UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division

Ebony spleenwort (*Asplenium platyneuron*) growing in a can at the Site

Arsenic Bioaccumulation in Ferns: A Pilot Study Woolfolk Chemical Works Superfund Site Ft. Valley, Peach County, Georgia

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1.0 Introduction

The Woolfolk Chemical Works Superfund Site (Site) was a production and packaging facility that produced organic and inorganic insecticides (including arsenic and lead-based products), pesticides, and herbicides (USEPA 1994). The facility began operations in 1926. During World War II an inorganic intermediate (arsenic trichloride) was reportedly produced at the facility for the War Production Board. Production was expanded during the 1950s to include the formulation of various organic pesticides, including dichlorodiphenyl trichloroethane (DDT), lindane, toxaphene, and other chlorinated pesticides. These organic pesticides, insecticides, and herbicides were formulated, packaged, or warehoused at the facility. The Site was contaminated with metals and various pesticides during manufacturing and packaging practices. As a result, the Site was added to the National Priority List in 1990.

During a removal action in 1995, the United States Environmental Protection Agency (USEPA) dug up and disposed of sediments from a ditch leaving the Site down to Lavender Street. The on-site facility soils, which are designated as Operable Unit 3 (OU), have been remediated (per remedial project manager). The off-site storm water drainage system located south of Lavender Street, which forms the basis of the current study, is designated as OU5. The unnamed tributary flows into Big Indian Creek after about 4 miles, and the habitat is a braided stream system with several beaver dams.

An ecological risk assessment (ERA) for OU5 was completed in March 2009 by Integrated Laboratory Systems, Inc. (ILS), a USEPA Region 4 contractor (ILS 2009). At the time the ERA was completed, the creek area was considered OU4, but is now designated as OU5. The results of the risk characterization indicated that ecological receptors may be at risk from exposure to pesticides and metals, particularly arsenic. Arsenic was determined to be the driver of risk for both ecological and human health at the Site. Arsenic tends to concentrate and remain in upper soil layers indefinitely and downward migration has been reported to be greater in sandy soil than in clayey loam soils (ATSDR 2000). Ecological remedial goal options (RGO) calculated for arsenic in surface soils ranged from 0.3 mg/kg for the most sensitive ecological receptor to 76.2 mg/kg for the least sensitive receptor. The human health cleanup goal for arsenic in the remediated Site soils is 20 mg/kg (USEPA 2009).

The ecological soil screening level (Eco-SSL) for arsenic reported for the protection of terrestrial plants is 18 mg/kg dry weight (dw) (USEPA 2005). This Eco-SSL is a screening benchmark and is not regarded as a cleanup number. Plants are more sensitive to the effects of arsenic than avian and mammalian receptors and there is no Eco-SSL currently available for soil invertebrates.

1.1 Background

Ma *et al*. (2001) at the University of Florida have identified the ladder brake fern (*Pteris vittata*) as a hyperaccumulator of arsenic from contaminated environmental media. Hyperaccumulators are plants that achieve a shoot-to-root analyte concentration ratio greater than one (McGrath *et al*. 2002). Ma *et al*. (2001) found that the ladder brake fern could accumulate as much as 21,290 and 22,630 mg arsenic/kg in soils spiked with 500 and 1,500 mg arsenic/kg, respectively, after six weeks of growth. Most of the arsenic extracted by the plants (up to 93 percent) was concentrated in the fronds (shoots). After two weeks of exposure, arsenic bioaccumulation factors (i.e., ratio of arsenic concentration in plant tissue to that in soil) of 126 and 8.8 were calculated from soils contaminated with 6 mg arsenic/kg and 400 mg arsenic/kg, respectively. The ladder brake fern, therefore, holds great potential for bioremediation of arsenic-contaminated soil. In another study, Wang *et al*. (2002) reported uptake of 27,000 mg arsenic/kg dw from hydroponic solutions. Other ferns, such as *Pteris cretica, Pteris longifolia, Pteris umbrosa*, and *Pityrogramma calomelanos*, have also been shown to hyperaccumulate arsenic from contaminated environmental media (Francesconi *et al*. 2002; Visoottiviseth *et al*. 2002; Zhao *et al*. 2002; Wei and Chen 2006).

Phytoremediation has been used as a viable low-cost alternate to current remediation methods that involve soil removal, physical stabilization, or other treatment and disposal methods that are disruptive, costly, and time-consuming. These remedial methods also disturb or destroy natural habitats. Phytoremediation can be used for cleaning vast areas of contaminated media (Ma *et al*. 2001; Kertulis-Tartar *et al*. 2006; Rathinasabapathi *et al*. 2006). If phytoremediation is used at a contaminated site, fronds should be harvested before the plants senesce because senescent or withered plants lose some of their arsenic (Kertulis-Tartar *et al*. 2006).

Ferns have been observed previously along the creek and in adjoining floodplains of OU5. These include:

- Ebony Spleenwort (*Asplenium platyneuron*);
- Wood Ferns *(Dryopteris* sp.);
- Netted Chain Fern (*Woodwardia areolata*);
- Bracken Fern (*Pteridium aquilinum*);
- Cinnamon Fern (*Osmunda cinnamomea*);
- Royal Fern (*Osmunda regalis*);
- Sensitive Fern (*Onoclea sensibilis*); and
- Other ferns.

Because native ferns are already established in the area of concern, the potential of local ferns to phytoextract arsenic from the contaminated media should be explored. If native ferns hyperaccumulate arsenic, then they would be better candidates for phytoremediation in arsenic-contaminated areas because the ladder brake fern is a non-native species. It is also considered a noxious weed by the Florida Department of

Agriculture and Consumer Services in central and south Florida, but not altering (FLEPPC 2009).

The Edenspace™ Corporation, in association with the University of Florida, has a patent to grow and sell *P. vittata* under the trade name Edenfern™. The ferns have been used in pilot studies for the remediation of arsenic-contaminated soils at different Superfund Sites in Region 4 (Carlton *et al*. 2010; Salido *et al*. 2003) and Region 3 at the Crozet, Virginia Site (USEPA 2007), and Ryeland Road Site (USEPA 2010a). The second fern planting was completed May 2010 at the Ryeland Road Site.

1.2 Objectives of the Site Investigation

The primary objective of this pilot study was to determine if arsenic was bioavailable to the ladder brake fern. Soils were collected from known areas of contamination at the Site and brought to the USEPA Region 4 Science and Ecosystem Support Division (SESD) laboratory in Athens, Georgia to perform the bench-scale study. Previous investigations, including an ERA, indicated that elevated arsenic concentrations extend beyond the creek channel due to the braided nature and beaver dams in this riverine system. Because of the nature of this type of habitat, it would be difficult to perform removal of areas exceeding RGOs without destruction of the wetlands/riparian buffer. This Pilot Study was initiated to determine if arsenic in the Site soils is bioavailable to ferns, and if phytoremediation could be a potential suitable remedy for the Site. A secondary objective of this study was to determine if native ferns were a viable alternative to the non-native ladder brake fern.

2.0 Pilot Study Investigation

On February 3 and 4, 2009, SESD and ILS personnel collected surface soil or sediment samples from five stations. The stations were selected based on arsenic concentrations from previous sampling events. With the exception of Stations WC125 and WC150A, the global positioning system (GPS) coordinates were already available in the SESD EQuIS computer tracking system. The coordinates for the two stations not in EQuIS were logged with a Trimble® Geo XT™ GPS in the field. Native ferns found in these areas were also collected to determine arsenic concentrations.

All samples were collected in accordance with the following Region 4 SESD operating procedures:

SESDPROC-010-R3, Logbooks
SESDPROC-110-R2, Global Positioning System
SESDPROC-107-R1, Field X-Ray Fluorescence (XRF) Measurement
SESDPROC-300-R1, Soil Sampling
SESDPROC-209-R1, Packing, Marking, Labeling, and Shipping of Environmental and Waste Samples.

2.1 Soil Sampling

Some of the stations were inundated with water or the soil was soggy, but the soil/sediment samples will hereafter be referred to as soil in this report. Prior to the collection of the soil samples, arsenic concentrations were estimated *in situ* using a Thermoscientific Niton® XL3T Model XL3A600 XRF analyzer, which was on loan from CMC, Inc. (personnel from CMC, Inc. calibrated the instrument prior to use). After the arsenic measurement, two 2-liter buckets were filled with surficial soil (i.e., 0 – 15 cm depth) at each station. The buckets were placed on ice at 4 ± 2 °C, and transported to the SESD laboratory for the phytoremediation pilot study. The sample locations are shown in Figure 1 and listed in Table 1. Table 1 also indicates whether the medium sampled was soil or sediment.

2.2 Fern Sampling

When available, ferns were collected in the vicinity of the sample stations (see Table 2). They were collected by breaking off the dried stems, or if live, cut with scissors or pulled gently by the roots. Care was taken to brush off all dirt from the ferns. Ferns were then placed in clean plastic bags, labeled with the station number and date, and placed on ice at 4 ± 2 °C.

3.0 Methods for Arsenic Analysis in Soil and Ferns

At the SESD laboratory, a subsample of the soil was dried to obtain a more accurate arsenic reading. Ferns were identified and shipped to an analytical laboratory for arsenic analysis.

3.1 Soil Physical/Chemical Parameters and Estimated Arsenic Measurements

The surface soils were oven dried for 24 hours at 100 ± 4 °C and analyzed for arsenic by XRF using a NITON® Xli 700 Series Multi-element XRF Spectrum Analyzer. Total organic carbon (TOC) by SW846 Method 9060A and particle size distribution by ASTM Method D2217-85 (Reapproved 1998) were also measured in the soil samples.

3.2 Fern Identification and Arsenic Analysis

Ferns were identified to the species level (Snyder and Bruce1986; Radford *et al.* 1983; Weakley 2008). Some of the dried and senescent ferns were difficult to identify. Prior to shipping, the native ferns were screened for arsenic using XRF. One fern contained detectable concentrations (WC127ESA), and the rest were below level of detection (LOD) of about 20 mg/kg. After identification, the ferns listed in Table 2 were shipped to a USEPA Contract Laboratory Program (CLP) laboratory and analyzed for arsenic using a modification of the CLP Statement of Work for Inorganic Analysis (ILM05.3).

4.0 Pilot Phytoremediation Study

Two sets of pilot phytoremediation studies were conducted with the soil samples from the Site using three different species of ferns: Cretan brake (*Pteris cretica* 'Mayi'), ladder brake (*P. vittata*), and ebony spleenwort (*E. platyneuron*). The *Pteris* ferns were obtained from Milestone Agriculture, Inc., located in Apopka, Florida, and is under contract with Edenspace™ System Corporation in Dulles, Virginia to grow and market the plants. The ebony spleenworts were obtained from a local supplier in Athens, Georgia. The cretan brake fern was used as a surrogate species in the first set of tests because Edenspace™ Corporation did not have any ladder brake ferns available at the time of the pilot study. The salesman from Milestone Agriculture, Inc. indicated that the cretan brake fern had similar characteristics compared with the ladder brake fern and was appropriate for the intended pilot study. The second set of tests was performed with the ladder brake fern and ebony spleenwort. Ebony spleenwort was used because it was found growing locally and accumulated moderate amounts of arsenic (Table 2).

The first study with the cretan brake fern was conducted from February 27 through April 17, 2009. Twelve hundred to 1,600 grams of soil were added to one-half gallon plastic pots, with 4 replicates per sample. The pots were obtained from a local nursery and were rinsed with deionized water prior to use. Some samples were inundated with water and no attempts were made to dry them prior to testing. A total of five site soils (four site-related samples and one reference sample) and a laboratory control were used. All samples were thoroughly homogenized prior to the test. The control soil was Moisture Control Potting Mix from Miracle-Gro® and was obtained from a local nursery. The ferns were approximately 5 to 10 cm upon delivery, and were healthy and actively growing. They were acclimatized to the laboratory conditions of temperature and light for approximately 24 hours prior to the start of the study. Because the ferns were relatively small and actively growing, two ferns were planted in each of the four replicate tests plots. Figure 2a shows a set-up of the test vessels with the ferns in the first pilot study, and Figure 2b shows a close-up of the cretan brake fern.

The pH of the soils was measured before and after the pilot study. The ferns were grown under ambient laboratory illumination (i.e., 1,000 to 1,500 lux) at a temperature of $21 \pm 2\,^{o}C$ for up to 7 weeks and a photoperiod of 16 hours of light and eight hours of darkness. The ferns were observed daily and lightly misted with deionized water as needed. Ferns from two replicate plots were harvested after 3 weeks of exposure by cutting the shoots from the base with scissors and sent to a CLP laboratory for arsenic analysis. Ferns from the remaining two replicates were harvested in a similar fashion after 7 weeks and analyzed for arsenic. The plots, with the root system intact, were left under the same conditions to determine if the ferns would grow back.

The second study was conducted from June 16 through July 30, 2009 with the ladder brake fern and ebony spleenwort using some of the soil samples collected in February 2009. The focus was on Station WC127 because the fern accumulated 600 mg/kg in the first pilot study. The test conditions were the same as those in the first study. The ladder brake ferns were approximately 10-15 cm and the ebony spleenworts

were approximately 20 cm (~3 years old). In this experiment, portions of the original soil were pH-adjusted to between 7.3 and 7.9 with Bonide® Hydrated Lime. The pH was raised for optimal arsenic uptake because it was thought that inundated soils have arsenit, a less bioavailable form of arsenic. Due to a limited volume of soil not all of the soils used in the initial tests were retested. One teaspoon of Miracle-Gro® fertilizer was mixed with one gallon of water, and was added to Sample WC127 and retested to observe any variation in arsenic uptake. Figure 3 presents a set-up of the test vessels with the ferns in the second pilot study.

Arsenic Analysis in Ferns

The fern samples collected at the end of the pilot studies were analyzed for arsenic by Inductively Coupled Plasma (ICP) Atomic Emission Spectroscopy (AES) using a modification of the CLP Statement of Work for Inorganic analysis (ILM05.3).

5.0 Results and Discussion

The following section first describes results of arsenic concentrations and physical/chemical parameters in soil, followed by arsenic concentrations in native ferns. Results and discussion of the two pilot studies are then described. Appendix A contains the final analytical data packages with report narratives from the analytical laboratories.

5.1 Soil Physical/Chemical Parameters and Estimated Arsenic Concentrations

The results of percent solids, TOC, particle grain size, and arsenic concentrations in the soil are presented in Table 3. Excluding the reference station, the percent solids ranged from 22% at Station WC150A to 85% at Station WC127. The TOC ranged from 1.7 mg/kg at Station WC155 to 9.9 mg/kg at Station WC150A. The silt/clay fraction ranged from 4.8% at Station WC127 to 25.5% at Station WC150A. Of the five site-related samples collected for this project, Station WC150A had the lowest % solids, the highest TOC, and the highest silt/clay fraction. Station WC150A is located south of Carver Drive in a wetland, which was mostly saturated during the sampling event.

Because arsenic concentrations were measured with an XRF analyzer, all concentrations are considered estimated (i.e., J-qualified). Appendix D contains the raw data from the XRF readings. Estimated arsenic concentrations in the Site samples ranged from 22 mg arsenic/kg dw at Station WC155 to 180 mg arsenic/kg dw at Station WC127. No arsenic was detected at the reference Station WC125 above the estimated detection level of 19UJ mg/kg dw. The second highest arsenic concentration of 150 mg/kg dw was detected in the duplicate sample at Station WC155. The native sample collected at Station WC155 had the lowest arsenic concentration of 22 mg arsenic/kg dw.

5.2 Native Fern Arsenic Concentrations

The arsenic concentrations in the native ferns collected from the Site are presented in Table 2. Fern arsenic concentrations ranged from undetected (detection limit = 0.5 mg/kg) to 30 mg/kg dw. Ebony spleenwort ferns growing in the creek bank at Station WC127 had an arsenic concentration of 30 mg/kg dw (soil concentration approximately 180 mg/kg dw). The next highest arsenic concentration was 2.4 mg/kg dw, also detected in an ebony spleenwort fern and its duplicate sample at Station WC127, but these ferns were collected in the surrounding floodplain but outside the defined dried-creek bank.

Prior to sending the ferns to the laboratory for arsenic analysis, the ferns were screened using XRF. All but one fern sample was below LOD by the XRF analyzer (see Appendix D). The analytical results from the CLP laboratory indicate that the XRF screening of the ferns was relatively accurate. See Appendix A for analytical results of the native ferns.

5.3 First Pilot Study Results

The test conditions including average daily temperature, pH, and light intensity were acceptable throughout the course of the Pilot Study (see Appendix B). The temperature averaged 21 $\pm$ 2 ^{o}C and light intensity was approximately 1,200 lux throughout the study. The pH of the soils before and after the study is provided in Table 4. All of the soils, including the reference sample, used in the study were acidic, with pH values ranging from 3.42 to 5.07. The laboratory control soil pH started at 5.25 and fell to 4.56 by the end of the test. The pH values of the test soils were less than the optimum of pH 6-7 required for the extraction of arsenic from contaminated soil (Salido *et al*. 2003).

The arsenic concentrations in the first pilot study with the cretan brake fern, following 3 and 7 weeks of exposure are presented in Table 5. After 3 weeks of exposure, all ferns were below 10 mg As/kg, except Station WC127 (110 mg/kg). Fern arsenic concentrations ranged from 1.7 mg/kg dw in the duplicate sample from Station WC155 to 600 mg/kg dw in the sample from Station WC127 following 7 weeks of exposure. The laboratory control and field reference fern arsenic concentrations were 1.1 and 1.7 mg/kg, respectively after 7 weeks.

Arsenic uptake in the ferns did not follow any specific pattern in most of the samples. With the exception of the ferns in the sample from Station WC127, the arsenic concentrations in the ferns from the other stations were relatively negligible (Figure 4). Also, except for the ferns in the sample from Station WC127, there was little or no difference in arsenic uptake from Week 3 through Week 7. Arsenic concentrations in the test ferns (except Station WC127) were less than those in the ebony spleenwort collected from the site that had an arsenic concentration of 30 mg/kg dw.

The ferns planted in the sample from Station WC127 accumulated more arsenic compared to the other stations, possibly because this Station had the highest soil arsenic concentration, the least amount of moisture, and was sandier than other site-related samples except Station WC155, which only had an arsenic concentration of 22 mg/kg. Because this sample was sandier, it is likely that it was also more aerated compared to other samples collected for the tests (see Table 3 for grain size). Soils from the other stations were soggy and some were inundated with water. Also confounding the issue is that Station WC127 had the second to lowest pH (4.61) at the beginning of the experiment which contradicts Salido *et al*.'s (2003) conclusion of optimum pH of 6 to 7 for ferns to accumulate arsenic.

Plants preferentially take up arsenate (V) in their tissues rather than arsenite (III) (Rathinasabapathi *et al*. 2006). In the plant tissues, arsenate is reduced to arsenite which is sequestered in the fronds (Wang *et al*. 2002). Under aerobic conditions as at Station WC127, the predominant form of arsenic is arsenate which is readily taken up by the plants. However, under soggy conditions, the soils become anoxic and the predominant form of arsenic becomes arsenite which is not taken up by the plants to any appreciable extent. This may explain why the ferns at Station WC127 accumulated more arsenic than those at the other stations.

Bioaccumulation Factors

The uptake of a metal from abiotic to biotic media can be expressed in terms of a bioaccumulation factor (BAF). The BAF is a ratio of the metal concentration in biotic media to the concentration in the abiotic media. This ratio provides an estimate of the relative uptake of metal of interest into the tissues of the plant. A BAF of one or greater indicates that the plant is a metal accumulator and a BAF of less than one indicates that the plant is a metal excluder (Baker and Whiting 2002). The maximum BAF calculated in this Pilot Study following 7 weeks of exposure was 3.33 (Table 5). The maximum BAF was less than that reported by Ma *et al*. (2001), but was similar to that reported by Wei and Chen (2006).

5.4 Second Pilot Study Results

The second pilot study was conducted under the same conditions as the first test conditions (see Appendix B). The results of the second pilot study with the ladder brake fern and ebony spleenwort are presented in Table 6.

Ladder Brake Fern (*Pteris vittata*)

The ladder brake fern used in this study did not grow as expected. The lack of adequate growth may possibly have been due to transplanting shock. Some of the ferns withered during the course of the 6-week exposure (see figures in Appendix C). There was little to no uptake of arsenic in ferns in any of the samples (Table 6).

The maximum arsenic concentration in the ladder brake fern from this study was 26 mg/kg dw in the ferns from Station WC127 after 6 weeks of exposure. Figure 5 shows a graphical presentation of the arsenic concentrations in the soils from this study. This concentration is more than 23 times less than the 600 mg/kg dw accumulated by *P cretica* 'Mayi' at the same station in the first study. When the pH of a portion of the soils was adjusted to neutral and retested, there was some improvement in arsenic uptake at Stations WC150 and WC155 but not at Station WC127 (Figure 6). In fact there was a decrease in arsenic uptake at Station WC127 with the pH adjustment possibly due to senescence. It appears that more time was needed than 6 weeks to show appreciable uptake of arsenic in the ladder brake fern in this study.

In a study by Tu *et al*. (2002), up to 25 weeks were required to demonstrate appreciable arsenic uptake in the ladder brake fern. In the first pilot study, there was approximately six times more uptake of arsenic by the cretan brake fern between Week 3 and 7. The ladder brake fern fared poorly in our pilot study. It is not known why they did not accumulate arsenic to any appreciable levels. Perhaps anoxic conditions developed in the soils because they were kept in the refrigerator for approximately 4 months prior to initiating the second study, although holding times not to be exceeded is 6 months for arsenic analysis in soils (USEPA 2010b). A different laboratory also analyzed this set of ferns compared to the first study. Arsenite, which is not the preferred form for plant uptake, prevails under anoxic conditions, thereby preventing uptake by plants.

Ebony spleenworts (*Asplenium platyneuron*)

The ebony spleenwort ferns used in the study were approximately 3 years old. Like the ladder brake fern, the ebony spleenworts did not accumulate appreciable levels of arsenic during the 6-week study, although they appeared healthier than the cretan brake ferns (Appendix C). The maximum arsenic concentration was 39 mg/kg dw in ebony spleenwort from Station WC127 (Figure 5 and Table 6). This concentration is only slightly higher than the arsenic concentration of 30 mg/kg dw from ebony spleenwort collected natively growing at the site. It is rather surprising that arsenic accumulation in ebony spleenwort was higher than that of the ladder brake fern in the same sample (WC127) and under similar conditions of exposure since researchers have shown Pteris ferns to be hyperaccumulators (the arsenic concentration in the ladder brake fern was 26 mg/kg and the arsenic concentration of the ebony spleenwort was 39 mg/kg).

Adjusting the pH of the test soils to neutral had little or no effect on arsenic uptake. There were decreases in arsenic uptake in the samples from Station WC127 and WC155 following the pH adjustment**,** and Reference Station WC125; but the Station WC156 arsenic concentration increased by adjusting pH from nondetected to 11 mg/kg. See Figures 5 and 6 for specific details.

Additional studies may be required either on-site or in a greenhouse setting in order to determine if phytoremediation is possible in floodplain soils at the Woolfolk Site. Considerations for any additional studies may include the following:

- soil aeration/tilling to loosen soils and induce oxic conditions;
- addition of ethylene diaminetetraacetic acid (EDTA);
- pH adjustment to near neutral with lime;
- fertilizer application – consideration should be given to the fact that arsenate uptake is suppressed by phosphate but arsenite uptake is not affected;
- use younger actively-growing plants etc.;
- longer exposure duration;
- drying saturated soils; or
- using additional fern species.

6.0 Quality Control

In addition to the environmental samples, quality control (QC) samples were collected. One QC sample was a variability duplicate soil sample collected from Station WC155 in the same area as the primary sample, but this was not a split sample (i.e., homogenized sample split between two containers). The difference of arsenic concentration in the duplicate sample from the primary sample indicates that the arsenic is not evenly distributed in the floodplain. In addition, the arsenic concentration was determined by XRF, which is a screening tool and provides an estimate. The soil samples were not analyzed by a CLP laboratory.

A duplicate sample of native ferns was sent to the laboratory for arsenic analysis for quality control purposes. Native ebony spleenwort ferns collected from the area of Station WC127 had the same arsenic concentration (2.4 mg/kg). These ferns were collected in the braided stream/floodplain system of the creek habitat.

7.0 Conclusions

Ferns are present in almost all terrestrial environments in every continent with different growth characteristics. A field study conducted by Salido *et al*. (2003) at a Superfund site concluded that at least eight years would be required to reduce arsenic to a safe level of 40 mg/kg in the soil with the ladder brake fern from an initial average arsenic concentration of 121 mg/kg in soil. Our original idea was to study arsenic uptake by the ladder brake fern because it has been shown world-wide to be a hyperaccumulator of arsenic. However, because the ladder brake fern wasn't available, the cretan brake fern was used in the first set of tests. Under the conditions of our pilot studies, the cretan brake fern proved to be a very successful accumulator of arsenic in one sample from the Site soils compared with the ladder brake fern. The ladder brake fern accumulated little or no arsenic in the second pilot study, possibly because of transplanting shock and the fact that the soils had been stored in the refrigerator for several months and anoxic conditions may have developed. Based on EPA guidelines, ferns would be considered hazardous waste with arsenic concentrations of 100 mg/kg and above (Rathinasabapathi and Srivastava 2006). Only the *P. cretica* 'Mayi' from Station WC127 would qualify as

hazardous waste under the conditions of the Pilot Studies. Possible indigenous ferns might have potential use for bioremediation based on one station where native ferns were collected, but additional studies would be required to draw conclusions.

8.0 Recommendations

- Repeat the study in the lab with *P. vittata* using fresh soil from the Site.
- Perform a limited pilot study on-Site using both *P. vittata* and *P. cretica* 'Mayi'. The study should consider soil aeration/tilling and fertilization, soil amendments, pH adjustments, EDTA application, irrigation, etc.
- Collect non-senescent actively-growing native ferns from the Site for arsenic analysis.
- Consider alternate remedies for the Site.

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TABLES

Table 1. Station and Sample Identifications, and Ferns Collected at the Woolfolk Chemical Works Superfund Site, Ft. Valley, Georgia

Station ID	Sample ID	Ferns Collected?	Fern Description
WC125 (reference)	WC1250209	No	None
WC127	WC1270209	Yes	Evergreen
WC150A	WC150A0209	Yes	Mixed Evergreen and Withered
WC155	WC1550209	Yes	Withered
WC156	WC1560209	Yes	Mixed Evergreen and Withered

ID = Identification

Table 2. Native Fern Identification, Station and Sample Identifications, and Fern Arsenic Concentrations, Woolfolk Chemical Works Superfund Site, Ft. Valley, Georgia

Station ID	Sample ID	Identification	Description	Arsenic Conc. (mg/kg dw)
WC127	WC127ESA	Ebony spleenwort (*Asplenium platyneuron*)	Collected in edge of creek channel	30
WC127	WC127ESB	Ebony spleenwort (*Asplenium platyneuron*)	Collected in vicinity of floodplain	2.4
WC127 (dup)	WC127ESBD	Ebony spleenwort (*Asplenium platyneuron*)	Collected in vicinity of floodplain	2.4
WC150A	WC150AUF	Unknown fern	Dried and withered	0.5 U
WC150A	WC150ADS	Wood fern (*Dryopteris* sp.)	Dried	1.6
WC155	WC155WAF	Netted chain fern (*Woodwardia areolata*)	a) fertile fronds of the fern below. Collected upland from station	0.5 U
WC155	WC155WAS	Netted chain fern (*Woodwardia areolata*)	b) sterile fronds of the above fern. Collected upland from station	0.25 J
WC155	WC155PA	Bracken fern (*Pteridium aquilinum*)	Fern collected upland from station	0.26 J
WC156	WC156ES	Ebony spleenwort (*Asplenium platyneuron*)	Growing upland from station	0.5 U
WC156	WC156WA	Netted chain fern (*Woodwardia areolata*)	Growing near edge of station	0.18 J
WC156	WC156DS	Wood fern (*Dryopteris* sp.)	Growing near edge of station	1.2

ID = Identification
Conc. = Concentration
mg/kg dw = Milligram per kilogram dry weight
dup = Duplicate
U = Not detected above the sample quantitation limit
Sp. = Species
J = Estimated concentration

Table 3. Percent Solids, Total Organic Carbon, Particle Grain Size, and Arsenic Concentrations in Site Soils, Woolfolk Chemical Works Superfund Site, Ft. Valley, Georgia

Station ID	Solids (%)	TOC (%)	Particle Grain Size (%)			Arsenic Concentration (mg/kg dw)
			Gravel	Sand	Silt/Clay	
WC125 (ref)	79	0.59	1.0	95.3	3.7	19 UJ
WC127	85	2.4	5.6	89.6	4.8	180 J
WC150A	22	9.9	9.4	65.1	25.5	63 J
WC155	66	1.7	4.0	90.4	5.6	22 J
WC155 (dup)	46	6.8	22.4	67.1	10.5	150 J
WC156	37	8.3	20.8	68.5	10.7	140 J

ID = Identification
TOC = Total organic carbon
mg/kg dw = Milligrams per kilogram dry weight
ref = Reference
U = Not detected above the sample quantitation limit
J = Estimated concentration
dup = Duplicate

Table 4. pH of Soil in the Initial Pilot Study, Woolfolk Chemical Works Superfund Site, Ft. Valley, Georgia

Station ID	pH (standard units)	
	Initial	Final
Control	5.25	4.56
WC125 (reference)	4.61	4.22
WC127	4.74	4.07
WC150A	5.07	3.72
WC155	5.06	4.53
WC155 (duplicate)	5.02	4.25
WC156	3.52	3.42

ID = Identification

Table 5. Arsenic Bioaccumulation Factors in *Pteris cretica* 'Mayi' Following 3 and 7 Weeks of Exposure, Woolfolk Chemical Works Superfund Site, Ft. Valley, Georgia

Station ID	Soil Arsenic (mg/kg dw)	Fern Arsenic Concentration (mg/kg dw) and BAF			
		After 3 weeks	BAF*	After 7 weeks	BAF
Control	NM**	1.6	NM	1.1	NM
WC125 (reference)	19 U	1.1	0.056	1.7	0.09
WC127	180 J	110	0.61	600	3.33
WC150A	63 J	7.2	0.11	11	0.17
WC155	22 J	2.3	0.10	2.3	0.10
WC155 (duplicate)	150 J	2.1	0.014	1.7	0.011
WC156	140 J	2.9	0.02	6.8	0.049

ID = Identification
mg/kg dw = Milligrams per kilogram dry weight
BAF = Bioaccumulation factor (Fern arsenic concentration:soil arsenic concentration)
* Estimated using the full soil quantitation limit for the non-detected concentrations
** Not measured
U = Not detected above the sample quantitation limit
J = Estimated concentration

Table 6. Arsenic Bioaccumulation Factors in Ladder Brake Fern (*Pteris vittata*) and Ebony Spleenwort (*Asplenium platyneuron*) Following 6 Weeks of Exposure, Woolfolk Chemical Works Superfund Site, Ft. Valley, Georgia

Station ID	Soil Arsenic (mg/kg dw)	Fern Arsenic Concentration (mg/kg dw) and BAF*			
		Ladder Brake	BAF	Ebony Spleenwort	BAF
Control	NM	NM	NM	2.5 U	NM
WC125 (reference)	19U	1.4 J	0.074	1.7	0.09
WC125 (pH 7)	19 U	1.3 J	0.068	0.076	0.004
WC127	180 J	26	0.14	39	0.22
WC127 (pH 7)	180 J	3.1	0.017	10	0.056
WC127 (fertilized)	180 J	4.2	0.023	5	0.028
WC155	22 J	2.3 J	0.105	5.5	0.25
WC155 (pH 7)	22 J	12	0.55	2.7 U	0.12
WC156	140 J	4.3 J	0.03	3.4 U	0.024
WC156 (pH 7)	140 J	9.2	0.066	11	0.079

ID = Identification
mg/kg dw = Milligrams per kilogram dry weight
BAF = Bioaccumulation factor (Fern arsenic concentration:soil arsenic concentration)
* Estimated using the full quantitation limit for the non-detected concentrations
NM = Not measured
U = Not detected above the sample quantitation limit
J = Estimated concentration

FIGURES


N
W
E
S
WC127
UNIVERSITY BLVD
WC-125
WC156
WC155
WC150A
Site Location, Ft. Valley, Ga
0
1,250
2,500
5,000 Feet
Legend
Reference Sediment Location
Sediment Sample Location
Figure 1
Sample Locations
Woolfolk Chemical Works Superfund Site
Fort Valley, Georgia

Figure 2a. Set-up of *Pteris cretica* 'Mayi' Laboratory Study, Woolfolk Chemical Works Superfund Site, Ft. Valley, Georgia

Figure 2b. Close-up of *Pteris cretica* 'Mayi', Woolfolk Chemical Works Superfund Site, Ft. Valley, Georgia

Figure 3a. Set-up of *Pteris vittata* and *Asplenium platyneuron* Laboratory Study, Woolfolk Chemical Works Superfund Site, Ft. Valley, Georgia

Figure 3b. Close-up of *Asplenium platyneuron* (left) and *Pteris vittata* (right), Woolfolk Chemical Works Superfund Site, Ft. Valley, Georgia

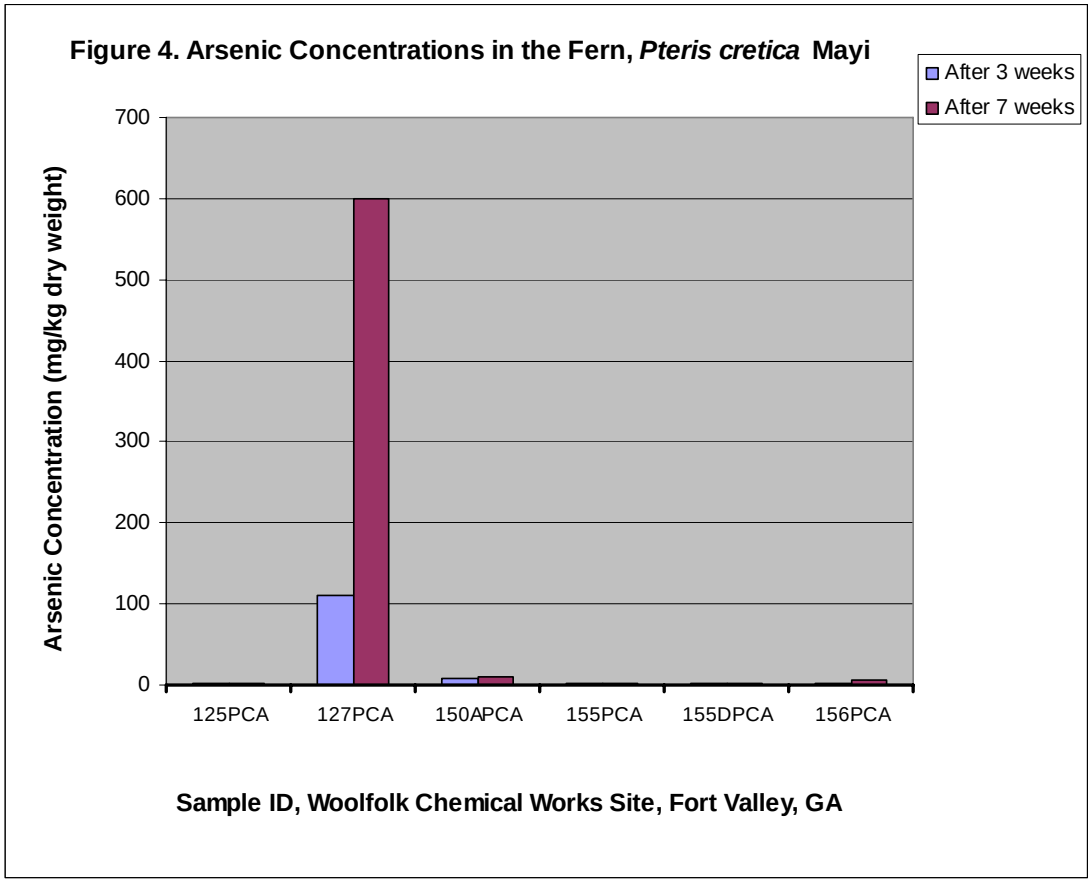
Figure 4. Arsenic Concentrations in the Fern, *Pteris cretica* Mayi
After 3 weeks
After 7 weeks
Arsenic Concentration (mg/kg dry weight)
700
600
500
400
300
200
100
0
125PCA
127PCA
150APCA
155PCA
155DPCA
156PCA
Sample ID, Woolfolk Chemical Works Site, Fort Valley, GA

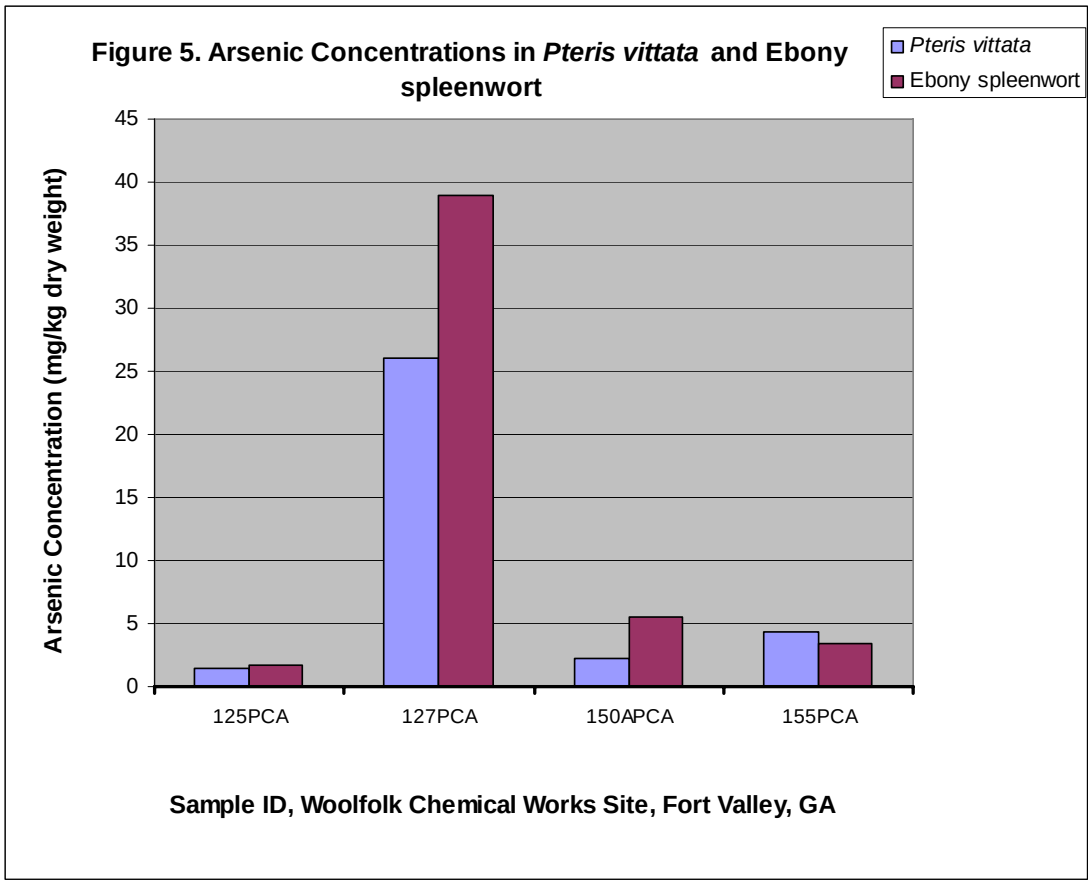
Figure 5. Arsenic Concentrations in *Pteris vittata* and Ebony spleenwort
Pteris vittata
Ebony spleenwort
Arsenic Concentration (mg/kg dry weight)
45
40
35
30
25
20
15
10
5
0
125PCA
127PCA
150APCA
155PCA
Sample ID, Woolfolk Chemical Works Site, Fort Valley, GA

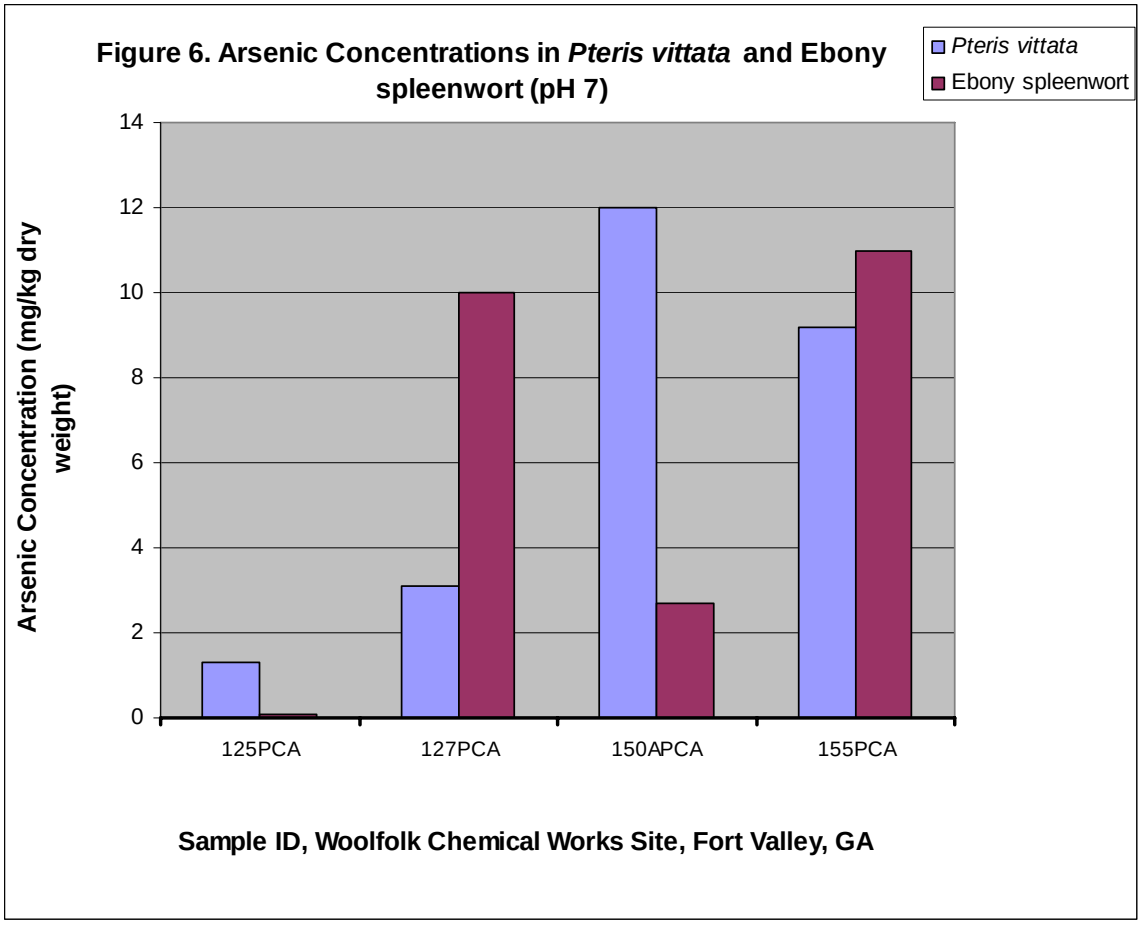
Figure 6. Arsenic Concentrations in *Pteris vittata* and Ebony spleenwort (pH 7)
Pteris vittata
Ebony spleenwort
Arsenic Concentration (mg/kg dry weight)
14
12
10
8
6
4
2
0
125PCA
127PCA
150APCA
155PCA
Sample ID, Woolfolk Chemical Works Site, Fort Valley, GA

Appendix A Analytical Results: Woolfolk Chemical Works Superfund Site, Ft. Valley, Georgia

Particle Size Characterization and Total Organic Carbon (total of 22 pages)

Native Ferns – Arsenic Concentrations (total of 15 pages)

1st Pilot Study, Fern Arsenic Concentrations after 3 Weeks (total of 11 pages)

1st Pilot Study, Fern Arsenic Concentrations after 7 Weeks (total of 11 pages)

2nd Pilot Study, Fern Arsenic Concentrations (total of 22 pages)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0525, Woolfolk Chemical - Reported by Denise Goddard

February 18, 2010

4SESD-MTSB

MEMORANDUM

SUBJECT: FINAL Analytical Report
Project: 09-0525, Woolfolk Chemical
Superfund Remedial

FROM: Denise Goddard
Quality Assurance Section Chemist

THRU: Marilyn Maycock, Chief
Quality Assurance Section

TO: Linda George

Attached are the final results for the analytical groups listed below. These analyses were performed in accordance with the associated contract Statement Of Work (SOW). In general, project data quality objectives have not been used to evaluate these data prior to release by the Quality Assurance Section. For a listing of specific data qualifiers and explanations, please refer to the Data Qualifier Definitions included in this report.

Analyses Included in this report:	Method Used:
Classical/Nutrient Analyses (CNA)	
Classical/Nutrients	Contract SOW
Particle Size Characterization (PSC)	
Particle Size Distribution	Contract SOW
Physical Properties (PHYSP)	
Physical Properties	Contract SOW

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D.A.R.T. Id: 09-0195
Project: 09-0525, Woolfolk Chemical - Reported by Denise Goddard

Report Narrative for Work Order C092702, Project: 09-0525
Data Review and Validation Report
Site Name: Woolfolk Chemical, Fort Valley, GA
Case No. NA, Project No. 09-0525, Work Order No. C092702
ELEMENT Sample IDs.: C092702-01 - C092702-06
Sampling Dates: 02/03-04/09
Laboratory Performing Inorganic Analysis: SETS Engineering Services, Tucker, GA
Date Received from Lab: 08/12/09

Analyses conducted: Total Organic Carbon and Particle Size Distribution

These results are being re-issued on 2/18/10 because the particle size distribution results are being reported as percents.

The ESAT Work Team has reviewed the above-captioned CLP data package consisting of six soil samples for Total Organic Carbon (TOC) and Particle Size Distribution (PSD) according to EPA guidelines. This package presents acceptable contractual and technical performance. Additional details are provided below.

Examination of blank samples revealed no apparent low-level contamination with Total Organic Carbon.

Total Organic Carbon SW846 9060A

No Quality Assurance/Quality Control issues were observed in the raw data for these samples. No data qualifiers were applied.

Particle Size Distribution ASTM Method

No Quality Assurance/Quality Control issues were observed in the raw data for these samples. No data qualifiers were applied.

A validation equivalent to manual stage 2B was performed on all verified samples in this document.

cc: Nardina Turner

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SAMPLES INCLUDED IN THIS REPORT

Project: 09-0525, Woolfolk Chemical

Sample ID	Laboratory ID	Matrix	Date Collected	Date Received
WC1250209	C092702-01	Surface Soil	2/3/09 13:45	2/4/09 00:00
WC1270209	C092702-02	Surface Soil	2/4/09 10:00	2/4/09 00:00
WC150A0209	C092702-03	Surface Soil	2/3/09 14:30	2/4/09 00:00
WC1550209	C092702-04	Surface Soil	2/3/09 16:00	2/4/09 00:00
WC1550209D	C092702-05	Surface Soil	2/3/09 16:15	2/4/09 00:00
WC1560209	C092702-06	Surface Soil	2/4/09 11:40	2/4/09 00:00

DATA QUALIFIER DEFINITIONS

U	The analyte was not detected at or above the reporting limit.

ACRONYMS AND ABBREVIATIONS

CAS	Chemical Abstracts Service Note: Analytes with no known CAS identifiers have been assigned codes beginning with "E", the EPA ID as assigned by the EPA Substance Registry System (www.epa.gov/srs), or beginning with "R4-", a unique identifier assigned by the EPA Region 4 laboratory.
MDL	Method Detection Limit - The minimum concentration of a substance (an analyte) that can be measured and reported with a 99% confidence that the analyte concentration is greater than zero.
MRL	Minimum Reporting Limit - Analyte concentration that corresponds to the lowest demonstrated level of acceptable quantitation. The MRL is sample-specific and accounts for preparation weights and volumes, dilutions, and moisture content of soil/sediments.
TIC	Tentatively Identified Compound - An analyte identified based on a match with the instrument software's mass spectral library. A calibration standard has not been analyzed to confirm the compound's identification or the estimated concentration reported.

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Classical/Nutrient Analyses

Project: 09-0525, Woolfolk Chemical

Sample ID: WC1250209
Station ID: WC-125

Lab ID: C092702-01
Matrix: Surface Soil

Date Collected: 2/3/09 13:45

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E701250	Total Organic Carbon	5900		mg/kg dry	50	8/30/09	8/30/09	Contract SOW

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Particle Size Characterization

Project: 09-0525, Woolfolk Chemical

Sample ID: WC1250209
Station ID: WC-125

Lab ID: C092702-01
Matrix: Surface Soil

Date Collected: 2/3/09 13:45

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
R4-8000304	PSD @ <0.002 mm	0.00	U	%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000306	PSD @ >8.000 mm	100		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000290	PSD @ 0.002-0.063 mm	3.70		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000291	PSD @ 0.063-0.125 mm	6.80		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000292	PSD @ 0.125-0.250 mm	14.1		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000293	PSD @ 0.250-0.500 mm	40.8		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000295	PSD @ 0.500-1.000 mm	72.9		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000296	PSD @ 1.000-2.000 mm	93.0		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000748	PSD @ 2.000-4.000 mm	99.0		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000749	PSD @ 4.000-8.000 mm	100		%	0.00	8/01/09	8/07/09	Contract SOW

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Physical Properties

Project: 09-0525, Woolfolk Chemical

Sample ID: WC1250209
Station ID: WC-125

Lab ID: C092702-01
Matrix: Surface Soil

Date Collected: 2/3/09 13:45

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	79		%		8/30/09	8/30/09	Contract SOW

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Classical/Nutrient Analyses

Project: 09-0525, Woolfolk Chemical

Sample ID: WC1270209
Station ID: WC127

Lab ID: C092702-02
Matrix: Surface Soil

Date Collected: 2/4/09 10:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E701250	Total Organic Carbon	24000		mg/kg dry	50	8/30/09	8/30/09	Contract SOW

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D.A.R.T. Id: 09-0195
Project: 09-0525, Woolfolk Chemical - Reported by Denise Goddard

Particle Size Characterization

Project: 09-0525, Woolfolk Chemical

Sample ID: WC1270209
Station ID: WC127

Lab ID: C092702-02
Matrix: Surface Soil

Date Collected: 2/4/09 10:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
R4-8000304	PSD @ <0.002 mm	0.00	U	%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000306	PSD @ >8.000 mm	100		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000290	PSD @ 0.002-0.063 mm	4.80		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000291	PSD @ 0.063-0.125 mm	8.00		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000292	PSD @ 0.125-0.250 mm	13.1		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000293	PSD @ 0.250-0.500 mm	29.6		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000295	PSD @ 0.500-1.000 mm	58.9		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000296	PSD @ 1.000-2.000 mm	86.7		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000748	PSD @ 2.000-4.000 mm	94.4		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000749	PSD @ 4.000-8.000 mm	99.6		%	0.00	8/01/09	8/07/09	Contract SOW

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D.A.R.T. Id: 09-0195
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Physical Properties

Project: 09-0525, Woolfolk Chemical

Sample ID: WC1270209
Station ID: WC127

Lab ID: C092702-02
Matrix: Surface Soil

Date Collected: 2/4/09 10:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	85		%		8/30/09	8/30/09	Contract SOW

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D.A.R.T. Id: 09-0195
Project: 09-0525, Woolfolk Chemical - Reported by Denise Goddard

Classical/Nutrient Analyses

Project: 09-0525, Woolfolk Chemical

Sample ID: WC150A0209
Station ID: WC150A

Lab ID: C092702-03
Matrix: Surface Soil

Date Collected: 2/3/09 14:30

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E701250	Total Organic Carbon	99000		mg/kg dry	50	8/30/09	8/30/09	Contract SOW

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D.A.R.T. Id: 09-0195
Project: 09-0525, Woolfolk Chemical - Reported by Denise Goddard

Particle Size Characterization

Project: 09-0525, Woolfolk Chemical

Sample ID: WC150A0209
Station ID: WC150A

Lab ID: C092702-03
Matrix: Surface Soil

Date Collected: 2/3/09 14:30

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
R4-8000304	PSD @ <0.002 mm	0.00	U	%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000306	PSD @ >8.000 mm	100		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000290	PSD @ 0.002-0.063 mm	25.5		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000291	PSD @ 0.063-0.125 mm	36.5		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000292	PSD @ 0.125-0.250 mm	40.4		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000293	PSD @ 0.250-0.500 mm	48.4		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000295	PSD @ 0.500-1.000 mm	59.3		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000296	PSD @ 1.000-2.000 mm	76.2		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000748	PSD @ 2.000-4.000 mm	90.6		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000749	PSD @ 4.000-8.000 mm	100		%	0.00	8/01/09	8/07/09	Contract SOW

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Project: 09-0525, Woolfolk Chemical - Reported by Denise Goddard

Physical Properties

Project: 09-0525, Woolfolk Chemical

Sample ID: WC150A0209
Station ID: WC150A

Lab ID: C092702-03
Matrix: Surface Soil

Date Collected: 2/3/09 14:30

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	22		%		8/30/09	8/30/09	Contract SOW

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0525, Woolfolk Chemical - Reported by Denise Goddard

Classical/Nutrient Analyses

Project: 09-0525, Woolfolk Chemical

Sample ID: WC1550209
Station ID: WC155

Lab ID: C092702-04
Matrix: Surface Soil

Date Collected: 2/3/09 16:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E701250	Total Organic Carbon	17000		mg/kg dry	50	8/30/09	8/30/09	Contract SOW

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D.A.R.T. Id: 09-0195
Project: 09-0525, Woolfolk Chemical - Reported by Denise Goddard

Particle Size Characterization

Project: 09-0525, Woolfolk Chemical

Sample ID: WC1550209
Station ID: WC155

Lab ID: C092702-04
Matrix: Surface Soil

Date Collected: 2/3/09 16:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
R4-8000304	PSD @ <0.002 mm	0.00	U	%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000306	PSD @ >8.000 mm	100		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000290	PSD @ 0.002-0.063 mm	5.60		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000291	PSD @ 0.063-0.125 mm	16.9		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000292	PSD @ 0.125-0.250 mm	29.2		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000293	PSD @ 0.250-0.500 mm	53.9		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000295	PSD @ 0.500-1.000 mm	71.7		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000296	PSD @ 1.000-2.000 mm	87.9		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000748	PSD @ 2.000-4.000 mm	96.0		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000749	PSD @ 4.000-8.000 mm	99.2		%	0.00	8/01/09	8/07/09	Contract SOW

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D.A.R.T. Id: 09-0195
Project: 09-0525, Woolfolk Chemical - Reported by Denise Goddard

Physical Properties

Project: 09-0525, Woolfolk Chemical

Sample ID: WC1550209
Station ID: WC155

Lab ID: C092702-04
Matrix: Surface Soil

Date Collected: 2/3/09 16:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	66		%		8/30/09	8/30/09	Contract SOW

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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D.A.R.T. Id: 09-0195
Project: 09-0525, Woolfolk Chemical - Reported by Denise Goddard

Classical/Nutrient Analyses

Project: 09-0525, Woolfolk Chemical

Sample ID: WC1550209D
Station ID: WC155

Lab ID: C092702-05
Matrix: Surface Soil

Date Collected: 2/3/09 16:15

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E701250	Total Organic Carbon	68000		mg/kg dry	50	8/30/09	8/30/09	Contract SOW

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D.A.R.T. Id: 09-0195
Project: 09-0525, Woolfolk Chemical - Reported by Denise Goddard

Particle Size Characterization

Project: 09-0525, Woolfolk Chemical

Sample ID: WC1550209D
Station ID: WC155
Lab ID: C092702-05
Matrix: Surface Soil
Date Collected: 2/3/09 16:15

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
R4-8000304	PSD @ <0.002 mm	0.00	U	%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000306	PSD @ >8.000 mm	98.1		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000290	PSD @ 0.002-0.063 mm	10.5		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000291	PSD @ 0.063-0.125 mm	18.0		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000292	PSD @ 0.125-0.250 mm	21.7		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000293	PSD @ 0.250-0.500 mm	29.0		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000295	PSD @ 0.500-1.000 mm	40.3		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000296	PSD @ 1.000-2.000 mm	60.9		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000748	PSD @ 2.000-4.000 mm	77.6		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000749	PSD @ 4.000-8.000 mm	92.4		%	0.00	8/01/09	8/07/09	Contract SOW

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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D.A.R.T. Id: 09-0195
Project: 09-0525, Woolfolk Chemical - Reported by Denise Goddard

Physical Properties

Project: 09-0525, Woolfolk Chemical

Sample ID: WC1550209D
Station ID: WC155

Lab ID: C092702-05
Matrix: Surface Soil

Date Collected: 2/3/09 16:15

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	46		%		8/30/09	8/30/09	Contract SOW

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0525, Woolfolk Chemical - Reported by Denise Goddard

Classical/Nutrient Analyses

Project: 09-0525, Woolfolk Chemical

Sample ID: WC1560209
Station ID: WC156

Lab ID: C092702-06
Matrix: Surface Soil

Date Collected: 2/4/09 11:40

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E701250	Total Organic Carbon	83000		mg/kg dry	50	8/30/09	8/30/09	Contract SOW

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0525, Woolfolk Chemical - Reported by Denise Goddard

Particle Size Characterization

Project: 09-0525, Woolfolk Chemical

Sample ID: WC1560209
Station ID: WC156

Lab ID: C092702-06
Matrix: Surface Soil

Date Collected: 2/4/09 11:40

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
R4-8000304	PSD @ <0.002 mm	0.00	U	%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000306	PSD @ >8.000 mm	100		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000290	PSD @ 0.002-0.063 mm	10.7		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000291	PSD @ 0.063-0.125 mm	18.4		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000292	PSD @ 0.125-0.250 mm	22.2		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000293	PSD @ 0.250-0.500 mm	29.5		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000295	PSD @ 0.500-1.000 mm	41.0		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000296	PSD @ 1.000-2.000 mm	62.1		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000748	PSD @ 2.000-4.000 mm	79.2		%	0.00	8/01/09	8/07/09	Contract SOW
R4-8000749	PSD @ 4.000-8.000 mm	94.2		%	0.00	8/01/09	8/07/09	Contract SOW

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
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D.A.R.T. Id: 09-0195
Project: 09-0525, Woolfolk Chemical - Reported by Denise Goddard

Physical Properties

Project: 09-0525, Woolfolk Chemical

Sample ID: WC1560209
Station ID: WC156

Lab ID: C092702-06
Matrix: Surface Soil

Date Collected: 2/4/09 11:40

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	37		%		8/30/09	8/30/09	Contract SOW

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0195, Woolfolk Chemical - Reported by Denise Goddard

February 26, 2009

4SESD-MTSB

MEMORANDUM

SUBJECT: FINAL Analytical Report
Project: 09-0195, Woolfolk Chemical
Superfund Remedial

FROM: Denise Goddard
Quality Assurance Section Chemist

THRU: Marilyn Maycock, Chief
Quality Assurance Section

TO: Linda George

Attached are the final results for the analytical groups listed below. These analyses were performed in accordance with the associated contract Statement Of Work (SOW). In general, project data quality objectives have not been used to evaluate these data prior to release by the Quality Assurance Section. For a listing of specific data qualifiers and explanations, please refer to the Data Qualifier Definitions included in this report.

Analyses Included in this report:	Method Used:
Total Metals (TMTL)	
Total Metals	CLP Inorganics
Total Metals	Contract SOW

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0195, Woolfolk Chemical - Reported by Denise Goddard

Report Narrative for Work Order C090703, Project: 09-0195
Data Review and Validation Report
Site Name: Woolfolk Chemical, Fort Valley, GA
Case No. 38221, Project No. 09-0195, Work Order No. C090703
ELEMENT Sample IDs:. C090703-01 - C090703-11
Sampling Dates: 02/03-09/09
Labratory Performing Inorganic Analysis: Chemtech Consulting Group, Mountainside, NJ
Date Received from Lab: 02/20/09

Analyses conducted: arsenic

The ESAT Work Team has reviewed the above-captioned CLP data package consisting of 11 vegetation tissue samples for arsenic analysis by ICP-AES by SOW ILM05.3, according to the contract Statement of Work and EPA guidelines. This package presents acceptable contractual and technical performance with qualifications. Further details are provided below and in the attached review summary form.

Examination of blank samples revealed no apparent low-level contamination with arsenic.

ICP-AES Analysis

PE Sample Results

No performance evaluation sample was submitted with the field samples since all field samples were vegetation and there is no vegetation performance evaluation sample provided by QATS.

Other QA/QC Results

No other Quality Assurance/Quality Control problems were observed for the field samples for arsenic analysis. Therefore, no data qualifiers were applied.

Other Comments

The laboratory stated that they only received 1.2 g for each field sample and the procedure required 2.0 g of sample to 100 ml for analysis. The laboratory requested and received permission from Region 4 to use a reduced volume of 1.0 g of sample to 50 ml to obtain the requested Contract Required Quantitation Limits.

cc: Nardina Turner

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0195, Woolfolk Chemical - Reported by Denise Goddard

SAMPLES INCLUDED IN THIS REPORT

Project: 09-0195, Woolfolk Chemical **Contract Lab Case: 38221**

Sample ID	Laboratory ID	MD#	D#	Matrix	Date Collected	Date Received
WC127ESA	C090703-01	51R8		Vegetation	2/4/09 10:00	2/5/09 00:00
WC127ESB	C090703-02	51R9		Vegetation	2/4/09 10:00	2/5/09 00:00
WC127ESBD	C090703-03	51S0		Vegetation	2/4/09 10:00	2/5/09 00:00
WC150ADS	C090703-04	51S1		Vegetation	2/3/09 14:45	2/5/09 00:00
WC150AUF	C090703-05	51S2		Vegetation	2/3/09 14:45	2/5/09 00:00
WC155PA	C090703-06	51S3		Vegetation	2/3/09 16:00	2/5/09 00:00
WC155WAF	C090703-07	51S4		Vegetation	2/3/09 16:00	2/5/09 00:00
WC155WAS	C090703-08	51S5		Vegetation	2/3/09 16:00	2/5/09 00:00
WC156DS	C090703-09	51S6		Vegetation	2/4/09 11:40	2/5/09 00:00
WC156ES	C090703-10	51S7		Vegetation	2/4/09 11:40	2/5/09 00:00
WC156WA	C090703-11	5307		Vegetation	2/4/09 11:40	2/5/09 00:00

DATA QUALIFIER DEFINITIONS

U	The analyte was not detected at or above the reporting limit.
J	The identification of the analyte is acceptable; the reported value is an estimate.
Q-2	Result greater than MDL but less than MRL.

ACRONYMS AND ABBREVIATIONS

CAS — Chemical Abstracts Service

Note: Analytes with no known CAS identifiers have been assigned codes beginning with "E", the EPA ID as assigned by the EPA Substance Registry System (www.epa.gov/srs), or beginning with "R4-", a unique identifier assigned by the EPA Region 4 laboratory.

MDL — Method Detection Limit - The minimum concentration of a substance (an analyte) that can be measured and reported with a 99% confidence that the analyte concentration is greater than zero.

MRL — Minimum Reporting Limit - Analyte concentration that corresponds to the lowest demonstrated level of acceptable quantitation. The MRL is sample-specific and accounts for preparation weights and volumes, dilutions, and moisture content of soil/sediments.

TIC — Tentatively Identified Compound - An analyte identified based on a match with the instrument software's mass spectral library. A calibration standard has not been analyzed to confirm the compound's identification or the estimated concentration reported.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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D.A.R.T. Id: 09-0195
Project: 09-0195, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0195, Woolfolk Chemical

Contract Lab Case: 38221

MD No: 51R8 CHEM

Sample ID: WC127ESA

Station ID: WC127

Lab ID: C090703-01

Matrix: Vegetation

D No:

Date Collected: 2/4/09 10:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	100		%		2/17/09	2/18/09	CLP Inorganics
7440-38-2	Arsenic	30		mg/kg	0.50	2/17/09	2/18/09	CLP ILM05.4 P

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980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0195, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0195, Woolfolk Chemical

Contract Lab Case: 38221

MD No: 51R9 CHEM

Sample ID: WC127ESB

Station ID: WC127

Lab ID: C090703-02

Matrix: Vegetation

D No:

Date Collected: 2/4/09 10:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	100		%		2/17/09	2/18/09	CLP Inorganics
7440-38-2	Arsenic	2.4		mg/kg	0.50	2/17/09	2/18/09	CLP ILM05.4 P

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980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0195, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0195, Woolfolk Chemical

Contract Lab Case: 38221

MD No: 51S0 CHEM

Sample ID: WC127ESBD

Station ID: WC127

Lab ID: C090703-03

Matrix: Vegetation

D No:

Date Collected: 2/4/09 10:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	100		%		2/17/09	2/18/09	CLP Inorganics
7440-38-2	Arsenic	2.4		mg/kg	0.50	2/17/09	2/18/09	CLP ILM05.4 P

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Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0195, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0195, Woolfolk Chemical

Contract Lab Case: 38221

MD No: 51S1 CHEM

Sample ID: WC150ADS

Station ID: WC150A

Lab ID: C090703-04

Matrix: Vegetation

D No:

Date Collected: 2/3/09 14:45

CAS Number	*Analyte*	*Results*	*Qualifiers*	*Units*	*MRL*	*Prepared*	*Analyzed*	*Method*
E1642941	% Solids	100		%		2/17/09	2/18/09	CLP Inorganics
7440-38-2	Arsenic	1.6		mg/kg	0.50	2/17/09	2/18/09	CLP ILM05.4 P

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D.A.R.T. Id: 09-0195
Project: 09-0195, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0195, Woolfolk Chemical

Contract Lab Case: 38221

MD No: 51S2 CHEM

Sample ID: WC150AUF

Station ID: WC150A

Lab ID: C090703-05

Matrix: Vegetation

D No:

Date Collected: 2/3/09 14:45

CAS Number	*Analyte*	*Results*	*Qualifiers*	*Units*	*MRL*	*Prepared*	*Analyzed*	*Method*
E1642941	% Solids	100		%		2/17/09	2/18/09	CLP Inorganics
7440-38-2	Arsenic	0.50	U	mg/kg	0.50	2/17/09	2/18/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
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D.A.R.T. Id: 09-0195
Project: 09-0195, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0195, Woolfolk Chemical

Contract Lab Case: 38221

MD No: 51S3 CHEM

Sample ID: WC155PA

Station ID: WC155

Lab ID: C090703-06

Matrix: Vegetation

D No:

Date Collected: 2/3/09 16:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	100		%		2/17/09	2/18/09	CLP Inorganics
7440-38-2	Arsenic	0.26	J, Q-2	mg/kg	0.50	2/17/09	2/18/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0195, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0195, Woolfolk Chemical

Contract Lab Case: 38221

MD No: 51S4 CHEM

Sample ID: WC155WAF

Station ID: WC155

Lab ID: C090703-07

Matrix: Vegetation

D No:

Date Collected: 2/3/09 16:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	100		%		2/17/09	2/18/09	CLP Inorganics
7440-38-2	Arsenic	0.50	U	mg/kg	0.50	2/17/09	2/18/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0195, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0195, Woolfolk Chemical

Contract Lab Case: 38221

MD No: 51S5 CHEM

Sample ID: WC155WAS

Station ID: WC155

Lab ID: C090703-08

Matrix: Vegetation

D No:

Date Collected: 2/3/09 16:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	100		%		2/17/09	2/18/09	CLP Inorganics
7440-38-2	Arsenic	0.25	J, Q-2	mg/kg	0.50	2/17/09	2/18/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0195, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0195, Woolfolk Chemical

Contract Lab Case: 38221

MD No: 51S6 CHEM

Sample ID: WC156DS

Station ID: WC156

Lab ID: C090703-09

Matrix: Vegetation

D No:

Date Collected: 2/4/09 11:40

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	100		%		2/17/09	2/18/09	CLP Inorganics
7440-38-2	Arsenic	1.2		mg/kg	0.50	2/17/09	2/18/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0195, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0195, Woolfolk Chemical

Contract Lab Case: 38221

MD No: 51S7 CHEM

Sample ID: WC156ES

Station ID: WC156

Lab ID: C090703-10

Matrix: Vegetation

D No:

Date Collected: 2/4/09 11:40

CAS Number	*Analyte*	*Results*	*Qualifiers*	*Units*	*MRL*	*Prepared*	*Analyzed*	*Method*
E1642941	% Solids	100		%		2/17/09	2/18/09	CLP Inorganics
7440-38-2	Arsenic	0.50	U	mg/kg	0.50	2/17/09	2/18/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0195, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0195, Woolfolk Chemical

Contract Lab Case: 38221

MD No: 5307 CHEM

Sample ID: WC156WA

Station ID: WC156

Lab ID: C090703-11

Matrix: Vegetation

D No:

Date Collected: 2/4/09 11:40

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	100		%		2/17/09	2/18/09	CLP Inorganics
7440-38-2	Arsenic	0.18	J, Q-2	mg/kg	0.50	2/17/09	2/18/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0220, Woolfolk Chemical - Reported by Denise Goddard

April 13, 2009

4SESD-MTSB

MEMORANDUM

SUBJECT: FINAL Analytical Report
Project: 09-0220, Woolfolk Chemical
Superfund Remedial

FROM: Denise Goddard
Quality Assurance Section Chemist

THRU: Marilyn Maycock, Chief
Quality Assurance Section

TO: Linda George

Attached are the final results for the analytical groups listed below. These analyses were performed in accordance with the associated contract Statement Of Work (SOW). In general, project data quality objectives have not been used to evaluate these data prior to release by the Quality Assurance Section. For a listing of specific data qualifiers and explanations, please refer to the Data Qualifier Definitions included in this report.

Analyses Included in this report:	Method Used:
Total Metals (TMTL)	
Total Metals	CLP Inorganics
Total Metals	Contract SOW

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0220, Woolfolk Chemical - Reported by Denise Goddard

Report Narrative for Work Order C091306, Project: 09-0220
Data Review and Validation Report
Site Name: Woolfolk Chemical, Fort Valley, GA
Case No. 38354, Project No. 09-0220, Work Order No. C091306
ELEMENT Sample IDs.: C091306-01 - C091306-07
Sampling Dates: 03/20/09
Laboratory Performing Inorganic Analysis: Chemtech Consulting Group, Mountainside, NJ
Date Received from Lab: 04/03/09

Analyses conducted: arsenic

The ESAT Work Team has reviewed the above-captioned CLP data package consisting of seven vegetation samples for arsenic analysis by ICP-AES by SOW ILM05.3, according to the contract Statement of Work and EPA guidelines. This package presents acceptable contractual and technical performance with qualifications. Further details are provided below and in the attached review summary form.

Examination of blank samples revealed apparent low-level contamination with arsenic. Reported detection limits were adjusted as high as five times blank levels to discount possible false positives due to contamination.

ICP-AES Analysis

PE Sample Results

No performance evaluation sample was submitted with the field samples since they were vegetation samples.

Other QA/QC Results

There were no other QA/QC problems for arsenic analysis. Therefore, no data qualifiers were applied for these criteria.

cc: Nardina Turner

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0220, Woolfolk Chemical - Reported by Denise Goddard

SAMPLES INCLUDED IN THIS REPORT

Project: 09-0220, Woolfolk Chemical **Contract Lab Case: 38354**

Sample ID	Laboratory ID	MD#	D#	Matrix	Date Collected	Date Received
WCControlPCA	C091306-01	54N6		Control Tissue	3/20/09 11:00	3/21/09 00:00
WC125PCA	C091306-02	54N7		Vegetation	3/20/09 11:00	3/21/09 00:00
WC127PCA	C091306-03	54N8		Vegetation	3/20/09 11:00	3/21/09 00:00
WC150APCA	C091306-04	54N9		Vegetation	3/20/09 11:00	3/21/09 00:00
WC155DPCA	C091306-05	54S8		Vegetation	3/20/09 11:00	3/21/09 00:00
WC155PCA	C091306-06	54P0		Vegetation	3/20/09 11:00	3/21/09 00:00
WC156PCA	C091306-07	54P1		Vegetation	3/20/09 11:00	3/21/09 00:00

DATA QUALIFIER DEFINITIONS

ACRONYMS AND ABBREVIATIONS

CAS Chemical Abstracts Service

Note: Analytes with no known CAS identifiers have been assigned codes beginning with "E", the EPA ID as assigned by the EPA Substance Registry System (www.epa.gov/srs), or beginning with "R4-", a unique identifier assigned by the EPA Region 4 laboratory.

MDL Method Detection Limit - The minimum concentration of a substance (an analyte) that can be measured and reported with a 99% confidence that the analyte concentration is greater than zero.

MRL Minimum Reporting Limit - Analyte concentration that corresponds to the lowest demonstrated level of acceptable quantitation. The MRL is sample-specific and accounts for preparation weights and volumes, dilutions, and moisture content of soil/sediments.

TIC Tentatively Identified Compound - An analyte identified based on a match with the instrument software's mass spectral library. A calibration standard has not been analyzed to confirm the compound's identification or the estimated concentration reported.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0220, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0220, Woolfolk Chemical

Contract Lab Case: 38354

MD No: 54N6 CHEM

Sample ID: WCControlPCA

Station ID:

Lab ID: C091306-01

Matrix: Control Tissue

D No:

Date Collected: 3/20/09 11:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	100		%		3/31/09	3/31/09	CLP Inorganics
7440-38-2	Arsenic	1.6		mg/kg	0.50	3/31/09	3/31/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0220, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0220, Woolfolk Chemical

Contract Lab Case: 38354

MD No: 54N7 CHEM

Sample ID: WC125PCA

Station ID: WC-125

Lab ID: C091306-02

Matrix: Vegetation

D No:

Date Collected: 3/20/09 11:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	100		%		3/31/09	3/31/09	CLP Inorganics
7440-38-2	Arsenic	1.1		mg/kg	0.50	3/31/09	3/31/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0220, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0220, Woolfolk Chemical

Contract Lab Case: 38354

MD No: 54N8 CHEM

Sample ID: WC127PCA

Station ID: WC127

Lab ID: C091306-03

Matrix: Vegetation

D No:

Date Collected: 3/20/09 11:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	100		%		3/31/09	3/31/09	CLP Inorganics
7440-38-2	Arsenic	110		mg/kg	0.50	3/31/09	3/31/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0220, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0220, Woolfolk Chemical

Contract Lab Case: 38354

MD No: 54N9 CHEM

Sample ID: WC150APCA

Station ID: WC150

Lab ID: C091306-04

Matrix: Vegetation

D No:

Date Collected: 3/20/09 11:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	100		%		3/31/09	3/31/09	CLP Inorganics
7440-38-2	Arsenic	7.2		mg/kg	0.50	3/31/09	3/31/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0220, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0220, Woolfolk Chemical

Contract Lab Case: 38354

MD No: 54S8 CHEM

Sample ID: WC155DPCA

Station ID: WC155

Lab ID: C091306-05

Matrix: Vegetation

D No:

Date Collected: 3/20/09 11:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	100		%		3/31/09	3/31/09	CLP Inorganics
7440-38-2	Arsenic	2.1		mg/kg	0.50	3/31/09	3/31/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0220, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0220, Woolfolk Chemical

Contract Lab Case: 38354

MD No: 54P0 CHEM

Sample ID: WC155PCA

Station ID: WC155

Lab ID: C091306-06

Matrix: Vegetation

D No:

Date Collected: 3/20/09 11:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	100		%		3/31/09	3/31/09	CLP Inorganics
7440-38-2	Arsenic	2.3		mg/kg	0.50	3/31/09	3/31/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0220, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0220, Woolfolk Chemical

Contract Lab Case: 38354

MD No: 54P1 CHEM

Sample ID: WC156PCA
Station ID: WC156

Lab ID: C091306-07
Matrix: Vegetation

D No:

Date Collected: 3/20/09 11:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	100		%		3/31/09	3/31/09	CLP Inorganics
7440-38-2	Arsenic	2.9		mg/kg	0.50	3/31/09	3/31/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0221, Woolfolk Chemical - Reported by Denise Goddard

May 12, 2009

4SESD-MTSB

MEMORANDUM

SUBJECT: FINAL Analytical Report
Project: 09-0221, Woolfolk Chemical
Superfund Remedial

FROM: Denise Goddard
Quality Assurance Section Chemist

THRU: Marilyn Maycock, Chief
Quality Assurance Section

TO: Linda George

Attached are the final results for the analytical groups listed below. These analyses were performed in accordance with the associated contract Statement Of Work (SOW). In general, project data quality objectives have not been used to evaluate these data prior to release by the Quality Assurance Section. For a listing of specific data qualifiers and explanations, please refer to the Data Qualifier Definitions included in this report.

Analyses Included in this report:	Method Used:
Total Metals (TMTL)	
Total Metals	CLP Inorganics
Total Metals	Contract SOW

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0221, Woolfolk Chemical - Reported by Denise Goddard

Report Narrative for Work Order C091703, Project: 09-0221
Data Review and Validation Report
Site Name: Woolfolk Chemical, Fort Valley, GA
Case No. 38436, Project No. 09-0221, Work Order No. C091703
ELEMENT Sample ID. Nos. C091703-01 - 07
Sampling Dates: 04/17/09
Laboratory Performing Inorganic Analysis: Chemtech Consulting Group, Mountainside, NJ
Date Received from Lab: 05/04/09

Analyses conducted: Arsenic by IC-AES

The ESAT Work Team has reviewed the above-captioned CLP data package consisting of 7 tissue samples for arsenic analysis by ICP-AES by SOW ILM05.3, according to the contract Statement of Work and EPA guidelines. This package presents acceptable contractual and technical performance with qualifications. Further details are provided below and in the attached review summary form.

Examination of blank samples revealed no apparent low-level contamination with arsenic.

ICP-AES Analysis

PE Sample Results

A performance evaluation sample was not sent to the laboratory for analysis.

Other QA/QC Results

There were no other quality assurance/quality control problems associated with this case. Therefore, no data qualifiers were applied for these criteria.

cc: Nardina Turner

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0221, Woolfolk Chemical - Reported by Denise Goddard

SAMPLES INCLUDED IN THIS REPORT

Project: 09-0221, Woolfolk Chemical **Contract Lab Case: 38436**

Sample ID	Laboratory ID	MD#	D#	Matrix	Date Collected	Date Received
WCControlPCB	C091703-01	5644		Control Tissue	4/17/09 11:00	4/18/09 00:00
WC125PCB	C091703-02	5645		Vegetation	4/17/09 11:00	4/18/09 00:00
WC127PCB	C091703-03	5646		Vegetation	4/17/09 11:00	4/18/09 00:00
WC150APCB	C091703-04	5647		Vegetation	4/17/09 11:00	4/18/09 00:00
WC155DPCB	C091703-05	5648		Vegetation	4/17/09 11:00	4/18/09 00:00
WC155PCB	C091703-06	5649		Vegetation	4/17/09 11:00	4/18/09 00:00
WC156PCB	C091703-07	5650		Vegetation	4/17/09 11:00	4/18/09 00:00

DATA QUALIFIER DEFINITIONS

ACRONYMS AND ABBREVIATIONS

CAS Chemical Abstracts Service

Note: Analytes with no known CAS identifiers have been assigned codes beginning with "E", the EPA ID as assigned by the EPA Substance Registry System (www.epa.gov/srs), or beginning with "R4-", a unique identifier assigned by the EPA Region 4 laboratory.

MDL Method Detection Limit - The minimum concentration of a substance (an analyte) that can be measured and reported with a 99% confidence that the analyte concentration is greater than zero.

MRL Minimum Reporting Limit - Analyte concentration that corresponds to the lowest demonstrated level of acceptable quantitation. The MRL is sample-specific and accounts for preparation weights and volumes, dilutions, and moisture content of soil/sediments.

TIC Tentatively Identified Compound - An analyte identified based on a match with the instrument software's mass spectral library. A calibration standard has not been analyzed to confirm the compound's identification or the estimated concentration reported.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0221, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0221, Woolfolk Chemical

Contract Lab Case: 38436

MD No: 5644 CHEM

Sample ID: WCControlPCB

Station ID:

Lab ID: C091703-01

Matrix: Control Tissue

D No:

Date Collected: 4/17/09 11:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	100		%		4/29/09	4/29/09	CLP Inorganics
7440-38-2	Arsenic	1.1		mg/kg	0.50	4/29/09	4/29/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0221, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0221, Woolfolk Chemical

Contract Lab Case: 38436

MD No: 5645 CHEM

Sample ID: WC125PCB

Station ID: WC-125

Lab ID: C091703-02

Matrix: Vegetation

D No:

Date Collected: 4/17/09 11:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	100		%		4/29/09	4/29/09	CLP Inorganics
7440-38-2	Arsenic	1.7		mg/kg	0.50	4/29/09	4/29/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0221, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0221, Woolfolk Chemical

Contract Lab Case: 38436

MD No: 5646 CHEM

Sample ID: WC127PCB

Station ID: WC127

Lab ID: C091703-03

Matrix: Vegetation

D No:

Date Collected: 4/17/09 11:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	100		%		4/29/09	4/29/09	CLP Inorganics
7440-38-2	Arsenic	600		mg/kg	0.50	4/29/09	4/29/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0221, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0221, Woolfolk Chemical

Contract Lab Case: 38436

MD No: 5647 CHEM

Sample ID: WC150APCB

Station ID: WC150A

Lab ID: C091703-04

Matrix: Vegetation

D No:

Date Collected: 4/17/09 11:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	100		%		4/29/09	4/29/09	CLP Inorganics
7440-38-2	Arsenic	11		mg/kg	0.50	4/29/09	4/29/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0221, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0221, Woolfolk Chemical

Contract Lab Case: 38436

MD No: 5648 CHEM

Sample ID: WC155DPCB

Station ID: WC155

Lab ID: C091703-05

Matrix: Vegetation

D No:

Date Collected: 4/17/09 11:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	100		%		4/29/09	4/29/09	CLP Inorganics
7440-38-2	Arsenic	1.7		mg/kg	0.50	4/29/09	4/29/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0221, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0221, Woolfolk Chemical

Contract Lab Case: 38436

MD No: 5649 CHEM

Sample ID: WC155PCB

Station ID: WC155

Lab ID: C091703-06

Matrix: Vegetation

D No:

Date Collected: 4/17/09 11:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	100		%		4/29/09	4/29/09	CLP Inorganics
7440-38-2	Arsenic	2.3		mg/kg	0.50	4/29/09	4/29/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0221, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0221, Woolfolk Chemical

Contract Lab Case: 38436

MD No: 5650 CHEM

Sample ID: WC156PCB

Station ID: WC156

Lab ID: C091703-07

Matrix: Vegetation

D No:

Date Collected: 4/17/09 11:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	100		%		4/29/09	4/29/09	CLP Inorganics
7440-38-2	Arsenic	6.8		mg/kg	0.50	4/29/09	4/29/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0610, Woolfolk Chemical - Reported by Denise Goddard

December 17, 2009

4SESD-MTSB

MEMORANDUM

SUBJECT: FINAL Analytical Report
Project: 09-0610, Woolfolk Chemical
Superfund Remedial

FROM: Denise Goddard
Quality Assurance Section Chemist

THRU: Marilyn Maycock, Chief
Quality Assurance Section

TO: Linda George

Attached are the final results for the analytical groups listed below. These analyses were performed in accordance with the associated contract Statement Of Work (SOW). In general, project data quality objectives have not been used to evaluate these data prior to release by the Quality Assurance Section. For a listing of specific data qualifiers and explanations, please refer to the Data Qualifier Definitions included in this report.

Analyses Included in this report:	Method Used:
Total Metals (TMTL)	
Total Metals	CLP Inorganics
Total Metals	Contract SOW

Report Narrative for Work Order C093108, Project: 09-0610
Data Review and Validation Report
Site Name: Woolfolk Chemical, Fort Valley, GA
Case No. 38830, Project No. 09-0610, Work Order No. C093108
ELEMENT Sample IDs.: C093108-01 - C093108-17
Sampling Dates: 07/30/09
Laboratory Performing Inorganic Analysis: Bonner Analytical Testing, Hattiesburg, MS
Date Received from Lab: 08/14/09

Analyses conducted: Arsenic

This report is being reissued to report the arsenic results on a wet weight basis.

The ESAT Work Team has reviewed the above-captioned CLP data package consisting of 17 tissue samples for arsenic analysis by ICP-AES by SOW ILM05.3, according to the contract Statement of Work and EPA guidelines. This package presents acceptable contractual and technical performance with qualifications. Additional details are provided below.

Examination of blank samples revealed no apparent low-level arsenic contamination present.

ICP-AES Analysis

PE Sample Results

No performance evaluation sample was submitted to the laboratory since all field samples were tissue samples.

Other QA/QC Results

There were no other Quality Assurance/Quality Control problems observed for arsenic in this data package. Therefore, no data qualifiers were applied based on these criteria.

A Stage 4 validation consisting of electronic and manual review was performed on the inorganic samples submitted for this case.

Deliverables

There was a discrepancy between the detection limits reported on the Form1s, CADRE, and spreadsheets and the Method Reporting Limits (MRLs) for the arsenic results. The reported MRL calculations were checked and verified by the data reviewer and shown to be correct. The laboratory was contacted and asked to resolve this discrepancy. Corrected Form 1s were received 08/24/09.

cc: Nardina Turner

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0610, Woolfolk Chemical - Reported by Denise Goddard

SAMPLES INCLUDED IN THIS REPORT

Project: 09-0610, Woolfolk Chemical **Contract Lab Case: 38830**

Sample ID	Laboratory ID	MD#	D#	Matrix	Date Collected	Date Received
ControlES0709	C093108-01	5BP5		Control Tissue	7/30/09 13:00	7/31/09 00:00
125PV0709	C093108-02	5BP6		Vegetation	7/30/09 13:00	7/31/09 00:00
125PVN0709	C093108-03	5BP7		Vegetation	7/30/09 13:00	7/31/09 00:00
127ES0709	C093108-04	5BP8		Vegetation	7/30/09 13:00	7/31/09 00:00
127ESF0709	C093108-05	5BP9		Vegetation	7/30/09 13:00	7/31/09 00:00
127ESN0709	C093108-06	5BQ0		Vegetation	7/30/09 13:00	7/31/09 00:00
127PV0709	C093108-07	5BQ1		Vegetation	7/30/09 13:00	7/31/09 00:00
127PVF0709	C093108-08	5BQ2		Vegetation	7/30/09 13:00	7/31/09 00:00
127PVN0709	C093108-09	5BQ3		Vegetation	7/30/09 13:00	7/31/09 00:00
155ES0709	C093108-10	5BQ4		Vegetation	7/30/09 13:00	7/31/09 00:00
155ESN0709	C093108-11	5BQ5		Vegetation	7/30/09 13:00	7/31/09 00:00
155PV0709	C093108-12	5BQ6		Vegetation	7/30/09 13:00	7/31/09 00:00
155PVN0709	C093108-13	5BQ7		Vegetation	7/30/09 13:00	7/31/09 00:00
156ES0709	C093108-14	5BQ8		Vegetation	7/30/09 13:00	7/31/09 00:00
156ESN0709	C093108-15	5BQ9		Vegetation	7/30/09 13:00	7/31/09 00:00
156PV0709	C093108-16	5BR0		Vegetation	7/30/09 13:00	7/31/09 00:00
156PVN0709	C093108-17	5BR1		Vegetation	7/30/09 13:00	7/31/09 00:00

DATA QUALIFIER DEFINITIONS

U	The analyte was not detected at or above the reporting limit.
J	The identification of the analyte is acceptable; the reported value is an estimate.
Q-2	Result greater than MDL but less than MRL.

ACRONYMS AND ABBREVIATIONS

CAS — Chemical Abstracts Service

Note: Analytes with no known CAS identifiers have been assigned codes beginning with "E", the EPA ID as assigned by the EPA Substance Registry System (www.epa.gov/srs), or beginning with "R4-", a unique identifier assigned by the EPA Region 4 laboratory.

MDL — Method Detection Limit - The minimum concentration of a substance (an analyte) that can be measured and reported with a 99% confidence that the analyte concentration is greater than zero.

MRL — Minimum Reporting Limit - Analyte concentration that corresponds to the lowest demonstrated level of acceptable quantitation. The MRL is sample-specific and accounts for preparation weights and volumes, dilutions, and moisture content of soil/sediments.

TIC — Tentatively Identified Compound - An analyte identified based on a match with the instrument software's mass spectral library. A calibration standard has not been analyzed to confirm the compound's identification or the estimated concentration reported.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0610, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0610, Woolfolk Chemical

Contract Lab Case: 38830

MD No: 5BP5 BONNER

Sample ID: ControlES0709

Station ID:

Lab ID: C093108-01

Matrix: Control Tissue

D No:

Date Collected: 7/30/09 13:00

CAS Number	*Analyte*	*Results*	*Qualifiers*	*Units*	*MRL*	*Prepared*	*Analyzed*	*Method*
E1642941	% Solids	40		%		8/10/09	8/11/09	CLP Inorganics
7440-38-2	Arsenic	1.0	U	mg/kg	1.0	8/10/09	8/11/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0610, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0610, Woolfolk Chemical

Contract Lab Case: 38830

MD No: 5BP6 BONNER

Sample ID: 125PV0709

Station ID: WC-125

Lab ID: C093108-02

Matrix: Vegetation

D No:

Date Collected: 7/30/09 13:00

CAS Number	*Analyte*	*Results*	*Qualifiers*	*Units*	*MRL*	*Prepared*	*Analyzed*	*Method*
E1642941	% Solids	27		%		8/10/09	8/11/09	CLP Inorganics
7440-38-2	Arsenic	0.36	J, Q-2	mg/kg	1.0	8/10/09	8/11/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0610, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0610, Woolfolk Chemical

Contract Lab Case: 38830

MD No: 5BP7 BONNER

Sample ID: 125PVN0709

Station ID: WC-125

Lab ID: C093108-03

Matrix: Vegetation

D No:

Date Collected: 7/30/09 13:00

CAS Number	*Analyte*	*Results*	*Qualifiers*	*Units*	*MRL*	*Prepared*	*Analyzed*	*Method*
E1642941	% Solids	24		%		8/10/09	8/11/09	CLP Inorganics
7440-38-2	Arsenic	0.31	J, Q-2	mg/kg	1.0	8/10/09	8/11/09	CLP ILM05.4 P

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Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0610, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0610, Woolfolk Chemical

Contract Lab Case: 38830

MD No: 5BP8 BONNER

Sample ID: 127ES0709

Station ID: WC127

Lab ID: C093108-04

Matrix: Vegetation

D No:

Date Collected: 7/30/09 13:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	47		%		8/10/09	8/11/09	CLP Inorganics
7440-38-2	Arsenic	18		mg/kg	1.0	8/10/09	8/11/09	CLP ILM05.4 P

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Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0610, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0610, Woolfolk Chemical

Contract Lab Case: 38830

MD No: 5BP9 BONNER

Sample ID: 127ESF0709

Station ID: WC127

Lab ID: C093108-05

Matrix: Vegetation

D No:

Date Collected: 7/30/09 13:00

CAS Number	*Analyte*	*Results*	*Qualifiers*	*Units*	*MRL*	*Prepared*	*Analyzed*	*Method*
E1642941	% Solids	28		%		8/10/09	8/11/09	CLP Inorganics
7440-38-2	Arsenic	1.4		mg/kg	1.0	8/10/09	8/11/09	CLP ILM05.4 P

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Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0610, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0610, Woolfolk Chemical

Contract Lab Case: 38830

MD No: 5BQ0 BONNER

Sample ID: 127ESN0709

Station ID: WC127

Lab ID: C093108-06

Matrix: Vegetation

D No:

Date Collected: 7/30/09 13:00

CAS Number	*Analyte*	*Results*	*Qualifiers*	*Units*	*MRL*	*Prepared*	*Analyzed*	*Method*
E1642941	% Solids	31		%		8/10/09	8/11/09	CLP Inorganics
7440-38-2	Arsenic	3.1		mg/kg	1.0	8/10/09	8/11/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0610, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0610, Woolfolk Chemical

Contract Lab Case: 38830

MD No: 5BQ1 BONNER

Sample ID: 127PV0709

Station ID: WC127

Lab ID: C093108-07

Matrix: Vegetation

D No:

Date Collected: 7/30/09 13:00

CAS Number	*Analyte*	*Results*	*Qualifiers*	*Units*	*MRL*	*Prepared*	*Analyzed*	*Method*
E1642941	% Solids	51		%		8/10/09	8/11/09	CLP Inorganics
7440-38-2	Arsenic	13		mg/kg	1.0	8/10/09	8/11/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0610, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0610, Woolfolk Chemical

Contract Lab Case: 38830

MD No: 5BQ2 BONNER

Sample ID: 127PVF0709

Station ID: WC127

Lab ID: C093108-08

Matrix: Vegetation

D No:

Date Collected: 7/30/09 13:00

CAS Number	*Analyte*	*Results*	*Qualifiers*	*Units*	*MRL*	*Prepared*	*Analyzed*	*Method*
E1642941	% Solids	89		%		8/10/09	8/11/09	CLP Inorganics
7440-38-2	Arsenic	3.7		mg/kg	1.0	8/10/09	8/11/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0610, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0610, Woolfolk Chemical

Contract Lab Case: 38830

MD No: 5BQ3 BONNER

Sample ID: 127PVN0709

Station ID: WC127

Lab ID: C093108-09

Matrix: Vegetation

D No:

Date Collected: 7/30/09 13:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	33		%		8/10/09	8/11/09	CLP Inorganics
7440-38-2	Arsenic	1.0		mg/kg	1.0	8/10/09	8/11/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0610, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0610, Woolfolk Chemical

Contract Lab Case: 38830

MD No: 5BQ4 BONNER

Sample ID: 155ES0709

Station ID: WC155

Lab ID: C093108-10

Matrix: Vegetation

D No:

Date Collected: 7/30/09 13:00

CAS Number	*Analyte*	*Results*	*Qualifiers*	*Units*	*MRL*	*Prepared*	*Analyzed*	*Method*
E1642941	% Solids	35		%		8/10/09	8/11/09	CLP Inorganics
7440-38-2	Arsenic	1.9		mg/kg	1.0	8/10/09	8/11/09	CLP ILM05.4 P

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Region 4 Science and Ecosystem Support Division
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D.A.R.T. Id: 09-0195
Project: 09-0610, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0610, Woolfolk Chemical

Contract Lab Case: 38830

MD No: 5BQ5 BONNER

Sample ID: 155ESN0709

Station ID: WC155

Lab ID: C093108-11

Matrix: Vegetation

D No:

Date Collected: 7/30/09 13:00

CAS Number	*Analyte*	*Results*	*Qualifiers*	*Units*	*MRL*	*Prepared*	*Analyzed*	*Method*
E1642941	% Solids	36		%		8/10/09	8/11/09	CLP Inorganics
7440-38-2	Arsenic	1.0	U	mg/kg	1.0	8/10/09	8/11/09	CLP ILM05.4 P

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Region 4 Science and Ecosystem Support Division
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D.A.R.T. Id: 09-0195
Project: 09-0610, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0610, Woolfolk Chemical

Contract Lab Case: 38830

MD No: 5BQ6 BONNER

Sample ID: 155PV0709

Station ID: WC155

Lab ID: C093108-12

Matrix: Vegetation

D No:

Date Collected: 7/30/09 13:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	24		%		8/10/09	8/11/09	CLP Inorganics
7440-38-2	Arsenic	0.55	J, Q-2	mg/kg	1.0	8/10/09	8/11/09	CLP ILM05.4 P

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Region 4 Science and Ecosystem Support Division
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D.A.R.T. Id: 09-0195
Project: 09-0610, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0610, Woolfolk Chemical

Contract Lab Case: 38830

MD No: 5BQ7 BONNER

Sample ID: 155PVN0709

Station ID: WC155

Lab ID: C093108-13

Matrix: Vegetation

D No:

Date Collected: 7/30/09 13:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	21		%		8/10/09	8/11/09	CLP Inorganics
7440-38-2	Arsenic	2.5		mg/kg	1.0	8/10/09	8/11/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
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D.A.R.T. Id: 09-0195
Project: 09-0610, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0610, Woolfolk Chemical

Contract Lab Case: 38830

MD No: 5BQ8 BONNER

Sample ID: 156ES0709

Station ID: WC156

Lab ID: C093108-14

Matrix: Vegetation

D No:

Date Collected: 7/30/09 13:00

CAS Number	*Analyte*	*Results*	*Qualifiers*	*Units*	*MRL*	*Prepared*	*Analyzed*	*Method*
E1642941	% Solids	30		%		8/10/09	8/11/09	CLP Inorganics
7440-38-2	Arsenic	1.0	U	mg/kg	1.0	8/10/09	8/11/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0610, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0610, Woolfolk Chemical

Contract Lab Case: 38830

MD No: 5BQ9 BONNER

Sample ID: 156ESN0709

Station ID: WC156

Lab ID: C093108-15

Matrix: Vegetation

D No:

Date Collected: 7/30/09 13:00

CAS Number	Analyte	Results	Qualifiers	Units	MRL	Prepared	Analyzed	Method
E1642941	% Solids	36		%		8/10/09	8/11/09	CLP Inorganics
7440-38-2	Arsenic	4.1		mg/kg	1.0	8/10/09	8/11/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0610, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0610, Woolfolk Chemical

Contract Lab Case: 38830

MD No: 5BR0 BONNER

Sample ID: 156PV0709

Station ID: WC156

Lab ID: C093108-16

Matrix: Vegetation

D No:

Date Collected: 7/30/09 13:00

CAS Number	*Analyte*	*Results*	*Qualifiers*	*Units*	*MRL*	*Prepared*	*Analyzed*	*Method*
E1642941	% Solids	22		%		8/10/09	8/11/09	CLP Inorganics
7440-38-2	Arsenic	0.92	J, Q-2	mg/kg	1.0	8/10/09	8/11/09	CLP ILM05.4 P

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 4 Science and Ecosystem Support Division
980 College Station Road, Athens, Georgia 30605-2700
D.A.R.T. Id: 09-0195
Project: 09-0610, Woolfolk Chemical - Reported by Denise Goddard

Total Metals

Project: 09-0610, Woolfolk Chemical

Contract Lab Case: 38830

MD No: 5BR1 BONNER

Sample ID: 156PVN0709

Station ID: WC156

Lab ID: C093108-17

Matrix: Vegetation

D No:

Date Collected: 7/30/09 13:00

CAS Number	*Analyte*	*Results*	*Qualifiers*	*Units*	*MRL*	*Prepared*	*Analyzed*	*Method*
E1642941	% Solids	25		%		8/10/09	8/11/09	CLP Inorganics
7440-38-2	Arsenic	2.3		mg/kg	1.0	8/10/09	8/11/09	CLP ILM05.4 P

Appendix B Chain of Custody Records and Raw Data for Bioaccumulation Tests: Woolfolk Chemical Works Superfund Site, Ft. Valley, Georgia

(total of 10 pages)

DAILY OBSERVATIONS LOG

Industry/Study: Woolfolk Chemical Arsenic Phytoremediation Test Species: *Pteris vittata*

2/27/09 KS - Loaded pots with ~500-1000g each of soil/sediment. Planted two fern plugs per pot (~2" to 4" each plant). Placed under fluorescent lighting set at 16 hr light / 8 hr darkness. Light intensity ~1000 - 1500 Lux.
Several samples waterlogged (150A, 155, 155D).
Watered controls and 127 with DI water and misted all plants with DI.
4 pots/replicates per sample; 6 samples + control.

3/3/09 KS - Lightly watered controls and 127.
Misted all plants with DI.

3/4/09 KS - Misted all plants with DI

3/5/09 KS - Received Ebony Spleenworts (Asplenium platyneuron). Placed in control soils & watered.
Lightly misted all replicates with DI.

3/6/09 KS - Lightly watered all replicates and misted with DI.

3/9/09 KS - misted all replicates with DI

3/10/09 KS - misted all replicates with DI.

3/11/09 JY - Temperature ~20°C. Evidence of slight yellowing in some replicates of #125, 127, 150 and 155

3/11/09 KS - misted all replicates with DI.

3/12/09 KS - lightly watered all plants & misted with DI. Light ~1100 lux Temp = 21°C

3/13/09 KS - misted all replicates with DI.

3/16/09 KS - misted all replicates with DI.

3/17/09 KS - misted all replicates with DI.

3/18/09 KS - misted all replicates with DI.

3/19/09 JY - Misted all replicates with DI water.
Temperature = 21°C. Light = 1200 Lux

3/20/09 JY - Temperature = 22°C. Growth in sample 150 appears less than the rest of the soils. Harvested 2 of the 4 replicates for chemical analysis

3/23/09 KS - misted all replicates with DI.

COMMENTS:

DAILY OBSERVATIONS LOG

Industry/Study: Woolfolk Chemical Arsenic Phytoremediation Test Species: *Pteris vittata*

3/24/09 KS - Misted all replicates with DI.
3/25/09 KS - Lightly watered + misted all replicates with DI. Checked soil pH: WC125 - 4.61 ; WC127 - 4.74 ; WC150A - 5.07 ; WC155 - 5.06 ; WC155D - 5.02 ; WC156 - 3.52 ; Control - 5.25
3/26/09 KS - Misted all replicates with DI
3/27/09 KS - Misted all replicates with DI.
3/30/09 KS - Misted all replicates with DI.
3/31/09 KS - Misted all replicates with DI.
4/1/09 KS - misted all replicates with DI.
4/2/09 KS - Lightly watered and misted all replicates with DI
4/3/09 KS - Misted all replicates with DI.
4/6/09 KS - Misted all replicates with DI.
4/7/09 KS - Watered and misted all replicates with DI. 150A-B, 150A-D, and 155-D have dried fronds and don't seem to be doing well.
4/8/09 KS - Misted all replicates with DI.
4/9/09 KS - Misted all replicates with DI.
4/10/09 KS - Misted all replicates with DI.
4/13/09 JY - Misted all replicates with D.I water. Temperature = 23°C Light intensity = ~1200 Lux Growth of ferns in sample 150 clearly less than rest of samples.
4/14/09 KS - Misted all replicates with DI.
4/15/09 KS - Misted all replicates with DI.
4/16/09 KS - Misted all replicates with DI.
*127 appears to have grown much taller than the rest of the soils. Is this due to better soil conditions?
4/17/09 KS - Harvested 2 of 4 replicates for chemical analysis. Misted all replicates and watered with DI. 155D and 125C are almost completely dry (fronds). 150A-B and 150A-D are not healthy. 22°C = Temp. ~1200 Lux = Light intensity

COMMENTS:

Rec'd 3/5/09

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DON'T PANIC IF IT IS COLD & FROSTY, PLANTS HAVE BEEN OUTSIDE. PLANTING & STORAGE INFO ENCLOSED!

10 Chevy Silverado

IMPORTANT INFO ABOUT THIS BOX

The circled ~~or checked~~ statement applies to this box

THIS IS A COMPLETE SHIPMENT. EVERYTHING ORDERED IS INSIDE.

THIS IS A PARTIAL SHIPMENT. MORE WILL FOLLOW LATER, **NO NEED TO CALL.** WE OFTEN DO SPLIT SHIPMENTS 1 TO 4 WEEKS APART.

THIS IS A BALANCE OF SHIPMENT. COMPLETING ORDER.

THIS IS A PART SHIPMENT; BALANCE WASN'T AVAILABLE. YOU'LL GET A REFUND; IF CHARGE, YOU WERE ONLY CHARGED FOR PLANTS SENT.

THERE ARE __ ITEMS IN THIS BOX

For ferns & wildflowers sold in groups of 5, total plants equals 1 item. Example: 5 Bloodroot & 10 Hepatica would be 2 items.

NOTE **CAREFUL!** WILDFLOWERS ARE DELICATE. DO NOT APPLY PRESSURE TO BAGS. READ INSTRUCTION SHEET INSIDE.

IF NOT PLANTING RIGHT AWAY PUT BOX IF POSSIBLE INTO FRIDGE OR PUT THE PLANTS INSIDE IN THE FRIDGE. KEEP IN BAGS; DON'T ADD MOISTURE. THEY CAN BE KEPT THIS WAY UP TO 3 WEEKS DEPENDING ON VARIETY & DORMANCY.

KEEP BOX COOL & OUT OF SUN! DO NOT LEAVE IT IN A WARM SPOT!

SEE INSTRUCTIONS! PLANTS CAN BE STORED IF KEPT COLD!

Thank you for your order!

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407/889-5443 FAX
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Sales Order

Ship Date	S.O. No.
2/24/2009	103384

Bill To

EDEN SPACE SYSTEM CORP
3810 CONCORDE PARKWAY
SUITE 100
DULLES, VA 20151

Ship To

EPA
ATTN: KRISTI SIMPSON
980 COLLEGE STATION RD
ATHENS, GA 30605
706-355-8775

Enter Date	Ship Via	FOB	Terms
2/23/2009	FED EX 2 DAY	APOPKA	NET 30 DAYS

P.O. No.	Sales Rep	Week #
F09-002	CHRIS	8

Description	Pack	Trays	Pulled	Quantity
PTERIS MAYI FERN	72	1	✓	72
SMALL BOX				1

Received 2/26/09
Kristi Simpson

1 bx @ 22x12x12

THANK YOU FOR YOUR BUSINESS.

Signature _____

EPA REGION 4
U.S. ENVIRONMENTAL PROTECTION AGENCY

CHAIN OF CUSTODY RECORD

SCIENCE AND ECOSYSTEMS SUPPORT DIVISION
980 COLLEGE STATION ROAD
ATHENS, GA 30605-2720

PROJECT NO.	PROJECT NAME / LOCATION	SAMPLERS (SIGN)
09-0195	Woolfolk Chemical	
PROJECT LEADER	**REMARKS / AIR BILL**	
L. George		

LAB USE ONLY	STATION ID (1)	SAMPLE ID (2)	MEDIA CODE (3)	2009 DATE	TIME	COMP OR GRAB	REMARKS	TOTAL CONTAINERS	COD, TOC, NUTRIENTS	BOD, SOLIDS	METALS	EXT ORG / PEST / PCBs	VOA	CYANIDE	Arsenic - XRF	Bioaccumulation	TAG NUMBER
	WC-125	WC1250209	SF	2/3	1345	G		2						X	X		
	WC 127	WC1270209	SF	~~2/3~~ 2/4	1000	G		2						X	X		
	WC 150A	WC150A0209	SD	2/3	1445	G		2						X	X		
	WC 155	WC1550209	SD	2/3	1600	G		2						X	X		
	WC155	WC1550209D	SD	2/3	1615	G		2						X	X		
	WC156	WC1560209	SF	2/4	1140	G		2						X	X		

RELINQUISHED BY: (PRINT)	DATE:	RECEIVED BY: (PRINT)	RELINQUISHED BY: (PRINT)	DATE:	RECEIVED BY: (PRINT)
Linda George	2/4/09	JOE Owusu-Ansah			
(SIGN)	TIME:	(SIGN)	(SIGN)	TIME:	(SIGN)
	1600				

DISTRIBUTION: White and Pink copies accompany sample shipment to laboratory; Pink copy retained by laboratory; White copy is returned to samplers; Yellow copy retained by samplers.

10/05

4B-0165

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- IN ORDER TO TRANSPLANT, GENTLY DISLODGE THE PLUGS BY A SPATULA OR DE-LODGER, **DO NOT** PULL OUT BY LEAVES.

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- DAMAGES IN TRANSIT, INCLUDING FREEZING, OVERHEATING, AND TOPPLING OVER, ARE THE RESPONSIBILITY OF THE CARRIER. SHOULD THESE OCCUR, OR IF BOXES ARE DAMAGED, FILE A CLAIM WITH THE SHIPPING COMPANY, IMMEDIATELY.
- CLAIMS REGARDING PRODUCT QUALITY MUST BE RECEIVED BY MILESTONE WITHIN 24 HOURS OF PLANT ARRIVAL, AND MUST BE ACCOMPANIED BY PHOTOGRAPHIC EVIDENCE
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DAILY OBSERVATIONS LOG Ebony Spleenwort and

Industry/Study: Woodfolk Test Species: Cristata

6/17/09 KS - Adjusted pH of half of each sample: 125 - 7.9 ; 127 - 7.25 ; 155 (mix) - 7.73 ; 156 - 7.25. Loaded amended soils into pots and placed in fridge.

6/18/09 KS - Removed refrigerated soils to come to room temperature (19.0°C). Loaded unamended soils into pots ; removed plants from potting soil and got as much soil off root systems as possible without damaging plants. Planted into test pots as follows: 125A (pH 7.9) - Cristata ; 125B - Cristata ; 127A (pH 7.25) - Spleenwort ; 127B (pH 7.25) - Cristata ; 127C - Spleenwort ; 127D - Cristata ; 155A (pH 7.7) - Spleenwort ; 155B (pH 7.7) - Cristata ; 155C - Spleenwort ; 155D - Cristata ; 156A (pH 7.25) - Spleenwort ; 156B (pH 7.25) - Cristata ; 156C - Spleenwort ; 156D - Cristata ; Control A - Spleenwort ; Control B - Cristata.
Some used (from another study) Sample 127 was mixed with Osmocote (slow-release) fertilizer (approx. 2 teaspoons) and used for two more pots as follows: used 127 - Spleenwort ; used 127 - Cristata.
All plants were placed in low light conditions overnight at 19.0°C. gKS

6/19/08 KS - Restored light conditions to 16h light / 8h dark. ~1200 Lux, 19.0°C.

6/24/09 KS - 127D - Cristata wilting / drying out. Filled base with water (DI).
127B (pH adjusted) Cristata also looking dry.
Used 127 with fertilizer - Cristata beginning to dry. Filled bases with DI.

6/25/09 KS - All 127 bases filled with DI yesterday are dry again. Refilled D/C ferns still dry.

COMMENTS:

DAILY OBSERVATIONS LOG

Industry/Study: Woolfolk Test Species: Ebony Spleenwort & Edenfern

6/26/09 KS - watered & misted ferns with DI. 127 replicates mentioned on 6/24/09 STILL dry.

6/29/09 KS - 127 replicates (Cristata) all dry. They might not make it; watered with DI

7/6/09 KS - watered & misted replicates with DI

7/14/09 KS - watered & misted replicates with DI 127D and used 127 with fertilizer (Cristata) appear dead

7/21/09 KS - watered & misted replicates with DI 155D, Control B, and 125B have leaves that look dead & "burned"

7/27/09 KS - watered & misted replicates with DI.

7/30/09 KS - all replicates taken down. Each fern's fronds clipped & placed in bags for analysis.

COMMENTS:

EPA USEPA Contract Laboratory Program
Inorganic Traffic Report & Chain of Custody Record

Case No: 38830 **R**
DAS No:

Region:	4	**Date Shipped:**	7/30/2009	**Chain of Custody Record**	**Sampler Signature:**
Project Code:	09-0610	**Carrier Name:**	FedEx	**Relinquished By (Date / Time)**	**Received By (Date / Time)**
Account Code:	09-0195	**Airbill:**	865935735539	1	
CERCLIS ID:		**Shipped to:**	Bonner Analytical Testing Company 2703 Oak Grove Rd Hattiesburg MS 39402 (601) 264-2854	2	
Spill ID:				3	
Site Name/State:	Woolfolk Chemical Works Inc./GA			4	
Project Leader:	Linda George				
Action:					
Sampling Co:	PL-SESD				

INORGANIC SAMPLE No.	MATRIX/ SAMPLER	CONC/ TYPE	ANALYSIS/ TURNAROUND	TAG No./ PRESERVATIVE/ Bottles	STATION LOCATION	SAMPLE COLLECT DATE/TIME		ORGANIC SAMPLE No.	QC Type
MD5BP5	Control Tissue/ Linda George	/G	As (14)	106888 (Ice Only) (1)	ControlES0709	S: 7/30/2009	13:00		QC
MD5BP6	Vegetation/ Linda George	/G	As (14)	106889 (Ice Only) (1)	125PV0709	S: 7/30/2009	13:00		--
MD5BP7	Vegetation/ Linda George	/G	As (14)	106890 (Ice Only) (1)	125PVN0709	S: 7/30/2009	13:00		--
MD5BP8	Vegetation/ Linda George	/G	As (14)	106891 (Ice Only) (1)	127ES0709	S: 7/30/2009	13:00		--
MD5BP9	Vegetation/ Linda George	/G	As (14)	106892 (Ice Only) (1)	127ESF0709	S: 7/30/2009	13:00		--
MD5BQ0	Vegetation/ Linda George	/G	As (14)	106893 (Ice Only) (1)	127ESN0709	S: 7/30/2009	13:00		--
MD5BQ1	Vegetation/ Linda George	/G	As (14)	106894 (Ice Only) (1)	127PV0709	S: 7/30/2009	13:00		--
MD5BQ2	Vegetation/ Linda George	/G	As (14)	106895 (Ice Only) (1)	127PVF0709	S: 7/30/2009	13:00		--
MD5BQ3	Vegetation/ Linda George	/G	As (14)	106896 (Ice Only) (1)	127PVN0709	S: 7/30/2009	13:00		--
MD5BQ4	Vegetation/ Linda George	/G	As (14)	106897 (Ice Only) (1)	155ES0709	S: 7/30/2009	13:00		--
MD5BQ5	Vegetation/ Linda George	/G	As (14)	106898 (Ice Only) (1)	155ESN0709	S: 7/30/2009	13:00		--

Shipment for Case Complete? Y	**Sample(s) to be used for laboratory QC:**	**Additional Sampler Signature(s):**	**Chain of Custody Seal Number:**
Analysis Key:	**Concentration:** L = Low, M = Low/Medium, H = High	**Type/Designate:** Composite = C, Grab = G	**Shipment Iced?** _____
As = Arsenic by ICP-AES			

TR Number: **4-013399868-072809-0001**

REGION COPY

PR provides preliminary results. Requests for preliminary results will increase analytical costs.

Send Copy to: Sample Management Office, Attn: Heather Bauer, CSC, 15000 Conference Center Dr., Chantilly, VA 20151-3819; Phone 703/818-4200; Fax 703/818-4602

USEPA Contract Laboratory Program
Inorganic Traffic Report & Chain of Custody Record

Case No: 38830 **R**
DAS No:

Region:	4	**Date Shipped:**	7/30/2009	**Chain of Custody Record**	**Sampler Signature:**
Project Code:	09-0610	**Carrier Name:**	FedEx	**Relinquished By (Date / Time)**	**Received By (Date / Time)**
Account Code:	09-0195	**Airbill:**	865935735539	1	
CERCLIS ID:		**Shipped to:**	Bonner Analytical Testing Company 2703 Oak Grove Rd Hattiesburg MS 39402 (601) 264-2854	2	
Spill ID:				3	
Site Name/State:	Woolfolk Chemical Works Inc./GA			4	
Project Leader:	Linda George				
Action:					
Sampling Co:	PL-SESD				

INORGANIC SAMPLE No.	MATRIX/ SAMPLER	CONC/ TYPE	ANALYSIS/ TURNAROUND	TAG No./ PRESERVATIVE/ Bottles	STATION LOCATION	SAMPLE COLLECT DATE/TIME		ORGANIC SAMPLE No.	QC Type
MD5BQ6	Vegetation/ Linda George	/G	As (14)	106899 (Ice Only) (1)	155PV0709	S: 7/30/2009	13:00		--
MD5BQ7	Vegetation/ Linda George	/G	As (14)	106900 (Ice Only) (1)	155PVN0709	S: 7/30/2009	13:00		--
MD5BQ8	Vegetation/ Linda George	/G	As (14)	106901 (Ice Only) (1)	156ES0709	S: 7/30/2009	13:00		--
MD5BQ9	Vegetation/ Linda George	/G	As (14)	106902 (Ice Only) (1)	156ESN0709	S: 7/30/2009	13:00		--
MD5BR0	Vegetation/ Linda George	/G	As (14)	106903 (Ice Only) (1)	156PV0709	S: 7/30/2009	13:00		--
MD5BR1	Vegetation/ Linda George	/G	As (14)	106904 (Ice Only) (1)	156PVN0709	S: 7/30/2009	13:00		--

Shipment for Case Complete? Y	Sample(s) to be used for laboratory QC:	Additional Sampler Signature(s):	Chain of Custody Seal Number:
Analysis Key:	**Concentration:** L = Low, M = Low/Medium, H = High	**Type/Designate:** Composite = C, Grab = G	**Shipment Iced?** _____
As = Arsenic by ICP-AES			

TR Number: **4-013399868-072809-0001**

REGION COPY

PR provides preliminary results. Requests for preliminary results will increase analytical costs.

Send Copy to: Sample Management Office, Attn: Heather Bauer, CSC, 15000 Conference Center Dr., Chantilly, VA 20151-3819; Phone 703/818-4200; Fax 703/818-4602

Appendix C Additional Photographs of Fern Bioaccumulation Tests: Woolfolk Chemical Works Superfund Site, Ft. Valley, Georgia

(total of 3 pages)

First Pilot Test – *Pteris Cretica* 'Mayi'. February 27 – April 17, 2009

Station WC150A

Station WC155

As noted in the Daily Observation Log, less growth in Sample WC150A was noted compared with the rest of the samples. Soil concentration was 63J mg As/kg, and fern concentration was 11 mg As/kg (bioaccumulation factor of 0.17).

Station WC155 fern was not as healthy looking compared with the Control. Soil concentration was 22J mg As/kg, and fern concentration was 2.3 mg As/kg (bioaccumulation factor of 0.10).

Control Station

First Pilot Test – *Pteris Cretica* 'Mayi'. February 27 – April 17, 2009

This is a view of several stations. The fern with the most growth, Station WC127 (pink label in the center of photograph), had a bioaccumulation factor of 3.33. This fern and its replicate accumulated 600 mg As/kg from soil that contained 180J mg As/kg.

Second Pilot Test – *Pteris vittata* and *Asplenium platyneuron*.
June 17 – July 30, 2009

Station WC127 – *Pteris vittata*. Left to right: straight soil, pH adjusted to 7, fertilizer added.

Reference Station WC125

The ferns in soil from Station WC127 did not grow as well as the ferns growing in soil from the reference station. As early as June 24th, ferns growing in soil from Station WC127 were wilting and drying out (see Daily Observation Log). Although the fern in the far left (straight soil from Station WC127) doesn't appear healthy, it accumulated the most arsenic in this study (concentration of 26 mg/kg).

Station WC127 *Asplenium platyneuron*

In comparison, these ferns (different species) looked much healthier in the same soils.

Appendix D Niton Multi-Element XRF Analyzer Logbook: Woolfolk Chemical Works Superfund Site, Ft. Valley, Georgia

(total of 9 pages)

Niton Multi-Element XRF Analyzer Logbook

Site Name: Woolfolk Chemical

Location: Ft. Valley, GA
Date: February 2009

Facility Code: 110005665930
DART ID: ~~08-0326~~ BA 2/6/09
09-0195

Project Leader: Linda George

NITON Multi-element Analyzer Logbook

Site: Woolfolk Chemical Ft. Valley, GA DART ID: ~~08-0326~~ 09-0195 KN 2/6/9 Date 2/5/08

Res: 215.7

Ambient Temp: 68.7°F

Reading # 1 Time: 13:22 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☐Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: _____ Other readings: _____
Sample Location: Comments: Calibration

Battery: 88%

Bias: 122.70

Reading # 2 Time: 13:30 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☒NIST 2710
Sampling Mode: ☐*In-situ* ☐Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: 652.8 ± 132.0 Other readings: _____
Sample Location: Comments:

Reading # 3 Time: 13:32 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☐Other ☒SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☐Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: <LOD = 8.9 Other readings: _____
Sample Location: Comments:

Reading # 4 Time: 13:43 Analyst: B. Herndon Sampler:
Matrix: ☒Soil ☐Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: 132.5 ± 24.3 Other readings: _____
Sample Location: WC1270209 Comments: wet

Reading # 5 Time: 13:44 Analyst: B. Herndon Sampler:
Matrix: ☒Soil ☐Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: 112.0 ± 22.2 Other readings: _____
Sample Location: WC1270209 Comments: Duplicate-QA sample

Reading # 6 Time: 13:52 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☒Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: <LOD = 9.4 Other readings: _____
Sample Location: WC1250209 Comments: wet

Reading # ~~BW~~ 7 Time: 13:59 Analyst: B. Herndon Sampler:
Matrix: ~~☒~~Soil ☒Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: 11.3 ± 4.0 Other readings: _____
Sample Location: WC150A0209 Comments: wet

NITON Multi-element Analyzer Logbook

Site: Woolfolk Chemical Ft. Valley, GA DART ID: ~~08-0326~~ 09-0195 BH 2/6/09 Date 2/5/09

Reading # 8 Time: 14:08 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☒Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: 46.9 ± 9.3 Other readings: _____
Sample Location: WC1550209 Comments: wet

Reading # 9 Time: 14:14 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☒Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: 12.9 ± 7.6 Other readings: _____
Sample Location: WC1550209 Comments: wet

Reading # 10 Time: 14:15 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☒Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: 17.7 ± 7.6 Other readings: _____
Sample Location: Comments: Replicate of WC1550209

Reading # 11 Time: 14:16 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☒Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: 18.3 ± 7.2 Other readings: _____
Sample Location: Comments: Replicate of WC1550209

Reading # 12 Time: 14:17 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☒Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: 19.3 ± 7.9 Other readings: _____
Sample Location: Comments: Replicate of WC1550209

Reading # 13 Time: 14:18 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☒Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: 24.3 ± 8.2 Other readings: _____
Sample Location: Comments: Replicate of WC1550209

Reading # 14 Time: 14:19 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☒Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: 18.0 ± 7.6 Other readings: _____
Sample Location: Comments: Replicate of WC1550209

Samples placed in drying oven on 2/5/09 @ 14:15
Ingoing Temp: 104.7°C

NITON Multi-element Analyzer Logbook

Site: Woolfolk Chemical Ft. Valley, GA DART ID: ~~08-0326~~ 09-0195 BH 2/6/09 Date 2/5/09

Reading # 15 Time: 14:20 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☒Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST ________
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: <LOD = 10.7 Other readings: ________
Sample Location: Comments: Replicate of WC1550209

Reading # 16 Time: 14:26 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☒NIST 2710
Sampling Mode: ☐*In-situ* ☐Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: 540.2 ± 128.8 Other readings: ________
Sample Location: Comments: Standard verification

Last Run for 2/5/09

Reading # 17 Time: 14:28 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☐Other ☒SiO_2 Blank ☐Ottowa Sand ☐NIST ________
Sampling Mode: ☐*In-situ* ☐Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: <LOD = 9.3 Other readings: ________
Sample Location: Comments: Blank

Reading # Time: Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST ________
Sampling Mode: ☐*In-situ* ☐Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: ________ Other readings: ________
Sample Location: Comments:

Reading # Time: Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST ________
Sampling Mode: ☐*In-situ* ☐Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: ________ Other readings: ________
Sample Location: Comments:

Reading # Time: Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST ________
Sampling Mode: ☐*In-situ* ☐Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: ________ Other readings: ________
Sample Location: Comments:

BH

Reading # Time: Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST ________
Sampling Mode: ☐*In-situ* ☐Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: ________ Other readings: ________
Sample Location: Comments:

NITON Multi-element Analyzer Logbook

Site: Woolfolk Chemical Ft. Valley, GA DART ID: ~~08-0326~~ 09-0195 BH 2/6/09 Date 2/6/09

Ambient Temp: 68.0°F

Reading # 18 Time: 8:55 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____ Res: 210.7
Sampling Mode: ☐*In-situ* ☐Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: _____ Other readings: _____ Bias: 122.70
Sample Location: _____ Comments: Calibration Battery: 100%

Reading # 19 Time: 9:01 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☒NIST 2710
Sampling Mode: ☐*In-situ* ☐Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: 612 ± 126.1 Other readings: _____
Sample Location: _____ Comments: Standard verification

Reading # 20 Time: 9:04 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☐Other ☒SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☐Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: <LOD = 9.8 Other readings: _____
Sample Location: _____ Comments: Blank

Reading # 21 Time: 9:10 Analyst: B. Herndon Sampler:
Matrix: ☒Soil ☐Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☒Dried ☐Milled ☐Sieved
Readings: As: 196.6 ± 27.9 Other readings: _____
Sample Location: WC-127-0209 Comments: Dried

Reading # 22 Time: 9:24 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☒Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☒Dried ☐Milled ☐Sieved
Readings: As: <LOD = 12.0 Other readings: _____
Sample Location: WC 125-0209 Comments: Dried

Reading # 23 Time: 9:26 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☒Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☒Dried ☐Milled ☐Sieved
Readings: As: <LOD = 12.8 Other readings: _____
Sample Location: WC 125-0209 Comments: Dried-Duplicate/QA split

Reading # 24 Time: 9:28 Analyst: B. Herndon Sampler:
Matrix: ☒Soil ☐Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☒Dried ☐Milled ☐Sieved
Readings: As: 63.0 ± 15.3 Other readings: _____
Sample Location: WC150A-0209 Comments: Dried

-Dried samples remove from oven on 2/6/09, 08:40 @ 102.4°C

NITON Multi-element Analyzer Logbook

Site: Woolfolk Chemical Ft. Valley, GA DART ID: ~~08-0326~~ 09-0195 BN 2/6/9 Date 2/6/09

Reading # 25 Time: 9:38 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☒Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☒Dried ☐Milled ☐Sieved
Readings: As: 147.1 ± 22.5 Other readings: _____
Sample Location: WC155D-0209 Comments: Dried - field Dup of WC155-0209

Reading # 26 Time: 9:43 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☒Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☒Dried ☐Milled ☐Sieved
Readings: As: 21.6 ± 12.4 Other readings: _____
Sample Location: WC155 – 0209 Comments: Dried

Reading # 27 - 32 Time: 9:45-9:51 Analyst: B. Herndon Sampler:
Matrix: ☒Soil ☐Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☒Dried ☐Milled ☐Sieved
Readings: As: _____ Other readings: _____
Sample Location: WC127-0209 Comments: Replicate Readings. See spreadsheet for values

Reading # 33 Time: 9:52 Analyst: B. Herndon Sampler:
Matrix: ☒Soil ☐Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☒NIST 2710
Sampling Mode: ☐*In-situ* ☐Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: 567.1 ± 130.8 Other readings: _____
Sample Location: Comments: standard verification

Reading # 34 Time: 9:54 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☐Other ☐SiO_2 Blank ☒Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☐Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: < LOD = 9.3 Other readings: _____
Sample Location: Comments: Method Blank

Reading # 35 Time: 9:56 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☒NIST 2710
Sampling Mode: ☐*In-situ* ☐Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: 639.6 ± 123.0 Other readings: _____
Sample Location: Comments: standard verification

Reading # 36 Time: 9:58 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☐Other ☒SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☐Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: < LOD = 9.7 Other readings: _____
Sample Location: Comments: instrument Blank

NITON Multi-element Analyzer Logbook

Site: Woolfolk Chemical Ft. Valley, GA DART ID: ~~08-0326~~ 09-0195 BH 2/6/9 Date 2/6/09

Reading # 37 Time: 10:38 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☒Other ☐SiO_2 Blank ☐Ottowa Sand☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: 14.3 ± 6.1 Other readings: _____
Sample Location: WC127ESA Comments: Fern

Reading # 38 Time: 10:40 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☒Other ☐SiO_2 Blank ☐Ottowa Sand☐NIST_____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: 14.5 ± 5.7 Other readings: _____
Sample Location: WC127ESA Comments: Fern

Reading # 39 Time: 10:45 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☒Other ☐SiO_2 Blank ☐Ottowa Sand☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: <LOD = 5.6 Other readings: _____
Sample Location: WC127ESB Comments: fern

Reading # 40 Time: 10:48 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☒Other ☐SiO_2 Blank☐Ottowa Sand ☐NIST_____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: <LOD = 5.2 Other readings: _____
Sample Location: WC127ESBD Comments: fern

Reading # 41 Time: 10:54 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☒Other ☐SiO_2 Blank☐Ottowa Sand☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: <LOD = 5.8 Other readings: _____
Sample Location: WC150ES Comments: fern

Reading # 42 Time: 10:59 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☒Other ☐SiO_2 Blank☐Ottowa Sand☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: <LOD = 7.9 Other readings: _____
Sample Location: WC150ADS Comments: fern

Reading # 43 Time: 1100 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☒Other ☐SiO_2 Blank☐Ottowa Sand☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: <LOD = 7.9 Other readings: _____
Sample Location: WC150AUF Comments: fern

NITON Multi-element Analyzer Logbook

Site: Woolfolk Chemical Ft. Valley, GA DART ID: ~~08-0326~~ 09-0195 SU 2/6/9 Date 2/6/09

Reading # 44 Time: 11:05 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☒Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: <LOD = 9.4 Other readings: _____
Sample Location: WC156DC Comments: fern

Reading # 45 Time: 11:08 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☒Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: <LOD = 7.2 Other readings: _____
Sample Location: WC156WA Comments: fern

Reading # 46 Time: 11:13 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☒Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: _____ Other readings: _____
Sample Location: WC155PA Comments: fern

Reading # 47 Time: 11:18 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☒Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: <LOD = 5.6 Other readings: _____
Sample Location: WC155WAF Comments: fern

Reading # 48 Time: 11:26 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☒Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: <LOD = 6.3 Other readings: _____
Sample Location: WC155WAS Comments: fern

Reading # 49 Time: 11:29 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☒Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: 50.0 ± 9.7 Other readings: _____
Sample Location: WC156-0209 Comments: wet

Reading # 50 Time: 11:35 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☒NIST 2710
Sampling Mode: ☐*In-situ* ☐Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: 640.3 ± 120.5 Other readings: _____
Sample Location: Comments: standard verification

WC156 placed in drying oven on 2/6/09 @ 11:32 @ 104.8°C
WC156 removed from drying oven on 2/6/09 @ 15:10 @ 102.7°C

NITON Multi-element Analyzer Logbook

Site: Woolfolk Chemical Ft. Valley, GA DART ID: ~~08-0326~~ 09-0195 BH 2/6/9 Date 2/6/09

Reading # 51 Time: 9:36 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☐Other ☒SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☐Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: <LOD = 8.5 Other readings: _____
Sample Location: Comments: instrument blank

Reading # ~~50~~ Time: 15:15 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☐Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: _____ Other readings: _____
Sample Location: Comments: Calibration

Ambient ~ 70.3°F

Bias: 122.70
Res: 216.3
Battery: 79%

Reading # 53 Time: 15:21 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☒NIST 2710
Sampling Mode: ☐*In-situ* ☐Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: 608.2 ± 127.8 Other readings: _____
Sample Location: Comments: standard verification

Reading # 54 Time: 15:22 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☐Other ☒SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☐Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: <LOD = 8.8 Other readings: _____
Sample Location: Comments: instrument blank

Reading # 55 Time: 15:24 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☒Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☒Collected ☐Neat ☒Dried ☐Milled ☐Sieved
Readings: As: 144.5 ± 21.5 Other readings: _____
Sample Location: WC156-0209 Comments: dried

Reading # 56 Time: 15:26 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☐Other ☐SiO_2 Blank ☐Ottowa Sand ☒NIST 2710
Sampling Mode: ☐*In-situ* ☐Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: 665.9 ± 125.5 Other readings: _____
Sample Location: Comments: standard verification

Reading # 57 Time: 15:27 Analyst: B. Herndon Sampler:
Matrix: ☐Soil ☐Sediment ☐Other ☒SiO_2 Blank ☐Ottowa Sand ☐NIST _____
Sampling Mode: ☐*In-situ* ☐Collected ☐Neat ☐Dried ☐Milled ☐Sieved
Readings: As: <LOD = 10.5 Other readings: _____
Sample Location: Comments: instrument blank

File downloaded from instrument @ 1530 on 2/6/09

- End of Logbook BH 2/6/09

End of Report