoff, erosion, decay, volatilization, foliar washoff, advection, dispersion, and retardation. PRZM-2.0 solves the transport equation

Figure 4. Illustration of Chemical Movement as Modeled by PRZM- 2.0 (Carsel, 1994).

with one of two finite-difference numerical solutions; the backwards-difference implicit scheme, or a Method of Characteristics (MOC) algorithm that greatly reduces numerical dispersion (Carsel *et al.*, 1994). The hydrologic components of pesticide transport equations (i.e., moisture content and soil-water velocities) are solved separately and then numerically integrated into the equation in succeeding time steps. Output can be summarized as daily, monthly, annually, or a daily time series value for various fluxes or storages can be written to sequential files during program execution (Carsel *et al.*, 1994)

PRZM-2.0 also links another transport code, VADOFT. VADOFT is also a one-dimensional solute transport code that only models the vadose zone. The two models, PRZM and VADOFT, are the two major components of PRZM-2.0. In addition, PRZM-2.0 includes a Monte Carlo pre- and post- processor, that can perform probability-based exposure assessments. However, the predominant focus of this research effort precludes the use of these modeling compartments. Therefore, only the PRZM code, without the use of the Monte Carlo processor, will be used and discussed further.

2.3.2 Limitations

Limitations associated with PRZM-2.0 have been well documented. Carsel et al. (1994) states the four major categories:

- Hydrology
- Method of solution of the transport equation
- Soil hydraulics
- Deterministic nature of the model

Hydraulic computations are performed in PRZM on a daily time step, therefore

parameters that vary throughout the day (i.e., evaporation, runoff, etc.) could be overestimated or underestimated. This has the effect, especially in larger soil cores, of inducing a greater-than-anticipated movement of chemical through the profile. For shorter soil cores, PRZM-2.0 can obviously be used to represent the entire vadose zone. PRZM-2.0 retained its daily time step due to the relative availability of daily meteorological data. Evapotranspiration is calculated using Hamon's formula, in the absence of evaporation data. When Hamon's formula was compared against field data at an irrigated citrus crop in Florida, PRZM-2.0 substantially underestimated evapotranspiration (Dean *et al.*, 1985). However, the author suspects the gap would be closed when compared to a much less dynamic system such as turf grass with an extremely shallow, sandy aquifer.

PRZM-2.0 is unable to calculate the heat loss through the soil profile as a result from evaporation of water. The energy associated with changing water from liquid to vapor phase is enough to have a cooling effect in the soil column. The upward movement of water in response to gradients induced by evapotranspiration cannot be simulated by PRZM-2.0 as it only considers the advective, downward movement of water. For chemicals with a low vapor pressure, hence low volatilization, this process is important for renewing the chemical concentration at the surface.

If the user does not solve for transport with the MOC method, especially for advection-dominated systems, PRZM tends to produce a high degree of numerical dispersion in such systems. This results in overprediction of downward movement due to smearing of the peak and subsequent overestimation of loadings to groundwater (Carsel *et al.*, 1994). In low-advection systems, the MOC approach reduces to the original

backwards-difference solution scheme, which is exact for velocities approaching zero.

The input file which contains the pesticide partition coefficient parameter for each contaminant modeled, only allows for the input of K_d . Use of the Freundlich isotherm cannot be used if the contaminant exhibits nonlinear sorption as the exponent $1/n$ has not been incorporated into the model. Thus, only chemicals with linear type adsorption characteristics can be modeled with PRZM-2.0, leaving only the use of Langmuir and Linear adsorption parameters for this modeling effort.

2.3.3 Algorithms

Because the use of PRZM-2.0 is a secondary goal of this work, the reader is advised to refer to the detailed listing of the various solutions that can be found in PRZM-2.0, "A Model for Predicting Pesticide Fate in the Crop Root and Unsaturated Soil Zones: User Manual for Release 2.0". However, the two major equations, chemical and water transport, will be briefly reviewed in order to explain how the developers chose the driving mechanisms for this program. Figure 5 illustrates the mass balances between each phase for a single contaminant.

Both the surface and subsurface zones will use the following partial differential equations to simulate transport in soil for each of the dissolved, adsorbed, and vapor phases respectively:

$$\frac{A \Delta z \partial (C_w \theta)}{\partial t} = J_D - J_V - J_{DW} - J_U - J_{QR} + J_{APP} + J_{FOF} \pm J_{TRN} \quad (9)$$

$$\frac{A \Delta z \partial (C_s \rho_s)}{\partial t} = J_{DS} - J_{ER} \quad (10)$$

Figure 5. Illustration of chemical movement and transformations (Carsel, 1994)

$$\frac{A \Delta z \partial (C_g a)}{\partial t} = J_{GD} - J_{DG} \quad (11)$$

where

A	=	cross-sectional area of soil column (cm ²)
Δz	=	depth dimension of compartment (cm)
C _w	=	dissolved concentration of pesticide (g cm ⁻³)
C _s	=	sorbed concentration of pesticide (g g ⁻¹)
C _g	=	gaseous concentration of pesticide (g cm ⁻³)
θ	=	volumetric water content of soil (cm ³ cm ⁻³)
a	=	volumetric air content of the soil (cm ³ cm ⁻³)
ρ _s	=	soil bulk density (g cm ⁻³)
t	=	time (d)
J _D	=	represents effect of dispersion/diffusion of dissolved phase (g day ⁻¹)
J _V	=	represents the effect of advection of dissolved phase (g day ⁻¹)
J _{GD}	=	represents effect of dispersion and diffusion in vapor phase (g day ⁻¹)
J _{DW}	=	mass loss due to degradation in the dissolved phase (g day ⁻¹)
J _{DG}	=	mass loss due to degradation in the vapor phase (g day ⁻¹)
J _U	=	mass loss by plant uptake of dissolved phase (g day ⁻¹)
J _{QR}	=	mass loss by removal in runoff (g day ⁻¹)
J _{APP}	=	mass gain due to pesticide deposition on the soil surface (g day ⁻¹)
J _{FOF}	=	mass gain due to washoff from plants to soil (g day ⁻¹)
J _{DS}	=	mass loss due to degradation of sorbed phase chemical (g day ⁻¹)
J _{ER}	=	mass loss by removal on eroded sediments (g day ⁻¹)
J _{TRN}	=	mass gain or loss due to parent/daughter transformations

In the application of equations (9), (10), and (11), the variables J_{QR} , J_{FOF} , and J_{ER} would not be included in the subsurface zones. J_{APP} is used only when the

herbicide/pesticide is applied below the surface and J_U is also only used for surface layers below the root zone.

The transport of water is a combination of Darcy's law and the continuity equation which yields the Richards differential equation as follows:

$$\frac{\partial \theta}{\partial t} = \frac{\partial}{\partial z} \left[K(\theta) \frac{\partial h}{\partial t} \right] \quad (12)$$

where

$K(\theta)$ = hydraulic conductivity at various heads (cm sec^{-1})

θ = soil water content ($\text{cm}^3 \text{ cm}^{-3}$)

The water balances for each of the 3 zones (surface zone, root zone, and unsaturated zone) are solved separately.

There are four other major categories of algorithms including chemical application and foliar washoff, chemical runoff, soil erosion, and volatilization. The variables representing the solutions to these other categories are included in equations (9), (10), (11), and (12). Again, the reader is advised to refer to the PRZM-2.0 user's manual for all the detailed solutions to the above equations.

3.0 METHODS

This section describes the materials, methods, equipment, protocols, and documentation used throughout this work.

3.1 Equipment

This section is intended to provide a list of each major piece of equipment and a brief description of the purpose it was used for.

Field sampling at the West Palm Beach Golf Course required the use of a hand operated auger (Environmental Sampling Kit, Art's Manufacturing & Supply, American Falls, ID, 83211; 1/4 " Stainless Steel Rods). All samples were homogenized (mixed) in a 5" x 5" x 3" stainless steel tray and subsequently placed in a plastic storage bag. Soils were dried overnight in a Fisher Scientific Isotemp Oven Model 725F. Soil samples were split, and poured into a set of ASTM brass sieves (#'s 16, 30, 40, 60, 140, and 200), and shaken with a mechanical shaker (Baker, 1/2HP).

All kinetics tests were conducted in 33 mL Fisher Scientific glass flat-bottomed tubular reactors with teflon coated screw caps. Subsequent adsorption tests were conducted in 130 mL glass bottles with teflon coated septas and aluminum caps. All weighings of soil and contaminants were performed with a microbalance (range 400g - 0.0001g, calibrated through May, 1998). Centrifugation of all experimental reactors was performed in a Marathon 6K Centrifuge (33 mL reactor bottles) or an IEC Model K Centrifuge (130 mL reactor bottles). Mixing of samples for both kinetics and adsorption tests was accomplished with a mechanical rotator (Environmental Services, tumbling

motion, 30 rotations per minute). Glassware (Kimax and Pyrex) used: volumetric pipettes (1-50 mL, class A), 400 mL beakers, disposable pipettes, volumetric flasks (5-500 mL, class A), and crucibles (Coors, Inc). pH readings were performed with a Corning pH Meter 245 which was calibrated for each use with Fisher Scientific pH Buffer Solutions (pH's of 4,7, and 10). A Fisher Isotemp Muffle Furnace was used to ignite the soil for Total Organic Carbon (TOC) measurements. All atomic adsorption (AA) analyses for arsenic were performed on a Perkin Elmer 5100 C fitted with an AS-60 autosampler and a graphite furnace equipped with a L'vov platform for good replicability. Computer simulations were modeled on a Hitachi Visionbook 4000 Series, 32 MB RAM, 133MHz, with PRZM-2.0 (Pesticide Root Zone Model). Daily laboratory room temperatures were monitored using a mercury thermometer and recorded into a notebook.

3.2 Materials

All kinetics and adsorption tests were conducted with distilled de-ionized water (dd-water) supplied from the Department of Southeast Environmental Restoration Program at Florida International University (FIU). MSMA 6.6 (Lesco, Inc.) was purchased from Lesco, Inc. (Ft. Lauderdale, FL) with a registered purity of 6.6 lbs MSMA per gallon (23.8% by wt. as elemental As). Inorganic arsenic (+5) was studied using sodium arsenate ($\text{Na}_2\text{HASO}_4 \cdot 7\text{H}_2\text{O}$, analytical grade, Aldrich Chemical Company, Milwaukee, WI). Trace metal grade nitric acid (HNO_3 , Fisher Scientific), and hydrogen peroxide (30% H_2O_2 , Fisher Scientific) were used in the digestion procedures, and nickel nitrate (nickelous (II) nitrate, $\text{Ni}(\text{NO}_3)_2 \cdot \text{H}_2\text{O}$, Fisher Scientific) was used as a modifier

for As analysis. Soap (Laboratory Soap with Calgon, Fisher Scientific) was used to clean glassware.

3.3 Preliminary Work

Final experimental adsorption and analytical methods will require preliminary work to determine at least two important issues: (1) established equilibrium conditions, and (2) maximized analytical methods for the determination of arsenic.

3.3.1 Kinetics

Prior to any equilibrium adsorption tests, it was necessary for the contaminant mixture to have reached a point of equilibrium between the adsorbed phase and the dissolved phase. Though previous research illustrated that most inorganic As species need approximately 48 hours to reach equilibrium, it was critical for this study to conduct kinetics tests to eliminate any unforeseen deviations from the norm in either the equipment, procedures, or analysis (Goldberg *et al.*, 1988; Masscheleyn *et al.*, 1991, 1991, 1993; Aurillo *et al.*, 1994; Darland *et al.*, 1997).

Kinetics testing began by preparing the soil solution ratios which were based on previous studies (Roy *et al.*, 1987). A 10 ppm solution of As(+5) (as sodium arsenate) was mixed with the five different soil fractions while keeping the same soil to solution ratio identical for all replicates. The reactors were mixed in a rotator and removed for analysis at the following intervals: 2, 4, 8, 16, 24, 48, 96, and 168 hours. Samples were then digested for Total Recoverable As as listed in Standard Methods (1995).

Equilibrium was considered to be established when there was a less than 2% difference in the mass of As removed between 2 consecutive intervals. The following formula shows the calculation necessary to determine when the system reached equilibrium:

$$\{(C_1 - C_2) * V_{sol}\} * 100\% = \% \text{ Difference} \quad (13)$$

where,

C_1 = Concentration of sample at interval 1

C_2 = Concentration of sample at interval 2

V_{sol} = Volume of liquid in reactor

Figures 6 and 7 illustrate the results from two sets of kinetic experiments. Figure 6 shows the kinetics for the As(+5):Soil 1 system, from which a 48 hour equilibration period was determined. However, the system exhibited a non-linear approach towards equilibrium. The same pattern occurred for the other soils as well (See Appendix A). To verify that no experimental errors were made, a second kinetics test was conducted. From the second set of kinetics, it was determined that the systems do require 48 hours to reach equilibrium (See Appendix A) as indicated by Roy (1987). The equilibration for MSMA was extrapolated from the sodium arsenate tests since both are ionizable As species.

3.3.2 Atomic Adsorption Analysis

Figure 6. Plot of Equilibrium Concentration vs. Time, Soil 1 from Kinetics Experiments #1.

Figure 7. Plot of Control - Equilibrium Concentration vs. Time, 3 soils from Kinetics Experiments #2.

The graphite furnace atomic adsorption (GFAA) method is an EPA accepted method for the determination of As (US Army Corps of Engineers, 1995). The optimum range for analyzing arsenic concentrations is from 1 - 200 ppb for the Perkin Elmer 5100C. However, interference from other dissolved minerals or metals can either reduce the sensitivity of the instrument, or the replicability of a given set of samples. Therefore, it is important to use a matrix modifier during the analysis for As. Nickel nitrate, when added to a sample as a matrix modifier, will allow modifications to the temperature program in optimizing the instrument's response to a sample. The Perkin Elmer 5100C is controlled using WINLAB v. 4.0 software that allowed modifications to the analytical procedures (i.e., adding a matrix modifier, changing temperature). This software, in conjunction with a matrix modifier, maximized both the sensitivity and precision for each analysis. Consequently, sample replicability was greatly improved.

3.4 Experimental Protocol

Where applicable, all experimental procedures were followed in strict accordance to accepted methods and protocols. This section outlines all field and laboratory procedures performed during this study and the source of each method will accompany its' description.

3.4.1 Sampling

A soil sample was taken from the West Palm Beach Country Club (WPBCC) located at 7001 Parker Avenue, West Palm Beach, Florida, on the 4th of November 1997

(See Appendix A for map of area). All methods were followed according to strict Quality Assurance (QA) procedures as defined by the Florida Department of Environmental Protection (FDEP) Standard Operating Procedures (SOP's) for Laboratory Operations and Sample Collecting Activities Manual (DEP - QA-001/92). FDEP personnel - Leslie Smith (Waste Cleanup Section) and Terry Davis (Environmental Specialist) - and Dr. Hector R. Fuentes were present to coordinate sampling activities.

Upon reviewing reports of previous field studies at the WPBCC (Ardaman & Associates, Inc. *et.al.*, 1996), it was decided to take a sample from an area that was untended (i.e. area where MSMA had not been applied). Thus, the likelihood of acquiring a soil sample, from any depth above the ground water table, containing arsenic at levels above the anticipated background of ~5 ug/kg would be greatly reduced. All samples were retrieved using a hand-operated auger which was cleaned using an in-field cleaning method for field equipment (DEP - QA-001/92).

Sampling began by clearing away the top 4 inches of soil (mostly root material) using a stainless steel spade. An extension from the auger equipment was placed across the prepared area to be used as a reference point in measuring the depth of the samples taken. The auger bucket was 12 inches in length and 4 inches in diameter and, thus, was able to retrieve a maximum of 150.8 cubic inches of soil each sampling. When the samples were brought to the surface, the bucket was emptied into a precleaned stainless steel pan for immediate observations. Samples were mixed for homogeneity and placed into a sealed plastic bag. Five samples were taken at the following depth ranges: (1) 4" - 9", (2) 1'2" - 1'11", (3) 3'6" - 4'6", (4) 5'6" - 6'6", (5) 7'6" - 8'6", and labeled, at the time

of sampling, Surficial 4" – 9", gd – 2, gd – 3, gd – 4, and gd – 5 respectively. Samples were immediately stored in a cooler of ice and brought back to Florida International University (FIU) for storage at 4°C.

3.4.2 Soil Sieving

After sampling the soil from the West Palm Beach Golf Course, a portion of each soil sample was placed out on a clean sheet of plastic and allowed to air dry at room temperature in a contaminant free environment for 1 week. A portion of the air dried samples (approximately 300 grams) was used for sieve analysis. The remainder (<700 grams) was placed in a sealed plastic bag for use in all batch kinetic and adsorption experiments.

Sieving was performed using the following ASTM brass sieves: #16, #30, #40, #60, #140, and #200. After each soil sample was prepared, approximately 400 g was partitioned for sieve analysis. The following procedure (ASTM D1140-54) was used for each sieving:

- 1) Determine weight of sample to be sieved.
- 2) Assemble sieves in numerical order so that the sieve #200 is on the bottom.

Place a pan beneath sieve #200, pour sample in the uppermost sieve. Place a cover on sieve #16.
- 3) Insert sieve arrangement into a mechanical shaker, and shake 5 min – 10 min.
- 4) Remove from mechanical shaker and weigh each sieve noting the weight of

sample that each sieve retained.

- 5) Carefully transfer all sample portions to the original beaker (using various brushes to remove particles caught in the mesh).
- 6) Repeat steps 1-5 twice, so that each sample is sieved a total of three times.

3.4.3 Soil Characterization

A fraction of each soil sample was sent to the FDEP Chemistry Laboratory for analysis of background levels of Total Phosphorus, and Total Recoverable Arsenic and Iron. These background concentrations are important to know when evaluating adsorption isotherms and determining if the presence of other constituents influence arsenic's mobility and sorptivity to the soils obtained from the WPBCC.

In addition to this, the soils were analyzed for Total Organic Carbon at FIU. After the soils were oven dried (104°C) overnight, they were placed in a crucible, weighed, and ignited at 450°C for 48 hours. Once samples were removed from the crucible and cooled to room temperature in a dessicator, they were re-weighed to determine how much organic matter was removed. Jaffe (1998) stated that all organic matter is completely destroyed at these temperatures and should give a good estimate of the TOC for each soil.

3.4.4 Standards and Solutions

All solution preparation methodologies have been followed in strict accordance to those outlined in the Standard Methods for the Examination of Water and Wastewater

(19th ed.). To prevent trace level As cross-contamination when preparing standards and solutions, laboratory glassware were washed with a soap solution (10:1, dd-water:soap) and rinsed with acidified dd-water ($\text{pH} < 2$), and dd-water. All standards were created using either stock As(+3) Atomic Adsorption, MSMA, or sodium arsenate solutions.

3.4.5 Adsorption

Adsorption tests were conducted to evaluate the sorptivity of both As(+5) and MSMA towards each soil fraction (5). The soil fractions, from this point on, are renamed as follows: Surficial 4" - 9" to Soil 1, gd-2 to Soil 2, gd-3 to Soil 3, gd-4 to Soil 4, gd-5 to Soil 5. Each soil fraction was tested with 4 to 6 different concentrations (3 replicate attempts per concentration), plus one soil blank (dd-water), one water blank (dd-water), and one control (with the original As(+5) or MSMA concentration for comparison). Thus, a total of 18 to 21 samples were created per soil per contaminant. The soil to solution ratios mentioned previously, were modified so that approximately 30% of the original total As will remain in the equilibrated solution. This allowed for a statistically valid comparison of replicate versus controls, and a value that can be more easily reproduced. Soil:solution ratios were then set at 1:250 (0.5000 g of soil/125 mL solution) for soils 1-4 and 1:500 for soil 5 (0.2500 g of soil/125 mL of solution).

Unlike the kinetics experiments, both adsorption trials used 125 mL of solution in 140 mL glass reactors with teflon coated septas capped with aluminum rings. The 15 mL of headspace was designed to maintain oxidizing conditions within the reactor during the experiment. Thus, the predominant species in the As(+5) experiments were assumed to

be As(+5). However, the fraction of As(+5) remaining in solution at the end of the equilibration period was not expected to exceed the 87% as found in Masscheleyn's study (1991). Once the samples were prepared, they were wrapped in protective cloth and placed into the rotator for 48 hours of mixing/equilibration time. After 48 hours, each sample was centrifuged for 10 minutes at 1,100 rpm in the IEC Model K centrifuge. Applying the following formula, an estimate of the largest particle remaining in solution can be made:

$$t = \frac{9\eta \ln(R_b/R_t)}{2\omega^2 r^2 (\rho_p/\rho)} \quad (14)$$

where,

$$\omega = 4\pi^2(\text{rpm}^2)/60$$

$$\rho = \text{density of solution (g/cu.cm)}$$

$$\eta = \text{viscosity of water (8.95E-03 g/sec-cm @ 25C)}$$

$$t = \text{time (min)}$$

$$\rho_p = \text{particle density (g/cu.cm)}$$

$$R_b = \text{distance (cm) from center of centrifuge rotor to top of solution.}$$

$$R_t = \text{distance (cm) from center of centrifuge rotor to bottom of tube.}$$

Thus, particles larger than 0.3 microns have settled during centrifugation. A 100 mL aliquot of each sample was then digested, in accordance with Standard Methods (1995) method 3113 for Total Recoverable As (atomic adsorption electrothermal furnace). Once

digestion was complete, each sample was split into two; (1) for analysis at the Florida Department of Environmental Protection - Chemistry Lab, and (2) for analysis at Florida International University.

3.4.6 Modeling

The value of computer simulations are largely based on the quantity and quality of data and the inevitable necessary assumptions. However, all data that was estimated for simulations came from recommendations from the PRZM-2.0 user's manual (gained through years of trial and error), from peer review sources, or was determined experimentally. It is recognized that a complete calibration and verification of the model should be performed before results are considered as fact. Because this study has focused largely on other issues (i.e., laboratory derived K_d values for both MSMA and arsenate to a set of sampled soils), simulations should be viewed as preliminary work towards understanding the possible fate and transport of MSMA.

Using the sources mentioned above and experimental data on the partitioning of MSMA and arsenate to all five soil fractions, a simulation of MSMA transformation and transport was conducted to estimate dissolved arsenic concentrations in the soil profile down to the water table interface. The entire vadose zone was categorized into 5 horizons (154 cm total depth), each representing the different soil types found at the WPBCC sample site (see Figure 71, Appendix A). At the WPBCC sample site, the depth to the water table was estimated at 8 feet, but records show that the water table was found at depths as little as 5 feet (Ardaman & Associates, Inc. *et.al.*, 1996).

The method of solving for the transport equations by PRZM-2.0 was performed using the backward-difference scheme. Another important issue is whether to link PRZM-2.0 to the VADOFT model. Since the simulated soil core is so short (5 feet), it was not deemed necessary to utilize the VADOFT model. This assumption is based on the likelihood of the drainage of field capacitance in one day. One of the parameters used for determining the actual water velocity in any media is known as the hydraulic conductivity or coefficient of permeability (de Marsily *et.al.*, 1986). Under saturated conditions, the hydraulic conductivity for fine sands is 2.5 m/day (Gupta *et.al.*, 1989). However, under unsaturated conditions the hydraulic conductivity is found to be smaller (even when saturated during rain events) and should be determined experimentally (de Marsily *et.al.*, 1986). To find the estimated maximum pore water velocity or seepage velocity for fine sands under saturated conditions, the Darcy's velocity must first be found (de Marsily *et.al.*, 1986):

$$V_D = K i \quad (15)$$

where , V_D is the Darcy's velocity ($L T^{-1}$)

K is the saturated hydraulic conductivity ($L T^{-1}$)

i is the hydraulic gradient ($\Delta h/L$, Dimensionless)

For the conditions in this simulation, the hydraulic gradient is equal to 1 when considering that the head differential (5 ft) is equal to the length along which it is

measured (5 ft). Thus, the maximum Darcy's velocity is equal to the saturated hydraulic conductivity. The actual pore water velocity, which would be slower in the vadose zone to some degree, is related to the Darcy's velocity in this soil using the following relationship discussed by Gupta (1989):

$$v = \frac{V_D}{\eta} \quad (16)$$

where, v is the seepage or pore water velocity ($L T^{-1}$)

V_D is the Darcy's velocity ($L T^{-1}$)

η is the porosity (Dimensionless)

Assuming a porosity range of 0.20 to 0.40 for the fine sands, then the seepage velocity would range from 6.25 - 12.5 m/day. Since the simulated soil core is only 1.54 m (5' 5/8"), the drainage of field capacity in one day can be accomplished under maximum, saturated conditions. Thus, the assumption must be made that the seepage velocity in the vadose zone during rain events must be at least 12 - 25% of the velocities found in the saturated zone under similar hydraulic gradients.

Other parameters necessary for simulations can be summarized into three major categories: soil characteristics, hydrology and meteorology, and herbicide characteristics and application. Simulations were performed so that comparisons can be made against results derived from ranges of certain input parameters instead of just single values. By increasing and decreasing the values of certain input parameters, this study would

illustrate which parameters may have the strongest impact (aside from increasing MSMA applications and/or rates) on the resulting soil concentration profiles. The input parameters that will be varied are: (1) K_d values , (2) Irrigation, and (3) Hydrodynamic Dispersion. The values for these parameters are discussed in section 3.6. The other parameters that will not vary throughout the simulations will be discussed in the following sections and will be referred to as the "Reference Parameters". Since there are over 120 different input parameters, only the more important ones will be listed.

3.4.6.1 Soil Parameters

Based on the particle size characterization study of the five soils (all classified as sand), and the PRZM-2.0 user's manual recommendations of soil parameters for this type of soil group, the following major soil parameters were used:

<u>Parameter</u>	<u>Value</u>
• Total depth of soil core:	154.0 cm
• Plant uptake factor:	0.2 (ranges are 0.2-0.4 for very soluble herbicides)
• Irrigation:	Yes, over the canopy, max. rate of 1cm/hr (recommended value)
• Fraction of water capacity triggering irrigation:	0.55 (recommended range 0.45 - 0.55)
• Soil surface albedo:	0.21 (recommended value)
• Reflectivity:	0.96 (recommended value)
• Ave Temp at water table:	25°C (recommended value)

- Horizons: 5, 1 for each soil type
- Thickness per horizon: Top layer first (cm) 14, 42, 30, 40, 28
- Bulk density: 1.45 (g/cu.cm, recommended value)
- Initial soil water content: 0.1 (cu. cm/ cu. cm, recommended value)
- Adsorbed, dissolved, vapor decay rate: 0.1 for MSMA, 0.0 for arsenate
- Field capacity: 0.1 (recommended value)
- Wilting point: 0.05 (recommended value)
- Organic carbon: Top Lyr (%) 0.43, 0.23, 0.01, 0.74, 1.15

3.4.6.2 Hydrology Parameters

The following major hydrology parameters were used for this simulation:

<u>Parameter</u>	<u>Value</u>
• Pan factor:	0.72 (recommended value)
• Maximum depth evaporation is extracted:	15 cm
• Maximum interception storage:	0.03 cm (recommended value)
• Maximum rooting depth:	3 cm
• Runoff curve number:	30 (recommended value)
• Maximum canopy height:	4 cm

Because the model is based on agronomic systems, the dates of crop emergence,

maturation and harvest were required. All applications and simulations were performed during maturation of the crop (grass).

Daily meteorological data such as temperature, wind speed, and precipitation were downloaded from the National Climatic Data Center (NCDC, 1998) for the most recent 5 year period without any missing data points; January 1 water year 1988 to December 31 water year 1993. Other parameters such as albedo and evaporation were estimated and calculated respectively (via PRZM-2.0) based on temperatures and daylight hours for the WPBCC (based on longitude). Figure 8 illustrates the hyetograph (from the West Palm Beach International Airport weather station) and MSMA timing and application rates for the water years 1990 (See Appendix A for water years 1988-1993).

3.4.6.3 Chemical Parameters

Chemical parameters necessary for model execution are as follows:

<u>Parameters</u>	<u>Values</u>
• Application dates:	For each year there are 2 applications (i.e., 3/1/88 and 9/1/89). These dates were chosen since they are the approximate dates used at the WPBCC. Choosing the 6/1/xx application date was important.
• Application rate:	1.85 kg MSMA/ ha, 0.0 kg Arsenate/ha
• Names of Herbicides:	MSMA, daughter product - arsenate.
• Depth of application:	0.0 cm
• Filtration of herbicide off foliage:	linear application, nonlinear filtration.
• Henry's Coefficient:	1.5E-14, calculated: vapor pressure/water solubility

Figure 8. Hyetograph and Input Scheme of MSMA for Water Year 1990.

- MSMA decay rate: 100 days (FDACS *et.al.*, 1997)

In summary, the following list presents the major assumptions and conditions that were used for this modeling effort:

- Soil horizons in simulated soil column (water table depth of 5 feet) are proportional and spatially identical to sample site (water table depth of 8 feet).
- Drainage of field capacitance in 24 hours. Thus, seepage velocities are at least 1/10 - 1/4 the theoretical seepage velocities under completely saturated conditions.
- Range of effective dispersion values represent what may happen in field as follows (de Marsily *et.al.*, 1986):
 1. Low Dispersion - 100 cm²/day
 2. Medium Dispersion - 1,000 cm²/day
 3. High Dispersion - 10,000 cm²/day
- MSMA applied twice annually (March, September) at a rate of 1.85 kg/ha.
- 5 water years (January 1988 to December 1993) of precipitation, daily temperature, and wind speed were acquired from the NCDC.
- Field data was estimated from US EPA PRZM-2.0 User's Manual. Data in manual was compiled based on Soil Conservation Society (SCS) soil hydrologic groups and regional characteristics.
- Laboratory derived K_d values represent the likely interactions of MSMA and As(+5) in the sampled soils.

- K_d values, irrigation and dispersion coefficients are inputted using a range of values instead of single field average estimates.

3.5 QA/QC

All protocols were followed in strict accordance to procedures outlined in Standard Methods (1995) and Batch-Type Procedures for Estimating Soil Adsorption of Chemicals (EPA/530-SW-87-006-F). The various precautionary steps followed for minimum compliance with QA/QC requirements are given in this section.

3.5.1 Sampling, Storage , and Documentation

- For every sample obtained, field data such as date, depth, sample number, weather conditions, odor, and color were reported (Appendix B).
- For every sample obtained in the field, proper soil storage bags were placed in a cooler for shipment back to the University for long-term storage at 4°C.
- Duplicates of every sample were sent to FDEP's Chemistry Laboratory located in Tallahassee, Florida via common carrier. Each shipment of samples, both soil and aqueous, were accompanied with chain-of-custody forms, FDEP Laboratory Service request forms, sample description forms, and properly labeled sample containers as listed in FDEP's QA manual mentioned previously (DEP - QA-001/92). (Appendix C).
- Best sample containers (either TFE or polypropylene) were washed with 10% nitric acid and clearly labeled.

- Laboratory samples containers were properly labeled with ID # and stored acidified at 4°C.
- All arsenic laboratory sample documentation was entered into laboratory notebooks with carbon copies.
- A detailed report will be submitted to the Principle Investigator (US EPA) at the end of the experimentation.

3.5.2 General Experimental

- Standard solutions were prepared daily.
- Sorbates were preconditioned before experiments.
- Calibrations for AA analysis were conducted for every set of 18 samples ($R^2 \geq 0.9800$ for all calibrations) with either sodium arsenate (see materials) or Fisher Scientific As (+3) Atomic Adsorption Standard.
- The microscale was calibrated within the past year (6/97).
- All pH readings were performed after calibrations with buffer solutions (slopes ranged within 58.01-60.11)
- All experiments were conducted in accordance with minimum safety standards, including wearing laboratory coats, gloves, protective eyewear, and long pants.
- All use of acids was performed under a fume hood, and any hazardous material was disposed of properly.
- The following phone number was to be called in case of emergency: (305) 348-2621.

3.5.3 Statistical Data Analysis

All replicates for one sample point were statistically analyzed for purposes of eliminating outliers. An ideal minimum number of replicates necessary for a statistical analysis is three. In some cases, however, experimental error prevented having three replicates for each data point, thus statistical analysis could not be performed for those sets of replicates. Depending upon the number of replicates, Day *et al.* (1986) states that at least two tests can be applied to remove outliers for the following situations: for the rejection of a single data value from a set of data points, the Q-test can be applied to data sets of 3-5 replicates, and the $4d$ rule applies to data sets from 4-8 replicates.

The Q-test will be applied to all data sets containing three replicates, an example of this methodology follows:

1) Calculate the range of the results

2) Find the difference between suspect and nearest neighbor.

3) Divide the difference obtained from step 2 by the range in step 1 to obtain rejection quotient, Q.

Replicate 1	81.03
Replicate 2	85.67
Replicate 3	92.28
Range	11.25
Diff. from highest value	6.61
Q value	0.59
Diff. from lowest	4.64
Q value	0.41
Modified Mean	86.33

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Replicate 2	85.67
Replicate 3	92.28
Range	11.25
Diff. from highest value	6.61
Q value	0.59
Diff. from lowest	4.64
Q value	0.41
Modified Mean	86.33

- 4) If the Q value is >0.94 , then the result can be discarded with 90% confidence that there was some factor that did not operate on the other results.

For the case of rejecting one outlier from a group of 4 to 8 using the 4d rule, the method is outlined below, Day *et al.* (1986):

- 1) Compute the mean and the standard deviation of the "good" data.
- 2) Find the deviation of the suspected result from the mean of the "good" ones.
- 3) If the deviation of the suspected result from the mean of the good data is larger than 4 standard deviations (calculated from the good data) away, then the result must be rejected.

Replicates	Sample Data set
1	*
2	47.88
3	50.94
4	51.22
5	52.35
Suspect value	47.88
Mean "good" data	51.50
Std. Deviation	0.75
# of standard deviations away	4.85
Actions (4d rule)	discard
Modified Mean	51.50

* Denotes a known experimental error, thus can be discarded.

See Appendix C for sample calculations.

3.5.4 Replicability

Replicability is an important experimental factor. The ability to verify laboratory

or field data confirms that the experimental conditions involved do not vary enough to bias or scatter the data. Replicability needs to be established for two areas - in the experimental design and procedure and the analytical methods and procedures. The replicability of the data, based on the experimental design, has been satisfactorily established and confirmed through the use of the Q-Test and the $4d$ rule.

The replicability of the analysis and all associated analytical methods, such as digesting a sample for Total Recoverable As, must be determined. Smith *et al.* (FDEP, 1997) found that the analysis of arsenic can be variable from laboratory to laboratory.

The FDEP Laboratory also analyzed the FIU samples to help establish the replicability of the analytical methods associated with determining Total Recoverable As. Fifty-seven of the samples were compared against the same analyses performed at FIU. Figure 9 illustrates that approximately 84% of the data (26 samples from 2nd kinetics data) was within $\pm 6.34\%$ of each other once the correction was made for the minor differences in analyzing FIU's standards. Corrections to the FDEP values were accomplished by adding the difference between FDEP and FIU analysis of the same standard used for FIU analysis. The small, but noticeable, shift in sensitivity most likely would have been negligible if the FDEP Laboratory used the FIU standards to calibrate their equipment or visa versa. The same standard was analyzed by both laboratories (Figure 10) and was extremely comparable (R^2 of 0.9996 versus 0.9958). Another set of samples (31 samples from experiment 2, See Appendix A) were analyzed for replicability and found that approximately 71% of the samples were within $\pm 6.95\%$ of each other after corrections, as stated earlier were made to differences in analysis of FIU standard. The standard used

Figure 9. Difference of Corrected FIU Arsenic Analysis from FDEP Arsenic Analysis on Initial Kinetics Experiments.

Figure 10. Observed Concentrations of FIU Standards by FDEP Analysis.

for FIU analysis of experiment 2 samples was analyzed by the FDEP Laboratory and found to be comparable (R^2 of 0.9987 versus 0.9902). Thus, the replicability of the analytical procedures for this work have been satisfactorily established and confirmed by an outside laboratory. Recovery measurements of the inorganic form of arsenic (using As +3, AA standard), as seen in Table 3 when comparing column 1 versus 2, show that a loss in sample occurred during digestion. Since each sample was transferred to several different pieces of glassware, an average of 3.8% in recovery loss was observed. The calibration for all analysis in Table 3 were performed using As +5, as sodium arsenate, thus an additional 3% of sample recovery was lost (by comparing the recovered As +3 average to the 50 ppb As +5 standard) due to the incomplete conversion of As +5 to As +3 resulting in lowered instrument sensitivity. When comparing the recovery of MSMA against As +3, column 3 versus column 1, the values are within 1.6% of each other, and can be considered negligible.

3.6 Experimental Design

Five (5) sets of laboratory experiments were conducted to accomplish the major goal of this thesis. Table 4 presents a detailed matrix of the experimental work performed. The following is a summary of the major experimental categories:

- Experiments 1 and 5 characterize the soils for particle size distribution, and TOC. Analysis of Total Phosphorus, and Total Recoverable As and Fe were conducted by
- the FDEP-SED. This data helped establish background As levels and parameter

TABLE 3. REPLICABILITY AND RECOVERY OF As(+3) ATOMIC ADSORPTION STANDARD AND MSMA.

Replicates	Equilibrium concentration after initial at 50ppb digested As(+3) reference solution	Equilibrium concentration after initial at 50ppb undigested As(+3) reference solution	Equilibrium concentration after initial at 50ppb digested MSMA
1	*	45.06	48.71
2	47.88	52.96	51.90
3	50.94	52.98	52.14
4	51.22	53.99	53.14
5	52.35	54.23	55.54
Suspect value	47.88	45.06	55.54
Mean "good" data	51.50	53.54	51.47
Std. Deviation	0.75	0.67	1.92
# of ave dev. away	4.85	12.74	2.12
Actions (4d rule)	discard	discard	retain
Modified Mean	51.50	53.54	52.29

* Denotes a known experimental error, thus can be discarded.

TABLE 4. EXPERIMENTAL MATRIX TABLE.

Experiment	Variables	Other variables tested	Purpose
1	All 5 soils		1) Sampling 2) Characterize all 5 soils: particle size distributions.
2	As (+5)	Temperature	Adsorption tests, 5 soils and with 6 concentrations: (10, 50, 100, 200) ppb & (1,5) ppm
3	As (+5)	Temperature, pH	Perform replicates of experiment 2
4	MSMA	Temperature, pH	Adsorption tests, 5 soils and with 4 concentrations: (10, 50, 100, 200) ppb
5	All 5 soils		Characterize all 5 soils: Total Organic Carbon

- estimations for use in PRZM-2.0
- Experiments 2,3, and 4 develop the partitioning coefficients, K_d , for each soil. Partitioning coefficients were used in the modeling simulations with PRZM-2.0.
- These partitioning coefficients will also be able to be used for similar soils (that match in particle size, mineral, and organic content) when modeling MSMA or As(+5).

In addition to the experimental work, computer modeling was performed to simulate the impact of MSMA at the vadose zone/water table interface under conditions where it may be used. Modeling will attempt to simulate fate and transport in subsurface zones using the physicochemical parameters determined in the laboratory for MSMA, As(+5), and the soil characteristics found at the West Palm Beach Country Club sample site. Table 5 shows the matrix for all computer simulations. All Reference Parameters are those defined in sections 3.4.6.1 - 3.4.6.3, and the other parameters that vary are defined in the matrix table.

TABLE 5. MATRIX OF MODELING SCENARIOS¹.

Scenario	Input Mode	Parameters		Purpose/Comments
		Reference	Variable	
1	2 Chemicals: MSMA/As(+5) (Input/Metabolite), 5 Horizons, Irrigation, Precipitation	See Chapter 3	100% K_d ; $D = 1.0$ m^2/day ; irrigate @ 50% θ	Illustrates the effect of an average K_d ² , irrigate ³ , and a high D ⁴ .
2	2 Chemicals: MSMA/As(+5) (Input/Metabolite), 5 Horizons, Irrigation, Precipitation	See Chapter 3	100% K_d ; $D = 0.1$ m^2/day ; irrigate @ 50% θ	Illustrates the effect of an average K_d , Irrigate, and D .
3	2 Chemicals: MSMA/As(+5) (Input/Metabolite), 5 Horizons, Irrigation, Precipitation	See Chapter 3	100% K_d ; $D =$ $0.01 m^2/day$; irrigate @ 50% θ	Illustrates the effect of an average K_d , irrigate, and a low D .
4	2 Chemicals: MSMA/As(+5) (Input/Metabolite), 5 Horizons, Irrigation, Precipitation	See Chapter 3	150% K_d ; $D = 0.1$ m^2/day ; irrigate @ 50% θ	Illustrates the effect of an average D , irrigate, and a high K_d .
5	2 Chemicals: MSMA/As(+5) (Input/Metabolite), 5 Horizons, Irrigation, Precipitation	See Chapter 3	25% K_d ; $D = 0.1$ m^2/day ; irrigate @ 50% θ	Illustrates the effect of an average D , irrigate, and a low K_d .
6	2 Chemicals: MSMA/As(+5) (Input/Metabolite), 5 Soil Horizons, Irrigation, Precipitation	See Chapter 3	100% K_d ; $D = 0.1$ m^2/day ; irrigate @ 85% θ	Illustrates the effect of an average K_d , D , and high irrigate.
7	2 Chemicals: MSMA/As(+5) (Input/Metabolite), 5 Horizons, Irrigation, Precipitation	See Chapter 3	100% K_d ; $D = 0.1$ m^2/day ; irrigate @ 15% θ	Illustrates the effect of an average K_d , D and a low irrigate.
8	2 Chemicals: MSMA/As(+5) (Input/Metabolite), 5 Horizons, Precipitation	See Chapter 3	100% K_d ; $D = 0.1$ m^2/day ; No irrigation	Illustrates the effect of an average K_d , D no irrigation.

¹ Average monthly temperature of bottom boundary soil = 25° C

² K_d = Chemical Soil-Water Partitioning Coefficient.

³ Irrigate @ 50% θ = Irrigation triggered when soil moisture content is [.5(field capacity - wilting point)]

⁴ D = Effective dispersion, (molecular dispersion + hydrodynamic dispersion)

4.0 RESULTS AND DISCUSSION

There are 4 major sections of this chapter that are intended to present the findings, compare results against other published studies (if any), and to discuss any significant correlations. In this order, the four sections are:

§ 4.1 - Experiments 1 and 5

§ 4.2 - Experiments 2 and 3

§ 4.3 - Experiment 4

§ 4.4 - Computer Simulations

4.1 Experiments 1 and 5

Soil samples were successfully acquired from the West Palm Beach Country Club, located at 7001 Parker Avenue, West Palm Beach, FL on November 4th, 1997 (See Appendix A for Map). The samples were taken 100 feet NW from the 1st hole green, in between the edge of the 1st hole rough and a small forest-type area. There appeared to be 4 distinct soil horizons from which 5 representative samples were taken at even intervals. Each horizon consisted predominantly (99% by wt) of sands (See Appendix A). The uppermost sample (4" - 9") consisted of a grayish colored sand with small pieces of decaying root material. The second sample (1'2" - 1'11") appeared to be identical in color and composition to the uppermost sample, except much less root material. Soil 3 (3'6"-4'6") had a light cream colored appearance, void of organic matter or any other mineral coating (by inspection) and root material. Soil 4 (5'6" - 7'0") was dark brown with a

strong humic smell. Soil 5 (7'6" - 8'10") appeared to be a rusty orange color. Part of this sample was actually at or below the water table. Water could be seen at the bottom of the core which was approximately 8'0" - 8'6". Samples were immediately packed for transport back to FIU (Refer to Appendix C for Field Sample Data Sheets).

Results from the particle size analysis by sieving are presented in Figure 11. The majority of the sand particles (from 50.6% to 58.05%) for each soil fraction were between 0.25mm and 0.425mm, which can be classified as a fine sand. Soil 5 had the highest percentage (0.4%) of particles less than 0.075 mm which was twice as much as the next closest, soil 1 (0.2%).

According to the FDEP chemical analysis of the soils used in this study, it is clear that As levels are below detection limits (See Table 6). These As background concentrations also compare well against experimental results (Appendix A - Table 13). Thus, arsenic is not considered present in enough quantity to influence the results presented in this thesis. For all intents and purposes As concentrations in the soil are classified as negligible. Though the samples expired according to FDEP QA/QC standards (ice melted in shipping coolers before arrival to FDEP Laboratory), the reported concentrations increased with depth within the soil profile (Table 6). This increase is significant in that arsenic behaves in the natural environment much like P does. If there are large amounts of P lower in the soil column, then arsenic mobility would be enhanced the lower it travels vertically. There is also a large concentration of Iron (Fe) in soil 5. This may be attributed to iron oxides that are rather soluble and have accumulated due the close proximity of the fluctuating water table. This layer of Fe may actually act as barrier to As(+5) transport since it may bind strongly to iron oxides.

Figure 11. Bar Graph of Percentages For Each Range of Particle Sizes For All 5 Soils.

TABLE 6. SUMMARY OF VITAL SOIL CHARACTERISTICS.

Analysis	Soil 1	Soil 2	Soil 3	Soil 4	Soil 5
Arsenic ¹	0.5 mg/kg**	0.5 mg/kg**	0.4 mg/kg*	0.7 mg/kg**	0.7 mg/kg**
Iron ¹	233 mg/kg	237 mg/kg	43.5 mg/kg	34.5 mg/kg	1530 mg/kg
Total-P ¹	32 mg/kg	32 mg/kg	4.8 mg/kg	120 mg/kg	390 mg/kg
TOC ²	0.43%	0.23%	0.01%	0.74%	1.15%
Aluminum ^x					
Equilibrated pH of Soil Blank ²	6.77	6.72	6.24	6.85	6.57
Equilibrated As concentration of Soil Blank ²	BDL	BDL	BDL	BDL	BDL

* Material was analyzed for but not detected. The value reported is the minimum detection limit (FDEP Chemical Analysis Report, see Appendix E).

** Value reported is less than the minimum quantitation limit, and greater than or equal to the minimum detection limit (FDEP Chemical Analysis Report, see Appendix E).

x Aluminum analysis not available at time of thesis write up.

¹ Analysis (Total Recoverable - As & Fe) performed by FDEP.

² Analysis performed by FIU.

BDL Below Limit of Detection (1.0 µg/L).

Table 6 and the following summarize soil characteristics:

- High P levels which may enhance inorganic arsenic transport (Davenport *et.al.*, 1991). However, high Fe content in the lowermost horizon may influence sorption at the water table interface (Stumm *et.al.*, 1987, Aly *et. al.*, 1993, Masscheleyn *et.al.*, 1991, Onken *et.al.*, 1995, Raven *et.al.*, 1998).
- Soils are very low in organic matter content (values range from 0.01 % to 1.15%) which may be a controlling factor in the fate and transport of MSMA (organic contaminants) and As(+5) (Valsaraj *et. al.*, 1995).
- Total Recoverable As was not detected higher than the anticipated background levels of 5 mg/kg. The site of the sampling may have been in an area where MSMA was probably never applied.
- The soil profile is mostly sand. It is very likely that the soil drains well, thus may enhance transport of contaminants.

4.2 Experiments 2 and 3

Adsorption tests were completed over two separate trials. Data was combined together so that the Q-test could be applied for statistical analysis. "Modified Means" (resulting statistical means after applying the Q-Test) for each data point were successfully used in applying Linear, Freundlich and Langmuir isotherms. Figure 12 summarizes the adsorption of As(+5) to all five of the soils using the Linear isotherm. It is apparent that soil 5 has the strongest affinity for arsenate. As mentioned in Chapter 2, iron and aluminum oxides, and organic matter control the solubility of arsenate in aqueous systems via sorption. From this data, soil 5 would have the strongest tendency

Figure 12. As(+5) Adsorption @ 22.48 °C, Soil:pH: 1:6.37, 2:6.38, 3:6.07, 4:6.47, 5:6.52.

TABLE 7. SUMMARY OF BEST-FITTED ISOTHERM PARAMETERS (22.48 °C).

As (+5)									
Soil	Linear		Freundlich			Langmuir			pH
	K_d	R^2	K_f	$1/n$	R^2	K_L	M	R^2	
1	0.0741	0.8262	0.025	1.197	0.8943	0.00067	57.8	0.9988	6.37
2	0.0652	0.9791	0.0257	1.1256	0.9623	0.0074	9.852	0.9677	6.38
3	0.0709	0.9779	0.0133	1.2205	0.9626	0.00092	33.22	0.9982	6.07
4	0.0410	0.8646	0.0303	1.0633	0.9265	0.0077	7.2	0.9561	6.47
5	0.2295	0.9575	0.2318	0.9736	0.8721	0.0419	14.79	0.7143	6.52

K_d units = (L/g)

K_f units = (L/g)

K_L units = (L/ μ g)

M units = (μ g/g)

to sorb arsenate. Table 7 confirms that soil 5 has the highest partitioning coefficient of all the soils.

In evaluating the best isotherm fit, it appears that the adsorption for both contaminants follows linearity (R^2 ranges from 0.7143 to 0.9988 for As(+5)). Though, values for the Freundlich $1/n$ term ranges from 0.9736 to 1.2205, the adsorption behavior can be said to be semi-linear ($1/n = 1$ implies linearity). Figures 13 - 17 show the best fitting of the three isotherms for each soil (summarized from Table 7). For 3 of the 5 soils the Langmuir isotherm best described the partitioning of the arsenate:soil system. Langmuir implies monolayer accumulation and is usually driven by electrostatic forces (especially for ionized species). As a possible indicator of this behavior, soils 1 through 4 had approximately 3 - 5 times less Fe content than soil 5 and consequently had K_d values 3 to 5 times lower than soil 5 (comparing Tables 6, 7, and 8). Thus, the contaminant:soil system may in fact be electrostatically controlled. There appears to be no correlation between the soil TOC contents and their respective K_d values.

In summary, K_d values for arsenate adsorption to the five soils were successfully determined. The following summarizes the results of these experiments:

- Comparing another study, Darland *et al.* (1997) found the following Langmuir adsorption parameters of an arsenate/homogeneous single sand system in the presence of phosphorus:

$$134 \mu\text{M initial P} \quad M = 112 \mu\text{mol/kg} \quad K_L = 0.21 \text{ L}/\mu\text{mol}$$

this study found a range of sorption parameters, primarily due to the heterogeneity of the sands types used, in the presence of phosphorus:

$$3 \mu\text{M initial P} \quad M = 7.2 - 57.8 \mu\text{mol/kg} \quad K_L = 0.0089 - 0.559 \text{ L}/\mu\text{mol}$$

Figure 13. Langmuir Isotherm for the As(+5), Soil 1 System @ 22.48 °C (Experimental error $\pm 20\%$).

Figure 14. Linear Isotherm for the As(+5), Soil 2 System @ 22.48 °C (Experimental error $\pm 20\%$).

Figure 15. Langmuir Isotherm for the As(+5), Soil 3 System @ 22.48 °C (Experimental error $\pm 20\%$).

Figure 16. Langmuir Isotherm for the As(+5), Soil 4 System @ 22.48 °C (Experimental error $\pm 20\%$).

Figure 17. Linear Isotherm for the As(+5), Soil 5 System @ 22.48 °C (Experimental error $\pm 20\%$).

- Soil 5 has the strongest affinity for arsenic.
- Iron oxides seem to be a controlling factor for arsenate solubility.
- Equilibrium pH is relatively close to that found in the environment.
- The experimental Linear Isotherm partitioning coefficients (in units of L/g) of the soils are as follows: Soil 1: $K_d = 0.0385$; Soil 2: $K_d = .0652$; Soil 3: $K_d = 0.0304$; Soil 4: $K_d = 0.0557$; Soil 5: $K_d = 0.2295$.

4.3 Experiment 4

Adsorption tests for all 5 soils with MSMA were completed and Q-tests were applied for statistical analysis of the data (Figure 18). Modified means for each data point were successfully used in applying Linear, Freundlich and Langmuir isotherms. Again, Freundlich $1/n$ terms ranged from 0.6775 to 1.1846 which imply linear adsorption. Both the Linear and Langmuir isotherms fit better than the Freundlich isotherms which also illustrates linear adsorption behavior (See Table 8). Soil 5 again demonstrated the strongest affinity towards MSMA.

Figures 19 - 23 show the best fitting of the three isotherms for each soil. The Langmuir isotherm again, best described the partitioning of the MSMA:soil system for 3 of the 5 soils. The Fe content of soil 5 was many times higher than in the other soils yet had similar K_d values, thus indicating that the Fe content may not effect MSMA adsorption to these soils as it had on As(+5). However, the TOC content of the soils may have had an effect on MSMA sorption. Soils 4 and 5 had 2 to 5 times higher TOC than the other soils and had K_d values approximately twice that of the others, respectively. The following summarizes the results of this experiment:

Figure 18. MSMA Adsorption, Soil:pH; 1:6.03, 2:6.00, 3:5.80, 4:6.29, 5:6.28 @ 22.48 °C

TABLE 8. SUMMARY OF BEST-FITTED ISOTHERM PARAMETERS (22.48 °C).

MSMA									
Soil	Linear		Freundlich			Langmuir			pH
	K_d	R^2	K_f	$1/n$	R^2	K_L	M	R^2	
1	0.0179	0.8562	0.0077	1.1386	0.8397	0.0237	1.7197	0.9070	6.03
2	0.0151	0.9565	0.0067	1.1325	0.9523	0.0021	5.0302	0.9849	6.00
3	0.0102	0.8747	0.1023	0.4863	0.7546	0.0632	0.9162	0.7921	5.80
4	0.0153	0.9647	0.0609	0.6775	0.8633	0.0372	1.3212	0.8390	6.29
5	0.0255	0.9010	0.011	1.1846	0.9722	0.0043	3.5945	0.9985	6.28

 K_d units = (L/g) K_f units = (L/g) K_L units = (L/ μ g)M units = (μ g/g)

Figure 19. Langmuir Isotherm for the MSMA, Soil 1 System @ 22.48 °C.

Figure 20. Langmuir Isotherm for the MSMA, Soil 2 System @ 22.48 °C.

Figure 21. Linear Isotherm for the MSMA, Soil 3 System @ 22.48 °C.

Figure 22. Linear Isotherm for the MSMA, Soil 4 System @ 22.48 °C.

Figure 23. Langmuir Isotherm for the MSMA, Soil 5 System. @ 22.48 °C

- MSMA displayed linear adsorption behavior. Langmuir isotherms were the best fit method for 3 of the 5 soils. Electrostatic forces could be the anticipated driving force behind sorption in this system, based on the associated controlling mechanisms (Sparks *et. al.*, 1986).
- MSMA equilibrium solutions were slightly lower in pH than the arsenate system.
- The following K_d values (L/g) were determined: Soil 1: $K_d = 0.0138$; Soil 2: $K_d = 0.0108$; Soil 3: $K_d = 0.0102$; Soil 4: $K_d = 0.0153$; Soil 5: $K_d = 0.0155$.
- K_d values for MSMA were 4 to 6 times less than arsenate for soils 1-4, and 22 times less than arsenate for soil 5. This would imply that MSMA may be more likely to be flushed from the soil column than would its by-product, arsenate (As(+5)).
- The TOC contents of the soils appear to have an effect on its sorptivity to MSMA.

4.4 Computer Simulations

Computer simulations of MSMA use in environments that may be found in southern Florida were completed. Eight simulation scenarios were conducted with PRZM-2.0 to evaluate the fate and transport of MSMA for a period of 5 years (January 1 water year 1988 to December 31 water year 1993) with results showing predicted concentrations of Total Dissolved As and the two composing fractions, As +5 and MSMA, at the water table interface. PRZM-2.0 has the capability to determine the concentrations of any biodegradation product throughout the soil profile. Since MSMA is expected to undergo oxidative-demethylation in oxygenated environments like that found in shallow, sandy/limestone aquifers, As +5 is the expected daughter product. Results will also be discussed from the FDEP regulatory perspective of Total As with regards to

dissolved As concentrations in the groundwater (or in this case, Total Dissolved As at the water table interface).

4.4.1 Predictions

Figures 24 - 37 show the Total As and fractional concentrations of As(+5) and MSMA at the water table interface as a function of time over a 5 year interval (See Tables 22 - 24 in Appendix A). Data points along the time line represent concentrations at intervals of 1 day, 1 week, and 1 month after each application of MSMA (total of 10 applications and 30 data points per scenario). Results from the model indicate that under conditions stated in Chapter 3, concentrations of Total Dissolved arsenic reached levels greater than 50 ppb at the vadose zone/water table within 1 month of every application of MSMA. In fact, concentrations of Total Dissolved arsenic reached levels as high as 399 ppb (Scenarios 1 and 8, high dispersion and no irrigation respectively). Data shows that the predominant remaining species (> 50 percent) of arsenic at the water table interface is the organic form, MSMA. Significant quantities of the inorganic fraction were not present during the first year of application. However, in the second year of application, predictions showed that on average, from 53 to 87 percent of all the dissolved As present in every scenario was As(+5).

Results suggest that the higher dispersion coefficients influenced the mobility of MSMA transport (dispersive transportation). Concentrations of Total Dissolved As varied between scenarios 1,2, and 3 which simulated dispersion coefficients ranging from 100 - 10,000 cm²/day (See Figures 24-29 and in Appendix A, Table 22). On the first day after the first application of MSMA, the Total Dissolved arsenic levels were the highest

Figure 24. Plot of Concentration versus Time for Total Dissolved Arsenic at the Water Table Interface. Conditions: Laboratory K_d , Dispersion = $10,000 \text{ cm}^2/\text{day}$, Irrigation at 50% Field Capacity (Scenario 1).

Figure 25. Plot of Concentration versus Time for Dissolved MSMA and Dissolved As(+5) at the Water Table Interface. Conditions: Laboratory K_d , Dispersion = $10,000 \text{ cm}^2/\text{day}$, Irrigation at 50% Field Capacity.

Figure 26. Plot of Concentration versus Time for Total Dissolved Arsenic at the Water Table Interface. Conditions: Laboratory K_d , Dispersion = $1,000 \text{ cm}^2/\text{day}$, Irrigation at 50% Field Capacity (Scenario 2).

Figure 27. Plot of Concentration versus Time for Dissolved MSMA and Dissolved As(+5) at the Water Table Interface. Conditions: Laboratory K_d , Dispersion = $1,000 \text{ cm}^2/\text{day}$, Irrigation at 50% Field Capacity.

Figure 28. Plot of Concentration verses Time for Total Dissolved Arsenic at the Water Table Interface. Conditions: Laboratory K_d , Dispersion = $100 \text{ cm}^2/\text{day}$, Irrigation at 50% Field Capacity (Scenario 3).

Figure 29. Plot of Concentration versus Time for Dissolved MSMA and Dissolved As(+5) at the Water Table Interface. Conditions: Laboratory K_d , Dispersion = $100 \text{ cm}^2/\text{day}$, Irrigation at 50% Field Capacity.

Figure 30. Plot of Concentration versus Time for Total Dissolved Arsenic at the Water Table Interface. Conditions: 150% Laboratory K_d , Dispersion = 1,000 cm²/day, Irrigation at 50% Field Capacity (Scenario 4).

Figure 31. Plot of Concentration versus Time for Dissolved MSMA and Dissolved As(+5) at the Water Table Interface. Conditions: 150 % Laboratory K_d , Dispersion $\approx 1,000 \text{ cm}^2/\text{day}$, Irrigation at 50% Field Capacity.

Figure 32. Plot of Concentration versus Time for Total Dissolved Arsenic at the Water Table Interface. Conditions: 25% Laboratory K_d , Dispersion = $1,000 \text{ cm}^2/\text{day}$, Irrigation at 50% Field Capacity (Scenario 5).

Figure 33. Plot of Concentration versus Time for Dissolved MSMA and Dissolved As(+5) at the Water Table Interface. Conditions: 25 % Laboratory K_d , Dispersion = 1,000 cm²/day, Irrigation at 50% Field Capacity.

Figure 34. Plot of Concentration verses Time for Total Dissolved Arsenic at the Water Table Interface. Conditions: Laboratory K_d , Dispersion = 1,000 cm²/day, Irrigation at 85% Field Capacity (Scenario 6).

Figure 35. Plot of Concentration versus Time for Dissolved MSMA and Dissolved As(+5) at the Water Table Interface. Conditions: Laboratory K_d , Dispersion = $1,000 \text{ cm}^2/\text{day}$, Irrigation at 85% Field Capacity.

Figure 36. Plot of Concentration versus Time for Total Dissolved Arsenic at the Water Table Interface. Conditions: Laboratory K_d , Dispersion = $1,000 \text{ cm}^2/\text{day}$, Irrigation at 15% Field Capacity (Scenario 7).

Figure 37. Plot of Concentration versus Time for Dissolved MSMA and Dissolved As(+5) at the Water Table Interface. Conditions: Laboratory K_d , Dispersion = $1,000 \text{ cm}^2/\text{day}$, Irrigation at 15% Field Capacity.

Figure 38. Plot of Concentration versus Time for Total Dissolved Arsenic at the Water Table Interface. Conditions: Laboratory K_d , Dispersion = 1,000 cm²/day, No Irrigation (Scenario 8).

Figure 39. Plot of Concentration verses Time for Dissolved MSMA and Dissolved As(+5) at the Water Table Interface. Conditions: Laboratory K_d , Dispersion = $1,000 \text{ cm}^2/\text{day}$, No Irrigation.

(213 ppb) when a D value of 10,000 cm²/day was used in scenario 1. Concentrations on that day for scenarios 2 and 3 ranged from 0.00 to 36.20 ppb Total Dissolved As using D values of 1,000 and 10,000 cm²/day respectively.

Another major influence of MSMA and As(+5) transport was precipitation (advective transportation). MSMA was present at the water table interface in concentrations of at least 50 ppb within 1 month for every scenario (See Figures 24 - 37 and in Appendix A, Tables 22 - 24). This is significant in that PRZM-2.0 indicates that MSMA may have a high mobility within a very short time period. In addition, all the scenarios illustrated that the largest annual accumulation of As(+5) at the vadose zone/water table interface occurred during the 1989 water year, the driest period of the simulation (See Appendix A). This time period appears to have allowed accumulation of As(+5) as a result of the low precipitation. However, in May of 1990 when rainfall values returned to normal, concentrations of dissolved As(+5) decreased and did not accumulate at those concentrations again for the remainder of the simulation period (May 1990 through December 1993).

Results also suggest that the irrigation regime of the soils had a minor effect on the transport of dissolved MSMA and As(+5) (See Figures 23-28 and in Appendix A, Table 24). Reports from Ardaman & Associates, Inc (1996) indicated that the irrigation of the golf course may have influenced the movement of MSMA (and possibly its metabolites) in the soil column. For example, irrigation was triggered in scenario 7 when the water moisture content fell only 15% of the difference between 0.1 (initial water moisture content) and 0.05 (wilting point) which invoked irrigation more frequently. Therefore, when the water moisture content fell to 0.0925, the surface was irrigated at a

maximum rate of 1 cm/h. As a result, scenario 7 Total Dissolved arsenic concentrations were much lower at the 1 week intervals (148 to 349 ppb) than in the other 3 scenarios that varied irrigation (710 to 875 ppb). Since irrigation was triggered a lot more in scenario 7 due to the quicker time it took for the soil moisture to drop to 0.15 θ resulting in a higher irrigation frequency, MSMA and As (+5) were flushed through the soil column more than in scenarios 2, 6, and 8 (0.5 θ , 0.85 θ and no irrigation, respectively).

The effect of K_d values on contaminant transport was another influential parameter. Figures 25, 28 and 30 illustrate that the lowest concentration of Total Dissolved As occurred when the partitioning coefficient was at 150% of the normal K_d value. This high partitioning value retarded the movement of MSMA and As(+5) and resulted in less contaminant migrating from the advective/dispersive forces. However, it appears that every scenario, at some interval during the 5 year simulation, resulted in a violation of Florida's MCL for Total arsenic in groundwater (50 ppb).

When comparing the simulated data to actual field data acquired by Ardaman & Associates, Inc. (1996), PRZM-2.0 demonstrated reasonably close predictions. In the 1996 report (dated August 7, 1996) submitted to the FDEP, groundwater samples taken from the maintenance area (where MSMA is prepared for applications) at the WPBCC indicated that Dissolved As concentrations ranged from < 5 to 372 ppb. Assuming that the last time MSMA was applied at the golf course was in April of that year, the interval between the handling and sampling may have been 3 1/2 months. However, these groundwater samples were taken from sites that have varying water table depths (14.17 to 1.78 feet) and soil profiles. In addition, the amount of MSMA applied to these areas cannot be determined since it was probably never "dosed" analogous to this simulation.

Thus, only generalizations can be made between the field data and PRZM-2.0 simulations. Total Dissolved arsenic concentrations predicted by PRZM-2.0 for time intervals of 1 month after every application under scenario 2 (average: K_d , Irrigation, and D values) indicate that the Total Dissolved As concentrations ranged from 132.91 ppb to 376.94 ppb. Scenarios 6, and 7 also appears to have predicted concentrations closer to the actual field data for the 1 month intervals with ranges of Total Dissolved As values from 133.11 ppb to 379.64 ppb. It thus appears that PRZM-2.0 predictions are within a reasonable proximity of actual field data.

When looking at how long it takes, under average simulating conditions (scenario 2), for the bulk of both MSMA and As(+5) to pass through the soil core after only one application, it can be seen that MSMA peaks (714.8 ppb) after 10 days from the application (See Figures 69, 70 and Table 25, Appendix A). As(+5) peaks (98.42 ppb) approximately 60 days from the application, and the maximum Total Dissolved arsenic peak of 200 ppb occurs within 14 days after the application. Since As(+5) has K_d values 20 times higher than MSMA in soil 5 (bottom of simulated core), this may explain why the migration out of the soil core is greatly extended in comparison. Hence, the migration of As(+5) would be expected to be much slower through soils of this type.

The losses of MSMA due to volatilization, which have not been accounted for in this model, may also be an important factor. The following summarizes the results of the computer modeling:

- There is significant transport of both MSMA and arsenate which results in: (1) MSMA and As(+5) migration into the water table; (2) Total Dissolved As

concentrations persistently found at the water table interface that exceed 50 $\mu\text{g/L}$ in every scenario.

- The dispersion coefficient was found to be the most influential means of transport for MSMA and arsenate other than precipitation (considered to have the greatest impact on contaminant transport). This can be seen by reviewing scenarios 1 through 3 which show that migration towards the water table interface was accelerated when using the highest dispersion coefficient (Scenario 1). Concentrations ranged from 0.014 ppb (Scenario 3) to 871 ppb Total Dissolved As on similar days from each simulation.
- Other variable tested also had an impact on the contaminants transport. Since MSMA is highly soluble and can be transported greater distances (via the initial wetting front), higher irrigation frequencies flushed MSMA out of soil column and into the groundwater. Conversely, peak As (+5) concentrations at the water table interface occurred much later than MSMA due to its lower mobility (higher K_d values in the lower part of the soil column retained As (+5) better). Results also indicate that higher K_d values also retarded the movement of MSMA.
- It can be extrapolated from this gross estimate, that the possible use of MSMA at the recommended rates may result in dissolved As concentrations that exceed the groundwater limits set forth in FAC 62-550.

4.5 Limitations

The followings lists the limitations of this study:

- Although, care in minimum QA/QC protocols were used, the results from the analytical experimentation may have been influenced by: inaccurate preparation of standards, inaccurate spiking of experiments with MSMA and As(+5), variable and/or inaccurate readings from the Perkin Elmer 5100C due to age of equipment or operator error, loss of analyte from frequent handling of sample, or errors due to experimental design. As a result, and since this experimental data set may be the first developed based on actual field samples from a South Florida golf course, additional studies should be conducted to confirm the results before they are considered for other modeling exercises.
- Modeling results may have been possibly influenced by: assumptions of input applications, background conditions, selected boundaries, estimation of average field parameters, possible inherent nature of PRZM-2.0 that may not be applicable outside of agronomic systems, inaccurate representation of application rates and frequencies of MSMA. In addition, the process of model verification and calibration was not performed due to experimental data, time and financial constraints. Therefore, the results of this modeling exercise should be viewed as the potential of what may actually occur in the environment.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The objectives of this study were accomplished through experimental work and computer simulations.

5.1 Conclusions

The conclusions of this study are generalized as follows:

- Experimental work indicated that MSMA and arsenate adsorption may follow a linear-type behavior in the soils sampled from the West Palm Beach Country Club. Of the three isotherm equations used for comparison, the Linear equation best fit the adsorption characteristics for both MSMA and arsenate. Previous studies confirmed the sorptive characteristics of an arsenate:sand system in the presence of phosphorus.
- Simulations of MSMA and its byproduct arsenate, under the considered application scenarios, assumptions and limitations, indicate that dissolved concentrations at the vadose zone/Biscayne aquifer interface could exceed the state of Florida's groundwater limits on total arsenic (50 ppb) within 1 application. This study should point out that the registration of MSMA needs to be re-evaluated closely.
- According to PRZM-2.0 results, the predominant fraction of As over time is the organic fraction, MSMA. However, under different scenarios not simulated in this work, the concentrations of MSMA and As (+5) at the water table interface may differ from these results.
- Simulations are considered to be a gross estimate of the fate and transport of MSMA

and its byproduct, arsenate, for the various reasons mentioned in section 4.5.2. The procedure of calibration and verification of the model and inputted parameters were not part of this study.

5.2 Recommendations

Recommendations for further research in this area are as follows:

- A 3-Dimensional analytical computer model more suited for urban areas such as the Hydrologic Simulation Program-FORTRAN (HSPF) model would allow a more comprehensive approach to appropriately model the hydrology and hydraulics required. These two factors are ultimately the controlling mechanisms for transport of herbicides as soluble as MSMA.
- Of course, additional good information must be collected. Soil column or caisson experiments, which can more objectively simulate the vadose zone, should be used to verify the bench-scale batch K_d values for the soils from this study. These experiments will improve the estimation of K values and the calibration and verification of any modeling simulations.
- The influence of phosphates and other fertilizers on the transport of arsenate should be researched. Other related studies (Hiltbolt *et.al.*, 1974; Davenport *et.al.*, 1991; Darland *et.al.*, 1997) point out that this has already been observed in other situations.
- The registration of herbicides and pesticides, to date, use a very general method to quantify the effects that they may have over a wide variety of environments.

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Appendix A – Tables, Figures, and Maps

Figure 40. Plot of pH vs. Equilibrium Concentrations of As(+5) Adsorption Experiments @ 22.48 °C

Figure 41. Plot of pH vs. Equilibrium Concentrations of MSMA Adsorption Experiments @ 22.48 °C.

Figure 42. Linear Isotherm for the MSMA Soil 1 @ 22.48 °C.

Figure 43. Linear Isotherm for the MSMA, Soil 2 System @ 22.48 °C.

Figure 44. Langmuir Isotherm for the MSMA, Soil 3 System @ 22.48 °C.

Figure 45. Langmuir Isotherm for the MSMA, Soil 4 System @ 22.48 °C.

Figure 46. Linear Isotherm for the MSMA, Soil 5 System @ 22.48 °C.

Figure 47. Linear Isotherm for the As(+5), Soil 1 System @ 22.48 °C (Experimental error $\pm 20\%$).

Figure 48. Langmuir Isotherm for the As(+5), Soil 2 System @ 22.48 °C (Experimental error $\pm 20\%$).

Figure 49. Linear Isotherm for the As(+5), Soil 3 System @ 22.48 °C (Experimental error $\pm 20\%$).

Figure 50. Linear Isotherm for the As(+5), Soil 4 System @ 22.48 °C (Experimental error $\pm 20\%$).

Figure 51. Langmuir Isotherm for the As(+5), Soil 5 System @ 22.48 °C (Experimental error $\pm 20\%$).

Figure 52. Freundlich Isotherm for the MSMA, Soil 1 System at 22.48°C.

Figure 53. Freundlich Isotherm for the MSMA, Soil 2 System at 22.48°C.

Figure 54. Freundlich Isotherm for the MSMA, Soil 3 System at 22.48°C.

Figure 55. Freundlich Isotherm for the MSMA, Soil 4 System at 22.48°C.

Figure 56. Freundlich Isotherm for the MSMA, Soil 5 System at 22.48°C.

Figure 57. Freundlich Isotherm for the As(+5), Soil 1 System at 22.48°C.

Figure 58. Freundlich Isotherm for the As(+5), Soil 2 System at 22.48°C.

Figure 59. Freundlich Isotherm for the As(+5), Soil 3 System at 22.48°C.

Figure 60. Freundlich Isotherm for the As(+5), Soil 4 System at 22.48°C.

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Figure 62. Corrected Difference of FIU Analysis from FDEP Analysis on As(+5) Experiment 2.

Figure 63. Observed Concentrations of a Second FIU Standard by FDEP Analysis.

Figure 64. Hyetograph and Input Scheme of MSMA for Water Year 1988.

Figure 65. Hyetograph and Input Scheme of MSMA for Water Year 1989.

Figure 66. Hyetograph and Input Scheme of MSMA for Water Year 1991.

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Figure 69. Plot of MSMA and As(+5) as a Fraction of Total As versus Time after 1 Application of MSMA.

Figure 70. Plot of Total As versus Time after 1 Application of MSMA

Figure 71. Graphical Representation of 154 cm Modeled Soil Core

TABLE 9. Q-TEST APPLIED TO pH OF EQUILIBRATED As(+5) SAMPLES.

Replicates	Soil 1: pH of Equilibrated 10 ppb As(+5) Solution	Soil 2: pH of Equilibrated 10 ppb As(+5) Solution	Soil 3: pH of Equilibrated 10 ppb As(+5) Solution	Soil 4: pH of Equilibrated 10 ppb As(+5) Solution	Soil 5: pH of Equilibrated 10 ppb As(+5) Solution
1	5.90	6.01	5.76	6.18	6.17
Replicates	Soil 1: pH of Equilibrated 50 ppb As(+5) Solution	Soil 2: pH of Equilibrated 50 ppb As(+5) Solution	Soil 3: pH of Equilibrated 50 ppb As(+5) Solution	Soil 4: pH of Equilibrated 50 ppb As(+5) Solution	Soil 5: pH of Equilibrated 50 ppb As(+5) Solution
1	3.85	4.00	3.46	4.15	4.35
2	4.28	4.17	4.00	4.39	5.85
3	6.07	5.84	5.82	6.09	5.92
Range	2.22	1.84	2.36	1.94	1.57
Diff Highest	1.79	1.67	1.82	1.70	0.07
Q value	0.81	0.91	0.77	0.88	0.04
Diff Lowest	0.43	0.17	0.54	0.24	1.50
Q value	0.19	0.09	0.23	0.12	0.96
Modified Mean	4.73	4.67	4.43	4.88	5.89
Replicates	Soil 1: pH of Equilibrated 100 ppb As(+5) Solution	Soil 2: pH of Equilibrated 100 ppb As(+5) Solution	Soil 3: pH of Equilibrated 100 ppb As(+5) Solution	Soil 4: pH of Equilibrated 100 ppb As(+5) Solution	Soil 5: pH of Equilibrated 100 ppb As(+5) Solution
1	7.59	7.60	6.41	7.95	6.56
2	7.41	7.04	6.76	7.31	6.32
Mean	7.50	7.32	6.59	7.63	6.44

Box around data denotes known rejected values. * Symbol denotes known experimental error and was rejected.

TABLE 9 (Continued). Q-TEST APPLIED TO pH OF EQUILIBRATED As(+5) SAMPLES.

Replicates	Soil 1: pH of Equilibrated 200 ppb As(+5) Solution	Soil 2: pH of Equilibrated 200 ppb As(+5) Solution	Soil 3: pH of Equilibrated 200 ppb As(+5) Solution	Soil 4: pH of Equilibrated 200 ppb As(+5) Solution	Soil 5: pH of Equilibrated 200 ppb As(+5) Solution
1	5.99	6.05	5.57	6.07	6.02
2	6.51	6.24	6.15	6.30	7.62
3	6.58	7.03	6.96	6.61	7.76
Range	0.59	0.98	1.39	0.54	1.74
Diff Highest	0.07	0.79	0.81	0.31	0.14
Q value	0.12	0.81	0.58	0.57	0.08
Diff Lowest	0.52	0.19	0.58	0.23	1.60
Q value	0.88	0.19	0.42	0.43	0.92
Modified Mean	6.36	6.44	6.23	6.33	7.13
Replicates	Soil 1: pH of Equilibrated 1 ppm As(+5) Solution	Soil 2: pH of Equilibrated 1 ppm As(+5) Solution	Soil 3: pH of Equilibrated 1 ppm As(+5) Solution	Soil 4: pH of Equilibrated 1 ppm As(+5) Solution	Soil 5: pH of Equilibrated 1 ppm As(+5) Solution
1	6.16	6.03	5.43	6.40	6.22
2	6.41	6.47	6.40	6.40	6.39
3		6.95	6.74	6.54	6.50
Range		0.92	1.31	0.14	0.28
Diff Highest		0.48	0.34	0.14	0.11
Q value		0.52	0.26	1.00	0.39
Diff Lowest		0.44	0.97	0.00	0.17
Q value		0.48	0.74	0.00	0.61
Modified Mean	6.29	6.48	6.19	6.40	6.45

Box around data denotes known rejected values. * Symbol denotes known experimental error and was rejected.

TABLE 9 (Continued). Q-TEST APPLIED TO pH OF EQUILIBRATED As(+5) SAMPLES.

Replicates	Soil 1: pH of Equilibrated 5 ppm As(+5) Solution	Soil 2: pH of Equilibrated 5 ppm As(+5) Solution	Soil 3: pH of Equilibrated 5 ppm As(+5) Solution	Soil 4: pH of Equilibrated 5 ppm As(+5) Solution	Soil 5: pH of Equilibrated 5 ppm As(+5) Solution
1	6.84	7.02	7.04	6.55	6.98
2	7.07	7.03	7.07	6.99	7.00
3	7.07			7.01	
Range	0.23			0.46	
Diff Highest	0.00			0.02	
Q value	0.00			0.04	
Diff Lowest	0.23			0.44	
Q value	1.00			0.96	
Modified Mean	7.07	7.03	7.06	7.00	6.99
Control Type	pH of Equilibrated 50 ppb As(+5) Control	pH of Equilibrated 100 ppb As(+5) Control	pH of Equilibrated 200 ppb As(+5) Control	pH of Equilibrated 1 ppm As(+5) Control	pH of Equilibrated 5 ppm As(+5) Control
As(+5) Control 1	3.90	5.60	5.52	5.93	6.55
As(+5) Control 2	5.48	5.77	5.61	6.02	6.94
As(+5) Control 3	5.55	6.20	7.45	6.30	7.16
Range	1.65	0.60	1.93	0.37	0.61
Diff Highest	0.07	0.43	1.84	0.28	0.22
Q value	0.04	0.72	0.95	0.76	0.36
Diff Lowest	1.58	0.17	0.09	0.09	0.39
Q value	0.96	0.28	0.05	0.24	0.64
Modified Mean	5.52	5.69	5.57	6.08	6.88

Box around data denotes known rejected values. * Symbol denotes known experimental error and was rejected.

TABLE 10. Q-TEST APPLIED TO pH OF EQUILIBRATED As(+5) SAMPLES AND STANDARDS

Replicate	Soil 1 Water Blank	Soil 2 Water Blank	Soil 3 Water Blank	Soil 4 Water Blank	Soil 5 Water Blank	Water Blank
1	4.25	4.36	4.23	5.36	5.1	3.68
2	6.1	6.07	5.81	6.28	6.36	5.79
3	7.68	6.89	6.52	6.56	6.78	5.95
4	7.81	8.11	7.95	7.96	8.07	8.05
5	8.03	8.18	6.68	8.08	6.53	6.36
Suspect pH	4.25	4.36	4.23	5.36	5.1	3.68
Mean "good" data	7.41	7.31	6.74	7.22	6.94	6.54
Standard Deviation	0.88	1.02	0.89	0.93	0.78	1.04
# of Deviations Away From Stand. Dev.	3.58	2.90	2.82	2.00	2.36	2.76
Action (4d rule)	Retain	Retain	Retain	Retain	Retain	Retain
Modified Mean	6.77	6.72	6.24	6.85	6.57	5.97

Box around data denotes known rejected values. * Symbol denotes known experimental error and was rejected.

TABLE 12. Q-TEST APPLIED TO pH OF EQUILIBRATED MSMA SAMPLES.

Replicates	Soil 1: pH of Equilibrated 10 ppb MSMA Solution	Soil 2: pH of Equilibrated 10 ppb MSMA Solution	Soil 3: pH of Equilibrated 10 ppb MSMA Solution	Soil 4: pH of Equilibrated 10 ppb MSMA Solution	Soil 5: pH of Equilibrated 10 ppb MSMA Solution
1	6.23	6.13	5.91	6.39	6.3
2	6.28	6.24	6.01	6.41	6.41
3	6.35	6.32	6.03	6.43	6.44
Range	0.12	0.19	0.12	0.04	0.14
Diff Highest	0.07	0.08	0.02	0.02	0.03
Q value	0.58	0.42	0.17	0.50	0.21
Diff Lowest	0.05	0.11	0.10	0.02	0.11
Q value	0.42	0.58	0.83	0.50	0.79
Modified Mean	6.29	6.23	5.98	6.41	6.43
Replicates	Soil 1: pH of Equilibrated 50 ppb MSMA Solution	Soil 2: pH of Equilibrated 50 ppb MSMA Solution	Soil 3: pH of Equilibrated 50 ppb MSMA Solution	Soil 4: pH of Equilibrated 50 ppb MSMA Solution	Soil 5: pH of Equilibrated 50 ppb MSMA Solution
1	5.61	5.53	5.42	5.92	5.87
2	5.72	5.62	5.49	5.99	5.92
3	5.75	5.73	5.56	6.07	5.97
Range	0.14	0.20	0.14	0.15	0.10
Diff Highest	0.03	0.11	0.07	0.08	0.05
Q value	0.21	0.55	0.50	0.53	0.50
Diff Lowest	0.11	0.09	0.07	0.07	0.05
Q value	0.79	0.45	0.50	0.47	0.50
Modified Mean	5.69	5.63	5.49	5.99	5.95

Box around data denotes known rejected values. * Symbol denotes known experimental error and was rejected.

TABLE 12 (Continued). Q-TEST APPLIED TO pH OF EQUILIBRATED MSMA SAMPLES.

Replicates	Soil 1: pH of Equilibrated 100 ppb MSMA Solution	Soil 2: pH of Equilibrated 100 ppb MSMA Solution	Soil 3: pH of Equilibrated 100 ppb MSMA Solution	Soil 4: pH of Equilibrated 100 ppb MSMA Solution	Soil 5: pH of Equilibrated 100 ppb MSMA Solution
1	5.46	5.63	5.62	6.02	5.82
2	5.53	5.63	5.68	6.12	5.86
3	5.74	5.73	5.70	6.24	5.93
Range	0.28	0.10	0.08	0.22	0.11
Diff Highest	0.21	0.10	0.02	0.12	0.07
Q value	0.75	1.00	0.25	0.55	0.64
Diff Lowest	0.07	0.00	0.06	0.10	0.04
Q value	0.25	0.00	0.75	0.45	0.36
Modified Mean	5.58	5.66	5.67	6.13	5.90
Replicates	Soil 1: pH of Equilibrated 200 ppb MSMA Solution	Soil 2: pH of Equilibrated 200 ppb MSMA Solution	Soil 3: pH of Equilibrated 200 ppb MSMA Solution	Soil 4: pH of Equilibrated 200 ppb MSMA Solution	Soil 5: pH of Equilibrated 200 ppb MSMA Solution
1	5.77	5.68	5.24	5.96	6.50
2	5.79	5.75	5.80	6.07	6.52
3	5.96	5.80	5.81	6.15	6.55
Range	0.19	0.12	0.57	0.19	0.05
Diff Highest	0.17	0.05	0.01	0.08	0.03
Q value	0.89	0.42	0.02	0.42	0.60
Diff Lowest	0.02	0.07	0.56	0.11	0.02
Q value	0.11	0.58	0.98	0.58	0.40
Modified Mean	5.84	5.74	5.62	6.06	6.54

Box around data denotes known rejected values. * Symbol denotes known experimental error and was rejected.

TABLE 11. Q-TEST APPLIED TO pH OF EQUILIBRATED MSMA SAMPLES AND STANDARDS.

Control Type	pH of Equilibrated 10 ppb MSMA Control	pH of Equilibrated 50 ppb MSMA Control	pH of Equilibrated 100 ppb MSMA Control	pH of Equilibrated 200 ppb MSMA Control
MSMA Control 1	5.80	5.26	5.32	5.78
MSMA Control 2	5.81	5.31	5.43	5.81
MSMA Control 3	6.18	5.33	5.54	5.90
Range	0.38	0.07	0.22	0.12
Diff Highest	0.37	0.02	0.11	0.09
Q value	0.97	0.29	0.50	0.75
Diff Lowest	0.01	0.05	0.11	0.03
Q value	0.03	0.71	0.50	0.25
Modified Mean	5.93	5.30	5.43	5.83

Box around data denotes known rejected values. * Symbol denotes known experimental error and was rejected.

TABLE 13. ANALYSIS OF CONTROL SOIL BLANKS AND CONTROL DD WATER.

Replicate	Control Soil 1, DD H ₂ O (ppb As)	Control Soil 2, DD H ₂ O (ppb As)	Control Soil 3, DD H ₂ O (ppb As)	Control Soil 4, DD H ₂ O (ppb As)	Control Soil 5, DD H ₂ O (ppb As)	Control no soil, DD H ₂ O (ppb As)
1	-1.715	-1.46	-1.4	-1.227	-0.5	-0.704
2	-0.579	-0.777	-0.948	-0.74	-0.355	-0.1
3	-0.449	-0.289	-0.74	0.017	-0.31	-0.1
4	-0.187	0.052	-0.3	0.068	-0.138	0
5	-0.1	0.107	-0.1	0.1	0.1	0.107
6	0.227	0.421	0.2	0.2	0.129	0.223
7	0.5	0.52	0.3	0.3	0.29	0.271
8	0.578	0.7	0.419	0.327	0.616	0.5
9	0.596	0.776	0.452	0.631	0.635	0.795
10	0.692	0.842	0.821	1.01	0.74	0.9
11	0.869	1.537	0.9	2.182	0.796	1.05
12	1.96	1.672	1.365	2.521	1.073	1.285
13	2.358	2.277	2.037	2.989	1.1	1.672
AVG	0.37	0.49	0.23	0.64	0.32	0.45
STDEV	1.06	1.01	0.95	1.24	0.55	0.66

TABLE 14. Q-TEST APPLIED TO TOTAL ORGANIC CARBON DATA.

Replicate	Percentage Organic Matter				
	Soil 1	Soil 2	Soil 3	Soil 4	Soil 5
1	0.38	0.22	0.005	0.725	1.044
2	0.434	0.23	0.01	0.73	1.075
3	0.435	0.24	0.025	0.754	1.325
Range	0.06	0.02	0.02	0.03	0.28
Diff Highest	0.00	0.01	0.02	0.02	0.25
Q value	0.02	0.50	0.75	0.83	0.89
Diff Lowest	0.05	0.01	0.01	0.01	0.03
Q value	0.98	0.50	0.25	0.17	0.11
Modified Mean	0.43 %	0.23 %	0.01 %	0.74 %	1.15 %

Box around data denotes known rejected values. * Symbol denotes known experimental error and was rejected.

TABLE 15. COMPARISON OF FDEP VERSUS FIU ANALYSIS OF As(+5) KINETICS DATA AND STANDARDS.

Sample ID	Blank Corrected Signal (FIU)	FIU Observed Conc. As(+V) ppb's	FDEP Observed Conc. As(+V) ppb's	Actual % Away of FIU from FDEP	Corrected % Using Standards' Average Difference
8a:168k2	0.683	159.8	154.4	3.50%	0.45%
8b:168k2	0.725	169.5	164.8	2.85%	0.00%
8d:168k2	0.803	187.8	180.2	4.22%	1.61%
8e:168k2	0.804	188.1	193.6	-2.84%	-5.27%
8g:168k2	0.834	195	187.6	3.94%	1.44%
8i:168k2	0.828	193.6	183.6	5.45%	2.89%
8k:168k2	0.286	66.62	61	9.21%	1.51%
8l:168k2	0.292	68.29	61.4	11.22%	3.57%
AR-168K2	0.904	211.3	202	4.60%	2.28%
AR-2K2	0.886	207.2	204	1.57%	-0.74%
7a:96k2	0.824	176.7	177.2	-0.28%	-2.93%
7b:96k2	0.793	170.1	170.2	-0.06%	-2.82%
7d:96k2	0.735	157.7	180	-12.39%	-15.00%
7e:96k2	0.739	158.4	177.4	-10.71%	-13.36%
7g:96k2	0.766	164.2	186.2	-11.82%	-14.34%
7h:96k2	0.756	162.1	184.8	-12.28%	-14.83%
7k:96k2	0.427	91.51	90.2	1.45%	-3.76%
7l:96k2	0.438	94.01	93.6	0.44%	-4.58%
6a:48k2	0.676	169.2	165.8	2.05%	-0.78%
6b:48k2	0.7	175.8	169	4.02%	1.24%
6d:48k2	0.686	172.2	174.8	-1.49%	-4.18%
6e:48k2	0.73	183.2	181.2	1.10%	-1.49%
6g:48k2	0.722	181.2	187	-3.10%	-5.61%
6i:48k2	0.707	177.4	184.4	-3.80%	-6.34%
6k:48k2	0.471	118.3	107	10.56%	6.17%
6l:48k2	0.45	112.9	102	10.69%	6.08%
AS-0A	Standard	0	<2		
AS-5A	Standard	5	2	3 ppb	Average
AS-25A	Standard	25	19.2	5.8 ppb	Difference
AS-50A	Standard	50	45.6	5.4 ppb	4.7 ppb
AS-100A	Standard	100	94.4	5.6 ppb	

TABLE 16. COMPARISON OF FDEP VERSUS FIU ANALYSIS OF EXPERIMENT 2.

Sample ID	FIU Observed Conc. As(+V) ppb's	DEP analysis	Actual % Away from DEP	Corrected % Away from DEP
12;10	10.14	7.7	31.69%	30.00%
21;10	8.84	9.3	-4.95%	-5.96%
22;10	10.36	10.4	-0.38%	-1.33%
32;10	10.99	8.4	30.83%	29.29%
41;10	9.89	8.8	12.39%	11.12%
42;10	10.5	9.8	7.14%	6.06%
51;10	5.6	7	-20.00%	-21.13%
52;10	7.15	6.7	6.72%	5.15%
11;50	47.72	47.5	0.46%	-6.25%
12;50	50.18	47.7	5.20%	-1.80%
21;50	48.28	46.5	3.83%	-3.25%
22;50	49.74	44.6	11.52%	3.63%
31;50	48.3	44.5	8.54%	0.84%
32;50	49.98	40.5	23.41%	13.85%
41;50	52.5	44.5	17.98%	9.60%
42;50	52.28	46.6	12.19%	4.56%
51;50	45.36	37.3	21.61%	11.45%
11;100	95.16	87.3	9.00%	2.88%
12;100	96.47	93.2	3.51%	-1.96%
21;100	97.97	95.2	2.91%	-2.42%
22;100	96.1	86.9	10.59%	4.34%
31;100	99.48	93.7	6.17%	0.59%
32;100	100.2	88.6	13.09%	6.82%
42;100	100	88.3	13.25%	6.95%
51;100	92.34	82.3	12.20%	5.53%
11;200	153	139	10.07%	-4.38%
12;200	149.9	141	6.31%	-7.47%
21;200	*	80.8	*	*
22;200	155.7	140	11.21%	-3.29%
31;200	*	82.9	*	*
32;200	151	142	6.34%	-7.36%
41;200	154.5	140	10.36%	-4.04%
42;200	*	92.3	*	*
51;200	149.3	132	13.11%	-2.42%
52;200	*	74.8	*	*
Standard 5 ppb	5	4.9	-0.1	
Standard 25 ppb	25	23.6	-1.4	
Standard 50 ppb	50	46.6	-3.4	
Standard 100 ppb	100	94.8	-5.2	
Standard 200 ppb	200	179	-21	

* Symbol denotes known experimental/procedural error and was rejected.

TABLE 17. Q-TEST APPLIED TO SIEVING DATA.

Soil 1							
Sieve No.	Dia. (mm)	%Retained Replicate # 1	%Retained Replicate # 2	%Retained Replicate # 3	Suspect value	Q value	Corrected Mean (%)
16	1.190	0.30	0.20	0.20	0.30	1.00	0.20
30	0.600	3.10	2.90	2.90	3.10	1.00	4.30
40	0.425	-	16.70	16.90	-	-	16.80
60	0.250	-	57.30	58.80	-	-	58.05
140	0.106	19.30	22.40	20.70	22.40	0.55	20.80
200	0.075	0.30	0.30	0.30	-	-	0.30
Pan	<0.075	0.20	0.20	0.20	-	-	0.20
Soil 3							
Sieve No.	Dia. (mm)	%Retained Replicate # 1	%Retained Replicate # 2	%Retained Replicate # 3	Suspect value	Q value	Corrected Mean (%)
16	1.190	0.10	0.10	0.10	-	-	0.10
30	0.600	3.10	3.20	3.20	3.10	1.00	3.20
40	0.425	14.10	14.60	14.00	14.60	0.83	14.23
60	0.250	54.20	53.50	54.10	53.50	0.86	53.93
140	0.106	28.10	28.30	28.30	28.10	1.00	28.30
200	0.075	0.30	0.20	0.30	0.20	1.00	0.30
Pan	<0.075	0.20	0.10	0.10	0.20	1.00	0.10
Soil 5							
Sieve No.	Dia. (mm)	%Retained Replicate # 1	%Retained Replicate # 2	%Retained Replicate # 3	Suspect value	Q value	Corrected Mean (%)
16	1.190	0.30	0.10	0.00	0.30	0.67	0.13
30	0.600	4.30	4.40	4.60	4.60	0.67	4.43
40	0.425	12.10	12.00	11.90	-	-	12.00
60	0.250	51.50	50.60	50.60	51.50	1.00	50.60
140	0.106	31.40	32.30	32.30	31.40	1.00	32.30
200	0.075	0.10	0.20	0.20	0.10	1.00	0.20
Pan	<0.075	0.40	0.40	0.40	-	-	0.40

TABLE 17. Q-TEST APPLIED TO SIEVING DATA.

Soil 2						
Sieve #	%Retained Replicate #	%Retained Replicate #	%Retained Replicate #	Suspect value	Q value	Corrected Mean (%)
	1	2	3			
16	0.50	0.30	0.40	-	-	0.40
30	3.40	3.30	3.20	-	-	3.30
40	19.50	18.20	18.60	19.50	0.69	18.77
60	59.60	56.80	56.30	59.60	0.85	57.57
140	16.80	21.10	21.10	16.80	1.00	21.10
200	0.10	0.20	0.20	0.10	1.00	0.20
pan	0.10	0.10	0.10	-	-	0.10
Soil 4						
Sieve #	%Retained Replicate #	%Retained Replicate #	%Retained Replicate #	Suspect value	Q value	Corrected Mean (%)
	1	2	3			
16	0.10	0.03	0.10	0.03	1.00	0.10
30	3.40	3.50	3.40	3.50	1.00	3.40
40	13.10	12.90	13.00	-	-	13.00
60	55.90	54.90	55.00	55.90	0.90	55.27
140	27.20	28.40	28.30	27.20	0.92	27.97
200	0.10	0.10	0.10	-	-	0.10
pan	0.10	0.10	0.10	-	-	0.10

TABLE 18. RESULTS FROM ORIGINAL As(+5) EXPERIMENTS.

Soil; Replicate	Equilibrium conc (ppb), initial at ~10ppb	Equilibrium conc (ppb), initial at 50ppb	Equilibrium conc (ppb), initial at 100ppb	Equilibrium conc (ppb), initial at 200ppb	Equilibrium conc (ppb), initial at 1ppm	Equilibrium conc (ppb), initial at 5ppm
1;1	12.25	47.72	95.16	153.8	330.4	3720
1;2	10.14	50.18	96.47	149.9	343.9	4830
2;1	8.84	48.28	97.97	*	470.7	4104
2;2	10.36	49.74	96.1	155.7	382.3	3773
3;1	10.99	48.3	99.48	*	439.7	3816
3;2	11.54	49.98	100.2	151	381.6	3932
4;1	9.89	52.5	97.77	154.5	361.0	4698
4;2	10.5	52.28	100	*	425.3	3854
5;1	5.58	45.36	92.34	149.3	391.7	3310
5;2	7.15	-	88.31	*	468.2	3524
Control 1 (Initial)	11.37	57.31	108.9	*	*	4950
Soil; Replicate	Control - EQ (ppb), initial conc ~10ppb	Control - EQ (ppb), initial conc ~50ppb	Control - EQ (ppb), initial conc ~100ppb	Control - EQ (ppb), initial conc ~200ppb ¹	Control - EQ (ppb), initial conc ~1ppm ²	Control - EQ (ppb), initial conc ~5ppm
1;1	-0.88	9.59	13.74	48.0	574.4	1230
1;2	1.23	7.13	12.43	51.9	560.1	120
2;1	2.53	9.03	10.93	*	433.0	846
2;2	1.01	7.57	12.8	46.1	520.9	1177
3;1	0.38	9.01	9.42	*	463.9	1134
3;2	-0.17	7.31	8.7	50.8	522.3	1018
4;1	1.48	4.81	11.13	47.3	542.9	252
4;2	0.87	5.03	8.9	*	478.4	1096
5;1	5.79	11.95	16.56	52.5	512.1	1640
5;2	4.22	*	20.59	*	435.5	1426

* Symbol denotes known experimental/procedural error and was rejected.

¹ The corresponding ~200ppb control from 2nd As(+5) experiments was used.

² The corresponding ~1ppm control from 2nd As(+5) experiment was used.

TABLE 18 (Continued). RESULTS FROM SECOND SET OF As(+5) EXPERIMENTS.

Soil; Replicate	Equilibrium conc (ppb), initial at ~10ppb	Equilibrium conc. W/ initial at 50ppb	Equilibrium conc. W/ initial at 100ppb	Equilibrium conc. W/ initial at 200ppb	Equilibrium conc. W/ initial at 1ppm
1;3	3.742	44.2		186.7	
2;3	5.781	50.12		188	997.5
3;3	4.398	49.37		210.4	971.5
4;3	4.476	49.86		204.9	966.5
5;3	1.818	43.88		176.4	
5;4		42.48			
Control 2 (Initial)	7.85	48.5	99.5	192.1	828
Control 3 (Initial)	7.048	49.11	99.17	211.4	984.5
Control average (Initial)	7.449	48.805	99.335	201.75	906.75
Soil; Replicate	Control - EQ (ppb), initial conc ~10ppb	Control - EQ (ppb), initial conc ~50ppb	Control - EQ (ppb), initial conc ~100ppb	Control - EQ (ppb), initial conc ~200ppb	Control - EQ (ppb), initial conc ~1ppm
1;3	3.707	4.605		15.05	
2;3	1.668	-1.315		13.75	-90.75
3;3	3.051	-0.565		-8.65	-64.75
4;3	2.973	-1.055		-3.15	-59.75
5;3	5.631	4.925		25.35	
5;4		6.325			

TABLE 19. Q-TEST APPLIED TO EQUILIBRIUM CONCENTRATIONS FROM ALL As(+5) EXPERIMENTS.

	Soil 1 Equilibrium conc (ppb), initial at ~10ppb	Soil 2 Equilibrium conc (ppb), initial at ~10ppb	Soil 3 Equilibrium conc (ppb), initial at ~10ppb	Soil 4 Equilibrium conc (ppb), initial at ~10ppb	Soil 5 Equilibrium conc (ppb), initial at ~10ppb
Replicate 1	3.74	5.78	4.40	4.48	1.82
Replicate 2	10.14	8.84	10.99	9.89	5.58
Replicate 3	12.25	10.36	11.54	10.50	7.15
Range	8.51	4.58	7.14	6.02	5.33
Diff Highest	2.11	1.52	0.55	0.61	1.57
Q value	0.25	0.33	0.08	0.10	0.29
Diff Lowest	6.40	3.06	6.59	5.41	3.76
Q value	0.75	0.67	0.92	0.90	0.71
Modified Mean	8.71	8.33	8.98	8.29	4.85
	Soil 1 Equilibrium conc (ppb), initial at ~50ppb	Soil 2 Equilibrium conc (ppb), initial at ~50ppb	Soil 3 Equilibrium conc (ppb), initial at 50ppb	Soil 4 Equilibrium conc (ppb), initial at ~50ppb	Soil 5 Equilibrium conc (ppb), initial at ~50ppb
Replicate 1	44.20	48.28	48.30	49.86	42.48
Replicate 2	47.72	49.74	49.37	52.28	43.88
Replicate 3	50.18	50.12	50.00	52.50	45.36
Range	5.98	1.84	1.70	2.64	2.88
Diff Highest	2.46	0.38	0.63	0.22	1.48
Q value	0.41	0.21	0.37	0.08	0.51
Diff Lowest	3.52	1.46	1.07	2.42	1.40
Q value	0.59	0.79	0.63	0.92	0.49
Modified Mean	47.37	49.38	49.22	51.55	43.91

Box around data points denotes known rejected values. * Symbol denotes known experimental error and was rejected.

TABLE 19 (Continued). Q-TEST APPLIED TO EQUILIBRIUM CONCENTRATIONS FROM ALL As(+5) EXPERIMENTS.

	Soil 1 Equilibrium conc (ppb), initial at ~100ppb	Soil 2 Equilibrium conc (ppb), initial at ~100ppb	Soil 3 Equilibrium conc (ppb), initial at ~100ppb	Soil 4 Equilibrium conc (ppb), initial at ~100ppb	Soil 5 Equilibrium conc (ppb), initial at ~100ppb
Replicate 1	95.16	96.1	99.48	97.77	92.34
Replicate 2	96.47	97.97	100.2	100	88.31
Replicate 3					
Range					
Diff Highest Q value			Q-Test not applicable		
Diff Lowest Q value					
Modified Mean	95.82	97.04	99.84	98.89	90.33
	Soil 1 Equilibrium conc (ppb), initial at ~200ppb	Soil 2 Equilibrium conc (ppb), initial at ~200ppb	Soil 3 Equilibrium conc (ppb), initial at ~200ppb	Soil 4 Equilibrium conc (ppb), initial at ~200ppb	Soil 5 Equilibrium conc (ppb), initial at ~200ppb
Replicate 1	149.9	*	*	*	*
Replicate 2	153.8	155.7	151	154.5	149.3
Replicate 3	186.7	188	210.4	204.9	176.4
Range	36.8	104.58	124.72	108.91	88.21
Diff Highest Q value	32.9 0.89	32.3 0.31	59.4 0.48	50.4 0.46	27.1 0.31
Diff Lowest Q value	3.9 0.11	72.28 0.69	65.32 0.52	58.51 0.54	61.11 0.69
Modified Mean	163.5	171.9	180.7	179.7	162.9

Box around data points denotes known rejected values. * Symbol denotes known experimental error and was rejected.

TABLE 19 (Continued). Q-TEST APPLIED TO EQUILIBRIUM CONCENTRATIONS FROM ALL As(+5) EXPERIMENTS.

	Soil 1 Equilibrium conc (ppb), initial at ~1ppm	Soil 2 Equilibrium conc (ppb), initial at ~1ppm	Soil 3 Equilibrium conc (ppb), initial at ~1ppm	Soil 4 Equilibrium conc (ppb), initial at ~1ppm	Soil 5 Equilibrium conc (ppb), initial at ~1ppm
Replicate 1	330.4	383.9	382.5	361.9	392.7
Replicate 2	344.7	471.8	440.9	426.4	469.3
Replicate 3		997.5	971.5	966.5	
Range		613.6	589	604.6	
Diff Highest		525.7	530.6	540.1	
Q value		0.86	0.90	0.89	
Diff Lowest		87.9	58.4	64.5	
Q value		0.14	0.10	0.11	
Modified Mean	337.6	617.7	598.3	584.9	431
	Soil 1 Equilibrium conc (ppb), initial at ~5ppm	Soil 2 Equilibrium conc (ppb), initial at ~5ppm	Soil 3 Equilibrium conc (ppb), initial at ~5ppm	Soil 4 Equilibrium conc (ppb), initial at ~5ppm	Soil 5 Equilibrium conc (ppb), initial at ~5ppm
Replicate 1	3720	3773	3816	3854	3310
Replicate 2	4830	4104	3932	4698	3524
Replicate 3					
Range					
Diff Highest					
Q value			Q-Test not applicable		
Diff Lowest					
Q value					
Modified Mean	4275	3939	3874	4276	3417

Box around data points denotes known rejected values. * Symbol denotes known experimental error and was rejected.

TABLE 20. MASS OF As(+5) ADSORBED TO EACH SOIL AT EACH INITIAL CONCENTRATION.

	Soil 1: Mass adsorbed (ug), initial conc. ~10ppb	Soil 2: Mass adsorbed (ug), initial conc. ~10ppb	Soil 3: Mass adsorbed (ug), initial conc. ~10ppb	Soil 4: Mass adsorbed (ug), initial conc. ~10ppb	Soil 5: Mass adsorbed (ug), initial conc. ~10ppb
Replicate 1	-0.110	0.126	-0.020	0.109	0.528
Replicate 2	0.154	0.209	0.047	0.185	0.704
Replicate 3	0.463	0.316	0.382	0.372	0.724
Range	0.463	0.190	0.382	0.263	0.196
Diff Highest	0.310	0.108	0.334	0.187	0.020
Q value	0.668	0.566	0.875	0.710	0.101
Diff Lowest	0.154	0.082	0.047	0.076	0.177
Q value	0.332	0.434	0.125	0.290	0.899
Modified Mean	0.169	0.217	0.136	0.222	0.652
	Soil 1: Mass adsorbed (ug), initial conc. ~50ppb	Soil 2: Mass adsorbed (ug), initial conc. ~50ppb	Soil 3: Mass adsorbed (ug), initial conc. ~50ppb	Soil 4: Mass adsorbed (ug), initial conc. ~50ppb	Soil 5: Mass adsorbed (ug), initial conc. ~50ppb
Replicate 1	0.576	-0.160	-0.070	-0.130	0.616
Replicate 2	0.891	0.946	0.914	0.601	0.791
Replicate 3	1.199	1.126	1.126	0.629	1.494
Range	0.623	1.196	1.196	0.759	0.878
Diff Highest	0.308	0.210	0.213	0.028	0.703
Q value	0.493	0.176	0.178	0.036	0.801
Diff Lowest	0.316	0.986	0.984	0.731	0.175
Q value	0.507	0.824	0.822	0.964	0.199
Modified Mean	0.889	0.637	0.657	0.615	0.967

Box around data points denotes known rejected values. * Symbol denotes known experimental error and was rejected.

TABLE 20 (Continued). MASS OF As(+5) ADSORBED TO EACH SOIL AT EACH INITIAL CONCENTRATION.

	Soil 1: Mass adsorbed (ug), initial conc ~100ppb	Soil 2: Mass adsorbed (ug), initial conc ~100ppb	Soil 3: Mass adsorbed (ug), initial conc ~100ppb	Soil 4: Mass adsorbed (ug), initial conc ~100ppb	Soil 5: Mass adsorbed (ug), initial conc ~100ppb
Replicate 1	1.55	1.37	1.09	1.11	2.07
Replicate 2	1.72	1.60	1.18	1.39	2.57
Replicate 3					
Range					
Diff Highest Q value			Q-Test not applicable		
Diff Lowest Q value					
Modified Mean	1.64	1.48	1.13	1.25	2.32
	Soil 1: Mass adsorbed (ug), initial conc ~200ppb	Soil 2: Mass adsorbed (ug), initial conc ~200ppb	Soil 3: Mass adsorbed (ug), initial conc ~200ppb	Soil 4: Mass adsorbed (ug), initial conc ~200ppb	Soil 5: Mass adsorbed (ug), initial conc ~200ppb
Replicate 1	1.88	1.72	-1.08	-0.39	3.17
Replicate 2	5.99	5.76	6.34	5.91	6.56
Replicate 3	6.48	*	*	*	*
Range	4.600				
Diff Highest Q value	0.488		Q-Test not applicable		
Diff Lowest Q value	4.113				
	0.894				
Modified Mean	4.785	3.738	2.632	2.758	4.863

Box around data points denotes known rejected values. * Symbol denotes known experimental error and was rejected.

TABLE 20 (Continued). MASS OF As(+5) ADSORBED TO EACH SOIL AT EACH INITIAL CONCENTRATION.

	Soil 1: Mass As(+5) adsorbed (ug), initial conc. ~1 ppm	Soil 2: Mass As(+5) adsorbed (ug), initial conc. ~1 ppm	Soil 3: Mass As(+5) adsorbed (ug), initial conc. ~1 ppm	Soil 4: Mass As(+5) adsorbed (ug), initial conc. ~1ppm	Soil 5: Mass As(+5) adsorbed (ug), initial conc. ~1ppm
Replicate 1	70.01	-11.59	-8.34	-7.72	54.43
Replicate 2	71.79	54.12	57.98	59.79	64.01
Replicate 3		65.11	65.28	67.86	
Range		76.700	73.625	75.575	
Diff Highest		10.988	7.300	8.063	
Q value		0.143	0.099	0.107	
Diff Lowest		65.71	66.33	67.51	
Q value		0.86	0.90	0.89	
Modified Mean	70.90	35.88	38.31	39.98	59.22
	Soil 1: Mass As(+5) adsorbed (ug), initial conc. ~5ppm	Soil 2: Mass As(+5) adsorbed (ug), initial conc. ~5ppm	Soil 3: Mass As(+5) adsorbed (ug), initial conc. ~5ppm	Soil 4: Mass As(+5) adsorbed (ug), initial conc. ~5ppm	Soil 5: Mass As(+5) adsorbed (ug), initial conc. ~5ppm
Replicate 1	14*	106	128	32	178
Replicate 2	154	147	142	137	205
Replicate 3					
Range					
Diff Highest					
Q value			Q-Test not applicable		
Diff Lowest					
Q value					
Modified Mean	154	126	135	84	192

Box around data points denotes known rejected values. * Symbol denotes known experimental error and was rejected.

TABLE 21. Q-TEST APPLIED TO MSMA EQUILIBRIUM CONCENTRATIONS.

	Soil 1 Equilibrium conc (ppb), initial at ~10ppb	Soil 2 Equilibrium conc (ppb), initial at ~10ppb	Soil 3 Equilibrium conc (ppb), initial at ~10ppb	Soil 4 Equilibrium conc (ppb), initial at ~10ppb	Soil 5 Equilibrium conc (ppb), initial at ~10ppb	Control Equilibrium conc (ppb), initial at ~10ppb
Replicate 1	7.941	7.992	5.588	6.175	6.937	7.185
Replicate 2	8.386	8.837	9.404	6.99	7.995	10.36
Replicate 3	8.667	8.952	*	9.569	11.17	*
Range	0.726	0.960		3.394	4.233	
Diff. High	0.281	0.115		2.579	3.175	
Q value	0.39	0.12		0.76	0.75	
Diff. Low	0.445	0.845		0.815	1.058	
Q value	0.61	0.880		0.24	0.25	
Modified Mean	8.33	8.41	7.50	7.58	8.70	8.77
	Soil 1 Equilibrium conc (ppb), initial at ~50ppb	Soil 2 Equilibrium conc (ppb), initial at ~50ppb	Soil 3 Equilibrium conc (ppb), initial at 50ppb	Soil 4 Equilibrium conc (ppb), initial at ~50ppb	Soil 5 Equilibrium conc (ppb), initial at ~50ppb	Control Equilibrium conc (ppb), initial at ~50ppb
Replicate 1	47.72	48.44	46.48	45.93	44.13	25.45
Replicate 2	48.12	48.48	47.59	48.48	45.24	49.65
Replicate 3	50.44	49.98	48.4	48.74	49.3	49.92
Range	2.72	1.54	1.92	2.81	5.17	24.47
Diff. High	2.32	1.5	0.81	0.26	4.06	0.27
Q value	0.85	0.97	0.42	0.09	0.79	0.01
Diff. Low	0.4	0.04	1.11	2.55	1.11	24.2
Q value	0.15	0.03	0.58	0.91	0.21	0.99
Modified Mean	48.76	48.46	47.49	47.72	46.22	49.79

Box around data denotes known rejected values. * Symbol denotes known experimental error and was rejected.

TABLE 21 (continued). Q-TEST APPLIED TO MSMA EQUILIBRIUM CONCENTRATIONS.

	Soil 1 Equilibrium conc (ppb), initial at ~100ppb	Soil 2 Equilibrium conc (ppb), initial at ~100ppb	Soil 3 Equilibrium conc (ppb), initial at ~100ppb	Soil 4 Equilibrium conc (ppb), initial at ~100ppb	Soil 5 Equilibrium conc (ppb), initial at ~100ppb	Control Equilibrium conc (ppb), initial at ~100ppb
Replicate 1	81.03	84.46	90.29	87.95	79.67	90.45
Replicate 2	85.67	91.71	92.34	89.84	83.62	95.16
Replicate 3	92.28	94.59	96.04	91.17	86.56	100.2
Range	11.25	10.13	5.75	3.22	6.89	9.75
Diff. High	6.61	2.9	3.7	1.33	2.94	5.04
Q value	0.59	0.28	0.64	0.41	0.43	0.52
Diff. Low	4.64	7.25	2.05	1.89	3.95	4.71
Q value	0.41	0.72	0.36	0.59	0.57	0.48
Modified Mean	86.33	90.25	92.89	90.51	83.28	95.27
	Soil 1 Equilibrium conc (ppb), initial at ~200ppb	Soil 2 Equilibrium conc (ppb), initial at ~200ppb	Soil 3 Equilibrium conc (ppb), initial at ~200ppb	Soil 4 Equilibrium conc (ppb), initial at ~200ppb	Soil 5 Equilibrium conc (ppb), initial at ~200ppb	Control Equilibrium conc (ppb), initial at ~200ppb
Replicate 1	169.6	169.9	174.5	174.3	167	182.1
Replicate 2	177.6	178.8	181.2	176.5	170.1	184
Replicate 3	179	179.3	182.6	176.9	176.6	192.1
Range	9.4	9.4	8.1	2.6	9.6	10
Diff. High	1.4	0.5	1.4	0.4	6.5	8.1
Q value	0.15	0.05	0.17	0.15	0.68	0.81
Diff. Low	8.4	8.9	6.7	2.2	3.1	1.9
Q value	0.85	0.936	0.83	0.85	0.32	0.19
Modified Mean	175.4	176	179.4	175.9	171.2	186.1

Box around data points denotes known rejected values. * Symbol denotes known experimental error and was rejected.

TABLE 22. TABULATED RESULTS OF CONCENTRATION AS A FUNCTION OF TIME FOR SCENARIOS 1, 2, AND 3 (COMPARE VARYING DISPERSION VALUES).

Date	Scenario 1: Total Dissolved arsenic (ppb)	Scenario 2: Total Dissolved arsenic (ppb)	Scenario 3: Total Dissolved arsenic (ppb)
2-Mar-88	213.11	36.20	0.00
8-Mar-88	208.13	188.98	22.33
2-Apr-88	150.59	157.63	167.14
2-Sep-88	226.53	46.31	6.35
8-Sep-88	248.27	190.50	6.88
2-Oct-88	240.35	231.63	64.97
2-Mar-89	336.95	174.98	141.56
8-Mar-89	342.04	311.58	149.00
2-Apr-89	326.35	328.36	223.88
2-Sep-89	334.03	166.65	163.85
8-Sep-89	341.75	302.42	160.52
2-Oct-89	291.02	298.59	250.17
2-Mar-90	376.27	199.82	193.18
8-Mar-90	399.14	344.41	191.62
2-Apr-90	388.04	376.94	243.69
2-Sep-90	285.94	96.69	48.67
8-Sep-90	268.10	248.95	77.23
2-Oct-90	126.09	132.91	167.25
2-Mar-91	248.58	81.74	36.28
8-Mar-91	230.64	220.51	71.15
2-Apr-91	207.04	212.82	165.10
2-Sep-91	234.74	55.99	14.35
8-Sep-91	224.80	206.86	38.70
2-Oct-91	150.32	176.04	178.19
2-Mar-92	270.54	91.70	69.40
8-Mar-92	285.91	239.11	71.27
2-Apr-92	261.98	254.68	154.52
2-Sep-92	274.15	83.95	48.76
8-Sep-92	257.84	233.46	64.11
2-Oct-92	197.92	205.93	193.58

TABLE 23. TABULATED RESULTS OF CONCENTRATION AS A FUNCTION OF TIME FOR SCENARIOS 4 AND 5 (COMPARE VARYING K_d VALUES).

Date	Scenario 4: Total Dissolved arsenic (ppb)	Scenario 2: Total Dissolved arsenic (ppb)	Scenario 5: Total Dissolved arsenic (ppb)
2-Mar-88	0.00	36.20	0.01
8-Mar-88	15.70	188.98	43.38
2-Apr-88	132.78	157.63	277.40
2-Sep-88	12.39	46.31	0.84
8-Sep-88	12.17	190.50	3.24
2-Oct-88	53.56	231.63	128.59
2-Mar-89	120.26	174.98	170.17
8-Mar-89	125.39	311.58	186.19
2-Apr-89	182.59	328.36	333.96
2-Sep-89	163.47	166.65	117.55
8-Sep-89	160.97	302.42	116.32
2-Oct-89	229.57	298.59	307.64
2-Mar-90	188.32	199.82	176.76
8-Mar-90	186.81	344.41	176.27
2-Apr-90	224.26	376.94	292.38
2-Sep-90	78.60	96.69	9.76
8-Sep-90	97.16	248.95	68.61
2-Oct-90	167.13	132.91	177.67
2-Mar-91	47.85	81.74	16.11
8-Mar-91	72.56	220.51	82.42
2-Apr-91	144.39	212.82	261.08
2-Sep-91	24.76	55.99	2.53
8-Sep-91	40.91	206.86	51.45
2-Oct-91	152.08	176.04	262.42
2-Mar-92	73.75	91.70	45.95
8-Mar-92	74.46	239.11	53.17
2-Apr-92	135.70	254.68	227.31
2-Sep-92	71.99	83.95	11.23
8-Sep-92	80.51	233.46	49.84
2-Oct-92	178.83	205.93	284.40

TABLE 24. TABULATED RESULTS OF CONCENTRATION AS A FUNCTION OF TIME FOR SCENARIOS 2, 6, 7, AND 8 (COMPARE VARYING IRRIGATION).

Date	Scenario 7: Total Dissolved arsenic (ppb)	Scenario 2: Total Dissolved arsenic (ppb)	Scenario 6: Total Dissolved arsenic (ppb)	Scenario 8: Total Dissolved arsenic (ppb)
2-Mar-88	36.20	36.20	36.20	35.85
8-Mar-88	36.20	188.98	188.98	189.66
2-Apr-88	157.78	157.63	157.03	160.61
2-Sep-88	46.35	46.31	46.15	46.72
8-Sep-88	46.35	190.50	190.44	190.98
2-Oct-88	231.70	231.63	231.29	232.92
2-Mar-89	175.96	174.98	173.97	182.68
8-Mar-89	175.96	311.58	309.99	319.78
2-Apr-89	330.05	328.36	326.47	340.41
2-Sep-89	167.07	166.65	166.03	177.72
8-Sep-89	167.07	302.42	301.69	314.20
2-Oct-89	301.16	298.59	297.64	312.63
2-Mar-90	202.89	199.82	198.39	217.19
8-Mar-90	202.89	344.41	343.08	364.55
2-Apr-90	379.64	376.94	375.08	399.95
2-Sep-90	97.85	96.69	96.46	103.85
8-Sep-90	97.85	248.95	248.51	256.82
2-Oct-90	133.11	132.91	132.12	139.91
2-Mar-91	81.69	81.74	81.13	85.37
8-Mar-91	81.69	220.51	219.90	223.67
2-Apr-91	212.91	212.82	212.07	217.70
2-Sep-91	56.20	55.99	55.78	57.92
8-Sep-91	56.20	206.86	206.66	208.84
2-Oct-91	176.34	176.04	175.47	180.80
2-Mar-92	92.47	91.70	90.97	96.22
8-Mar-92	92.47	239.11	238.34	244.51
2-Apr-92	255.40	254.68	254.06	262.62
2-Sep-92	84.144	83.95	83.66	87.83
8-Sep-92	84.144	233.46	233.18	237.70
2-Oct-92	206.42	205.93	205.73	210.80

TABLE 25. TABULATED RESULTS OF CONCENTRATION VERSUS TIME FOR FRACTIONAL DISSOLVED MSMA, As(+5), AND TOTAL DISSOLVED ARSENIC AT GROUNDWATER INTERFACE AFTER ONE APPLICATION OF MSMA.

Date	Dissolved MSMA (ppb)	Dissolved As(+5) (ppb)	Total Dissolved arsenic (ppb)
1-Mar-88	46.92	0.2734	11.44
3-Mar-88	273.3	2.773	67.81
5-Mar-88	500.7	8.068	127.23
7-Mar-88	683.1	16.91	179.48
9-Mar-88	714.8	24.55	194.67
10-Mar-88	714.1	28.14	198.09
11-Mar-88	708.7	31.62	200.29
15-Mar-88	651.9	45.31	200.46
20-Mar-88	538.2	57.21	185.30
10-Apr-88	286.7	83.66	151.89
25-Apr-88	215.3	98.42	149.66
15-May-88	91.03	89.49	111.15
30-May-88	57.61	85.3	99.01
15-Jun-88	12.83	49.85	52.90
29-Jun-88	8.136	41.96	43.89
15-Jul-88	2.059	25.35	25.84
30-Jul-88	1.234	20.59	20.88
15-Aug-88	0.8676	19.38	19.58
30-Aug-88	0.1864	10.07	10.11

Appendix B – Supporting Documents

Florida International University Field Sample Data Sheet

Project: FIU/EPA MSMA Partitioning Study Sampling Date: 11/4/97
 Approximate Location: Left of green of 1st hole Sample #: Surficial 4-9
 Sampling Type and Equipment: Shovel, Auger
 Visual Fixes: Approximately 100' NW of 1st green as indicated by map below
 Depth of Sample: From 4" to 9"
 Photos - Roll: _____ Picture: 1-6
 Sample Description: Sandy soil
 Observed Weather Conditions: Cloudy, 84°F, 80% humidity, Very light wind
 Equipment Wash (before & after): YES NO Washwater: Wash soap, D-H₂O, Methanol
 Comments: 1st sample of the day. Removed top 4" off - a

Sample taken by: Terry Davis
 Witness(es) Present: Leslie Smith FDEP-SCD
Terry Davis FDEP-Port St. Lucie, George Drake
Dr. Hector Fuentes, Bernard Kimmel.

Northeastern most corner of the West Palm Beach Country Club

Florida International University Field Sample Data Sheet

Project: FIU/EPH USMA Part-time Study Sampling Date: 11/4/97
 Approximate Location: Left of green of 1st hole Sample #: Surficial 4-9"
 Sampling Type and Equipment: Shovel, Auger
 Visual Fixes: Approximately 100' NW of 1st green, as indicated by map below
 Depth of Sample: From 4" to 9"
 Photos - Roll: _____ Picture: 1-6
 Sample Description: Sandy soil
 Observed Weather Conditions: Cloudy, 78°F, 80% humidity, Very light wind
 Equipment Wash (before & after): YES NO Washwater: Washbasin, D-H₂O, Methodol
 Comments: 1st sample of the day. Removed top 4" off - a

Sample taken by: Terry Davis
 Witness(es) Present: Leslie Smith FDEP-SD,
Terry Davis FDEP-Bot St. Louis, George Drake
Dr. Hector Fuentes, Bernard Kimmel.

Northeastern most corner of the West Palm Beach Country Club

Florida International University
Field Sample Data Sheet

Project: FW/EPA MSMA Partitioning Study Sampling Date: 11/4/97

Approximate Location: SSS Sample #: GD-2

Sampling Type and Equipment: Same as Surface Sample (SSS)

Visual Fixes: Same as Surface Sample (SSS)

Depth of Sample: From 1' 2" to 1' 11"

Photos - Roll: X Picture: X

Sample Description: Sandy Soil

Observed Weather Conditions: Cloudy, Temperature (70-85°), ~83°

Equipment Wash (before & after): (YES) NO Washwater: SSS

Comments: Remove a piece of concrete.

Soil Description:
(I.E. color, type of
soil, depth to type)

Depth = 1' 2"

S.S.S.
Exception: no roots, or
any debris matter.

Sample taken by: Jerr. Davis

Witness(es) Present: SSS

Florida International University Field Sample Data Sheet

Project: FIU/EPA MSMA Partitioning Study Sampling Date: 11/4/97
 Approximate Location: S.S.S. Sample #: GD-3
 Sampling Type and Equipment: S.S.S.
 Visual Fixes: S.S.S.
 Depth of Sample: From 3'6" to 4'6"
 Photos - Roll: _____ Picture: 7-13
 Sample Description: S.S.S.
 Observed Weather Conditions: S.S.S.
 Equipment Wash (before & after): (YES) NO Washwater: S.S.S.
 Comments: @ 2'10" very light cream color sand.

Sample taken by: Terry Davis
 Witness(es) Present: S.S.S. exception:
Bernard Himmel

Florida International University Field Sample Data Sheet

Project: FIU/EPA MS1114 Partitioning Study Sampling Date: 11/4/97
 Approximate Location: S.S.S. Sample #: GD-4
 Sampling Type and Equipment: S.S.S.
 Visual Fixes: S.S.S.
 Depth of Sample: From 5'6" to 7'
 Photos - Roll: 4 Picture: 4-17
 Sample Description: Sandy Soil
 Observed Weather Conditions: S.S.S.
 Equipment Wash (before & after): YES NO Washwater: S.S.S.
 Comments: V. Musty smell - (organic smell) 5'
Color is Soluble in Washwater

Sample taken by: Terry Davis
 Witness(es) Present: S.S.S.
except Bernard Kimmel

Florida International University

Field Sample Data Sheet

Project: MEIU/EPA MSMA Partitioning Sampling Date: 11/4/92
 Approximate Location: S.S.S. Sample #: GD-5
 Sampling Type and Equipment: S.S.S.
 Visual Fixes: S.S.S.
 Depth of Sample: From 7'6" to ~~9'8"~~ 8'10"
 Photos - Roll: 11 Picture: 10-28
 Sample Description: S.S.S.
 Observed Weather Conditions: S.S.S.
 Equipment Wash (before & after): (YES) NO Washwater: _____
 Comments: Can see top of water table - measured @ 100" (8'6")

Sample taken by: George Dilach
 Witness(es) Present: Tony Davis, Leslie Smith
Dr. Hector Fuentes

**FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
CENTRAL LABORATORY SAMPLE SUBMITTAL FORM**

PMAS NO.: 1110

Lab ID: _____

Requestor: SE-WPB-WSM

Project ID: Golf Course arsenic study

RQ-98-JAN-05-1

Sample Location: _____ Collection Date: _____

Field ID/Name: _____ Collection Time _____

Storet Station Number: _____ Grab: _____

NPDES Number: _____ Composite Begin: _____ End: _____

WATER		BLANKS	SOIL/SEDIMENT	TISSUE	CHEMICAL WASTE
☐ SURFACE(FRESH)	☐ INFLUENT	☐ TRIP BLANK	☐ SOIL	☐ PLANT	
☐ SURFACE(SALT)	☐ EFFLUENT	☐ FIELD BLANK	☐ FRESHWATER SEDIMENT	☐ FISH	☐ CHEM WASTE
☐ GROUND		☐ EQUIPMENT BLANK	☐ MARINE SEDIMENT	☐ SHELLFISH	
☐ DRINKING			☐ SLUDGE	☐ OTHER	

Field Parameters Measured By: _____	Field Parameters:
Signature: _____	Depth (Feet): _____
Sampled By: _____	Chlorine, Total Residual - 50060 (mg/L): _____
Signature: _____	Dissolved Oxygen(Probe) - 00299 (mg/L): _____
Field Report Prepared By: _____	pH - 00400 (Std. Units): _____
Signature: _____	Salinity - 00480 (PPTH): _____
	Secchi Depth - 00078 (m): _____
	Specific Conductance -00094 (umho/cm): _____
	Temperature - 00010 (C): _____

Analyses	Bottle Type	# Bottles	Preservatives
W-ICPMS-F	P-500ML	1	HNO3

Send Final Report To: _____

[illegible]

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

1997

LOCAL CLIMATOLOGICAL DATA ANNUAL SUMMARY WITH COMPARATIVE DATA

ISSN 0198-1439

WEST PALM BEACH,
FLORIDA (PBI)

Daily Data

I CERTIFY THAT THIS IS AN OFFICIAL PUBLICATION OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, AND IS COMPILED FROM RECORDS ON FILE AT THE NATIONAL CLIMATIC DATA CENTER.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL ENVIRONMENTAL SATELLITE, DATA, AND INFORMATION SERVICE NATIONAL CLIMATIC DATA CENTER, ASHEVILLE, NORTH CAROLINA ACTING DIRECTOR, NATIONAL CLIMATIC DATA CENTER

James H. Anderson

METEOROLOGICAL DATA FOR 1997

WEST PALM BEACH, FL (PBI)

LATITUDE: 26° 41' 05" N LONGITUDE: 80° 05' 52" W ELEVATION (FT): GRND: 15 BARO: 24 TIME ZONE: EASTERN (UTC+ 5) WBAN: 12844

	ELEMENT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
TEMPERATURE °F	MEAN DAILY MAXIMUM	75.3	79.3	81.8	81.8	85.5	88.3	90.3	89.9	87.6	84.7	79.2	75.2	83.2
	HIGHEST DAILY MAXIMUM	85	85	89	90	91	93	94	95	92	90	86	87	95
	DATE OF OCCURRENCE	9	8	29	23+	31+	16	31	21	03	27	01	12	AUG 31
	MEAN DAILY MINIMUM	57.4	65.1	67.4	66.6	71.8	73.7	75.6	74.4	75.1	71.1	64.3	59.3	68.5
	LOWEST DAILY MINIMUM	35	44	60	49	64	70	71	71	71	56	49	45	35
	DATE OF OCCURRENCE	19	1	23	19	7	04	11	11	13-	20	9	07	JAN 19
	AVERAGE DRY BULB	66.4	72.2	74.6	74.2	78.7	81.0	83.0	82.2	81.4	77.9	71.8	67.3	75.9
	MEAN WET BULB	61.1	66.9	68.5	67.1		75.2	77.1	76.1		71.0		62.8	
	MEAN DEW POINT	56.7	63.9	65.2	62.5		72.9	75.0	74.1		67.5		59.5	
	NUMBER OF DAYS WITH:													
	MAXIMUM ≥ 90°	1	0	0	2	3	9	23	20	7	1	0	0	65
	MAXIMUM ≤ 32°	0	0	0	0	0	0	0	0	0	0	0	0	0
	MINIMUM ≤ 32°	0	0	0	0	0	0	0	0	0	0	0	0	0
	MINIMUM ≤ 0°	0	0	0	0	0	0	0	0	0	0	0	0	0
H/C	HEATING DEGREE DAYS	79	13	0	2	0	0	0	0	0	0	8	75	177
	COOLING DEGREE DAYS	128	223	305	285	431	490	564	541	500	408	218	154	4247
RH	MEAN (PERCENT)	73	77	74	70	75	79	80	80	80	72	77	79	76
	HOUR 01 LST	81	85	81	78	82	89	88	88	86	80	84	88	84
	HOUR 07 LST	84	85	86	79	83	86	88	91	89	83	86	88	86
	HOUR 13 LST	57	64	61	59	63	67	67	67	69	59	64	64	63
	HOUR 19 LST	71	76	72	68	76	77	79	78	79	72	76	79	75
S	PERCENT POSSIBLE SUNSHINE													
W/O	NUMBER OF DAYS WITH:													
	HEAVY FOG (VISBY ≤ 1/4 MI)	1	0	1	0	0	0	0	2	3	0	1	1	9
	THUNDERSTORMS	1	1	2	4	9	18	23	21	13	0	4	1	97
CLOUDINESS	SUNRISE-SUNSET: (OKTAS)													
	CEILOMETER (≤ 12,000 FT.)													
	SATELLITE (> 12,000 FT.)													
	MIDNIGHT-MIDNIGHT: (OKTAS)													
	CEILOMETER (≤ 12,000 FT.)													
PR	SATELLITE (> 12,000 FT.)													
	NUMBER OF DAYS WITH:													
	CLEAR													
	PARTLY CLOUDY													
	CLOUDY													
PR	MEAN STATION PRESS. (IN.)	30.10	30.13	30.06	29.97	30.01	29.94	30.02	30.01		29.99		29.97	
	MEAN SEA-LEVEL PRESS. (IN.)	30.12	30.15	30.08	29.99	30.03	29.96	30.04	30.03		30.01		29.99	
WINDS	RESULTANT SPEED (MPH)	1.5	3.6	1.4	1.5	3.3	2.3	2.0	1.4		4.2		2.7	
	RES. DIR. (TENS OF DEGS.)	06	10	15	16	11	09	12	11		28		25	
	MEAN SPEED (MPH)	8.3	10.3	9.9	10.9	8.6	7.1	6.0	5.4	7.4	9.7	8.5	8.5	8.4
	PREVAIL. DIR. (TENS OF DEGS.)	33	14	12	10	12	11	13	12	06	08	34	33	09
	MAXIMUM 2-MINUTE WIND:													
	SPEED (MPH)	32	25	26	28	28	30	38	33	25	24	32	30	38
	DIR. (TENS OF DEGS.)	32	05	11	31	33	21	33	10	20	07	30	26	33
	DATE OF OCCURRENCE	25+	17+	25+	23	27	12	11	24	27+	12+	02	29	JUL 11
	MAXIMUM 5-SECOND WIND:													
	SPEED (MPH)	39	31	31	38	32	34	45	39	31	29	39	36	45
	DIR. (TENS OF DEGS.)	31	20	29	31	24	19	33	09	20	07	30	27	33
	DATE OF OCCURRENCE	09	15	21+	23	13	12+	11	24+	27	10+	02	29	JUL 11
PRECIPITATION	WATER EQUIVALENT:													
	TOTAL (IN.)	4.24	4.45	3.39	4.66	3.34	11.75	3.29	10.60	6.85	0.56	3.98	5.02	62.13
	GREATEST 24-HOUR (IN.)	1.85	1.82	1.31	1.48	1.27	3.67	0.98	1.70	1.95	0.36	1.46	3.15	3.67
	DATE OF OCCURRENCE	13-14	15-16	14	12-13	12	01	20	26	11	19	22	13-14	JUN 01
	NUMBER OF DAYS WITH:													
	PRECIPITATION ≥ 0.01	8	8	8	12	11	19	19	20	19	6	7	6	143
SNOWFALL	PRECIPITATION ≥ 0.10	5	5	6	8	5	13	9	15	13	1	5	4	89
	PRECIPITATION ≥ 1.00	2	2	1	1	2	2	0	4	1	0	1	3	19
	SNOW, ICE PELLETS, HAIL:													
	TOTAL (IN.)				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	GREATEST 24-HOUR (IN.)				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	DATE OF OCCURRENCE				0	0	0	0	0	0	0	0	0	0
SNOWFALL	MAXIMUM SNOW DEPTH (IN.)				0	0	0	0	0	0	0	0	0	0
	DATE OF OCCURRENCE				0	0	0	0	0	0	0	0	0	0
	NUMBER OF DAYS WITH:													
	SNOWFALL ≥ 1.0				0	0	0	0	0	0	0	0	0	0

published by: NCDC Asheville, NC

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NORMALS, MEANS, AND EXTREMES

WEST PALM BEACH, FL (PBI)

LATITUDE: 26° 41' 05" N LONGITUDE: 80° 05' 58" W ELEVATION (FT): 15 BARO: 24 TIME ZONE: EASTERN (UTC- 5) WBAN: 12844

ELEMENT	NO.	TEMPERATURE °F												YEAR
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
NORMAL DAILY MAXIMUM	30	74.5	75.9	78.8	82.0	85.6	88.1	89.9	90.0	88.6	84.9	80.0	76.0	82.9
MEAN DAILY MAXIMUM	39	74.6	75.9	78.9	82.2	85.5	88.3	90.1	90.2	88.5	85.0	80.1	76.1	82.9
HIGHEST DAILY MAXIMUM	60	89	90	94	99	96	98	101	98	97	95	91	90	101
YEAR OF OCCURRENCE		1942	1949	1977	1971	1971	1980	1942	1963	1937	1929	1992	1941	JUL 1942
MEAN OF EXTREME MAXS.	49	83.7	85.7	88.2	90.5	91.8	93.7	94.3	94.2	92.9	90.6	86.5	84.4	89.7
NORMAL DAILY MINIMUM	30	55.7	56.5	61.2	64.7	69.7	73.1	74.5	75.0	74.6	70.7	64.5	58.7	66.6
MEAN DAILY MINIMUM	39	56.7	57.4	61.4	65.3	70.0	73.3	74.7	75.1	74.4	70.7	65.0	58.9	66.9
LOWEST DAILY MINIMUM	60	27	32	30	43	51	61	66	65	66	46	36	28	27
YEAR OF OCCURRENCE		1977	1989	1980	1987	1992	1984	1937	1957	1938	1958	1950	1989	JAN 1977
MEAN OF EXTREME MINS.	49	38.8	42.5	45.7	53.3	61.0	68.1	70.5	70.6	70.0	59.4	49.2	41.4	55.9
NORMAL DRY BULB	30	65.1	66.2	70.0	73.4	77.6	80.6	82.2	82.5	81.6	77.8	72.3	67.4	74.7
MEAN DRY BULB	49	66.0	67.1	70.3	73.8	77.9	80.9	82.5	82.7	81.6	77.8	72.4	67.7	75.1
MEAN WET BULB	46	60.1	61.0	63.5	66.2	70.6	74.2	75.6	75.8	75.2	71.0	66.0	61.8	68.4
MEAN DEW POINT	46	56.2	57.0	59.3	62.0	67.3	71.8	73.2	73.4	72.9	68.1	62.5	58.0	55.1
NORMAL NO. DAYS WITH:														
MAXIMUM ≥ 90°	30	0.0	0.0	0.5	1.9	3.8	9.6	18.2	20.1	11.2	2.2	0.1	0.0	67.8
MAXIMUM ≤ 32°	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MINIMUM ≤ 32°	30	0.4	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.8
MINIMUM ≤ 0°	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H/C														
NORMAL HEATING DEG. DAYS	30	122	85	27	0	0	0	0	0	0	0	15	74	323
NORMAL COOLING DEG. DAYS	30	125	119	182	252	391	468	533	543	498	397	234	149	3891
RH														
NORMAL (PERCENT)	30	73	71	70	68	72	77	76	76	78	74	73	73	73
HOUR 01 LST	10	81	80	78	76	79	84	85	84	84	80	80	80	81
HOUR 07 LST	30	83	83	81	79	80	84	85	85	87	83	83	82	83
HOUR 13 LST	30	59	56	56	54	59	65	64	64	66	62	61	59	60
HOUR 19 LST	30	72	70	68	65	71	76	75	75	78	74	73	73	72
S														
PERCENT POSSIBLE SUNSHINE														
W/O														
MEAN NO. DAYS WITH:														
HEAVY FOG (VISBY ≤ 1/4 MI)	54	1.7	1.1	0.9	0.9	0.3	0.3	0.0	0.1	0.3	0.4	0.6	1.1	7.7
THUNDERSTORMS	54	0.9	1.2	2.4	3.5	7.5	13.0	16.0	16.2	11.3	4.5	1.5	0.9	78.9
CLOUDINESS														
MEAN:														
SUNRISE-SUNSET (OKTAS)	1					5.6	4.8						5.6	
MIDNIGHT-MIDNIGHT (OKTAS)	1						4.8							
MEAN NO. DAYS WITH:														
CLEAR	1	1.0	8.5	7.0		5.0	6.0						2.0	
PARTLY CLOUDY	2	6.5	3.0	6.0		6.0	8.0						3.0	
CLOUDY	2	5.5	2.5	4.0		8.0	9.0							
PR														
MEAN STATION PRESSURE (IN)	24	30.09	30.07	30.04	30.01	29.98	30.00	30.05	30.02	29.97	29.98	30.04	30.08	30.03
MEAN SEA-LEVEL PRES. (IN)	46	30.12	30.09	30.06	30.04	30.00	30.01	30.06	30.02	29.97	29.98	30.05	30.11	30.04
WINDS														
MEAN SPEED (MPH)	35	10.3	10.7	11.2	11.0	9.9	8.4	7.9	7.9	8.8	10.3	10.6	10.2	9.8
PREVAIL. DIR. (TENS OF DEGS)	19	32	32	14	13	12	12	12	12	09	07	08	32	09
MAXIMUM 2-MINUTE:														
SPEED (MPH)	4	37	34	36	31	30	45	38	33	44	33	39	38	45
DIR. (TENS OF DEGS)	19	06	06	25	25	19	01	33	11	13	20	10	36	01
YEAR OF OCCURRENCE		1994	1994	1994	1996	1994	1994	1997	1994	1994	1996	1994	1994	JUN 1994
MAXIMUM 5-SECOND:														
SPEED (MPH)	4	46	40	43	38	39	53	45	41	52	45	46	48	53
DIR. (TENS OF DEGS)	19	06	06	25	26	20	36	33	12	12	20	11	36	36
YEAR OF OCCURRENCE		1994	1994	1994	1996	1994	1994	1997	1994	1994	1996	1994	1994	JUN 1994
PRECIPITATION														
NORMAL (IN)	30	2.80	2.69	3.66	2.91	6.13	8.09	6.14	6.02	8.53	6.60	4.69	2.49	60.75
MAXIMUM MONTHLY (IN)	58	11.01	8.71	16.78	18.26	15.22	17.91	17.74	13.52	24.86	18.74	14.63	11.69	24.86
YEAR OF OCCURRENCE		1983	1983	1982	1942	1976	1966	1941	1950	1960	1965	1982	1994	SEP 1960
MINIMUM MONTHLY (IN)	58	0.22	0.29	0.33	0.04	0.39	1.07	1.22	1.73	1.77	0.56	0.23	0.06	0.04
YEAR OF OCCURRENCE		1960	1948	1956	1967	1967	1952	1961	1987	1985	1997	1970	1969	APR 1967
MAXIMUM IN 24 HOURS (IN)	58	8.45	4.70	8.80	15.23	7.04	9.21	5.83	6.72	8.71	9.58	7.67	6.45	15.23
YEAR OF OCCURRENCE		1991	1966	1982	1942	1958	1945	1972	1988	1960	1965	1984	1994	APR 1942
NORMAL NO. DAYS WITH:														
PRECIPITATION ≥ 0.01	30	7.7	7.4	7.6	5.6	11.0	14.4	14.3	15.9	16.7	12.2	9.2	7.7	129.7
PRECIPITATION ≥ 1.00	30	0.7	0.8	1.0	0.7	1.9	2.9	1.7	1.5	2.7	1.7	1.4	0.7	17.7
SNOWFALL														
NORMAL (IN)	30	T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAXIMUM MONTHLY (IN)	50	T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	T
YEAR OF OCCURRENCE		1977		1994						1993				MAR 1994
MAXIMUM IN 24 HOURS (IN)	50	T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	T	0.0	0.0	0.0	T
YEAR OF OCCURRENCE		1977		1994						1993				AUG 1993
MAXIMUM SNOW DEPTH (IN)	46	0	0	0	0	0	0	0	0	T	0	0	0	T
YEAR OF OCCURRENCE										1993				APR 1993
NORMAL NO. DAYS WITH:														
SNOWFALL ≥ 1.0	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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PRECIPITATION (inches) 1997 WEST PALM BEACH, FL (PBI)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1968	0.56	4.44	1.48	0.72	13.82	16.78	4.66	8.14	14.01	10.24	2.51	0.06	77.42
1969	3.59	1.67	5.53	0.73	8.32	12.25	7.43	7.75	14.56	13.47	3.29	1.16	79.75
1970	4.57	2.98	11.95	1.00	5.83	8.23	3.17	5.47	7.61	4.13	0.23	0.11	55.28
1971	0.82	1.08	0.55	1.27	5.04	9.03	5.13	4.38	6.24	5.13	10.77	1.87	51.31
1972	2.47	2.55	3.99	12.62	11.19	12.34	13.25	2.76	3.72	1.20	6.98	2.08	75.15
1973	2.62	2.71	2.28	1.45	4.13	7.53	7.74	7.51	7.59	6.97	2.06	2.15	54.74
1974	8.30	0.42	2.44	1.18	2.93	4.87	11.00	5.85	5.62	9.30	3.99	2.56	58.46
1975	0.47	0.68	0.85	0.57	6.23	7.18	5.67	2.49	11.58	5.60	1.81	1.27	44.40
1976	1.09	4.59	1.64	1.26	15.22	4.52	1.67	7.29	7.74	3.75	3.29	3.06	55.32
1977	3.49	1.11	0.53	1.65	14.80	4.03	2.19	8.03	13.21	2.01	5.84	7.37	64.26
1978	3.40	2.49	2.73	0.88	4.55	10.36	5.91	2.27	6.36	6.98	10.98	5.30	62.21
1979	3.06	0.80	1.06	8.71	5.09	6.34	1.89	3.08	19.63	4.78	4.08	2.66	61.18
1980	4.11	3.85	2.53	3.90	8.06	4.26	7.61	5.02	6.76	4.02	3.28	1.27	56.67
1981	0.43	4.22	2.49	0.43	5.12	4.58	3.72	10.33	9.30	2.16	4.52	2.50	49.74
1982	1.29	2.31	16.78	7.67	6.90	10.37	2.57	5.72	5.03	4.83	14.63	1.52	80.62
1983	11.01	8.71	3.42	3.27	5.30	9.39	4.71	8.21	9.62	7.80	4.24	7.03	82.71
1984	1.36	4.49	5.06	5.99	8.44	5.84	7.34	6.39	8.69	1.67	14.39	0.13	69.79
1985	0.84	0.53	3.49	3.35	4.63	4.24	10.77	5.38	9.38	2.89	0.54	1.35	47.99
1986	6.34	1.58	5.48	0.33	1.59	9.82	10.20	4.88	4.08	8.11	5.80	10.10	69.31
1987	1.17	1.20	7.75	2.61	5.63	6.60	4.42	1.73	11.90	4.78	9.43	1.47	58.69
1988	3.38	3.04	5.51	3.65	6.94	10.95	9.01	11.38	1.77	3.54	3.86	1.88	64.91
1989	0.97	1.00	2.58	6.04	0.75	4.96	3.52	5.83	4.05	5.84	1.15	1.94	38.66
1990	1.19	1.39	1.91	2.82	6.74	6.67	10.17	6.60	11.70	3.45	1.23	1.94	55.81
1991	10.43	4.36	3.36	9.54	8.94	7.45	7.16	7.34	6.44	7.58	2.32	4.44	79.36
1992	1.69	3.26	2.61	2.64	1.59	16.08	2.90	6.12	6.99	2.82	12.56	1.85	61.11
1993	8.05	2.06	11.06	2.53	2.22	2.89	5.41	4.78	5.35	11.99	5.78	0.82	62.94
1994	5.85	3.22	2.62	7.57	4.50	10.89	5.22	10.33	11.41	4.42	8.17	11.69	85.89
1995	3.85	1.12	2.37	3.91	0.85	7.79	6.86	20.12	5.69	11.11	1.49	1.60	66.76
1996	1.54	0.67	5.06	0.78	6.52	7.56	2.77	4.24	7.53	6.54	2.06	1.55	46.82
1997	4.24	4.45	3.39	4.66	3.34	11.75	3.29	10.60	6.85	0.56	3.98	5.02	62.13
POR= 59 YRS	2.96	2.52	3.53	3.62	5.45	7.83	6.23	6.84	8.92	7.03	3.88	2.73	61.54

WBAN : 12844

AVERAGE TEMPERATURE (°F) 1997 WEST PALM BEACH, FL (PBI)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1968	64.8	60.1	64.9	74.7	76.9	78.4	80.4	81.9	80.4	75.3	67.7	63.7	72.4
1969	65.1	61.7	64.7	74.8	77.0	80.4	82.8	81.4	80.5	78.8	67.7	62.7	73.1
1970	60.4	62.1	69.1	75.7	77.8	80.0	82.5	83.5	81.2	78.4	66.5	68.3	73.8
1971	65.0	67.4	65.9	71.8	78.8	80.9	82.3	83.1	81.1	79.0	73.1	73.1	75.1
1972	71.8	67.0	70.9	74.1	78.8	81.8	82.5	83.2	82.6	80.4	74.3	72.0	76.6
1973	68.7	64.0	73.6	74.5	79.2	81.7	82.1	81.7	82.0	77.5	75.0	66.4	75.5
1974	73.2	66.7	73.6	74.3	78.6	80.0	81.8	82.7	82.3	77.0	72.0	66.8	75.8
1975	71.2	72.1	71.8	73.9	77.8	79.5	79.8	81.4	80.5	77.6	71.3	66.9	75.3
1976	62.2	66.3	72.6	72.7	77.4	78.1	81.1	81.2	80.0	75.6	70.6	66.0	73.7
1977	58.5	63.6	73.7	75.0	76.9	81.2	81.9	82.5	81.0	75.3	72.6	67.3	74.1
1978	62.1	60.4	68.4	73.2	78.9	81.6	82.1	82.2	80.7	77.0	73.7	71.3	74.3
1979	62.7	63.7	68.0	74.4	76.0	80.2	82.7	82.5	81.3	77.5	73.2	67.1	74.1
1980	64.1	60.9	70.2	71.8	77.5	82.5	83.5	82.5	81.3	78.6	72.4	65.5	74.2
1981	58.7	67.6	67.9	75.7	78.5	83.4	84.1	82.6	81.1	78.1	67.9	65.2	74.3
1982	65.7	73.6	73.0	75.9	76.8	80.6	83.2	83.0	81.8	78.5	75.6	70.8	76.5
1983	64.8	66.1	66.5	72.2	77.6	80.6	84.0	84.3	81.6	76.9	70.0	68.3	74.4
1984	64.6	66.5	68.7	71.2	77.4	78.7	80.9	81.3	79.6	77.4	71.4	71.1	74.1
1985	60.7	67.5	71.3	73.1	77.3	82.3	81.0	82.9	80.3	80.4	75.7	65.0	74.8
1986	64.2	69.2	68.1	71.6	77.6	80.8	82.1	82.9	82.5	79.4	78.4	72.0	75.7
1987	64.5	68.7	70.3	69.0	77.8	82.3	83.2	84.9	82.7	76.5	73.8	68.4	75.2
1988	66.4	65.7	69.1	74.6	76.7	81.0	82.2	82.5	83.1	77.9	75.0	68.4	75.2
1989	71.3	68.5	72.2	74.8	79.5	81.9	83.0	83.8	83.1	77.6	74.3	62.5	76.0
1990	72.3	73.8	73.2	73.9	79.7	82.2	83.3	83.7	82.7	80.1	73.5	71.3	77.5
1991	71.0	68.2	72.6	77.0	80.2	81.9	83.2	83.6	82.0	78.6	71.5	70.2	76.7
1992	65.3	68.8	69.7	72.5	75.9	80.6	83.4	82.1	81.7	77.8	75.5	69.5	75.2
1993	71.5	66.3	69.0	71.1	77.7	81.6	82.9	83.0	82.3	79.0	74.4	65.6	75.4
1994	68.0	71.7	71.0	77.0	78.7	81.7	81.9	81.4	80.6	77.8	74.8	69.4	76.2
1995	64.2	65.0	72.0	75.7	80.7	80.8	82.2	82.7	82.4	80.5	70.7	65.7	75.2
1996	65.7	64.3	67.8	73.3	79.3	80.7	83.5	82.0	82.1	77.8	72.9	68.5	74.6
1997	66.4	72.2	74.6	74.2	78.7	81.0	83.0	82.2	81.4	77.9	71.8	67.3	75.9
POR= 59 YRS	66.0	67.0	70.3	73.9	77.8	80.8	82.5	82.7	81.6	77.8	73.3	67.8	75.0

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HEATING DEGREE DAYS (base 65°F) 1997 WEST PALM BEACH, FL (PBI)

YEAR	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	TOTAL
1968-69	0	0	0	6	60	129	55	110	88	0	0	0	448
1969-70	0	0	0	0	41	114	176	105	36	0	0	0	472
1970-71	0	0	0	0	66	32	113	73	79	18	0	0	381
1971-72	0	0	0	0	0	0	4	48	0	0	0	0	52
1972-73	0	0	0	0	5	37	56	81	4	5	0	0	188
1973-74	0	0	0	0	2	104	0	45	1	2	0	0	174
1974-75	0	0	0	0	4	67	18	3	15	5	0	0	112
1975-76	0	0	0	0	40	74	132	56	4	0	0	0	306
1976-77	0	0	0	0	15	68	220	93	2	0	0	0	404
1977-78	0	0	0	0	18	77	161	148	41	0	0	0	445
1978-79	0	0	0	0	0	2	124	118	23	0	0	0	267
1979-80	0	0	0	0	11	46	96	153	50	2	0	0	358
1980-81	0	0	0	0	22	76	193	41	27	0	0	0	365
1981-82	0	0	0	0	33	116	86	2	4	0	0	0	241
1982-83	0	0	0	0	0	46	88	36	58	0	0	0	236
1983-84	0	0	0	0	14	82	85	60	46	0	0	0	291
1984-85	0	0	0	0	10	30	176	85	0	0	0	0	316
1985-86	0	0	0	0	6	102	93	28	67	0	0	0	296
1986-87	0	0	0	0	0	2	104	22	10	30	0	0	177
1987-88	0	0	0	0	8	42	62	68	39	0	0	0	219
1988-89	0	0	0	0	0	49	7	66	26	0	0	0	148
1989-90	0	0	0	8	2	146	14	7	0	0	0	0	178
1990-91	0	0	0	2	0	11	18	44	17	0	0	0	92
1991-92	0	0	0	0	23	10	73	21	22	4	0	0	153
1992-93	0	0	0	0	9	27	11	28	28	1	0	0	104
1993-94	0	0	0	0	11	63	46	14	26	0	0	0	154
1994-95	0	0	0	0	0	31	91	93	3	0	0	0	218
1995-96	0	0	0	0	16	115	105	105	62	0	0	0	409
1996-97	0	0	0	0	1	35	79	13	0	2	0	0	130
1997-	0	0	0	0	2	75							

WBAN : 12844

COOLING DEGREE DAYS (base 65°F) 1997 WEST PALM BEACH, FL (PBI)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1969	64	23	87	300	380	471	561	515	468	438	128	50	3485
1970	42	29	171	329	403	459	551	580	495	423	119	140	3741
1971	121	147	116	227	434	484	542	569	486	440	249	257	4072
1972	223	112	192	277	436	511	547	573	534	486	296	261	4448
1973	177	60	279	296	446	509	539	526	517	397	311	154	4211
1974	262	117	274	288	429	457	526	552	528	378	218	130	4159
1975	216	208	230	280	403	442	467	514	472	397	235	139	4003
1976	53	97	251	237	393	404	507	509	457	334	193	105	3540
1977	25	62	287	308	376	493	531	548	484	329	253	155	3851
1978	78	27	152	252	440	506	540	540	477	380	265	203	3860
1979	59	87	123	287	349	461	555	549	496	396	266	117	3745
1980	75	37	218	213	395	530	562	551	492	427	258	100	3878
1981	1	118	124	325	425	557	599	558	487	414	127	129	3864
1982	116	249	263	336	371	476	568	566	510	425	324	234	4438
1983	87	73	110	229	396	474	597	604	506	378	172	191	3817
1984	81	110	165	198	391	417	500	514	444	391	208	226	3645
1985	49	159	210	256	389	523	502	582	464	485	335	107	4041
1986	76	151	170	206	397	481	536	561	534	455	410	224	4201
1987	95	134	180	166	402	522	574	626	539	363	278	152	4031
1988	114	94	173	293	370	488	539	548	550	408	301	162	4043
1989	208	171	257	302	454	515	563	525	522	406	283	75	4377
1990	247	259	262	276	460	520	574	561	542	473	263	211	4679
1991	211	140	263	366	478	514	571	582	512	436	221	180	4482
1992	58	136	175	238	345	476	575	527	507	404	332	172	3985
1993	218	71	158	192	400	506	564	564	527	439	298	91	4028
1994	145	210	214	365	435	505	533	515	473	401	305	175	4279
1995	74	102	228	330	499	483	542	558	528	490	196	141	4171
1996	136	93	155	263	451	478	579	534	519	405	246	153	4012
1997	128	223	305	285	431	492	564	541	503	408	213	154	4247

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SNOWFALL (inches) 1997 WEST PALM BEACH, FL (PBT)

YEAR	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	TOTAL
1970-71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971-72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972-73	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973-74	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974-75	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975-76	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976-77	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977-78	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978-79	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979-80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980-81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981-82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982-83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983-84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984-85	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985-86	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986-87	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987-88	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988-89	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989-90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990-91	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991-92	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992-93	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993-94	0.0	T	0.0	0.0	0.0	0.0	0.0	0.0	T	0.0	0.0	0.0	T
1994-95	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995-96	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996-97	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
POR=													
52 YRS	0.0	T	0.0	0.0	0.0	0.0	T	0.0	T	0.0	0.0	0.0	0.0

WBAN : 12844

REFERENCE NOTES:

PAGE 1:

THE TEMPERATURE GRAPH SHOWS NORMAL MAXIMUM AND NORMAL MINIMUM DAILY TEMPERATURES (SOLID CURVES) AND THE ACTUAL DAILY HIGH AND LOW TEMPERATURES (VERTICAL BARS).

PAGE 2 AND 3:

H/C INDICATES HEATING AND COOLING DEGREE DAYS.

RH INDICATES RELATIVE HUMIDITY

W/O INDICATES WEATHER AND OBSTRUCTIONS

S INDICATES SUNSHINE.

PR INDICATES PRESSURE.

CLOUDINESS ON PAGE 3 IS THE SUM OF THE CEILOMETER AND SATELLITE DATA NOT TO EXCEED EIGHT EIGHTHS (OKTAS).

GENERAL:

T INDICATES TRACE PRECIPITATION, AN AMOUNT GREATER THAN ZERO BUT LESS THAN THE LOWEST REPORTABLE VALUE.

- INDICATES THE VALUE ALSO OCCURS ON EARLIER DATES.

BLANK ENTRIES DENOTE MISSING OR UNREPORTED DATA.

NORMALS ARE 30-YEAR AVERAGES (1961 - 1990).

ASOS INDICATES AUTOMATED SURFACE OBSERVING SYSTEM.

PM INDICATES THE LAST DAY OF THE PREVIOUS MONTH.

POR (PERIOD OF RECORD) BEGINS WITH THE JANUARY DATA

MONTH AND IS THE NUMBER OF YEARS USED TO COMPUTE THE MEAN. INDIVIDUAL MONTHS WITHIN THE POR MAY BE MISSING.

WHEN THE POR FOR A NORMAL IS LESS THAN 30 YEARS,

THE NORMAL IS PROVISIONAL AND IS BASED ON THE NUMBER OF YEARS INDICATED.

0.0 OR * INDICATES THE VALUE OR MEAN-DAYS-WITH IS BETWEEN 0.00 AND 0.05.

CLOUDINESS FOR ASOS STATIONS DIFFERS FROM THE NON-ASOS

OBSERVATION TAKEN BY A HUMAN OBSERVER. ASOS STATION

CLOUDINESS IS BASED ON TIME-AVERAGED CEILOMETER DATA

FOR CLOUDS AT OR BELOW 12,000 FEET AND ON SATELLITE

DATA FOR CLOUDS ABOVE 12,000 FEET.

THE NUMBER OF DAYS WITH CLEAR, PARTLY CLOUDY, AND

CLOUDY CONDITIONS FOR ASOS STATIONS IS THE SUM

OF THE CEILOMETER AND SATELLITE DATA FOR THE

SUNRISE TO SUNSET PERIOD.

GENERAL CONTINUED:

CLEAR INDICATES 0 - 2 OKTAS, PARTLY CLOUDY INDICATES

3 - 6 OKTAS, AND CLOUDY INDICATES 7 OR 8 OKTAS.

WHEN AT LEAST ONE OF THE ELEMENTS (CEILOMETER OR

SATELLITE) IS MISSING, THE DAILY CLOUDINESS IS

NOT COMPUTED.

WIND DIRECTION IS RECORDED IN TENS OF DEGREES (2 DIGITS)

CLOCKWISE FROM TRUE NORTH. "00" INDICATES CALM. "36"

INDICATES TRUE NORTH.

RESULTANT WIND IS THE VECTOR AVERAGE OF THE SPEED AND DIRECTION.

AVERAGE TEMPERATURE IS THE SUM OF THE MEAN DAILY MAXIMUM AND MINIMUM TEMPERATURE DIVIDED BY 2.

SNOWFALL DATA COMPRISE ALL FORMS OF FROZEN

PRECIPITATION, INCLUDING HAIL.

A HEATING (COOLING) DEGREE DAY IS THE DIFFERENCE BETWEEN

THE AVERAGE DAILY TEMPERATURE AND 65°F.

DRY BULB IS THE TEMPERATURE OF THE AMBIENT AIR.

DEW POINT IS THE TEMPERATURE TO WHICH THE AIR MUST BE

COOLED TO ACHIEVE 100 PERCENT RELATIVE HUMIDITY.

WET BULB IS THE TEMPERATURE THE AIR WOULD HAVE IF THE

MOISTURE CONTENT WAS INCREASED TO 100 PERCENT RELATIVE HUMIDITY.

ON JULY 1, 1996, THE NATIONAL WEATHER SERVICE BEGAN USING THE "METAR" OBSERVATION CODE THAT WAS ALREADY EMPLOYED BY MOST OTHER NATIONS OF THE WORLD. THE MOST NOTICEABLE DIFFERENCE IN THIS ANNUAL PUBLICATION WILL BE THE CHANGE IN UNITS FROM TENS TO EIGHTH EIGHTHS FOR REPORTING THE AMOUNT OF SKY COVER.

1997
WEST PALM BEACH,
FLORIDA (PBI)

West Palm Beach and Palm Beach, both located on the coastal sand ridge of southeastern Florida, are separated by Lake Worth, a portion of the Inland Waterway. The entire coastal ridge is only about 5 miles wide and in early times the Everglades reached to its western edge. Now most of the swampland has been drained and is devoted to agriculture, the peat-like muck soil being very fertile when fortified with certain lacking minerals. The Atlantic Ocean forms the eastern edge of Palm Beach, and the Gulf Stream flows northward about 2 miles offshore, its nearest approach to the Florida coast.

Because of its southerly location and marine influences, the Palm Beach area has a notably equable climate. Cold continental air must either travel over water or flow down the Florida Peninsula to reach the area, and in either case its cold is appreciably modified. Actually, the coldest weather, with infrequent frosts, is experienced the second or third night after the arrival of the cold air, due to the loss of heat through radiation cooling. The frequency of temperatures as low as the freezing mark is about one per three years at the National Weather Service Office, but in the farmlands farther from the coast the frequency of light freezes is much higher.

Summer temperatures are tempered by the ocean breeze, and by the frequent formation of cumulus clouds, which shade the land somewhat without completely obscuring the sun. Temperatures of 89 degrees or higher have occurred in all months of the year, but the 100 degree mark has rarely occurred. August is the warmest month and has an average maximum temperature of about 90 degrees. The occurrence of 90 degree temperatures in August is so common that such can be expected on more than two-thirds of the days. However, temperatures as high as 100 degrees rarely occur.

The moist, unstable air in this area results in frequent showers, usually of short duration. Thunderstorms are frequent during the summer, occurring every other day. Rainfall is heaviest during the summer and fall, the fall rainfall occurring from occasional heavy rains accompanying tropical disturbances. High winds, associated with hurricanes, have been estimated at about 140 mph in the city.

Flying weather is usually very good in this area, with instrument weather occurring only rarely. Heavy fog occurs on an average of only one morning a month in the winter and spring, and almost never in the summer and fall.

STATION LOCATION

WEST PALM BEACH, FLORIDA

LOCATION	OCCUPIED FROM	OCCUPIED TO	AIRLINE DISPLACES AND DIRECTIONS FROM PREVIOUS LOCATION	LATITUDE NORTH	LONGITUDE WEST	ELEVATION ABOVE												REMARKS
						SEA LEVEL	GROUND											
							1	2	3	4	5	6	7	8	9	10	11	
Morrison Field South side, 4.5 miles SW of Post Office	6/24/35	8/16/46		26°41'	80°06'	15	26	5	5					5	3		CAA Station established. Weather Bureau effective 10/15/45.	
Morrison Field South side	8/16/46	2/17/48	250 ft. SSW	26°41'	80°06'	15	26	5	5					5	3		Building moved.	
Morrison Field North side	2/17/48	4/27/53	5/8 mi. N	26°41'	80°06'	18	41	5	5					5	3			
Palm Beach Int'l AP South side	4/27/53	3/1/77	5/8 mi. S	26°41'	80°06'	15	a22	c18	c18					18		b4	Office moved to new location and name of airport changed. a - 69 feet to 3/2/59. b - Commissioned 2/1/84 on field 21.0 feet west of thermometer site. c - Removed prior to 12/1966. d - Added as standby 9/1/74. e - Same site as prior to 3/2/77. f - Minor adjustment & type change 3/3/86. g - Effective 3/3/86. h - Raised 4/2/86.	
National Weather Svc. Bldg., Palm Beach International Airport	3/1/77	Present	0.9 mi. W	26°41'	80°07'	15	e22	h33	5	5	NA	3	3	NA	e4	f5	ASOS commissioned 04/01/93	

SUBSCRIPTION:

Price and ordering information available through: National Climatic Data Center, Federal Building, Asheville, North Carolina 28801.

INQUIRIES/COMMENTS CALL: (704) 271-4800

National Climatic Data Center
151 Patton Avenue, Rm 120
Asheville NC 28801-5001OFFICIAL BUSINESS
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FORWARD AND ADDRESS CORRECTIONFIRST CLASS
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United States Department of Commerce
NOAA Permit No. G-19

Appendix C – Sample Calculations

Sample Calculations

The following is an example of how equilibration values were compared against controls with statistical analysis

Given:

The following data points were found in Table 18, for Soil 1 with initial 10 ppb As(+5) solution. Controls used for these data points are also in Table 18. (Sample 13:10, Control 2, second page)

Sample ID	Equilibration (ppb)
11:10	12.25
12:10	10.14
13:10	3.742
Control 1	11.37
Control 2	7.449

Find:

Mass of As (+5) adsorbed per gram of soil using Q-Test.

Solution:

- 1) Find differences between the corresponding control and the data values (i.e. control 1 with 11:10, 12:10; and control 2 with 13:10)

Replicate 1	11.37	-	12.25	=	-0.88 ppb
Replicate 2	11.37	-	10.14	=	1.23 ppb
Replicate 3	7.449	-	3.742	=	3.71 ppb

- 2) Apply Q-Test to data:

Use procedures outlined in Section 3.6, there are no outliers in data set if Q values are < 0.94:

a) -0.88 1.23 3.71 <hr style="width: 100%;"/> 4.59 range	b) check highest point 1.23 -3.71 <hr style="width: 100%;"/> 2.48 difference		$\frac{2.278}{4.5} = 0.54, \text{ less than } 0.94$
			<p>Therefore, not an outlier.</p>

Sample Calculations (continued)

c) check lowest data point

$$\frac{-0.88}{2.11} \quad \text{difference} \quad \frac{2.11}{4.59} = 0.46, \text{ less than } 0.94$$

Therefore, not an outlier

3) Find average value (since all data are considered acceptable) and convert ppb to micrograms of arsenic adsorbed:

a) convert:

-0.88 ppb		= -0.11 ug As (+5) adsorbed
1.23 ppb	X 0.125L	= 0.154 ug As (+5) adsorbed
3.71 ppb		= 0.464 ug As (+5) adsorbed
	TOTAL	0.508 ug As(+5) adsorbed

b) find average:

$$0.508 \text{ As (+5) adsorbed divided by 3 samples} \\ = \mathbf{0.169 \text{ ug As(+5) adsorbed/sample}^*}$$

* For Soil 1, initial concentration of 10 ppb

4) Find As(+5) adsorbed per gram of soil:

$$0.169 \text{ ug As(+5) adsorbed/sample divided by } 0.5000^1 \text{ g of Soil 1} \\ = 0.338 \text{ ug As(+5) adsorbed/g Soil 1}$$

¹ Compare against value reported in Table 20, 0.338 versus 0.332
equates to 1.8 % accuracy of reporting

5) Thus, values 1 (As(+5) in solution) and 2 (As(+5) in Soil 1) were used with other points, to evaluate alternative isotherms (See Tables 9-20, and Figures 12-23 and 42-61).

Appendix D – FIU Data Sheets

Arsenic Data

=====
Element: As
Sample ID: 11:10
=====

Repl	SampleConc	StndConc	BlnkCorr	Peak	Bkgnd
#	µg/L	µg/L	Signal	Area	Area
1	12.25	12.25	0.025	0.022	0.058 3

=====
Element: As
Sample ID: 12:10
=====

Repl	SampleConc	StndConc	BlnkCorr	Peak	Bkgnd
#	µg/L	µg/L	Signal	Area	Area
1	10.14	10.14	0.021	0.018	0.055 3

=====
Element: As Date: 05/04/1998
Sample ID: 10:10
=====

Repl	SampleConc	StndConc	BlkCorr	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Area	
1	11.37	11.37	0.023	0.021	0.048	16:04:10

=====
Element: As
Sample ID: 21:10
=====

Repl	SampleConc	StndConc	BlkCorr	Peak	Bkgnd
#	µg/L	µg/L	Signal	Area	Area
1	8.839	8.839	0.018	0.015	0.053 3

=====
 Element: As
 Sample ID: soil 2 blank:10
 =====

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Bkgnd Area
1	0.452	0.452	0.001	-0.002	0.052 6

=====
 Element: As
 Sample ID: soil 3 blank:10
 =====

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Bkgnd Area
1	0.327	0.327	0.001	-0.002	0.048 6

Repl #	Sample Conc µg/L	Std Conc µg/L	Bkgrd Signal	Peak Area	Bkgrd Area
1	-0.355	-0.355	-0.001	-0.003	0.047

As

Element: As Date: 05/04/1998
 Sample ID: 42:10

Repl #	SampleConc µg/L	StdConc µg/L	BlankCorr Signal	Peak Area	Bkgnd Area	Time
1	10.50	10.50	0.022	0.019	0.055	16:07:27

As

Element: As
 Sample ID: soil 5 blank:10

Element: As						
Sample ID: soil 4 blank:10						
Repl	SampleConc	StdConc	BlkCorr	Peak	Area	Bkgnd
1	µg/L	µg/L	Signal	Area	Area	
	-1.227	-1.227	-0.003	-0.005	0.055	7
=====

Element: As						
Sample ID: soil 1 blank:10						
Repl	SampleConc	StdConc	BlkCorr	Peak	Area	Bkgnd
1	µg/L	µg/L	Signal	Area	Area	
	0.692	0.692	0.001	-0.001	0.051	5
=====

Element: As
Sample ID: 22:10

Repl #	SampleConc µg/L	StdConc µg/L	BlnkCorr Signal	Peak Area	Bkgnd Area
1	10.36	10.36	0.021	0.019	0.061 4

Element: As
Sample ID: 31:10

Repl #	SampleConc µg/L	StdConc µg/L	BlnkCorr Signal	Peak Area	Bkgnd Area
1	10.99	10.99	0.023	0.020	0.057 5

=====
Element: As
Sample ID: 32:10
=====

Repl	SampleConc	StndConc	BlkCorr	Peak	Bkgnd
#	µg/L	µg/L	Signal	Area	Area
1	11.54	11.54	0.024	0.021	0.050 7

=====
Element: As
Sample ID: 41:10
=====

Repl	SampleConc	StndConc	BlkCorr	Peak	Bkgnd
#	µg/L	µg/L	Signal	Area	Area
1	9.988	9.988	0.021	0.018	0.050 5

Element: As
Sample ID: 51:10

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Bkgnd Area
1	5.581	5.581	0.012	0.009	0.053 7

Element: As
Sample ID: 52:10

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Bkgnd Area
1	7.149	7.149	0.015	0.012	0.053 2

Element: As
Sample ID: 0:10

Repl	SampleConc	StdConc	BlnkCorr	Peak	Bkgnd
#	µg/L	µg/L	Signal	Area	Area
1	-0.704	-0.704	-0.001	-0.004	0.051 5

=====
Element: As Date: 05/04/1998
Sample ID: 21:50
=====

Repl	SampleConc	StndConc	BlkCorr	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Area	
1	48.28	48.28	0.100	0.097	0.055	16:23:09

=====
Element: As Date: 05/04/1998
Sample ID: 22:50
=====

Repl	SampleConc	StndConc	BlkCorr	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Area	
1	49.74	49.74	0.103	0.100	0.059	16:25:51

=====
Element: As
Sample ID: 11:50
=====

Repl	SampleConc	StdConc	BlnkCorr	Peak	Bkgnd
#	µg/L	µg/L	Signal	Area	Area
1	47.72	47.72	0.098	0.096	0.056 6

=====
Element: As Date: 05/04/1998
Sample ID: 12:50
=====

Repl	SampleConc	StdConc	BlnkCorr	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Area	
1	50.18	50.18	0.103	0.101	0.052	16:20:28

=====
Element: As Date: 05/04/1998
Sample ID: 31:50
=====

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Bkgnd Area	Time
1	48.30	48.30	0.100	0.097	0.060	16:28:33

=====
Element: As Date: 05/04/1998
Sample ID: 32:50
=====

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Bkgnd Area	Time
1	49.98	49.98	0.103	0.100	0.059	16:31:14

=====

Element: As Date: 05/04/1998

Sample ID: 51:50

Repl	SampleConc	StndConc	BlkCorr	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Area	
1	45.36	45.36	0.094	0.091	0.056	16:39:07

Element: As Date: 05/04/1998
Sample ID: 41:50

Repl	SampleConc	StndConc	BlkCorr	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Area	
1	52.50	52.50	0.108	0.105	0.062	16:33:53

Element: As Date: 05/04/1998
Sample ID: 42:50

Repl	SampleConc	StndConc	BlkCorr	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Area	
1	52.28	52.28	0.108	0.105	0.058	16:36:31

Element: As Date: 05/04/1998
Sample ID: soil5blank:50

Repl #	SampleConc $\mu\text{g/L}$	StndConc $\mu\text{g/L}$	BlkCorr Signal	Peak Area	Bkgnd Area	Time
1	1.073	1.073	0.002	-0.001	0.046	16:51:55

Element: As Date: 05/04/1998
Sample ID: 50:50

Repl #	SampleConc $\mu\text{g/L}$	StndConc $\mu\text{g/L}$	BlkCorr Signal	Peak Area	Bkgnd Area	Time
1	57.31	57.31	0.118	0.115	0.062	16:54:36

Sample ID: 0:50

Repl #	SampleConc µg/L	StdConc µg/L	BlnkCorr Signal	Peak Area	Bkgnd Area	Time
1	1.285	1.285	0.003	0.000	0.049	16:57:14

Element: As Date: 05/04/1998
Sample ID: soil4blank:50

Repl #	SampleConc µg/L	StdConc µg/L	BlnkCorr Signal	Peak Area	Bkgnd Area	Time
1	0.068	0.068	0.000	-0.003	0.055	16:49:18

=====
 Element: As Date: 05/04/1998
 Sample ID: 11:100
 =====

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	95.16	95.16	0.196	0.193	0.195	0.061	21:12:09

=====
 Element: As Date: 05/04/1998
 Sample ID: 12:100
 =====

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	96.47	96.47	0.199	0.196	0.194	0.067	21:14:47

Element: As Date: 05/04/1998
Sample ID: 22:100

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	96.10	96.10	0.198	0.195	0.220	0.060	21:20:07

Element: As Date: 05/04/1998
Sample ID: 31:100

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	99.17	99.48	0.204	0.202	0.226	0.062	21:22:48

=====
 Element: As Date: 05/04/1998
 Sample ID: 21:100
 =====

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	97.97	97.97	0.202	0.199	0.215	0.059	21:17:27

=====
 Element: As Date: 05/04/1998
 Sample ID: 32:100
 =====

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	100.2	100.2	0.207	0.204	0.226	0.069	21:25:26

=====
Element: As Date: 05/04/1998
Sample ID: 41:100
=====

Repl #	SampleConc µg/L	StdConc µg/L	BlncCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	97.77	97.77	0.202	0.199	0.210	0.064	21:28:04

=====
Element: As Date: 05/04/1998
Sample ID: 42:100
=====

Repl #	SampleConc µg/L	StdConc µg/L	BlncCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	100.00	100.00	0.206	0.203	0.219	0.064	21:30:41

=====
Element: As Date: 05/04/1998
Sample ID: 51:100
=====

Repl #	SampleConc µg/L	StdConc µg/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	92.34	92.34	0.190	0.188	0.217	0.060	21:33:17

=====

Element: As Date: 05/04/1998
Sample ID: 100:100

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	108.9	101.9	0.210	0.207	0.229	0.063	21:51:02

=====

Element: As Date: 05/04/1998
Sample ID: 0:100

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	0.795	0.795	0.002	-0.001	0.010	0.054	21:53:36

=====
 Element: As Date: 05/04/1998
 Sample ID: 52:100
 =====

Repl	SampleConc	StdConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	88.31	88.31	0.182	0.179	0.208	0.062	21:35:51

=====
 Element: As Date: 05/04/1998
 Sample ID: soilblank:100
 =====

Repl	SampleConc	StdConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	2.358	2.358	0.005	0.002	0.011	0.050	21:38:24

=====

Element: As Date: 05/04/1998

Sample ID: soil3blank:100

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	2.182	2.182	0.004	0.002	0.009	0.048	21:43:26

=====

Element: As Date: 05/04/1998

Sample ID: soil4blank:100

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	0.635	0.635	0.001	-0.001	0.009	0.051	21:45:57

=====

Element: As Date: 05/04/1998

Sample ID: soil2blank:100

Repl #	SampleConc µg/L	StdndConc µg/L	BlndCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	2.037	2.037	0.004	0.001	0.008	0.353	21:40:55

=====

Element: As Date: 05/04/1998

Sample ID: soil5blank:100

Repl #	SampleConc µg/L	StdndConc µg/L	BlndCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	1.545	1.545	0.003	0.000	0.010	0.042	21:48:29

=====
 Element: As Date: 05/04/1998
 Sample ID: 11:200
 =====

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	153.8	153.8	0.317	0.314	0.352	0.071	21:56:12

=====
 Element: As Date: 05/04/1998
 Sample ID: 12:200
 =====

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	149.9	149.9	0.309	0.306	0.347	0.066	21:58:49

=====
 Element: As Date: 05/04/1998
 Sample ID: 22:200
 =====

Repl	SampleConc	StndConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	155.7	155.7	0.321	0.318	0.375	0.070	22:04:09

=====
 Element: As Date: 05/04/1998
 Sample ID: 32:200
 =====

Repl	SampleConc	StndConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	151.0	151.0	0.311	0.308	0.350	0.061	22:09:32

=====
Element: As Date: 05/04/1998
Sample ID: 41:200
=====

Repl	SampleConc	StdConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	154.5	154.5	0.318	0.316	0.362	0.075	22:12:11

=====
Element: As Date: 05/04/1998
Sample ID: 51:200
=====

Repl	SampleConc	StdConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	149.3	149.3	0.308	0.305	0.372	0.069	22:17:24

=====
Element: As Date: 05/04/1998
Sample ID: 0:200
=====

Repl	SampleConc	StndConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	1.050	1.050	0.002	-0.001	0.009	0.012	23:00:43

=====
Element: As Date: 05/04/1998
Sample ID: 42:200
=====

Repl	SampleConc	StndConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	95.99	95.99	0.198	0.195	0.231	0.062	22:14:48

=====
 Element: As Date: 05/04/1998
 Sample ID: soilblank:200
 =====

Repl #	SampleConc µg/L	StndConc µg/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	0.869	0.869	0.002	-0.001	0.008	0.043	22:22:31

=====
 Element: As Date: 05/04/1998
 Sample ID: 52:200
 =====

Repl #	SampleConc µg/L	StndConc µg/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	88.19	88.19	0.182	0.179	0.207	0.058	22:19:59

Element: As Date: 05/04/1998
Sample ID: soil2blank:200

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	0.776	0.776	0.002	-0.001	0.008	0.011	22:25:02

Element: As Date: 05/04/1998
Sample ID: soil3blank:200

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	1.365	1.365	0.003	0.000	0.009	0.044	22:27:34

=====
 Element: As Date: 05/04/1998
 Sample ID: soil4blank:200
 =====

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	2.989	2.989	0.006	0.003	0.012	0.023	22:30:11

=====
 Element: As Date: 05/04/1998
 Sample ID: soil5blank:200
 =====

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	0.796	0.796	0.002	-0.001	0.009	0.000	22:32:52

Element: As Date: 05/04/1998
Sample ID: 200:200

Repl #	SampleConc µg/L	StdConc µg/L	BlankCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	51.59	51.59	0.106	0.104	0.201	0.020	22:33:29

Element: As Date: 05/05/1998
Sample ID: 11:01

Repl #	SampleConc µg/L	StndConc µg/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	31.97	31.97	0.066	0.063	0.138	0.007	00:06:15

Element: As Date: 05/04/1998
Sample ID: 12:01

Repl #	SampleConc µg/L	StndConc µg/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	33.28	33.28	0.069	0.066	0.133	0.022	23:07:29

=====

Element: As Date: 05/04/1998
Sample ID: 21:01

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	45.55	45.55	0.094	0.091	0.175	0.011	23:10:14

=====

Element: As Date: 05/04/1998
Sample ID: 22:01

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	37.06	37.06	0.076	0.074	0.151	0.002	23:13:01

=====
Element: As Date: 05/04/1998
Sample ID: 31:01
=====

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	42.56	42.56	0.088	0.085	0.166	0.012	23:15:47

=====
Element: As Date: 05/04/1998
Sample ID: 32:01
=====

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	36.93	36.93	0.076	0.073	0.150	0.008	23:18:34

Element: As Date: 05/04/1998
Sample ID: 41:01

Repl #	SampleConc µg/L	StndConc µg/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	34.94	34.94	0.072	0.069	0.145	0.011	23:21:21

Element: As Date: 05/04/1998
Sample ID: 42:01

Repl #	SampleConc µg/L	StndConc µg/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	41.16	41.16	0.085	0.082	0.171	0.007	23:24:08

Element: As Date: 05/04/1998
 Sample ID: 51:01

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	37.91	37.91	0.078	0.075	0.155	0.015	23:26:54

Element: As Date: 05/04/1998
 Sample ID: 52:01

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	45.31	45.31	0.093	0.091	0.180	0.011	23:29:42

Element: As Date: 05/04/1998
Sample ID: soil1blank:01

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	-1.715	-1.715	-0.004	-0.006	0.006	0.000	23:32:29

Element: As Date: 05/04/1998
Sample ID: soil2blank:01

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	2.277	2.277	0.005	0.002	0.009	0.005	23:35:13

=====

Element: As Date: 05/04/1998
Sample ID: soil3blank:01

Repl	SampleConc	StndConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	-0.948	-0.948	-0.002	-0.005	0.007	0.009	23:37:56

=====

Element: As Date: 05/04/1998
Sample ID: soil4blank:01

Repl	SampleConc	StndConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	0.017	0.017	0.000	-0.003	0.008	0.002	23:40:40

Element: As Date: 05/04/1998
 Sample ID: soil5blank:01

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	0.616	0.616	0.001	-0.001	0.007	0.001	23:43:24

Element: As Date: 05/04/1998
 Sample ID: 0:01

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	0.900	0.900	0.002	-0.001	0.009	0.006	23:48:51

Element: As Date: 05/05/1998
Sample ID: 05:05

Repl #	SampleConc µg/L	StdConc µg/L	BlankConc Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	247.5	247.5	0.510	0.507	0.843	0.040	01:52:35

Sample absorbance is greater than that of the highest standard.

Element: As Date: 05/05/1998
Sample ID: 0:05

Repl #	SampleConc µg/L	StdConc µg/L	BlankConc Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	1.672	1.672	0.003	0.001	0.008	0.005	01:44:07

Element: As Date: 05/05/1998
Sample ID: 11:05

Repl #	SampleConc µg/L	StndConc µg/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	186.1	186.1	0.384	0.381	0.648	0.025	01:00:00

Element: As Date: 05/05/1998
Sample ID: 12:05

Repl #	SampleConc µg/L	StndConc µg/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	241.9	241.9	0.499	0.496	0.806	0.041	01:02:44

Sample absorbance is greater than that of the highest standard.

Element: As Date: 05/05/1998
Sample ID: 22:05

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	188.6	188.6	0.389	0.386	0.653	0.025	01:08:15

Element: As Date: 05/05/1998
Sample ID: 31:05

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	190.8	190.8	0.393	0.390	0.671	0.031	01:11:02

=====

Element: As Date: 05/05/1998

Sample ID: 41:05

Repl	SampleConc	StndConc	BlnkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	234.9	234.9	0.484	0.481	0.799	0.034	01:16:36

Sample absorbance is greater than that of the highest standard.

=====

Element: As Date: 05/05/1998

Sample ID: 42:05

Repl	SampleConc	StndConc	BlnkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	192.7	192.7	0.397	0.394	0.696	0.032	01:19:23

Element: As Date: 05/05/1998
Sample ID: 52:05

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	176.2	176.2	0.363	0.360	0.604	0.025	01:24:56

Element: As Date: 05/05/1998
Sample ID: soilblank:05

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	1.960	1.960	0.004	0.001	0.007	0.000	01:27:43

=====

Element: As Date: 05/05/1998

Sample ID: soil3blank:05

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	0.821	0.821	0.002	-0.001	0.011	0.003	01:33:12

=====

Element: As Date: 05/05/1998

Sample ID: soil4blank:05

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	2.521	2.521	0.005	0.002	0.009	0.003	01:35:55

=====
Element: As Date: 05/05/1998
Sample ID: 21:05
=====

Repl	SampleConc	StndConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	205.2	205.2	0.423	0.420	0.702	0.033	01:05:29

=====
Element: As Date: 05/05/1998
Sample ID: 32:05
=====

Repl	SampleConc	StndConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	196.6	196.6	0.405	0.402	0.670	0.032	01:13:49

Element: As Date: 05/05/1998
 Sample ID: 51:05

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	165.5	165.5	0.341	0.338	0.575	0.027	01:22:10

Element: As Date: 05/05/1998
 Sample ID: soil5blank:05

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	-0.138	-0.138	0.000	-0.003	0.009	0.002	01:38:39

=====

Element: As Date: 05/05/1998
Sample ID: soil2blank:05

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	1.672	1.672	0.003	0.001	0.009	0.011	01:30:28

Element: As Date: 05/18/1998
Sample ID: 103:10

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	7.048	7.048	0.015	0.014	0.020	0.045	20:19:43

Element: As Date: 05/18/1998
Sample ID: 23:10

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	5.781	5.781	0.012	0.011	0.025	0.031	20:22:21

=====
Element: As Date: 05/18/1998
Sample ID: 43:10
=====

Repl	SampleConc	StndConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	4.476	4.476	0.009	0.008	0.022	0.031	20:35:43

=====
Element: As Date: 05/18/1998
Sample ID: 102:10
=====

Repl	SampleConc	StndConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	7.850	7.850	0.016	0.015	0.022	0.027	20:33:04

=====

Element: As Date: 05/18/1998

Sample ID: 43:10

Repl #	SampleConc µg/L	StndConc µg/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	1.476	4.476	0.009	0.008	0.022	0.031	20:35:43

=====

Element: As Date: 05/18/1998

Sample ID: 102:10

Repl #	SampleConc µg/L	StndConc µg/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	7.850	7.850	0.016	0.015	0.022	0.027	20:33:04

Element: As Date: 05/18/1998
Sample ID: 13:10

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	3.742	3.742	0.008	0.007	0.020	0.030	20:27:40

Element: As Date: 05/18/1998
Sample ID: 33:10

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	4.398	4.398	0.009	0.008	0.022	0.032	20:30:23

=====
Element: As Date: 05/18/1998
Sample ID: 53:10
=====

Repl	SampleConc	StdConc	BlnkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	1.818	1.818	0.000	0.003	0.019	0.040	20:25:00

Element: As Date: 05/18/1998
Sample ID: 33:50

Repl #	SampleConc µg/L	StdConc µg/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	49.37	49.37	0.102	0.101	0.115	0.038	19:59:21

Element: As Date: 05/18/1998
Sample ID: 54:50

Repl #	SampleConc µg/L	StdConc µg/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	42.48	42.48	0.088	0.087	0.108	0.037	20:01:54

=====
Element: As Date: 05/18/1998
Sample ID: 53:50
=====

Repl	SampleConc	StdConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	43.88	43.88	0.090	0.090	0.107	0.045	20:04:26

=====
Element: As Date: 05/18/1998
Sample ID: 13:50
=====

Repl	SampleConc	StdConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	44.20	44.20	0.091	0.090	0.117	0.054	20:06:57

=====
Element: As Date: 05/18/1998
Sample ID: 23:50

Repl SampleConc StndConc BlnkCorr Peak Peak Bkgnd Time
µg/L µg/L Signal Area Height Area
1 50.12 50.12 0.103 0.102 0.112 0.030 20:12:00

=====
Element: As Date: 05/18/1998
Sample ID: 503:50

Repl SampleConc StndConc BlnkCorr Peak Peak Bkgnd Time
µg/L µg/L Signal Area Height Area
1 49.11 49.11 0.101 0.100 0.106 0.031 20:14:32

Element: As Date: 05/18/1998
Sample ID: 43:50

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	49.86	49.86	0.103	0.102	0.106	0.028	20:17:07

Element: As Date: 05/18/1998
Sample ID: 502:50

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	48.50	48.50	0.100	0.099	0.112	0.041	20:09:28

=====
Element: As Date: 05/18/1998
Sample ID: 1002:100
=====

Repl	SampleConc	StndConc	BlnkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	99.50	99.50	0.205	0.204	0.232	0.044	19:54:11

=====
Element: As Date: 05/18/1998
Sample ID: 1003:100
=====

Repl	SampleConc	StndConc	BlnkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	99.17	99.48	0.205	0.204	0.225	0.045	19:56:47

Element: As Date: 05/18/1998
Sample ID: 33:200

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	210.4	210.4	0.400	0.404	0.412	0.058	21:21:58

Element: As Date: 05/18/1998
Sample ID: 2003:200

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	211.4	211.4	0.401	0.405	0.403	0.053	21:24:38

Element: As Date: 05/18/1998
 Sample ID: 43:200

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	204.9	204.9	0.389	0.393	0.368	0.054	21:19:19

Element: As Date: 05/18/1998
 Sample ID: 2003:200

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	188.2	188.2	0.388	0.387	0.455	0.063	19:43:33

Element: As Date: 05/18/1998
Sample ID: 2002:200

Repl	SampleConc	StdConc	BlnkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	192.1	192.1	0.396	0.395	0.434	0.061	19:35:35

Element: As Date: 05/18/1998
Sample ID: 013:01

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	196.9	196.9	0.374	0.378	0.277	0.067	22:01:06

Element: As Date: 05/18/1998
Sample ID: 23:01

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	199.5	199.5	0.379	0.383	0.335	0.054	22:22:11

=====
 Element: As Date: 05/18/1998
 Sample ID: 43:01
 =====

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	193.3	193.3	0.367	0.371	0.294	0.056	22:14:33

=====
 Element: As Date: 05/18/1998
 Sample ID: 33:01
 =====

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	194.3	194.3	0.369	0.373	0.295	0.054	22:17:17

=====
Element: As Date: 05/18/1998
Sample ID: 012:01
=====

Repl	SampleConc	StdConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	165.6	165.6	0.314	0.318	0.253	0.048	22:07:43

Arsenic (+3) Digested
Arsenic (+3) Undigested
MSMA Digested

Element: As Date: 05/18/1998
Sample ID: As3:501

Repl	SampleConc	StndConc	BlndCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	43.47	43.47	0.083	0.087	0.069	0.032	23:11:32

=====
Element: As Date: 05/18/1998
Sample ID: As3:502

Repl	SampleConc	StndConc	BlndCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	52.35	52.35	0.099	0.103	0.104	0.036	23:14:10

=====
Element: As Date: 05/18/1998
Sample ID: As3:503
=====

Repl	SampleConc	StndConc	BlnkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	47.88	47.88	0.091	0.095	0.108	0.033	23:16:50

=====
Element: As Date: 05/18/1998
Sample ID: As3:504
=====

Repl	SampleConc	StndConc	BlnkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	51.22	51.22	0.097	0.101	0.113	0.037	23:19:30

Element: As Date: 05/18/1998
Sample ID: As3:505

Repl #	SampleConc $\mu\text{g/L}$	StdConc $\mu\text{g/L}$	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	50.94	50.94	0.097	0.101	0.109	0.038	23:22:11

Element: As Date: 05/18/1998
Sample ID: As3:501u

Repl #	SampleConc $\mu\text{g/L}$	StdConc $\mu\text{g/L}$	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	45.06	45.06	0.086	0.090	0.077	0.029	23:24:50

Element: As Date: 05/18/1998
Sample ID: As3:502u

Repl	SampleConc	StdConc	BlnkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	52.96	52.96	0.101	0.105	0.076	0.034	23:27:28

Element: As Date: 05/18/1998
Sample ID: As3:503u

Repl	SampleConc	StdConc	BlnkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	53.99	53.99	0.103	0.107	0.075	0.029	23:30:05

=====
Element: As Date: 05/18/1998
Sample ID: As3:504u
=====

Repl	SampleConc	StndConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	54.23	54.23	0.103	0.107	0.075	0.038	23:32:41

=====
Element: As Date: 05/18/1998
Sample ID: As3:505u
=====

Repl	SampleConc	StndConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	52.98	52.98	0.101	0.105	0.068	0.032	23:35:15

Element: As Date: 05/18/1998
 Sample ID: MSMA:501

Repl #	SampleConc µg/L	StdConc µg/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	48.71	48.71	0.092	0.096	0.114	0.044	23:37:48

Element: As Date: 05/18/1998
 Sample ID: MSMA:502

Repl #	SampleConc µg/L	StdConc µg/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	51.90	51.90	0.099	0.103	0.116	0.045	23:40:21

=====
Element: As Date: 05/18/1998
Sample ID: MSMA:503
=====

Repl	SampleConc	StndConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	55.54	55.54	0.105	0.109	0.117	0.037	23:42:52

=====
Element: As Date: 05/18/1998
Sample ID: MSMA:504
=====

Repl	SampleConc	StndConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	52.14	52.14	0.099	0.103	0.105	0.028	23:45:23

=====

Element: As Date: 05/18/1998

Sample ID: MSMA:505

Repl	SampleConc	StdConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	53.14	53.14	0.101	0.105	0.109	0.047	23:47:55

MSMA Data

=====
Element: As Date: 05/19/1998
Sample ID: m22:10
=====

Repl	SampleConc	StdConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	7.992	7.992	0.016	0.017	0.029	0.040	01:25:01

Element: As Date: 05/19/1998
Sample ID: m52:10

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	6.937	6.937	0.014	0.014	0.028	0.023	01:32:35

Element: As Date: 05/19/1998
Sample ID: m53:10

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	7.995	7.995	0.016	0.017	0.025	0.033	01:35:06

=====

Element: As Date: 05/19/1998
Sample ID: ml03:10

Repl	SampleConc	StndConc	BlnkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	10.36	10.36	0.021	0.021	0.030	0.038	01:42:51

=====

Element: As Date: 05/19/1998
Sample ID: ml02:10

Repl	SampleConc	StndConc	BlnkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	7.185	7.185	0.015	0.015	0.027	0.033	01:48:33

=====

Element: As Date: 05/19/1998
Sample ID: m43:10

Repl #	SampleConc µg/L	StndConc µg/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	6.175	6.175	0.013	0.013	0.027	0.031	01:27:33

=====

Element: As Date: 05/19/1998
Sample ID: m51:10

Repl #	SampleConc µg/L	StndConc µg/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	11.17	11.17	0.023	0.023	0.029	0.043	01:30:04

=====
 Element: As Date: 05/19/1998
 Sample ID: m41:10
 =====

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	6.990	6.990	0.014	0.014	0.026	0.030	01:22:28

=====
 Element: As Date: 05/19/1998
 Sample ID: m42:10
 =====

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	9.569	9.569	0.020	0.020	0.022	0.032	01:09:24

Element: As Date: 05/19/1998
Sample ID: m33:10

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	12.44	12.44	0.025	0.026	0.026	0.024	01:19:54

Element: As Date: 05/19/1998
Sample ID: m32:10

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	9.404	9.404	0.019	0.019	0.027	0.047	01:17:18

=====
Element: As Date: 05/19/1998
Sample ID: m23:10
=====

Repl	SampleConc	StndConc	BlncCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	8.952	8.952	0.018	0.018	0.037	0.034	01:12:04

=====
Element: As Date: 05/19/1998
Sample ID: m31:10
=====

Repl	SampleConc	StndConc	BlncCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	5.588	5.588	0.011	0.012	0.026	0.028	01:14:42

=====
Element: As Date: 05/19/1998
Sample ID: m13:10
=====

Repl	SampleConc	StndConc	BlnkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	7.941	7.941	0.016	0.016	0.023	0.034	01:04:04

=====
Element: As Date: 05/19/1998
Sample ID: m21:10
=====

Repl	SampleConc	StndConc	BlnkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	8.857	8.857	0.018	0.018	0.031	0.032	01:06:44

Element: As Date: 05/19/1998
Sample ID: ml1:10

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	8.386	8.386	0.017	0.017	0.030	0.036	00:58:47

Element: As Date: 05/19/1998
Sample ID: ml2:10

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	8.667	8.667	0.018	0.018	0.028	0.034	01:01:25

=====

Element: As Date: 05/19/1998

Sample ID: ml1:50

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	50.44	50.44	0.107	0.098	0.089	0.045	02:20:37

=====

Element: As Date: 05/19/1998

Sample ID: ml2:50

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	48.12	48.12	0.103	0.093	0.091	0.026	02:23:15

Element: As Date: 05/19/1998
Sample ID: m13:50

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	47.72	47.72	0.109	0.099	0.095	0.049	02:25:55

Element: As Date: 05/19/1998
Sample ID: m21:50

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	48.48	48.48	0.103	0.094	0.093	0.035	02:28:35

=====
Element: As Date: 05/19/1998
Sample ID: m22:50
=====

Repl	SampleConc	StndConc	BlnkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	48.44	48.44	0.103	0.094	0.083	0.014	02:31:16

=====
Element: As Date: 05/19/1998
Sample ID: m23:50
=====

Repl	SampleConc	StndConc	BlnkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	49.98	49.98	0.106	0.097	0.087	0.032	02:33:55

=====
Element: As Date: 05/19/1998
Sample ID: m31:50
=====

Repl	SampleConc	StdConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	46.48	46.48	0.099	0.089	0.091	0.050	02:36:33

=====
Element: As Date: 05/19/1998
Sample ID: m32:50
=====

Repl	SampleConc	StdConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	47.59	47.59	0.101	0.092	0.098	0.029	02:39:10

=====
 Element: As Date: 05/19/1998
 Sample ID: m42:50
 =====

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	48.74	48.74	0.104	0.094	0.078	0.031	02:46:53

=====
 Element: As Date: 05/19/1998
 Sample ID: m43:50
 =====

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	45.93	45.93	0.098	0.088	0.091	0.039	02:49:25

Element: As Date: 05/19/1998
Sample ID: m51:50

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	49.30	49.30	0.105	0.095	0.097	0.022	02:51:56

Element: As Date: 05/19/1998
Sample ID: m52:50

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	45.24	45.24	0.096	0.087	0.088	0.039	02:54:27

Element: As Date: 05/19/1998
Sample ID: m53:50

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	44.13	44.13	0.094	0.084	0.097	0.031	02:56:58

Element: As Date: 05/19/1998
Sample ID: m501:50

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	49.92	49.92	0.106	0.097	0.104	0.026	02:59:30

=====
 Element: As Date: 05/19/1998
 Sample ID: m503:50
 =====

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	25.45	25.45	0.054	0.045	0.265	-0.005	03:04:41

=====
 Element: As Date: 05/19/1998
 Sample ID: m502:50
 =====

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	49.65	49.65	0.106	0.096	0.172	-0.001	03:02:05

=====
Element: As Date: 05/19/1998
Sample ID: m11:100
=====

Repl #	SampleConc µg/L	StndConc µg/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	81.03	81.03	0.172	0.174	0.108	0.031	06:12:32

=====
Element: As Date: 05/19/1998
Sample ID: m12:100
=====

Repl #	SampleConc µg/L	StndConc µg/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	92.28	92.28	0.196	0.198	0.183	0.028	06:15:09

Element: As Date: 05/19/1998
Sample ID: m13:100

Repl #	SampleConc $\mu\text{g/L}$	StdConc $\mu\text{g/L}$	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	85.67	85.67	0.182	0.184	0.183	0.043	06:17:46

Element: As Date: 05/19/1998
Sample ID: m21:100

Repl #	SampleConc $\mu\text{g/L}$	StdConc $\mu\text{g/L}$	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	91.71	91.71	0.195	0.197	0.172	0.038	06:20:29

=====
Element: As Date: 05/19/1998
Sample ID: m22:100
=====

Repl	SampleConc	StndConc	BlndCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	94.59	94.59	0.201	0.203	0.179	0.020	06:23:10

=====
Element: As Date: 05/19/1998
Sample ID: m23:100
=====

Repl	SampleConc	StndConc	BlndCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	85.27	85.27	0.181	0.183	0.171	0.037	06:25:48

=====
 Element: As Date: 05/19/1998
 Sample ID: m31:100

Repl #	SampleConc µg/L	StdConc µg/L	BlankCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	90.29	90.29	0.192	0.194	0.178	0.035	06:28:26

=====
 Element: As Date: 05/19/1998
 Sample ID: m32:100

Repl #	SampleConc µg/L	StdConc µg/L	BlankCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	94.34	94.34	0.200	0.202	0.166	0.031	06:31:03

=====
Element: As Date: 05/19/1998
Sample ID: m33:100
=====

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	96.04	96.04	0.204	0.206	0.169	0.024	06:33:39

=====
Element: As Date: 05/19/1998
Sample ID: m41:100
=====

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	99.17	99.17	0.210	0.213	0.161	0.032	06:36:13

Element: As Date: 05/19/1998
 Sample ID: m42:100

Repl #	SampleConc μg/L	StdConc μg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	87.95	87.95	0.187	0.189	0.169	0.032	06:38:46

Element: As Date: 05/19/1998
 Sample ID: m43:100

Repl #	SampleConc μg/L	StdConc μg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	89.87	89.87	0.191	0.193	0.186	0.037	06:41:18

=====
Element: As Date: 05/19/1998
Sample ID: m51:100
=====

Repl #	SampleConc µg/L	StdConc µg/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	86.56	86.56	0.184	0.186	0.165	0.034	06:43:49

=====
Element: As Date: 05/19/1998
Sample ID: m52:100
=====

Repl #	SampleConc µg/L	StdConc µg/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	83.62	83.62	0.177	0.180	0.170	0.037	06:46:20

=====
 Element: As Date: 05/19/1998
 Sample ID: ml003:100
 =====

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	100.2	100.2	0.190	0.193	0.182	0.039	06:56:33

=====
 Element: As Date: 05/19/1998
 Sample ID: ml002:100
 =====

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	95.16	95.16	0.191	0.193	0.172	0.024	06:53:57

=====
Element: As Date: 05/19/1998
Sample ID: m53:100
=====

Repl	SampleConc	StdConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	79.67	79.67	0.169	0.171	0.161	0.047	06:48:51

=====
Element: As Date: 05/19/1998
Sample ID: m1001:100
=====

Repl	SampleConc	StdConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	90.45	90.45	0.192	0.194	0.165	0.029	06:51:23

=====
 Element: As Date: 05/19/1998
 Sample ID: ml1:200
 =====

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	169.6	169.6	0.373	0.373	0.320	0.046	04:46:06

=====
 Element: As Date: 05/19/1998
 Sample ID: ml2:200
 =====

Repl #	SampleConc µg/L	StndConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	177.6	177.6	0.390	0.391	0.308	0.041	04:48:44

=====

Element: As Date: 05/19/1998
Sample ID: m13:200

Repl	SampleConc	StdConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	179.0	179.0	0.394	0.394	0.332	0.042	04:51:23

=====

Element: As Date: 05/19/1998
Sample ID: m21:200

Repl	SampleConc	StdConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	178.7	178.7	0.393	0.393	0.315	0.033	04:54:04

=====
 Element: As Date: 05/19/1998
 Sample ID: m22:200
 =====

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	179.3	179.3	0.394	0.394	0.321	0.047	04:56:44

=====
 Element: As Date: 05/19/1998
 Sample ID: m23:200
 =====

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	169.9	169.9	0.374	0.374	0.336	0.044	04:59:23

=====
Element: As Date: 05/19/1998
Sample ID: m31:200
=====

Repl	SampleConc	StndConc	BlnkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	181.2	181.2	0.398	0.399	0.321	0.052	05:02:00

=====
Element: As Date: 05/19/1998
Sample ID: m32:200
=====

Repl	SampleConc	StndConc	BlnkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	182.6	182.6	0.401	0.402	0.316	0.046	05:04:37

=====
Element: As Date: 05/19/1998
Sample ID: m33:200
=====

Repl	SampleConc	StdConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	174.5	174.5	0.384	0.384	0.336	0.052	05:07:13

=====
Element: As Date: 05/19/1998
Sample ID: m41:200
=====

Repl	SampleConc	StdConc	BlkCorr	Peak	Peak	Bkgnd	Time
#	µg/L	µg/L	Signal	Area	Height	Area	
1	176.9	176.9	0.389	0.389	0.351	0.043	05:09:47

Element: As Date: 05/19/1998
 Sample ID: m42:200

Repl #	SampleConc µg/L	StdConc µg/L	BlncCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	176.5	176.5	0.388	0.389	0.357	0.046	05:12:19

Element: As Date: 05/19/1998
 Sample ID: m43:200

Repl #	SampleConc µg/L	StdConc µg/L	BlncCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	174.3	174.3	0.383	0.384	0.330	0.041	05:14:51

=====
 Element: As Date: 05/19/1998
 Sample ID: m51:200
 =====

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	167.0	167.0	0.367	0.367	0.320	0.051	05:17:22

=====
 Element: As Date: 05/19/1998
 Sample ID: m52:200
 =====

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	170.1	170.1	0.374	0.374	0.341	0.046	05:19:52

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	192.1	192.1	0.393	0.393	0.332	0.040	05:27:31

Element: As Date: 05/19/1998
Sample ID: m2003:200

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	184.0	184.0	0.404	0.405	0.365	0.044	05:30:06

Element: As Date: 05/19/1998
 Sample ID: m53:300

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	176.6	176.6	0.388	0.389	0.321	0.043	05:22:24

Element: As Date: 05/19/1998
 Sample ID: m2001:200

Repl #	SampleConc µg/L	StdConc µg/L	BlkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Time
1	182.1	182.1	0.400	0.401	0.340	0.044	05:24:57

Appendix E – FDEP Data Sheets

Chemical Analysis Report

Event Name (ID): SE-DIST-1998-01-24-01

Florida Department of Environmental Protection
Central Laboratory
2600 Blair Stone Road
Tallahassee, FL 32399-2400
CompQAP# 870688G

Event Description: Golf Course Arsenic Study

Request ID: RQ-1998-01-05-17

Customer: SE-DIST

Project ID: OTHER-WSM

Job: TLH-1998-01-24-03

Group: Metals

Send Reports to

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Certified By: *TSF*

Report Printed Date: Feb 13, 1998

Date: *2/17/98*

Abbreviations and data remark codes

- A - Value reported is the mean of two or more determinations
- B - Results based on colony counts outside the acceptable range.
- I - Value reported is less than the minimum quantitation limit, and greater than or equal to the minimum detection limit.
- J - Estimated value
- K - Actual value is known to be less than value given
- L - Actual value is known to be greater than value given
- N - Presumptive evidence of presence of material.
- O - Sampled, but analysis lost or not performed.
- Q - Sample held beyond normal holding time.
- T - Value reported is less than the criterion of detection.
- U - Material was analyzed for but not detected; The value reported is the minimum detection limit.
- V - Analyte was detected in both sample and method blank.
- Z - Colonies were too numerous to count (TNTC).

Sample Location: WPBCC

Field ID: 1A:2K

Collection Date/Time: 1/13/1998 3:36 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303372					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	96.4		ug/L

Sample Location: WPBCC

Field ID: 1B:2K

Collection Date/Time: 1/13/1998 3:36 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303373					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	94.0		ug/L

Sample Location: WPBCC

Field ID: 1C:2K

Collection Date/Time: 1/13/1998 3:36 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303374					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: 1D:2K

Collection Date/Time: 1/13/1998 3:36 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303375					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	97.2		ug/L

Sample Location: WPBCC

Field ID: 1E:2K

Collection Date/Time: 1/13/1998 3:36 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303376					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	99.0		ug/L

Sample Location: WPBCC

Field ID: 1F:2K

Collection Date/Time: 1/13/1998 4:00 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303377					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	2	U	ug/L
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Sample Location: WPBCC

Field ID: 1G:2K

Collection Date/Time: 1/13/1998 4:00 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303378					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	95.6		ug/L
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Sample Location: WPBCC

Field ID: 1H:2K

Collection Date/Time: 1/13/1998 4:00 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303379					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	2	U	ug/L
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Sample Location: WPBCC

Field ID: 1I:2K

Collection Date/Time: 1/13/1998 4:00 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303380					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	98.0		ug/L
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Sample Location: WPBCC

Field ID: 1J:2K

Collection Date/Time: 1/13/1998 4:40 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303381					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	2	U	ug/L
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Sample Location: WPBCC

Field ID: 1K:2K

Collection Date/Time: 1/13/1998 4:40 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303382					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	90.9		ug/L
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Sample Location: WPBCC

Field ID: 1L:2K

Collection Date/Time: 1/13/1998 4:40 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303383					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	103	A	ug/L
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Sample Location: WPBCC

Field ID: 3H:8K

Collection Date/Time: 1/20/1998 5:15 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303384					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	2	U	ug/L
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Sample Location: WPBCC

Field ID: 3I:8K

Collection Date/Time: 1/20/1998 5:15 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303385					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	90.8		ug/L
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Sample Location: WPBCC

Field ID: 3J:8K

Collection Date/Time: 1/20/1998 5:15 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303386					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	2	U	ug/L
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Sample Location: WPBCC						
Field ID: 3K:8K						
Collection Date/Time: 1/20/1998 5:15 PM						
Matrix: W-SURF-FRH						
Lab ID	Storet Code	Component	Result	Code	Units	
303387						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	86.0		ug/L	
Sample Location: WPBCC						
Field ID: 3L:8K						
Collection Date/Time: 1/20/1998 5:15 PM						
Matrix: W-SURF-FRH						
Lab ID	Storet Code	Component	Result	Code	Units	
303388						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	89.7		ug/L	
Sample Location: WPBCC						
Field ID: 5A:24K						
Collection Date/Time: 1/17/1998 5:15 PM						
Matrix: W-SURF-FRH						
Lab ID	Storet Code	Component	Result	Code	Units	
303389						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	102		ug/L	
Sample Location: WPBCC						
Field ID: 5B:24K						
Collection Date/Time: 1/17/1998 5:15 PM						
Matrix: W-SURF-FRH						
Lab ID	Storet Code	Component	Result	Code	Units	
303390						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	101		ug/L	
Sample Location: WPBCC						
Field ID: 5C:24K						
Collection Date/Time: 1/17/1998 5:15 PM						
Matrix: W-SURF-FRH						
Lab ID	Storet Code	Component	Result	Code	Units	
303391						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	2	U	ug/L	

Sample Location: WPBCC						
Field ID: 5D:24K						
Collection Date/Time: 1/17/1998 3:15 PM						
Matrix: W-SURF-FRH						
Lab ID	Storet Code	Component	Result	Code	Units	
303392						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	102		ug/L	
Sample Location: WPBCC						
Field ID: 5E:24K						
Collection Date/Time: 1/17/1998 3:15 PM						
Matrix: W-SURF-FRH						
Lab ID	Storet Code	Component	Result	Code	Units	
303393						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	104		ug/L	
Sample Location: WPBCC						
Field ID: 5F:24K						
Collection Date/Time: 1/17/1998 5:15 PM						
Matrix: W-SURF-FRH						
Lab ID	Storet Code	Component	Result	Code	Units	
303394						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	2	U	ug/L	
Sample Location: WPBCC						
Field ID: 5G:24K						
Collection Date/Time: 1/17/1998 5:15 PM						
Matrix: W-SURF-FRH						
Lab ID	Storet Code	Component	Result	Code	Units	
303395						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	99.3		ug/L	
Sample Location: WPBCC						
Field ID: 5H:24K						
Collection Date/Time: 1/17/1998 5:15 PM						
Matrix: W-SURF-FRH						
Lab ID	Storet Code	Component	Result	Code	Units	
303396						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	2	U	ug/L	

Sample Location: WPBCC

Field ID: 5I:24K

Collection Date/Time: 1/17/1998 5:15 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303397					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	100		ug/L

Sample Location: WPBCC

Field ID: 5J:24K

Collection Date/Time: 1/17/1998 3:15 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303398					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: 5K:24K

Collection Date/Time: 1/17/1998 5:15 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303399					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	90.8		ug/L

Sample Location: WPBCC

Field ID: 5L:24K

Collection Date/Time: 1/17/1998 5:15 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303400					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	93.4		ug/L

Sample Location: WPBCC

Field ID: 8A:168K

Collection Date/Time: 1/14/1998 3:00 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303401					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	77.2		ug/L

Sample Location: WPBCC

Field ID: 8B:168K

Collection Date/Time: 1/14/1998 3:00 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303402					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	82.4		ug/L
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Sample Location: WPBCC

Field ID: 8C:168K

Collection Date/Time: 1/14/1998 3:00 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303403					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	2	U	ug/L
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Sample Location: WPBCC

Field ID: 8D:168K

Collection Date/Time: 1/14/1998 3:00 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303404					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	90.1	A	ug/L
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Sample Location: WPBCC

Field ID: 8E:168K

Collection Date/Time: 1/14/1998 3:30 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303405					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	96.8		ug/L
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Sample Location: WPBCC

Field ID: 8F:168K

Collection Date/Time: 1/14/1998 3:30 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303406					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	2	U	ug/L
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Sample Location: WPBCC

Field ID: 8G:168K

Collection Date/Time: 1/14/1998 3:30 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303407					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	93.8		ug/L
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Sample Location: WPBCC

Field ID: 8H:168K

Collection Date/Time: 1/14/1998 3:30 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303408					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	2	U	ug/L
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Sample Location: WPBCC

Field ID: 8I:168K

Collection Date/Time: 1/14/1998 4:00 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303409					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	91.8		ug/L
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Sample Location: WPBCC

Field ID: 8J:168K

Collection Date/Time: 1/14/1998 4:00 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303410					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	2	U	ug/L
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Sample Location: WPBCC

Field ID: 8K:168K

Collection Date/Time: 1/14/1998 4:00 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303411					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	30.5		ug/L
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Sample Location: WPBCC

Field ID: 8L:168K

Collection Date/Time: 1/14/1998 4:00 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303412					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	30.7		ug/L

Sample Location: WPBCC

Field ID: AR-168K

Collection Date/Time: 1/14/1998 5:00 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303420					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	101	A	ug/L

Sample Location: WPBCC

Field ID: AR-24K

Collection Date/Time: 1/17/1998 5:15 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303418					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	98.8		ug/L

Sample Location: WPBCC

Field ID: AR-2K

Collection Date/Time: 1/13/1998 4:40 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303415					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	102		ug/L

Sample Location: WPBCC

Field ID: AR-48K

Collection Date/Time: 1/13/1998 6:00 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303419					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	101		ug/L

Sample Location: WPBCC						
Field ID: AR-4K						
Collection Date/Time: 1/21/1998 3:56 PM						
Matrix: W-SURF-FRH						
Lab ID	Storet Code	Component	Result	Code	Units	
303416						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	91.0		ug/L	
Sample Location: WPBCC						
Field ID: AR-8K						
Collection Date/Time: 1/17/1998 6:00 PM						
Matrix: W-SURF-FRH						
Lab ID	Storet Code	Component	Result	Code	Units	
303417						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	97.5		ug/L	
Sample Location: WPBCC						
Field ID: AS-0A						
Collection Date/Time: 1/20/1998 3:00 PM						
Matrix: W-SURF-FRH						
Lab ID	Storet Code	Component	Result	Code	Units	
303413						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	2	U	ug/L	
Sample Location: WPBCC						
Field ID: AS-150A						
Collection Date/Time: 1/12/1998 3:00 PM						
Matrix: W-SURF-FRH						
Lab ID	Storet Code	Component	Result	Code	Units	
303414						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	26.9		ug/L	
Sample Location: WPBCC						
Field ID: CONTROL I						
Collection Date/Time: 1/13/1998 4:40 PM						
Matrix: W-SURF-FRH						
Lab ID	Storet Code	Component	Result	Code	Units	
303421						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	2	U	ug/L	

Sample Location: WPBCC

Field ID: CONTROL V

Collection Date/Time: 1/17/1998 5:15 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303422					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: CONTROL VIII

Collection Date/Time: 1/14/1998 5:00 PM

Matrix: W-SURF-FRH

Lab ID	Storet Code	Component	Result	Code	Units
303423					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	2	U	ug/L

Quality Control Report

Job ID: TLH-1998-01-24-03

Test	Analyte	LFB %Recovery	MS %Recovery	Precision %RPD	Precision %RSD
W-ICPMS-F	Arsenic				
Batch ID: 30671			82.4 83.8	0.0834	
Batch ID: 30672			93.7 94.4	0.735	
Batch ID: 30771			103 109	1.70	
Batch ID: 30772			86.1 93.3	1.87	

Chemical Analysis Report

Event Name (ID): SE-DIST-1998-01-20-01

Florida Department of Environmental Protection
Central Laboratory
2600 Blair Stone Road
Tallahassee, FL 32399-2400
CompQAP# 870688G

Event Description: Golf Course Arsenic Study

Request ID: RQ-1998-01-12-13

Customer: SE-DIST

Project ID: OTHER-WSM

Job: TLH-1998-01-20-29

Group: Metals

Job: TLH-1998-01-20-30

Group: Nutrients

Job: TLH-1998-01-20-31

Group: Metals

Send Reports to

FL Dept. of Environmental Protection

P.O. Box 15425

400 N. Congress Ave.

West Palm Beach, FL 33401

Attn: John Molton

For additional information please contact

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Certified By:

Han

Date: 2-27-98

Report Printed Date: Feb 25, 1998

Abbreviations and data remark codes

A - Value reported is the mean of two or more determinations

B - Results based on colony counts outside the acceptable range.

I - Value reported is less than the minimum quantitation limit, and greater than or equal to the minimum detection limit.

J - Estimated value

K - Actual value is known to be less than value given

L - Actual value is known to be greater than value given

N - Presumptive evidence of presence of material.

O - Sampled, but analysis lost or not performed.

Q - Sample held beyond normal holding time.

T - Value reported is less than the criterion of detection.

U - Material was analyzed for but not detected; The value reported is the minimum detection limit.

V - Analyte was detected in both sample and method blank.

Z - Colonies were too numerous to count (TNTC).

Sample Location: WPBCC

Field ID: 2A:4K

Collection Date/Time: 1/12/1998 4:10 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302301					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	98.0		ug/L

Sample Location: WPBCC

Field ID: 2B:4K

Collection Date/Time: 1/12/1998 6:10 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302302					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	97.4		ug/L

Sample Location: WPBCC

Field ID: 2C:4K

Collection Date/Time: 1/12/1998 6:10 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302303					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: 2D:4K

Collection Date/Time: 1/12/1998 6:10 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302304					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: 2E:4K

Collection Date/Time: 1/12/1998 4:10 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302305					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	97.6		ug/L

Sample Location: WPBCC

Field ID: 2F:4K

Collection Date/Time: 1/12/1998 4:10 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302306					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	101		ug/L
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Sample Location: WPBCC

Field ID: 2G:4K

Collection Date/Time: 1/12/1998 4:10 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302307					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	93.9		ug/L
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Sample Location: WPBCC

Field ID: 2H:4K

Collection Date/Time: 1/12/1998 4:10 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302308					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	2	U	ug/L
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Sample Location: WPBCC

Field ID: 2I:4K

Collection Date/Time: 1/12/1998 4:10 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302309					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	96.8		ug/L
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Sample Location: WPBCC

Field ID: 2J:4K

Collection Date/Time: 1/12/1998 4:10 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302310					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	90.4		ug/L
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Sample Location: WPBCC

Field ID: 2K:4K

Collection Date/Time: 1/12/1998 4:10 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302311					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	88.9	A	ug/L

Sample Location: WPBCC

Field ID: 4A:16K

Collection Date/Time: 1/9/1998 1:30 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302269					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	88.6		ug/L

Sample Location: WPBCC

Field ID: 4C:16K

Collection Date/Time: 1/9/1998 1:30 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302270					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: 4G:16K

Collection Date/Time: 1/9/1998 1:30 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302271					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: 4H:16K

Collection Date/Time: 1/9/1998 1:30 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302272					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	91.8		ug/L

Sample Location: WPBCC

Field ID: 4I:16K

Collection Date/Time: 1/9/1998 1:30 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302273					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	90.4		ug/L
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Sample Location: WPBCC

Field ID: 4J:16K

Collection Date/Time: 1/9/1998 2:00 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302274					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	2	U	ug/L
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Sample Location: WPBCC

Field ID: 4K:16K

Collection Date/Time: 1/9/1998 2:00 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302275					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	60.2		ug/L
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Sample Location: WPBCC

Field ID: 4L:16K

Collection Date/Time: 1/9/1998 2:00 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302276					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	60.3		ug/L
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Sample Location: WPBCC

Field ID: 6A:48K

Collection Date/Time: 1/9/1998 1:30 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302277					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	82.9		ug/L
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Sample Location: WPBCC

Field ID: 6B:48K

Collection Date/Time: 1/9/1998 1:30 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302278					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	84.5		ug/L
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Sample Location: WPBCC

Field ID: 6C:48K

Collection Date/Time: 1/9/1998 1:30 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302279					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	2	U	ug/L
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Sample Location: WPBCC

Field ID: 6D:48K

Collection Date/Time: 1/9/1998 2:00 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302280					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	87.4		ug/L
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Sample Location: WPBCC

Field ID: 6E:48K

Collection Date/Time: 1/9/1998 2:00 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302281					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	90.6		ug/L
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Sample Location: WPBCC

Field ID: 6F:48K

Collection Date/Time: 1/9/1998 2:00 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302282					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	2	U	ug/L
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Sample Location: WPBCC					
Field ID: 6G:48K					
Collection Date/Time: 1/9/1998 2:30 PM					
Matrix: W-GROUND					
Lab ID	Storet Code	Component	Result	Code	Units
302283					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	93.5		ug/L
Sample Location: WPBCC					
Field ID: 6H:48K					
Collection Date/Time: 1/9/1998 2:30 PM					
Matrix: W-GROUND					
Lab ID	Storet Code	Component	Result	Code	Units
302284					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	2	U	ug/L
Sample Location: WPBCC					
Field ID: 6I:48K					
Collection Date/Time: 1/9/1998 2:30 PM					
Matrix: W-GROUND					
Lab ID	Storet Code	Component	Result	Code	Units
302285					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	92.2		ug/L
Sample Location: WPBCC					
Field ID: 6J:48K					
Collection Date/Time: 1/9/1998 3:00 PM					
Matrix: W-GROUND					
Lab ID	Storet Code	Component	Result	Code	Units
302286					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	2	U	ug/L
Sample Location: WPBCC					
Field ID: 6K:48K					
Collection Date/Time: 1/9/1998 3:00 PM					
Matrix: W-GROUND					
Lab ID	Storet Code	Component	Result	Code	Units
302287					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	53.5		ug/L

Sample Location: WPBCC

Field ID: 6L:48K

Collection Date/Time: 1/9/1998 3:00 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302288					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	51.0		ug/L

Sample Location: WPBCC

Field ID: 7A:96K

Collection Date/Time: 1/11/1998 12:00 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302289					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	88.6		ug/L

Sample Location: WPBCC

Field ID: 7B:96K

Collection Date/Time: 1/11/1998 12:00 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302290					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	85.1		ug/L

Sample Location: WPBCC

Field ID: 7C:96K

Collection Date/Time: 1/11/1998 12:00 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302291					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: 7D:96K

Collection Date/Time: 1/11/1998 12:00 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302292					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	90.0		ug/L

Sample Location: WPBCC

Field ID: 7E:96K

Collection Date/Time: 1/11/1998 2:00 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302293					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	88.7		ug/L

Sample Location: WPBCC

Field ID: 7F:96K

Collection Date/Time: 1/11/1998 12:00 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302294					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: 7G:96K

Collection Date/Time: 1/11/1998 12:00 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302295					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	93.1		ug/L

Sample Location: WPBCC

Field ID: 7H:96K

Collection Date/Time: 1/11/1998 12:00 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302296					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	92.4		ug/L

Sample Location: WPBCC

Field ID: 7I:96K

Collection Date/Time: 1/11/1998 12:00 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302297					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: 7J:96K

Collection Date/Time: 1/11/1998 12:00 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302298					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: 7K:96K

Collection Date/Time: 1/11/1998 12:00 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302299					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	45.1		ug/L

Sample Location: WPBCC

Field ID: 7L:96K

Collection Date/Time: 1/11/1998 12:00 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302300					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	46.8		ug/L

Sample Location: WPBCC

Field ID: AS-100A

Collection Date/Time: 1/7/1998 9:10 AM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302267					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	47.2		ug/L

Sample Location: WPBCC

Field ID: AS-200A

Collection Date/Time: 1/7/1998 9:00 AM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302268					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	71.5		ug/L

Sample Location: WPBCC

Field ID: AS-25A

Collection Date/Time: 1/7/1998 9:10 AM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302265					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	9.6		ug/L
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Sample Location: WPBCC

Field ID: AS-50A

Collection Date/Time: 1/7/1998 9:00 AM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302266					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	2	1	ug/L
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Sample Location: WPBCC

Field ID: AS-5A

Collection Date/Time: 1/12/1998 4:10 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302312					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	22.8		ug/L
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Sample Location: WPBCC

Field ID: CONTROL II

Collection Date/Time: 1/12/1998 4:10 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302313					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	2	U	ug/L
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Sample Location: WPBCC

Field ID: CONTROL IV

Collection Date/Time: 1/9/1998 2:00 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302314					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	2	U	ug/L
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Handwritten note: "Sw. to 1" with arrows pointing to the 'Code' column of the second and third sample tables.

Sample Location: WPBCC

Field ID: CONTROL VI

Collection Date/Time: 1/9/1998 3:00 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302315					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	2	U	ug/L
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Sample Location: WPBCC

Field ID: CONTROL VII

Collection Date/Time: 1/11/1998 12:00 PM

Matrix: W-GROUND

Lab ID	Storet Code	Component	Result	Code	Units
302316					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	2	U	ug/L
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Sample Location: WPBCC

Field ID: GD:2D

Collection Date/Time: 11/4/1997 3:00 PM

Matrix: S-SOIL

Lab ID	Storet Code	Component	Result	Code	Units
302255					

Test: Metals, total recoverable, in solid samples using ICP emission spectroscopy. (EPA 6010 mod.)

The Fe precision was outside the control limits.

01003	Arsenic	8	U	mg/kg
01170	Iron	237	J	mg/kg

302260

Test: Total Phosphorus in solid matrices (EPA 365.4 mod.)

Sample expired prior to receipt.

Total-P		32	Q	mg/kg
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Sample Location: WPBCC

Field ID: GD:3D

Collection Date/Time: 11/4/1997 3:00 PM

Matrix: S-SOIL

Lab ID	Storet Code	Component	Result	Code	Units
302256					

Test: Metals, total recoverable, in solid samples using ICP emission spectroscopy. (EPA 6010 mod.)

The Fe precision was outside the control limits.

01003	Arsenic	7	U	mg/kg
01170	Iron	43.5	J	mg/kg

302261

Test: Total Phosphorus in solid matrices (EPA 365.4 mod.)

Sample expired prior to receipt.

Total-P	4.8		mg/kg
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Sample Location: WPBCC

Field ID: GD:4D

Collection Date/Time: 11/4/1997 3:00 PM

Matrix: S-SOIL

Lab ID	Storet Code	Component	Result	Code	Units
302257					

Test: Metals, total recoverable, in solid samples using ICP emission spectroscopy. (EPA 6010 mod.)

The Fe precision was outside the control limits.

01003	Arsenic	8	U	mg/kg
01170	Iron	34.5	J	mg/kg

302262

Test: Total Phosphorus in solid matrices (EPA 365.4 mod.)

Sample expired prior to receipt.

Total-P	120	Q	mg/kg
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Sample Location: WPBCC

Field ID: GD:5D

Collection Date/Time: 11/4/1997 3:00 PM

Matrix: S-SOIL

Lab ID	Storet Code	Component	Result	Code	Units
302258					

Test: Metals, total recoverable, in solid samples using ICP emission spectroscopy. (EPA 6010 mod.)

The As MDL was adjusted due to matrix interference. The Fe precision was outside the control limits.

01003	Arsenic	20	U	mg/kg
01170	Iron	1530	J	mg/kg

302263

Test: Total Phosphorus in solid matrices (EPA 365.4 mod.)

Sample expired prior to receipt.

Total-P	390	Q	mg/kg
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Sample Location: WPBCC

Field ID: SURF 4"-9"D

Collection Date/Time: 11/4/1997 3:00 PM

Matrix: S-SOIL

Lab ID	Storet Code	Component	Result	Code	Units
302259					

Test: Metals, total recoverable, in solid samples using ICP emission spectroscopy. (EPA 6010 mod.)

The Fe precision was outside the control limits.

01003	Arsenic	7	U	mg/kg
01170	Iron	233	J	mg/kg

302264

Test: Total Phosphorus in solid matrices (EPA 365.4 mod.)

Sample expired prior to receipt.

Total-P	32	Q	mg/kg
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Quality Control Report

* -- Item failed QC

Job ID: TLH-1998-01-20-29

Test	Analyte	LFB %Recovery	MS %Recovery	Precision %RPD	Precision %RSD
S-ICP	Arsenic				
Batch ID: 30618			91.9 97.8	5.16	
S-ICP	Iron				
Batch ID: 30618			99.3	73.2*	

* -- Item failed QC

Job ID: TLH-1998-01-20-30

Test	Analyte	LFB %Recovery	MS %Recovery	Precision %RPD	Precision %RSD
S-TP	Total-P				
Batch ID: 30488			91.3 92.3	6.40	

* -- Item failed QC

Job ID: TLH-1998-01-20-31

Test	Analyte	LFB %Recovery	MS %Recovery	Precision %RPD	Precision %RSD
W-ICPMS-F	Arsenic				
Batch ID: 30649			94.7 96.3	1.65	
Batch ID: 30671			82.4 83.8	0.0834	
Batch ID: 30672			93.7 94.4	0.735	
Batch ID: 30673			93.3 95.2	1.99	

Chemical Analysis Report

Event Name (ID): SE-DIST-1998-05-12-01

990004

Florida Department of Environmental
Central Laboratory
2600 Blair Stone Road
Tallahassee, FL 32399-2400
CompQAP# 870688G

Event Description: Golf Course Arsenic Study

Request ID: RQ-1998-05-11-30

Customer: SE-DIST

Project ID: OTHER-WSM

Job: TLH-1998-05-12-26	Group: Metals
Job: TLH-1998-05-12-30	Group: Metals
Job: TLH-1998-05-12-40	Group: Metals
Job: TLH-1998-05-12-41	Group: Metals

Send Reports to
FL Dept. of Environmental Protection
P.O. Box 15425
400 N. Congress Ave.
West Palm Beach, FL 33401
Attn: Leslie Smith

For additional information please contact
Timothy W. Fitzpatrick
Yuh-Hsu Pan, Ph.D.
Julio Arrecis, Ph.D.
Liang-Tsair Lin, Ph.D.
Suncom 277-2571 Phone (850) 487-2571

Certified By: *Han*

Date: 6-30-98

Report Printed Date: Jun 26, 1998

Abbreviations and data remark codes

- A - Value reported is the mean of two or more determinations
- B - Results based on colony counts outside the acceptable range.
- I - Value reported is less than the minimum quantitation limit, and greater than or equal to the minimum detection limit.
- J - Estimated value
- K - Actual value is known to be less than value given
- L - Actual value is known to be greater than value given
- N - Presumptive evidence of presence of material.
- O - Sampled, but analysis lost or not performed.
- Q - Sample held beyond normal holding time.
- T - Value reported is less than the criterion of detection.
- U - Material was analyzed for but not detected; The value reported is the minimum detection limit.
- V - Analyte was detected in both sample and method blank.
- Z - Colonies were too numerous to count (TNTC).

Sample Location: WPBCC

Field ID: 00:05

Collection Date/Time: 5/4/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323505					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
01000		Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: 05:05

Collection Date/Time: 5/4/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323803					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
01000		Arsenic	6100		ug/L

Sample Location: WPBCC

Field ID: 0:10

Collection Date/Time: 4/2/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323666					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
01000		Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: 0:100

Collection Date/Time: 4/30/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323809					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
01000		Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: 0:50

Collection Date/Time: 4/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323498					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
01000		Arsenic	2	U	ug/L

Sample Location: WPBCC
 Field ID: 1 BLANK:10
 Collection Date/Time: 4/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323475					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	2	U	ug/L

Sample Location: WPBCC
 Field ID: 1 BLANK:50
 Collection Date/Time: 4/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323474					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
Comments: The As result was confirmed on 05/27/98.					
	01000	Arsenic	45.2		ug/L

Sample Location: WPBCC
 Field ID: 100:100
 Collection Date/Time: 5/1/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323808					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	93.1		ug/L

Sample Location: WPBCC
 Field ID: 10:10
 Collection Date/Time: 4/2/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323663					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	9.5		ug/L

Sample Location: WPBCC
 Field ID: 11:100
 Collection Date/Time: 5/1/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323483					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	87.3		ug/L

Sample Location: WPBCC

Field ID: 11:16

Collection Date/Time: 3/2/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323652					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	13.4		ug/L

Sample Location: WPBCC

Field ID: 11:200

Collection Date/Time: 5/1/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323824					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	139		ug/L

Sample Location: WPBCC

Field ID: 11:50

Collection Date/Time: 4/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323810					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	47.5		ug/L

Sample Location: WPBCC

Field ID: 11:96

Collection Date/Time: 3/4/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323805					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	14.9		ug/L

Sample Location: WPBCC

Field ID: 12:01

Collection Date/Time: 5/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323828					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	864		ug/L

Sample Location: WPBCC

Field ID: 12:05

Collection Date/Time: 5/4/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323674					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	5840		ug/L
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Sample Location: WPBCC

Field ID: 12:10

Collection Date/Time: 4/2/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323506					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	7.7		ug/L
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Sample Location: WPBCC

Field ID: 12:100

Collection Date/Time: 5/1/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323821					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	93.2		ug/L
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Sample Location: WPBCC

Field ID: 12:200

Collection Date/Time: 5/1/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323813					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	141		ug/L
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Sample Location: WPBCC

Field ID: 12:50

Collection Date/Time: 4/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323826					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	47.7		ug/L
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Sample Location: WPBCC

Field ID: 12:96

Collection Date/Time: 3/4/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323468					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	10.9		ug/L

Sample Location: WPBCC

Field ID: 2 BLANK:10

Collection Date/Time: 4/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323667					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: 2 BLANK:50

Collection Date/Time: 4/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323822					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
Comments: The As result was confirmed on 6/16/98.					
	01000	Arsenic	47.7		ug/L

Sample Location: WPBCC

Field ID: 21:05

Collection Date/Time: 5/4/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323503					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	4520		ug/L

Sample Location: WPBCC

Field ID: 21:10

Collection Date/Time: 4/2/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323662					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	9.3		ug/L

Sample Location: WPBCC

Field ID: 21:100

Collection Date/Time: 5/1/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323510					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	95.2		ug/L

Sample Location: WPBCC

Field ID: 21:168

Collection Date/Time: 3/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323655					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	13.2		ug/L

Sample Location: WPBCC

Field ID: 21:200

Collection Date/Time: 5/1/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323827					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	80.8		ug/L

Sample Location: WPBCC

Field ID: 21:50

Collection Date/Time: 4/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323504					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	46.5		ug/L

Sample Location: WPBCC

Field ID: 21:96

Collection Date/Time: 3/4/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323467					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	10.7		ug/L

Sample Location: WPBCC

Field ID: 22:01

Collection Date/Time: 5/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323671					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	827	ug/L
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Sample Location: WPBCC

Field ID: 22:05

Collection Date/Time: 5/4/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323801					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	4680	ug/L
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Sample Location: WPBCC

Field ID: 22:10

Collection Date/Time: 4/2/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323511					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	10.4	ug/L
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Sample Location: WPBCC

Field ID: 22:100

Collection Date/Time: 5/1/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323484					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	86.9	ug/L
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Sample Location: WPBCC

Field ID: 22:200

Collection Date/Time: 5/1/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323812					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	140	ug/L
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Sample Location: WPBCC

Field ID: 22:50

Collection Date/Time: 4/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323471					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	44.6		ug/L

Sample Location: WPBCC

Field ID: 22:96

Collection Date/Time: 3/4/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323806					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	14.2		ug/L

Sample Location: WPBCC

Field ID: 3 BLANK:10

Collection Date/Time: 4/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323477					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: 3 BLANK:50

Collection Date/Time: 4/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323823					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
Comments: The As result was confirmed on 6/16/98.					
	01000	Arsenic	48.4		ug/L

Sample Location: WPBCC

Field ID: 31:01

Collection Date/Time: 5/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323672					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	811		ug/L

Sample Location: WPBCC					
Field ID: 31:05					
Collection Date/Time: 5/4/1998 12:00 AM					
Matrix: W-OTHER					
Lab ID	Storet Code	Component	Result	Code	Units
323496					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	4460		ug/L

Sample Location: WPBCC					
Field ID: 31:100					
Collection Date/Time: 5/1/1998 12:00 AM					
Matrix: W-OTHER					
Lab ID	Storet Code	Component	Result	Code	Units
323509					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	93.7		ug/L

Sample Location: WPBCC					
Field ID: 31:200					
Collection Date/Time: 5/1/1998 12:00 AM					
Matrix: W-OTHER					
Lab ID	Storet Code	Component	Result	Code	Units
323818					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	82.9		ug/L

Sample Location: WPBCC					
Field ID: 31:50					
Collection Date/Time: 4/3/1998 12:00 AM					
Matrix: W-OTHER					
Lab ID	Storet Code	Component	Result	Code	Units
323478					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	44.5		ug/L

Sample Location: WPBCC					
Field ID: 32:05					
Collection Date/Time: 5/4/1998 12:00 AM					
Matrix: W-OTHER					
Lab ID	Storet Code	Component	Result	Code	Units
323677					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	4580		ug/L

Sample Location: WPBCC

Field ID: 32:10

Collection Date/Time: 4/7/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323669					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	8.4		ug/L

Sample Location: WPBCC

Field ID: 32:100

Collection Date/Time: 5/1/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323479					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	88.6		ug/L

Sample Location: WPBCC

Field ID: 32:200

Collection Date/Time: 5/1/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323814					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	142		ug/L

Sample Location: WPBCC

Field ID: 32:50

Collection Date/Time: 4/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323500					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	40.5		ug/L

Sample Location: WPBCC

Field ID: 3A:8K

Collection Date/Time: 2/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323457					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	97.1		ug/L

Sample Location: WPBCC

Field ID: 3C:8K

Collection Date/Time: 2/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323651					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	2	U	ug/L
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Sample Location: WPBCC

Field ID: 3D:8K

Collection Date/Time: 2/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323458					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	100		ug/L
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Sample Location: WPBCC

Field ID: 3E:8K

Collection Date/Time: 2/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323650					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	103		ug/L
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Sample Location: WPBCC

Field ID: 3F:8K

Collection Date/Time: 2/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323459					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	2	U	ug/L
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Sample Location: WPBCC

Field ID: 4 BLANK:10

Collection Date/Time: 4/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323476					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	2	U	ug/L
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Sample Location: WPBCC

Field ID: 4 BLANK:50

Collection Date/Time: 4/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323816					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: 41:01

Collection Date/Time: 5/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323508					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	842		ug/L

Sample Location: WPBCC

Field ID: 41:05

Collection Date/Time: 5/4/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323502					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	6060		ug/L

Sample Location: WPBCC

Field ID: 41:10

Collection Date/Time: 4/7/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323668					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	8.8		ug/L

Sample Location: WPBCC

Field ID: 41:200

Collection Date/Time: 5/1/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323811					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	140		ug/L

Sample Location: WPBCC						
Field ID: 41:50						
Collection Date/Time: 4/3/1998 12:00 AM						
Matrix: W-OTHER						
Lab ID	Storet Code	Component	Result	Code	Units	
323472						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	44.5		ug/L	
Sample Location: WPBCC						
Field ID: 42:05						
Collection Date/Time: 3/4/1998 12:00 AM						
Matrix: W-OTHER						
Lab ID	Storet Code	Component	Result	Code	Units	
323657						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	4400		ug/L	
Sample Location: WPBCC						
Field ID: 42:10						
Collection Date/Time: 4/2/1998 12:00 AM						
Matrix: W-OTHER						
Lab ID	Storet Code	Component	Result	Code	Units	
323664						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	9.8		ug/L	
Sample Location: WPBCC						
Field ID: 42:100						
Collection Date/Time: 5/1/1998 12:00 AM						
Matrix: W-OTHER						
Lab ID	Storet Code	Component	Result	Code	Units	
323480						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	88.3		ug/L	
Sample Location: WPBCC						
Field ID: 42:200						
Collection Date/Time: 5/1/1998 12:00 AM						
Matrix: W-OTHER						
Lab ID	Storet Code	Component	Result	Code	Units	
323820						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	92.3		ug/L	

Sample Location: WPBCC

Field ID: 42:50

Collection Date/Time: 4/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323507					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	46.6		ug/L
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Sample Location: WPBCC

Field ID: 5 BLANK:10

Collection Date/Time: 4/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323473					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	2	U	ug/L
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Sample Location: WPBCC

Field ID: 50:50

Collection Date/Time: 4/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323501					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	46.2		ug/L
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Sample Location: WPBCC

Field ID: 51:01

Collection Date/Time: 5/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323673					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	814		ug/L
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Sample Location: WPBCC

Field ID: 51:05

Collection Date/Time: 5/4/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323494					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	4390		ug/L
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Sample Location: WPBCC						
Field ID: 7E:96K						
Collection Date/Time: 1/11/1998 2:00 PM						
Matrix: W-GROUND						
Lab ID	Storet Code	Component	Result	Code	Units	
302293						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	88.7		ug/L	
Sample Location: WPBCC						
Field ID: 7F:96K						
Collection Date/Time: 1/11/1998 12:00 PM						
Matrix: W-GROUND						
Lab ID	Storet Code	Component	Result	Code	Units	
302294						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	2	U	ug/L	
Sample Location: WPBCC						
Field ID: 7G:96K						
Collection Date/Time: 1/11/1998 12:00 PM						
Matrix: W-GROUND						
Lab ID	Storet Code	Component	Result	Code	Units	
302295						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	93.1		ug/L	
Sample Location: WPBCC						
Field ID: 7H:96K						
Collection Date/Time: 1/11/1998 12:00 PM						
Matrix: W-GROUND						
Lab ID	Storet Code	Component	Result	Code	Units	
302296						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	92.4		ug/L	
Sample Location: WPBCC						
Field ID: 7I:96K						
Collection Date/Time: 1/11/1998 12:00 PM						
Matrix: W-GROUND						
Lab ID	Storet Code	Component	Result	Code	Units	
302297						
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)						
	01000	Arsenic	2	U	ug/L	

Sample Location: WPBCC

Field ID: 51:10

Collection Date/Time: 4/2/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323665					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	7.0		ug/L

Sample Location: WPBCC

Field ID: 51:100

Collection Date/Time: 5/1/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323481					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	82.3		ug/L

Sample Location: WPBCC

Field ID: 51:16

Collection Date/Time: 3/2/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323460					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	18.9		ug/L

Sample Location: WPBCC

Field ID: 51:168

Collection Date/Time: 3/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323464					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	18.2		ug/L

Sample Location: WPBCC

Field ID: 51:200

Collection Date/Time: 5/1/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323804					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	132	A	ug/L

Sample Location: WPBCC
 Field ID: 51:50
 Collection Date/Time: 4/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323499					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	37.3		ug/L

Sample Location: WPBCC
 Field ID: 52:10
 Collection Date/Time: 4/2/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323470					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	6.7		ug/L

Sample Location: WPBCC
 Field ID: 52:16
 Collection Date/Time: 3/2/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323463					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	12.0		ug/L

Sample Location: WPBCC
 Field ID: 52:168
 Collection Date/Time: 3/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323653					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	21.3		ug/L

Sample Location: WPBCC
 Field ID: 52:200
 Collection Date/Time: 5/1/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323670					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	74.8		ug/L

Sample Location: WPBCC

Field ID: 52:96

Collection Date/Time: 3/4/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323466					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	19.4		ug/L

Sample Location: WPBCC

Field ID: 57:05

Collection Date/Time: 5/4/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323807					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	4610		ug/L

Sample Location: WPBCC

Field ID: AS-100B

Collection Date/Time: 1/8/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323453					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	433		ug/L

Sample Location: WPBCC

Field ID: AS-150B

Collection Date/Time: 1/8/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323648					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	657		ug/L

Sample Location: WPBCC

Field ID: AS-200B

Collection Date/Time: 1/8/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323649					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	860		ug/L

Sample Location: WPBCC

Field ID: AS-25B

Collection Date/Time: 1/20/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323455					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	8.9		ug/L

Sample Location: WPBCC

Field ID: AS-50B

Collection Date/Time: 1/8/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323647					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	221		ug/L

Sample Location: WPBCC

Field ID: AS-OB

Collection Date/Time: 1/20/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323454					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: CONTROL 1&2

Collection Date/Time: 3/2/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323461					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	10.9		ug/L

Sample Location: WPBCC

Field ID: CONTROL 5

Collection Date/Time: 3/2/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323462					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	19.5		ug/L

Sample Location: WPBCC

Field ID: CONTROL 5

Collection Date/Time: 3/4/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323802					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
01000		Arsenic	22.8		ug/L

Sample Location: WPBCC

Field ID: CONTROL III

Collection Date/Time: 2/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323456					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
01000		Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: CS-0

Collection Date/Time: 3/31/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323658					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
01000		Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: CS-100

Collection Date/Time: 3/31/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323659					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
01000		Arsenic	94.8		ug/L

Sample Location: WPBCC

Field ID: CS-25

Collection Date/Time: 3/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323656					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
01000		Arsenic	23.6		ug/L

Sample Location: WPBCC

Field ID: CS-5

Collection Date/Time: 3/31/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323661					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	4.9	I	ug/L

Sample Location: WPBCC

Field ID: CS-50

Collection Date/Time: 3/31/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323660					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	46.6		ug/L

Sample Location: WPBCC

Field ID: CS:200

Collection Date/Time: 3/3/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323654					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	179		ug/L

Sample Location: WPBCC

Field ID: SOIL 1 BLANK:100

Collection Date/Time: 5/1/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323819					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: SOIL 1 BLANK:168

Collection Date/Time: 5/4/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323678					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
	01000	Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: SOIL 2 BLANK:05

Collection Date/Time: 5/4/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323676					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
01000		Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: SOIL 2 BLANK:200

Collection Date/Time: 5/1/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323482					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
01000		Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: SOIL 3 BLANK:05

Collection Date/Time: 5/4/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323495					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
01000		Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: SOIL 3 BLANK:100

Collection Date/Time: 5/1/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323817					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
01000		Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: SOIL 3 BLANK:200

Collection Date/Time: 5/1/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323497					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
01000		Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: SOIL 4 BLANK:200

Collection Date/Time: 5/1/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323825					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
01000		Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: SOIL 5 BLANK 96

Collection Date/Time: 3/4/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323469					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
01000		Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: SOIL 5 BLANK:05

Collection Date/Time: 5/4/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323675					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
01000		Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: SOIL 5 BLANK:100

Collection Date/Time: 5/1/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323815					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
01000		Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: SOIL 5 BLANK:200

Collection Date/Time: 5/1/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323829					
Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)					
01000		Arsenic	2	U	ug/L

Sample Location: WPBCC

Field ID: WATER BLANK 96

Collection Date/Time: 3/4/1998 12:00 AM

Matrix: W-OTHER

Lab ID	Storet Code	Component	Result	Code	Units
323465					

Test: Metals, dissolved, in filtered, aqueous samples using ICP mass spectroscopy. (EPA 200.8 mod.)

01000	Arsenic	2	U	ug/L
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Quality Control Report

Job ID: TLH-1998-05-12-26

Test	Analyte	LFB %Recovery	MS %Recovery	Precision %RPD	Precision %RSD
W-ICPMS-F	Arsenic		93.8 94.4	0.622	
W-ICPMS-F	Arsenic	88.2	88.5 91.2	3.07	
W-ICPMS-F	Arsenic		96.5 98.0	1.50	

Job ID: TLH-1998-05-12-30

Test	Analyte	LFB %Recovery	MS %Recovery	Precision %RPD	Precision %RSD
W-ICPMS-F	Arsenic		95.5 95.8	0.247	
W-ICPMS-F	Arsenic	95.3	91.1 92.0	1.06	
W-ICPMS-F	Arsenic	107	93.9 96.1	2.20	

Job ID: TLH-1998-05-12-40

Test	Analyte	LFB %Recovery	MS %Recovery	Precision %RPD	Precision %RSD
W-ICPMS-F	Arsenic	85.8	91.8 92.7	0.981	
W-ICPMS-F	Arsenic		95.5 95.8	0.247	
W-ICPMS-F	Arsenic	95.3	91.1 92.0	1.06	
W-ICPMS-F	Arsenic	107	93.9 96.1	2.20	

Job ID: TLH-1998-05-12-41

Test	Analyte	LFB %Recovery	MS %Recovery	Precision %RPD	Precision %RSD
W-ICPMS-F	Arsenic	107	93.9 96.1	2.20	
W-ICPMS-F	Arsenic	94.7	94.3 97.7	3.51	
W-ICPMS-F	Arsenic	92.2	102 98.2	4.05	

990711

SE-DIST-1998-10-14-02
 Serial Number: 0001524
 Section 1 of 2
 Chemical Analysis Report
 Page 1 of 2

Chemical Analysis Report

Event Name (ID): SE-DIST-1998-10-14-02

Florida Department of Environmental Protection
 Central Laboratory
 2600 Blair Stone Road
 Tallahassee, FL 32399-2400
 CompQAP# 870688G

Event Description: Golf Course Arsenic Study

Request ID: RQ-1998-10-12-29

Customer: SE-DIST

Project ID: OTHER-WSM

RECEIVED
 DEC 1 1998
 DEPT. OF ENVIRONMENTAL PROTECTION

Job: TLK-1998-10-14-22

Group: Metals

Send Reports to
 FL Dept. of Environmental Protection
 P.O. Box 15425
 400 N. Congress Ave.
 West Palm Beach, FL 33401
 Attn: Leslie Smith

For additional information please contact
 Timothy W. Fitzpatrick
 Yuh-Hsu Pan, Ph.D.
 Julio Arrecis, Ph.D.
 Liang-Tsair Lin, Ph.D.
 Suncom 277-2571 Phone (850) 487-2571

Certified By: *HL*

Date: 11-24-98

Report Printed Date: Nov 23, 1998

Abbreviations and data remark codes

- A - Value reported is the mean of two or more determinations
- B - Results based on colony counts outside the acceptable range.
- I - Value reported is less than the minimum quantitation limit, and greater than or equal to the minimum detection limit.
- J - Estimated value
- K - Actual value is known to be less than value given
- L - Actual value is known to be greater than value given
- N - Presumptive evidence of presence of material.
- O - Sampled, but analysis lost or not performed.
- Q - Sample held beyond normal holding time.
- T - Value reported is less than the criterion of detection.
- U - Material was analyzed for but not detected; The value reported is the minimum detection limit.
- V - Analyte was detected in both sample and method blank.
- Y - The laboratory analysis was from an unpreserved or improperly preserved sample. The data may not be accurate
- Z - Colonies were too numerous to count (TNTC).

Sample Location: WPBCC
 Field ID: SOIL 1&2Z
 Collection Date/Time: 10/13/1998 1:00 PM

Matrix: S-SOIL

Lab ID	Storet Code	Component	Result	Code	Units
351569					
Test: Metals, total recoverable, in solid samples using trace-ICP emission spectroscopy. (EPA 6010 mod.)					
	01003	Arsenic	0.5	I	mg/kg
	01170	Iron_271	128	A	mg/kg

Sample Location: WPBCC
 Field ID: SOIL 32
 Collection Date/Time: 10/13/1998 1:00 PM

Matrix: S-SOIL

Lab ID	Storet Code	Component	Result	Code	Units
351568					
Test: Metals, total recoverable, in solid samples using trace-ICP emission spectroscopy. (EPA 6010 mod.)					
	01003	Arsenic	0.4	U	mg/kg
	01170	Iron_271	70.6		mg/kg

Sample Location: WPBCC
 Field ID: SOIL 42
 Collection Date/Time: 10/13/1998 1:00 PM

Matrix: S-SOIL

Lab ID	Storet Code	Component	Result	Code	Units
351567					
Test: Metals, total recoverable, in solid samples using trace-ICP emission spectroscopy. (EPA 6010 mod.)					
	01003	Arsenic	0.7	I	mg/kg
	01170	Iron_271	39.2		mg/kg

Sample Location: WPBCC
 Field ID: SOIL 52
 Collection Date/Time: 10/13/1998 1:00 PM

Matrix: S-SOIL

Lab ID	Storet Code	Component	Result	Code	Units
351566					
Test: Metals, total recoverable, in solid samples using trace-ICP emission spectroscopy. (EPA 6010 mod.)					
	01003	Arsenic	0.7	I	mg/kg
	01170	Iron_271	1400		mg/kg

Quality Control Report

Job ID: TLH-1998-10-14-22

Test	Analyte	LFB %Recovery	MS %Recovery	Precision %RPD	Precision %RSD
S-ICP-TR					
	Arsenic	96.4	90.6 92.2	1.73	
	kon_271	101	99.0	4.57	

Login Authorisation Report for SE-DIST-1998-10-14-02 on 16-OCT-1998 15:22

Golf Course Arsenic Study

Project: OTHER-WSM
Request ID: RQ-1998-10-12-29

Job ID: TLH-1998-10-14-22			Job Status: V
<u>Sample</u>	<u>St</u>	<u>Field ID</u>	<u>Sampling Location</u>
351566 S-ICP-TR	V	SOIL 52	WPBCC
351567 S-ICP-TR	V	SOIL 42	WPBCC
351568 S-ICP-TR	V	SOIL 32	WPBCC
351569 S-ICP-TR	V	SOIL 1&2Z	WPBCC

Log-in Checklist

RQ ID: 1998-10-12-29

Cooler Check

Cooler ID	Ice Present?		If No, Temperature	Evidence Tape Present?		Evidence Tape Intact?		Tracking Number
	Yes	No		Yes	No	Yes	No	
308	☒	☐		☐	☒	☐	☐	802921252017

Note: If the the temperature of a cooler is above 6° C or an evidence seal is damaged then identify the bottles, in the affected cooler(s), on back of form.

Shipping Method: FED Ex

Acid Preserved Samples pH Checked: pH $\leq$ 2? Yes ☐ No ☐ NA ☒
If No, fill out back of form.

Base Preserved Samples pH Checked: All OK? Yes ☐ No ☐ NA ☒
(W-CN, OV-CN - pH $\geq$ 12), (W-SULFDE-F, W-SULFIDE - pH $\geq$ 9)
If No, fill out back of form.

Evidence Tape on Bottles Present: Yes ☐ No ☒
If Yes, is it intact? Yes ☐ No ☐
If not intact then fill out back of form.

Condition of Containers:

Loose Caps: Yes ☐ No ☒
If Yes, fill out back of form.

Broken Containers: Yes ☐ No ☒
If Yes, fill out back of form.

Chain Of Custody Form Included? Yes ☒ No ☐
If Yes verify receipt of all containers listed then sign custody form. Document discrepancies (i.e. missing containers) on COC form.

Event ID: SE-NST-1998-10-14-07

Coolers Unpacked/Checked by: 86 Date: 10-14-98

Event Logged in by: [Signature]

NA - Not Applicable (i.e. sediment samples)

Cooler Packing Worksheet For Request: RQ-97-DEC-01-15
 Golf Course arsenic study
 Ship Cooler On: 24-NOV-1997

Customer: SE-WPB-WSM

Requestor: LESLIE SMITH

Phone Number: sc 226-6704

Send kit to: Dr. Hector Fuentes, Center for Engi
 Dept. of Civil/Environmental Engineering/EIU
 10555 West Flagler
 Miami, FL 33174

Comments: Run W-ICP-23 for Fe. Run S-ICP for As and Fe. Run ICPMS fo

Comms (2): NONE

Requested Analyses:

# samples	Analysis	Analysis Description	
26	W-ICPMS-F	ICPMS analysis for dissolved metals in water	
12	W-IF	Total PHOSPHOROUS in water samples by Method	
12	W-ICP-23-F	ICP analysis of filtered water samples by Method	
8	S-ICP	ICP multi-element analysis for soil by Method	
5	S-IF	Total PHOSPHOROUS in soil or sediment samples	
Bottle Type	Bottle Lot Number	# Bottles	Preservative
P-500ML	1055052	15	HNO3
P-500ML	0131029	12	HNO3
P-500ML	6276092	12	HNO3
GT-250ML	6276092	5	HCL

Cooler Packed By: Amzel

Date: 11-20-97

DEP Cooler ID #(s): 846, 39T 508, 230, 622, + 1 more (???)

PLEASE RETURN ALL COOLERS!

4

W
S-ICPMS-F

ICPMS Arsenic analysis for soil. ~~to the~~
 Please use extraction method possib
 best available

• This is the last of
 the coolers & samples!

• The last ^{soil} samples results came back

With a MDL of 8-20 mg/Kg which
 was totally useless for my work!

Thank You,
 George D. Carbo - PI

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
CENTRAL LABORATORY SAMPLE SUBMITTAL FORM

PMAS NO.: 1110

Requestor: SE-WPB-WSM

Lab ID: _____

Project ID: Golf Course arsenic study

RQ-98-JAN-

Sample Location: WPPCC Collection Date: 10/13/98
Field ID/Name: Soil-52 Collection Time: 1:00
Storet Station Number: _____ Grab: X
NPDES Number: _____ Composite Begin: _____ End: _____

WATER		BLANKS	SOIL/SEDIMENT	TISSUE	CHEMICAL WASTE
☐ SURFACE (FRESH)	☐ INFLUENT	☐ TRIP BLANK	☒ SOIL	☐ PLANT	☐ CHEM WASTE
☐ SURFACE (SALT)	☐ EFFLUENT	☐ FIELD BLANK	☐ FRESHWATER SEDIMENT	☐ FISH	☐ CHEM WASTE
☐ GROUND		☐ EQUIPMENT BLANK	☐ MARINE SEDIMENT	☐ SHELLFISH	
☐ DRINKING			☐ SLUDGE	☐ OTHER	

Field Parameters Measured By: _____	Field Parameters:
Signature: _____	Depth (feet): _____
Sampled By: _____	Chlorine, Total Residual - 50060 (mg/L): _____
Signature: _____	Dissolved Oxygen (Probe) - 00299 (mg/L): _____
Field Report Prepared By: _____	pH - 00400 (Std. Units): _____
Signature: _____	Salinity - 00480 (PPTH): _____
	Secchi Depth - 00078 (m): _____
	Specific Conductance - 00094 (umho/cm): _____
	Temperature - 00010 (C): _____

Analyses	Bottle Type	# Bottles	Preservatives
W-ICPMS-F	P-500ML	1	<u>HN03</u> <u>ICE</u>

Send Final Report To: Leslie Smith - Waste Cleanup (SEP)

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
CENTRAL LABORATORY SAMPLE SUBMITTAL FORM

PMAS NO.: 1110

Lab ID: _____

Requestor: SE-WPB-WSM

Project ID: Golf Course arsenic study

RQ-28-JAN-05

Sample Location: WPB/C Collection Date: 10/13/98
Field ID/Name: Soil 42 Collection Time: 100
Storet Station Number: _____ Grab: X
NPDES Number: _____ Composite Begin: _____ End: _____

WATER		BLANKS	SOIL/SEDIMENT	TISSUE	CHEMICAL WASTE
☐ SURFACE(SALT)	☐ INFLUENT	☐ TRIP BLANK	☒ SOIL	☐ PLANT	☐ CHEM WASTE
☐ GROUND	☐ EFFLUENT	☐ FIELD BLANK	☐ FRESHWATER SEDIMENT	☐ FISH	
☐ DRINKING		☐ EQUIPMENT BLANK	☐ MARINE SEDIMENT	☐ SHELLFISH	
			☐ SLUDGE	☐ OTHER	

Field Parameters Measured By: _____	Field Parameters:
Signature: _____	Depth (feet): _____
Sampled By: _____	Chlorine, Total Residual - 50060 (mg/L): _____
Signature: _____	Dissolved Oxygen(Probe) - 00299 (mg/L): _____
Field Report Prepared By: _____	pH - 00400 (Std. Units): _____
Signature: _____	Salinity - 00480 (PPTH): _____
	Secchi Depth - 00078 (m): _____
	Specific Conductance - 00094 (umho/cm): _____
	Temperature - 00010 (C): _____

Analyses	Bottle Type	# Bottles	Preservatives
<u>6</u> <u>ICPMS+P</u>	P-500ML	1	<u>HNO3</u> <u>ICE</u>

Send final Report to: Leslie Smith-Waste Cleanup(SED)

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
CENTRAL LABORATORY SAMPLE SUBMITTAL FORM

PMAS NO.: 1110

Requestor: SE-WPB-WSM

Lab ID: _____

Project ID: Golf Course arsenic study

RQ-98-JAN-01

Sample Location: WPBCC

Collection Date: 10/13/98

Field ID/Name: Soil 32

Collection Time 1:00 PM

Storet Station Number: _____

Grab: X

NPDES Number: _____

Composite Begin: _____ End: _____

WATER		BLANKS		SOIL/SEDIMENT		TISSUE		CHEMICAL WASTE	
☒ SURFACE (WATER)	☐ INFLUENT	☐ TRIP BLANK	☒ SOIL	☐ PLANT					
☐ SURFACE (SALT)	☐ EFFLUENT	☐ FIELD BLANK	☐ FRESHWATER SEDIMENT	☐ FISH				☐ CHEM WASTE	
☐ GROUND		☐ EQUIPMENT BLANK	☐ MARINE SEDIMENT	☐ SHELLFISH					
☐ DRINKING			☐ SLUDGE	☐ OTHER					

Field Parameters Measured By: _____

Field Parameters:

Depth (Feet): _____

Signature: _____

Chlorine, Total Residual - 50060 (mg/L): _____

Sampled By: _____

Dissolved Oxygen (Probe) - 00299 (mg/L): _____

Signature: _____

pH - 00400 (Std. Units): _____

Field Report Prepared By: _____

Salinity - 00480 (PPTH): _____

Signature: _____

Secchi Depth - 00078 (m): _____

Specific Conductance - 00094 (umho/cm): _____

Temperature - 00010 (C): _____

Analyses

Bottle Type

Bottles

Preservatives

W-ICPMS-F

P-500ML

1

HNO3

ICE

Send Final Report To: Leslie Smith-Waste Cleanup (SEP)

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
CENTRAL LABORATORY SAMPLE SUBMITTAL FORM

PMAS NO.: 1110

Requestor: SE-WPB-WSM

Lab ID: _____

Project ID: Golf Course arsenic study

RQ-98-JAN-05

Sample Location: WPPCC Collection Date: 10/13/98
Field ID/Name: Soil IE 22 Collection Time: 1:00p
Core Station Number: _____ Grab: X
PDES Number: _____ Composite Begin: _____ End: _____

WATER		BLANKS	SOIL/SEDIMENT	TISSUE	CHEMICAL WASTE
☐ SURFACE (FRESH)	☐ INFLUENT	☐ TRIP BLANK	☒ SOIL	☐ PLANT	
☐ SURFACE (SALT)	☐ EFFLUENT	☐ FIELD BLANK	☐ FRESHWATER SEDIMENT	☐ FISH	☐ CHEM WASTE
☐ GROUND		☐ EQUIPMENT BLANK	☐ MARINE SEDIMENT	☐ SHELLFISH	
☐ DRINKING			☐ SLUDGE	☐ OTHER	

Field Parameters Measured By: _____	Field Parameters:
Signature: _____	Depth (feet): _____
Sampled By: _____	Chlorine, Total Residual - 50060 (mg/L): _____
Signature: _____	Dissolved Oxygen (Probe) - 00299 (mg/L): _____
Field Report Prepared By: _____	pH - 00400 (Std. Units): _____
Signature: _____	Salinity - 00480 (PPTH): _____
	Secchi Depth - 00078 (m): _____
	Specific Conductance - 00094 (umho/cm): _____
	Temperature - 00010 (C): _____

Analyses	Bottle Type	# Bottles	Preservatives
W-ICPMS-F	P-500ML	1	HNO ₃ <u>ICE</u>

Send Final Report To: Leslie Smith-Waste Cleanup (SED)

[illegible]