Removal Action Work Plan
Forshaw Chemicals, Inc. Site
650 State Street
Charlotte, North Carolina
Site ID NCN 000 409 865

H&H Job No. FOR-001

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Revision 1

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Charlotte, North Carolina

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1.0 INTRODUCTION

This Removal Action Work Plan (RAWP) has been prepared by Hart & Hickman, PC (H&H) in accordance with the *Administrative Settlement Agreement and Order on Consent for Removal Action* between the United States Environmental Protection Agency (EPA) and Forshaw Chemicals, Inc. (Forshaw) effective August 17, 2009 (Settlement Agreement). The RAWP provides a description of the Removal Action (RA) activities, performance goals for the RA, and a schedule for RA implementation.

The purposes of the RA are to remove and control the source of pentachlorophenol (PCP) and dioxins/furans which have been detected in the stormwater conveyance system at the site, prevent off-site migration of these compounds to the adjacent Stewart Creek through the stormwater conveyance system, and to minimize potential worker exposure at the site. In general, the RA will consist of removal of impacted soil near a portion of the stormwater conveyance system, replacement of a portion of the stormwater conveyance system with seamless pipe, flushing and collecting sediment from downstream portions of the stormwater line, on-site treatment of the removed materials, and confirmation sampling.

A brief description of background information is provided in Section 2.0, and the RA components are described in Sections 3.0 through 7.0.

2.0 BACKGROUND INFORMATION

2.1 SITE DESCRIPTION

The Forshaw site is located at 650 State Street in Charlotte, Mecklenburg County, North Carolina. A site location map is provided as Figure 1. The site consists of three land parcels totaling approximately 6 acres in area. The site contains six structures totaling approximately 52,000 square feet. The main warehouse building is located in the central portion of the property, and a two-story office building is located south of the main warehouse building (Figure 2).

The site is primarily used for the distribution of pesticide and herbicide products for use by commercial pest control companies. Pesticides and herbicides are stored and distributed from the main warehouse in the central portion of the site. The rest of the buildings are used for limited warehouse, maintenance, and storage purposes. Other activities conducted at the site include retrofitting trucks with plastic tanks, pumps, and hoses for use by pest control companies. No repackaging, mixing, blending, or formulation of pesticide or herbicide products is performed on-site.

A stormwater conveyance system traverses portions of the property. Stormwater enters the site from off-site piping located west and south of the site and also enters stormwater catch basins on the property. Thus, the system conveys stormwater that is generated off-site as well as on-site. The approximate location of the stormwater conveyance system is shown on Figure 2. The stormwater eventually discharges to Stewart Creek, which borders the far eastern portion of the property. A containment basin is located in the eastern portion of the site and is designed for use as emergency secondary containment in the event of a major spill in the warehouse building.

The site is almost entirely fenced except for perimeter areas along railroad tracks, roads, and the far eastern portion of the site. Approximate surface areas covered with surface vegetation, pavement, and gravel are indicated on Figure 2.

Surrounding land usage is primarily commercial and industrial. The site is bordered to the south by vacant land, National Welders, and Southern Concrete Supply. The site is bordered to the west by railroad tracks and a warehouse, to the north by county-owned wooded land, and to the east by Stewart Creek, with a former textile mill located beyond Stewart Creek. The site and surrounding areas are zoned I-2 (industrial) except for the county-owned land which is zoned R-5 (residential). Municipal water and sewer are supplied to the site area.

2.2 SITE HISTORY

Forshaw began PCP formulation operations at a portion of the site in 1970. Prior to use by Forshaw, the site was occupied by Leffler Concrete Block Company (Leffler), which operated a septic system construction and maintenance facility. In addition to building septic systems, Leffler would reportedly clean out septic systems and discharge the wastes into ponds and a city sewer infall on the property.

From approximately 1970 to 1986, Forshaw site operations included PCP formulation. From 1970 to approximately 1975, PCP formulation was conducted east of the southwestern warehouse in the approximate location indicated on Figure 2. From 1975 to approximately 1983, PCP formulation was moved to a location north of the southwestern warehouse as indicated in Figure 2. During these time periods, PCP truck loading and unloading was conducted east of the original PCP formulation area (Figure 2). Forshaw ceased PCP formulation in 1986. From approximately 1984 to 2003, Wood Protection Products, Inc. conducted PCP formulation in the warehouse located in the northwestern corner of the property and potentially other areas at the site.

Small batch formulation of the pesticides diazinon, chlordane, lindane, and dieldrin was also conducted at the site, primarily in and near the warehouse in the southwestern portion of the site. According to site personnel, no formulation, repackaging, mixing, or blending of arsenic-based compounds has ever occurred on the property.

2.3 PREVIOUS ASSESSMENT ACTIVITIES

In March 2005, during a Site Inspection (SI) for the adjacent Clorox site located west of the Forshaw property, the North Carolina Department of Environment and Natural Resources (DENR) collected two surface soil samples along the west side of the Forshaw property between the southwestern warehouse and the railroad tracks. The results of the soil sample analyses indicated the presence of PCP, arsenic, and pesticides.

In December 2005 and January 2006, an Expanded Site Inspection (ESI) was conducted at the Clorox site and included collection of samples on the Forshaw site. Sampling conducted at the Forshaw site included collection of soil samples along a suspected overland flow path and surface water and sediment samples from the stormwater conveyance system. Sampling results indicated the presence of arsenic, PCP, and dioxins/furans in and near the stormwater conveyance system on the Forshaw site. The results of the SI and ESI sampling were presented in an Expanded Site Inspection report for Forshaw Chemicals, Inc. dated June 29, 2006. The ESI recommended further action under CERCLA. DENR ESI sample locations are shown on Figure 3, and a summary of the analytical detections is provided in Appendix A.

In June 2007, EPA collected surface water and sediment samples from the stormwater conveyance system at the Forshaw site. The sampling confirmed the presence of concentrations of arsenic, PCP, and/or dioxins/furans in the stormwater conveyance system. EPA's sample locations are shown on Figure 3, and EPA's analytical data tables are summarized in Appendix A.

Based upon the results of the DENR and EPA sampling, a time-critical RA to minimize the potential for off-site migration of the compounds detected in the stormwater conveyance system to the adjacent Stewart Creek and to minimize the potential for on-site worker exposure was considered by EPA.

Prior to the initiation of the RA, EPA determined that additional data would be collected to facilitate the contemplated RA. On June 13, 2008, H&H submitted a Sampling and Analysis

Plan for the source assessment activities. The plan was approved by EPA in an e-mail dated June 18, 2008.

In July 2008, H&H advanced 20 soil borings at the site and at background locations on the county-owned property north of the site. On-site soil samples were collected from surficial unpaved areas and from locations along the stormwater conveyance system near the former PCP plants and former PCP truck loading area. The locations of the July 2008 soil sampling locations are indicated in Figure 4, and the July 2008 background sampling locations are shown in Figure 5. The results of the soil sample analyses are summarized in Tables 1 and 2. In addition, a camera survey of portions of the stormwater system was also performed.

Based upon the results of the source assessment, H&H made the following summary and conclusions:

- The results of the surface soil sampling conducted by H&H did not indicate the presence of compounds in surface soils at the site that would pose a worker protection concern. Previous DENR sampling indicated one shallow soil sample (CLX-002-SS) west of the main warehouse with a dioxins/furans concentration above the industrial use screening level.

- Only one soil sample collected by H&H (SB-8 at 4-6 ft) contained an arsenic concentration above the EPA regional screening level (RSL) at a lifetime incremental cancer risk (LICR) of 10^{-4}. This sample is not located near a former PCP plant, and no PCP was detected in this location. As such, the presence of arsenic does not appear related to the former PCP plants and Forshaw operations. Surface soil in this area sampled by DENR indicated arsenic concentrations significantly below the EPA RSL. There is no evidence that arsenic is present at concentrations or locations that would present a worker protection concern in surface soil on the property.

- The highest concentrations of PCP and dioxins in the July 2008 source assessment soil samples were detected in sample SB-7 (collected at 5-7 ft below land surface (bls)) in the area of the former PCP truck loading area (see Figure 4). In this sample, PCP was detected at a concentration of 3,070 mg/kg, and dioxins/furans were detected at a 2,3,7,8-TCDD equivalence of 19.18 µg/l. The presence of elevated levels of PCP and dioxins in this sample was consistent with field observations, which indicated the presence of black stained soil at a depth of approximately 6-7 ft bls in this area.

- The results of the camera survey did not provide any obvious indication of source material entering the stormwater conveyance system. However, the camera survey was limited by debris accumulations in some areas, which prevented a full inspection of the line. The line did not contain large accumulations of sediment except in some isolated areas where debris has accumulated.

- Based upon the results of the assessment activities, H&H concluded that the primary source of the compounds in the stormwater conveyance system at the site is located in the vicinity of former PCP truck loading area near sample SB-7, most likely in the black, stained soil in the area. In this area, it appears that water draining along the stormwater conveyance system has infiltrated impacted soil in the former truck loading area and mobilized compounds in soil. This water has infiltrated the storm drain and created impacted sediment in areas of sediment accumulation in the stormwater pipe. H&H also concluded that it was possible that exposed surface soil in the area of the catch basin west of the warehouse building near previous DENR soil sample CLX-002-SS may also be contributing to detections of dioxins/furans in the stormwater conveyance system.

The Source Assessment Report was submitted to EPA in September 2008. Based on the results of the source assessment, EPA and Forshaw entered into the Settlement Agreement. This RAWP is intended to comply with Section 15.a. of the Settlement Agreement, which requires submittal of a draft work plan within 21 days of its effective date.

3.0 REMOVAL ACTION PLAN

3.1 REMOVAL ACTION OBJECTIVES

The objectives of the RA are to remove and control the source of PCP and dioxins/furans that have been detected in the stormwater conveyance system at the site, prevent off-site migration of these compounds and arsenic to the adjacent Stewart Creek through the stormwater conveyance system, minimize potential worker exposure at the site, and perform confirmation sampling. In general, the RA will consist of removal of impacted soil near a portion of the stormwater conveyance system, replacement of a portion of the stormwater conveyance system with seamless pipe, flushing and collecting sediment from downstream portions of the stormwater line, and on-site treatment of the removed materials.

For the soil source removal activities, the site cleanup goals (CGs) are 300 mg/kg for PCP and 5 µg/kg for dioxins (2,3,7,8-TCDD equivalence). The CGs are based on our discussions with EPA, the RSLs, and EPA guidance on the cleanup of dioxins/furans (reference: *Approach for Addressing Dioxin in Soil at CERCLA and RCRA Sites* (OSWER Directive 9200.4-26 dated April 13, 1998)).

3.2 SOIL REMOVAL AND TREATMENT

Based on the results of the assessment activities, two excavation areas are targeted for soil removal and treatment. The approximate locations and extents of the removal areas are shown in Figure 6. Excavation Area 1 is located in the area of the PCP truck loading area where PCP and dioxins/furans were detected above the site CGs in the July 2008 sampling. H&H estimates that approximately 700 cubic yards (cy) of soil above the site CGs will be removed from this area (approximate dimensions of 60 ft by 30 ft by 10 ft deep). Excavation Area 2 is located in the grassed area around the catch basin west of the warehouse where elevated dioxins/furans were detected in shallow soil in a previous DENR sample. H&H estimates that approximately 50 cy of soil above the site CGs will be removed from this area (approximate dimensions of 20 ft by 20 ft by 3 ft deep).

The RA soil excavation and treatment activities are detailed in the following sections.

3.2.1 Site Preparation

Prior to beginning soil excavation activities, the following tasks will be accomplished in preparation for RA activities:

- An existing electric utility pole (shown on Figure 6) located near Excavation Area 1 will be removed and/or repositioned. This task is to be accomplished by the electric utility company.

- A sliding gate exists in the immediate vicinity of Excavation Area 1. The gate will remain open during RA excavation and stormwater conveyance system retrofit activities. In order to provide site and work area security during the RA activities, a temporary fence will be installed approximately 50 feet north of State Street in the approximate location shown on Figure 6. In addition, an approximate 3-foot section of fencing (located within the lateral extent of Excavation Area 1) that abuts a brick retaining wall at the end of the sliding gate will be removed.

- An approximately 80-foot section of a brick retaining wall and reported concrete debris located behind (southwest of) the retaining wall that overlies a portion of Excavation Area 1 will be removed. Shoring may need to be installed after removal to provide protection of the excavation area from collapse of the exposed sidewall. The debris will be removed to its base depth (top of soil). The debris may be disposed off-site in a construction and demolition (C&D) or other suitable landfill or may be reused on-site as fill or for construction of a replacement retaining wall.

- The stormwater conveyance pipe that runs through Excavation Area 1 will be blocked off at the manhole shown on Figure 6 to prevent stormwater from going through the pipe during the RA activities. During the time the pipe is blocked, stormwater will

flow through the existing stormwater pipe which flows east of the manhole around the main warehouse and to Stewart Creek.

- Temporary fencing will be procured for placement about the soil treatment cell area. The temporary fencing will be erected after the placement of soil in the treatment area.

3.2.2 Soil Excavation

Soil removal from Excavation Area 1 will include the excavation of soil from the surface to approximately 7 to 10 feet bls. The surface level of soil located behind the retaining wall (described in Section 3.2.1) is unknown, but assumed to be the same as that to the east of the retaining wall. Soil removal from Excavation Area 2 will include the excavation of soils from the surface to approximately 2 to 3 feet bls. The excavation will be expanded as necessary and practical to remove soil above the site CGs.

Soil from each area will be excavated using a backhoe or trackhoe and placed in a dump truck (or other appropriate transport container) for on-site mobilization and placement in the treatment cell area shown on Figure 6. Section 3.2.5.2 contains information concerning the treatment cell construction.

During removal of soil from Excavation Area 1, a catch basin and the stormwater conveyance pipe located in that area will also be removed. Refer to Section 3.3.1 for details of the stormwater conveyance pipe removal. Note that there is a catch basin located within Excavation Area 2 that appears to be in good condition. If possible, this catch basin will remain in place during excavation activities. If, during soil removal activities, it appears that this catch basin is in poor condition, it will be repaired or replaced.

3.2.3 Excavation Confirmation Sampling

Confirmation soil sampling and analysis will be conducted at both excavation areas prior to backfilling the excavations with fill to demonstrate that the site CGs have been met. The

confirmation samples will be collected along each sidewall and base of the excavation at a maximum of 20 ft intervals provided that at least one sample is collected from each base and sidewall of the excavation. As an example, for an excavation that is 60 ft long, 30 ft wide, and 10 ft deep, 3 sidewall samples would be collected from each long sidewall, two samples would be collected from each short sidewall, and three samples would be collected from the base. The samples will be centrally located along the face of the excavation that is being sampled.

Confirmation soil sample collection and quality control procedures are discussed in Section 6.0. The confirmation samples from each excavation area will be analyzed for PCP by EPA Method 8270 and for dioxins/furans by EPA Method 8280. If analytical results from a sample indicate compound concentrations above the CGs, additional excavation and confirmation sampling will be conducted as practical in the area of that sample.

3.2.4 Excavation Area Backfilling

Upon confirmation that soils impacted above CGs have been adequately removed, and after completion of the stormwater conveyance system alterations detailed in Section 3.3.1, the excavation areas will be backfilled, graded uniform with the surrounding area, and covered with asphalt or seeded to match the pre-excavation surface conditions. Forshaw may elect to replace the removed retaining wall. If the retaining wall is not replaced, measures will be taken to shore the soil behind the removed retaining wall west of Excavation Area 1. Backfill will be obtained from soils excavated for construction of the on-site treatment cell (see Section 3.2.5) and/or from imported clean fill soil.

Fill will be placed in horizontal lifts of 10 to 12-inch thicknesses and bucket or track compacted. When the backfilling activities are complete, the areas will be paved with asphalt or seeded with grass suitable for planting during the season. The asphalt thickness will be appropriate for use by vehicles operated at the site. The topsoil thickness and/or depth of seed placement, pound per acre application rate, and appropriate fertilizer will follow vendor recommendations. Subsequent site inspections will be conducted to evaluate whether additional follow-up maintenance is required.

3.2.5 On-Site Soil Treatment

Soils from Excavation Areas 1 and 2 will be treated within an on-site treatment cell by enhanced anaerobic bioremediation. The treatment cell will be located in an approximately 100 square (sf) area located in the northern portion of the site as shown on Figure 6. The following sections detail the soil bioremediation and treatment cell construction processes:

3.2.5.1 Treatability Study

Prior to full-scale treatment of soils on-site, a treatability study will be conducted by a subcontracted laboratory to verify that soils from the site exhibit PCP/dioxin-degradation activity and to optimize amendment addition rates. Soil for the treatability study will be obtained from soil that is removed from the two excavation areas and temporarily stockpiled in the treatment cell. In this manner, soil samples that are most representative of actual soil conditions can be obtained for the treatability study.

The treatability study will consist of amendment of up to three representative composite soil samples obtained from the stockpiled soil with mixtures of blood meal and sodium phosphate and subsequent bioremediation of the samples under anaerobic conditions. The blood meal will act as a substrate to stimulate growth/reproduction of microorganisms present in the soil that are capable of degrading the compounds of concern (COCs) and will be added to the soil at a rates ranging from 5-10 g/kg soil. The sodium phosphate acts as a buffer for pH control (which should remain within a range of 6.5-7.3) and will be added in amounts equal to the blood meal addition as a combination of dibasic and monobasic salts at a ratio of 1:1 on a weight basis. COC concentrations in the soils will be analyzed for PCP by EPA Method 8270 and for dioxins/furans by EPA Method 8280 prior to beginning the treatability study and approximately 60 days after beginning the study. Soil pH will be monitored throughout the study to ensure recommended ranges are maintained.

3.2.5.2 Treatment Cell Construction

Prior to beginning excavation of impacted soils, the on-site treatment cell will be constructed by excavating a 100 sf area to approximately 3 ft bls with a minimum 1:5 sidewall slope. The treatment cell will be lined with a minimum 10 mil polyethylene liner prior to placement of soil in the cell. Soils excavated for construction of the treatment cell will be stockpiled on-site for use as backfill of Excavation Areas 1 and 2.

Initially, the treatment cell will be used for the stockpiling of soils from Excavation Areas 1 and 2 while the treatability study is conducted. Water and sediment recovered from the stormwater conveyance system alterations and flush detailed in Section 3.3 will be placed in the treatment cell with the stockpiled soils. The soil and water will be placed in the cell and covered in a manner which will prevent infiltration by rainwater.

A temporary, gated fence will be installed about the perimeter of the treatment cell prior to placement of soils from Excavation Areas 1 and 2 in the cell. Once construction of the treatment cell is completed, the fence will be modified (if necessary) so that adequate space exists about the edges of the cell for technicians to perform sampling and maintenance activities.

After completion of the treatability study, the stockpiled soils from Excavation Areas 1 and 2 will be amended within the treatment cell (see Section 3.2.5.3), and the cell will be flooded with tap water until a free-standing water depth of 6-12 inches is achieved. The cell will be capped with a polyethylene or plastic liner that will be sealed to the bottom liner by folding over a portion of the cell liners and sealing them together. The sealed liner edges will be buried in ditches surrounding the edges of the pit.

Four evenly spaced cover vents / sample ports will be installed through the cover of the treatment cell to allow for collection of sample cores from the cell and periodic release of gas (methane and carbon dioxide) produced by the biodegradation processes. The sample ports will consist of 5-foot pieces of 4-inch diameter polyvinyl chloride (PVC) pipe. The pipe will be inserted through the cover, the cover sealed around the pipe, and the end of the pipe positioned above the

surface of the cell. The other end will be covered with a threaded PVC cap fitted with a check valve. The venting pipe will be attached to a vertical metal rod embedded in the soil adjacent to the cell.

3.2.5.3 Soil Blending, Transport, and Placement

As discussed in Section 3.2.2, soils from Excavation Areas 1 and 2 will be placed in a dump truck (or other appropriate transport container) for on-site mobilization to the treatment cell. Initially, the soils will be stockpiled within the treatment cell while the treatability study is completed. After the study is completed, the soils will be amended in a pug mill or suitable blending alternative with the quantity of nutrients determined to be ideal based on the treatability study. Subsequently, the blended soils will be spread within the treatment cell to a height of approximately 2 to 3 feet above the bottom of the cell using a front-end loader or other equipment that will not damage the treatment cell's bottom liner.

3.2.5.4 Treatment Cell Sampling and Monitoring

Samples will be collected from the treatment cell on a quarterly basis until the site CGs are reached. Four sample cores will be collected during each sample event through the treatment cell sample ports. Composites of each core will be analyzed for PCP by EPA Method 8270 and for dioxins/furans by EPA Method 8280. The pH of samples will also be analyzed to ensure recommended ranges are being maintained. Soil sampling and quality assurance are further described in Section 6.0.

During quarterly sampling events, sampling personnel will monitor the condition of the treatment cell liner, ports, and the fence surrounding the cell. Additional monitoring will be carried out if deemed necessary by the Project Coordinator (see Section 4.1.1).

3.2.5.5 Treatment Cell Closure

After it is determined that CGs have been reached and EPA approval is obtained for closure of the treatment cell, the treatment cell cover will be removed, the bottom liner of the treatment cell

will be punctured, the treatment cell will be backfilled level with the surrounding grade, and the surface will be seeded as specified in Section 3.2.4.

3.2.6 Soil Treatment Alternatives

In the case that CGs are not obtained by the bioremedial approach specified in the preceding sections, alternative approaches will be investigated. One alternative would be to blend nutrients and/or marketed compounds/organisms into the impacted soils to induce aerobic bioremediation. The soils would periodically be tilled and amended to maintain aerobic conditions. An alternative approach such as this would require additional treatability testing, and implementation would take place in the same area as the treatment cell location. Note that such aerobic bioremedial approaches have proven successful for the removal of PCP from soils.

In the event that alternate treatment alternatives are not effective in reaching the CGs, the soil in the treatment cell will be removed and disposed off-site at a permitted facility.

3.3 STORMWATER CONVEYANCE SYSTEM MAINTENANCE AND ALTERATION

3.3.1 Stormwater Conveyance System Alteration

To address COC impacts detected in sediment and surface water samples collected from the stormwater conveyance system at the site, an approximately 100 linear foot segment of 15-inch diameter pipe will be removed and replaced with non-jointed pipe. The segment to be replaced extends from just upgradient of the proposed excavation area, runs through Excavation Area 1, and ends at the catch basin in Excavation Area 2. The segment to be replaced is depicted on Figure 6.

Sediment, soil, and debris from the removed portions of the pipe will be removed by power-washing and/or scraping the pipe within or over a containment pit. The sediment and water captured in the containment pit will be placed in the treatment cell with the stockpiled soils from the excavation areas, and the cleaned pipe and debris will be disposed of in a C&D or other suitable landfill.

Prior to installation of the replacement stormwater conveyance pipe, a new manhole will be installed at the location of the northwestern extent of the pipe replacement. The manhole will be installed to provide a transition from the existing pipe to the new non-jointed pipe. In addition, the catch basin located within Excavation Area 1 will be replaced, and new non-jointed pipe will be installed between the new catch basin and the existing catch basin located within Excavation Area 2. After completing the stormwater conveyance system alterations, the areas around the new pipe will be backfilled as detailed in Section 3.2.4.

3.3.2 Stormwater Conveyance System Flush

After completion of the stormwater conveyance system alterations, the pipe located between the catch basin in Excavation Area 2 and the stormwater basin discharge area will be cleared of debris and sediment using a high pressure flush. The segment to be flushed is depicted on Figure 6. Water used to flush the pipe and sediment flushed from the pipe will be recovered at the stormwater basin discharge end of the segment and will be placed in the treatment cell with the stockpiled soils from Excavation Areas 1 and 2.

3.4 SITE RESTORATION

After backfilling and surface covering of Excavation Areas 1 and 2 are completed, the following site restoration tasks will be completed:

- Barbed wire fencing will be replaced from the end of the sliding gate to the newly installed retaining wall or shored slope located southwest of Excavation Area 1.
- The temporary fencing near State Street will be removed and use of the sliding gate may resume.
- The treatment cell will remain in place and be secured by a perimeter fence with locking gate until treatment cell closure.

- The impediment installed to block off the stormwater conveyance system northwest of the excavation areas will be removed to allow stormwater to flow through the newly installed pipe segments.

4.0 PROJECT MANAGEMENT PLAN

4.1 PROJECT ORGANIZATION AND RESPONSIBILITIES

Personnel involved in the RA implementation and generation of data become a part of the overall project management plan. Within that plan, the following individuals have specific responsibilities: the Project Coordinator, the On-Site Manager, Field Sampling Technicians, the Site Health and Safety Officer, Regulatory Agency Representatives, and Analytical Laboratory Personnel. In some cases, personnel may assume several roles and responsibilities. The typical responsibilities of each are outlined below.

4.1.1 Project Coordinator

The Project Coordinator (PC) will be responsible for the administration of all actions by Forshaw required by the Settlement Agreement, including managing RA implementation, project scheduling, development of activities required for attaining the project objectives, oversight of appropriate subcontractors, oversight and coordination of field personnel, and the quality assurance, engineering, scientific, and analytical operations required for project activities. The PC will also review documents for completeness, accuracy, and adherence to the required statement of work. To the greatest extent possible, the PC will be present on-site or readily available during site work. The PC is Steven Hart of H&H.

4.1.2 On-Site Manager

The On-Site Manager (OSM) is responsible for seeing that site activities are carried out in accordance with the RAWP. The OSM is responsible for providing quality assurance of field generated data, assisting in the preparation of progress reports, coordination of field activities conducted by subcontractors, and providing daily on-site quality control for field work. The OSM is Scott Drury of H&H.

4.1.3 Field Sampling Technician

The Field Sampling Technician is responsible for on-site sampling and sample handling activities. This includes proper labeling and security, chain-of-custody, analysis request forms, packaging, and shipping to laboratories. Typically, only one or two field sampling technicians will be on-site at one time. The field sampling technicians will be qualified H&H personnel.

4.1.4 Site Health and Safety Officer

The Site Health and Safety Officer advises the field team members on health and safety issues at the site. The Site Health and Safety Officer is Shannon Cottrill with H&H.

4.1.5 Regulatory Agency Representatives

Designated EPA and DENR representatives will review work products and provide field guidance as needed during the RA activities. The designated EPA On-Scene Coordinator (OSC) for the project is Stephen Ball, Jr.

4.1.6 Analytical Laboratory Personnel

An independent laboratory will be subcontracted to provide laboratory analytical services for the project. The laboratory will meet the requirements of Section 17 of the Settlement Agreement. Appropriate laboratory personnel will be responsible for assuring that internal sample entry, shipping chain-of-custody, sample handling, and analytical procedures are followed.

4.2 COMMUNICATIONS

In addition to the report submittals identified in Section 4.3, informal email and phone calls will be used to provide the agencies with advance notice of Forshaw's plans, to solicit informal feedback, and to request input on key points in the RA process. Notable communications will be documented via meeting notes, telephone logs, electronic mail, or other means.

The primary point of contact for EPA for technical matters will be Stephen Ball, Jr. and the primary technical point of contact for Forshaw will be Steven Hart at H&H. Contact information is provided below.

Mr. Stephen Ball, Jr.
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As the RA progresses, EPA will be notified by the PC or his designee of potentially significant issues, conditions, or changes as promptly as possible. Notification will outline the situation encountered, proposed resolution, a discussion of changes from the approved RAWP (if any), and justification for those deviations. Such issues must be resolved promptly to avoid schedule delays and costly stand-by charges.

4.3 REMOVAL ACTION DELIVERABLES

In accordance with Sections 18, 19, and 20 of the Settlement Agreement, the following deliverables will be prepared for submittal to EPA during the RA:

- Written progress reports shall be submitted to EPA every 30th day after the date of receipt of EPA's approval of the RAWP until termination of the Settlement Agreement, unless otherwise directed in writing by the OSC. The reports will include the information required by, and be submitted in accordance with, Section 19 of the Settlement Agreement.

- H&H will submit to EPA a Final Report within 30 days after the completion of all work required in the Settlement Agreement. The Final Report will include the information required by Section 20 of the Settlement Agreement.

- In accordance with Section 18 of the Settlement Agreement, a proposal for post-removal site control will be submitted to EPA following the removal action. The proposal will be consistent with Section 300.415(l) of the NCP and OSWER Directive No. 9360.2-02. In accordance with the schedule in Appendix B, the proposal for post-removal site control will be submitted 60 days after submittal of the Final Report.

In addition to the above, a brief letter report will be submitted after the treatability study is completed that documents the results of the treatability study and a final plan for amendments that will be used in the treatment cell. The submission of this document will occur after the treatability study and before mobilization for the treatment cell amendments as indicated in the schedule in Appendix B.

5.0 REMOVAL ACTION DELIVERY

5.1 REMOVAL ACTION SUBCONTRACTOR SERVICES

A removal action subcontractor (RAS) or subcontractors will be selected to assist with implementation of the RA work including heavy equipment work, soil excavation, treatment cell construction, etc. Bids will only be solicited from subcontractors identified by the PC as qualified and competent. The following information will be evaluated to identify qualified subcontractors:

- Experience with similar work on environmental removal or remediation sites;
- Backlog and ability to provide experienced labor, equipment, and materials within the project schedule;
- References;
- Health and safety record;
- Performance of installed systems;
- Bonding and/or insurance limits; and
- Type and availability of proposed equipment and alternates, if needed

Experience and price will be primary selection criteria, though the proposed schedule, equipment, health and safety, and material selection will also be evaluated.

5.2 REMOVAL ACTION SCHEDULE

A schedule of RA implementation is included in Appendix B. The schedule makes assumptions concerning EPA review time and approval of the RAWP. The schedule will be updated to reflect actual review times and approval dates after EPA approval of the RAWP.

The schedule is based on discussions with Harry L. Allen (US EPA, ERT-New Jersey), estimates provided by vendors and construction contractors, and H&H's experience with similar projects. As the RA progresses, schedule updates will be provided as necessary.

6.0 SAMPLING QUALITY ASSURANCE/QUALITY CONTROL

This section describes the Sampling Quality Assurance/Quality Control Plan (QA/QC Plan) for soil sampling that will be conducted as part of the RA. In accordance with Section 17 of the Settlement Agreement, the Sampling QA/QA Plan has been prepared in accordance with *Quality Assurance/Quality Control Guidance for Removal Activities: Sampling QA/QC Plan and Data Validation Procedures* (EPA OSWER Directive 9360.4-01, EPA/540/G-90/004) dated April 1990 (hereafter referred to as the OSWER Sampling QA/QC Guidance).

In accordance with the above referenced guidance, the Sampling QA/QC Plan should contain the following:

- Background
- Data Use Objectives
- Quality Assurance Objectives
- Approach and Sampling Methodology
- Project Organization and Responsibilities
- Deliverables
- Data Validation

Of these items, background information is provided in Section 2.0, project organization and responsibilities are described in Sections 4.1 and 4.2, and project deliverables are described in Section 4.3. As such, these items will not be repeated in this section.

6.1 DATA USE OBJECTIVES

Soil samples will be collected as part of the RA activities. The intended use of the soil sampling data will be for the following:

- Verification that soil has been adequately removed from each of the excavation areas such that remaining soil compound concentrations do not exceed the CGs (i.e., post-excavation verification samples).

- Verification that the soil in the treatment cell has been treated to compound concentrations below the CGs (i.e., soil treatment verification samples).

6.2 QUALITY ASSURANCE OBJECTIVES

The OSWER Sampling QA/QC Guidance outlines three QA/QC objectives (QA1, QA2, and QA3) for assessing and substantiating the collected data to support its intended use. For this project, QA objective 2 (QA2) was selected as the objective that supports the intended use of the data. In accordance with the OSWER Sampling QA/QC Sampling Guidance, the QA2 objective is used for verification of cleanup.

For the QA2 objective, EPA approved analytical methods will be used for identification and quantification of the analytes of concern. For this project, the analytes of concern are PCP and dioxins/furans.

6.3 APPROACH AND SAMPLING METHODOLOGIES

6.3.1 6.3.1 Field Protocols

Field protocols, including soil sample collection, equipment decontamination, chain-of-custody documentation, and field notes, will be conducted in accordance with the *Field Branches Quality System and Technical Procedures Manual, EPA Region 4 Science and Ecosystem Support Division* (effective date November 2007 or most recent version). Copies of relevant Region 4 technical protocols to be used in the field efforts are contained in Appendix C.

Soil samples will be collected using either manual soil sampling methods (i.e., hand augers, scoops) or using the backhoe sampling method as described in Soil Sampling Procedure in Appendix C.

6.3.2 Field Quality Assurance Samples

Field quality control checks will be utilized during sample collection through the use of the following:

Rinseate Blanks - These are samples of ultra-pure water supplied by the laboratory that have been in contact with decontaminated sampling equipment. These samples serve as a QA/QC check on the decontamination procedures. One rinseate blank will be collected each week during soil sampling per sample equipment type per matrix.

Field Duplicate Samples - Duplicate samples will be collected to allow determination of analytical repeatability. At a minimum, one duplicate sample for every 20 soil samples will be collected and submitted for analysis for the same parameters as specified for the parent sample.

Matrix Spike Sample - A matrix spike sample will be submitted as a further QC check. The matrix spike sample is actually a laboratory analytical QC item, which is discussed here because sufficient sample must be collected in the field in order to perform these analyses. These samples will be collected at the same frequency as stated above for the duplicate samples. These samples will allow the amount of recovery of spike compounds (the spike compounds are defined in the analytical protocols, where applicable) to be determined for matrix effects specific to the study site, through the addition of known concentrations of compounds into the sample at the laboratory and then performing the analysis. Additional soil volume will be collected for matrix spike and matrix spike duplicate samples as required by the laboratory. The matrix spike and matrix spike duplicate samples will be labeled with the soil sample identified followed by "MS/MSD" on the chain of custody record.

6.3.3 Laboratory Protocols

A laboratory or laboratories that meet the requirements of Section 17 of the Settlement Agreement will be retained to conduct laboratory analyses of soil samples for the RA. The laboratory will follow EPA method-prescribed quality assurance/quality control procedures, as well as their internal quality assurance protocols.

A field sample summary table specifying the expected number of soil samples, quality assurance samples, analytical methods, sample containers, preservation methods, etc. is provided as Table 3.

6.4 DATA VALIDATION

Data validation will be conducted in accordance with the OSWER Sampling QA/QC Guidance for the QA2 objective. For all samples, chain of custody, holding times, blank contamination (i.e., rinseate and method blanks), and detection limits will be reviewed and evaluated. In addition, for 10% of the samples, the analytical data packages will be evaluated for the following:

- Initial and continuing calibration
- Confirmation of identification and quantification of analytes via the EPA approved method through review of analytical data backup (such as GC/MS documentation)
- Matrix spike/matrix spike duplicate results
- Surrogate recoveries

The data validation procedures and qualifiers in the OSWER Sampling QA/QC Guidance will be used in the data validation process, and the results of the data validation will be included in the Final Report.

7.0 HEALTH AND SAFETY PLAN

In accordance with Section 16 of the Settlement Agreement, a site-specific RA Health and Safety Plan is included as Appendix D. The Health and Safety Plan includes provisions to protect on-site workers and public health and safety during the RA. In accordance with the Settlement Agreement, the plan was prepared in accordance with EPA's Standard Operating Safety Guide and OSHA Part 1910.

Table 1
Summary of July 2008 Pentachlorophenol and Arsenic Soil Sample Analyses
Forshaw Chemicals, Inc.
Charlotte, North Carolina
H&H Job No. FOR-001

Deeper Soil Samples									
Area	East of Former PCP Plant	Former PCP Plant/Storm Drain	Storm Drain Line	Former PCP Formulation Plant	Concrete Fill Area	Storm Drain Line/Former PCP Truck Loading Area			Storm Drain Line
Sample ID	SB-1	SB-2	SB-3	SB-4	SB-5	SB-6/DUP-1		SB-7	SB-8
Date	7/2/2008	7/1/2008	7/1/2008	7/1/2008	7/2/2008	7/2/2008	7/2/2008	7/2/2008	7/2/2008
Depth (ft)	4-6	6-8	6-8	4-6	4-6	4-6	4-6	5-7	4-6
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
SVOCs 8270C									
Pentachlorophenol	<2.02	47.2	<1.97	56.3	<1.93	<1.95	<1.97	3,070	<1.98
Metals 6010									
Arsenic	NA	3.5	3.2	26.1	NA	5.1	2.5	161	1,490

Surface Soil Samples								RA Performance Goal
Area	East of Former PCP Plant	Western Portion of Site	Central Portion of Site	Former PCP Formulation Plant	West Side of Main Warehouse		East Side of Main Warehouse	
Sample ID	HA-1	HA-2	HA-3	HA-4	HA-5	HA-6	HA-7	
Date	7/2/2008	7/2/2008	7/2/2008	7/2/2008	7/2/2008	7/2/2008	7/2/2008	
Depth (ft)	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
SVOCs 8270C								
Pentachlorophenol	<2.19	<1.75	<1.86	<1.86	<2.01	<1.92	<1.81	300
Metals 6010								
Arsenic	NA	NA	NA	NA	NA	NA	NA	--

Background					
Area	County Property North of Site				
Sample ID	BG-1	BG-2	BG-3	BG-4	BG-5
Date	7/2/2008	7/2/2008	7/2/2008	7/2/2008	7/2/2008
Depth (ft)	0-0.5	6-8	4-6	0-0.5	0-0.5
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
SVOCs 8270C					
Pentachlorophenol	NA	NA	NA	NA	NA
Metals 6010					
Arsenic	0.67	1.3	1.1	9.4	3.5

Notes:
NA = Not Analyzed
PCP = Pentachlorophenol

Table 2
Summary of July 2008 Dioxin/Furan Soil Sample Analyses (Page 1 of 2)
Forshaw Chemicals, Inc.
Charlotte, North Carolina
H&H Job No. FOR-001

Area	WHO 2005 TEF	East of Former PCP Plant		Former PCP Plant/Storm Drain		Storm Drain Line		Former PCP Formulation Plant		Concrete Fill Area		Storm Drain Line/Former PCP Truck Loading Area						Storm Drain Line		Background: County Property North of Site					
Sample ID		SB-1		SB-2		SB-3		SB-4		SB-5		SB-6/DUP-1				SB-7		SB-8		BG-1	BG-2	BG-3	BG-4		BG-5
Date		7/1/2008		7/1/2008		7/1/2008		7/1/2008		7/2/2008		7/2/2008		7/2/2008		7/2/2008		7/1/2008		7/2/2008	7/2/2008	7/2/2008	7/2/2008		7/2/2008
Depth (ft)		4-6		6-8		6-8		4-6		4-6		4-6		4-6		5-7		4-6		0-0.5	6-8	4-6	0-0.5		0-0.5
Units		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg	µg/kg	µg/kg	µg/kg		µg/kg
		raw	adjusted	raw	adjusted	raw	adjusted	raw	adjusted	raw	adjusted	raw	adjusted	raw	adjusted	raw	adjusted	raw	adjusted	raw	raw	raw	raw	adjusted	raw
2,3,7,8-TCDF	1	<1.0		<1.0		<1.0		<10		<1.0		<1.0		<1.0		<1.3		<1.0		<1.0	<1.0	<1.0	<1.0		<1.0
Total TCDF		<1.0		<1.0		<1.0		<10		<1.0		<1.0		<1.0		1.2		<1.0		<1.0	<1.0	<1.0	<1.0		<1.0
1,2,3,7,8-PeCDF	1	<2.5		<2.5		<2.5		<25		<2.5		<2.5		<2.5		<5.6		<2.5		<1.0	<1.0	<1.0	<1.0		<1.0
Total PeCDF		<2.5		<2.5		<2.5		<25		<2.5		<2.5		<2.5		<3.0		<2.5		<1.0	<1.0	<1.0	<1.0		<1.0
1,2,3,4,7,8-HxCDF	0.1	<2.5		<2.5		<2.5		<25		<2.5		3.1E*	0.31	<2.5		37E*	3.7	<2.5		<2.5	<2.5	<2.5	<2.5		<2.5
2,3,4,6,7,8-HxCDF	0.1	<2.5		<2.5		<2.5		<25								3.0	0.3	<2.5		<2.5	<2.5	<2.5	<2.5		<2.5
Total HxCDF										<2.5		<2.5		<2.5		19.0		<2.5		<2.5	<2.5	<2.5	<2.5		<2.5
1,2,3,6,7,8-HxCDD	0.1	<2.5		<2.5		<2.5		<25		<2.5		<2.5		<2.5		17.0	1.7	<2.5		<2.5	<2.5	<2.5	<2.5		<2.5
Total HxCDD		<2.5		<2.5		<2.5		<25		<2.5		<2.5		<2.5		31.0		<2.5		<2.5	<2.5	<2.5	<2.5		<2.5
1,2,3,4,6,7,8-HpCDF	0.01	<2.5		2.6	0.026	<2.5		120E	1.20	<2.5		<2.5		<2.5		100E*	1	<2.5		<2.5	<2.5	<2.5	<2.5		<2.5
1,2,3,6,7,8,9-HpCDF	0.01	<2.5		<2.5				<25		<2.5		<2.5		<2.5		13.0	0.13	<2.5		<2.5	<2.5	<2.5	<2.5		<2.5
Total HpCDF		<2.5		2.6		<2.5		260		<2.5		<2.5		<2.5		13.0		<2.5		<2.5	<2.5	<2.5	<2.5		<2.5
1,2,3,4,6,7,8-HpCDD	0.01	<2.5		27	0.27	<2.5		510	5.1	<2.5		<2.5		<2.5		1,100	11.0	<2.5		<2.5	<2.5	<2.5	<2.5		<2.5
Total HpCDD		<2.5		37		<2.5		720		<2.5		<2.5		<2.5		1,400		<2.5		<2.5	<2.5	<2.5	<2.5		<2.5
OCDF	0.0003	<5.0		24	0.0072	<5.0		1,100	0.3	<5.0		<5.0		<5.0		600	0.2	<5.0		<5.0	<5.0	<5.0	<5.0		<5.0
OCDD	0.0003	<5.0		310	0.093	5.3	0.00159	5,800	1.7	<5.0		23	0.0069	32	0.0096	3,900	1.2	6.3	0.00189	<5.0	<5.0	<5.0	29	0.0087	<5.0
Total Dioxin 2,3,7,8-TCDD Equivalence		ND		0.3962		0.0016		8.370		ND		0.3169		0.0096		19.18		0.00189		ND	ND	ND	0.0087		ND

Notes:
Only detected dioxins/furans shown in table. Refer to laboratory report for dioxins/furans analyzed but not detected
ND = Not Detected
WHO 2005 TEF = World Health Organization Toxicity Equivalency Factors (*The 2005 World Health Organization Re-Evaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-Like Compounds*)
E = PCDE Interference

Table 2
Summary of July 2008 Dioxin/Furan Soil Sample Analyses (Page 2 of 2)
Forshaw Chemicals, Inc.
Charlotte, North Carolina
H&H Job No. FOR-001

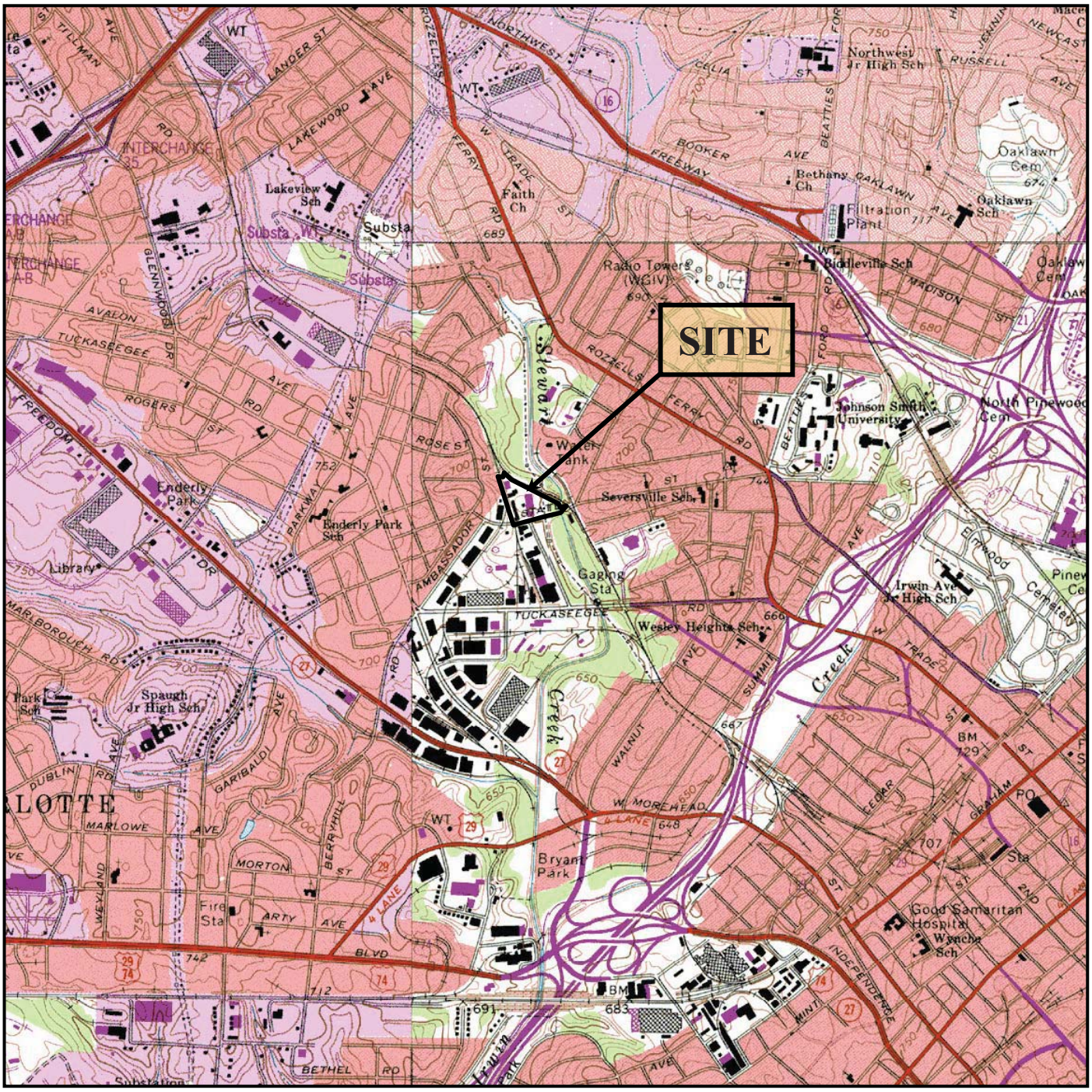
																Background					
Area	WHO 2005 TEF	East of Former PCP Plant		Western Portion of Site		Central Portion of Site		Former PCP Formulation Plant		West Side of Main Warehouse				East Side of Main Warehouse		County Property North of Site					
Sample ID		HA-1		HA-2		HA-3		HA-4		HA-5		HA-6		HA-7		BG-1	BG-2	BG-3	BG-4		BG-5
Date		7/2/2008		7/2/2008		7/2/2008		7/2/2008		7/2/2008		7/2/2008		7/2/2008		7/2/2008	7/2/2008	7/2/2008	7/2/2008		7/2/2008
Depth (ft)		0-0.5		0-0.5		0-0.5		0-0.5		0-0.5		0-0.5		0-0.5		0-0.5	6-8	4-6	0-0.5		0-0.5
Units		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg	µg/kg	µg/kg	µg/kg		µg/kg
		raw	adjusted	raw	adjusted	raw	adjusted	raw	adjusted	raw	adjusted	raw	adjusted	raw	adjusted	raw	raw	raw	raw	adjusted	raw
2,3,7,8-TCDF	1	<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0	<1.0	<1.0	<1.0		<1.0
Total TCDF		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0	<1.0	<1.0	<1.0		<1.0
1,2,3,7,8-PeCDF	1	<2.5		<2.5		<2.5		<2.5		<2.5		<2.5		<2.5		<1.0	<1.0	<1.0	<1.0		<1.0
Total PeCDF		<2.5		<2.5		<2.5		<2.5		<2.5		<2.5		<2.5		<1.0	<1.0	<1.0	<1.0		<1.0
1,2,3,4,7,8-HxCDF	0.1	<2.5		<2.5		2.9E	0.29	<2.5		<2.5		<2.5		<2.5		<2.5	<2.5	<2.5	<2.5		<2.5
2,3,4,6,7,8-HxCDF	0.1	<2.5		<2.5		<2.5		<2.5				<2.5		<2.5		<2.5	<2.5	<2.5	<2.5		<2.5
Total HxCDF										<2.5		2.6		<2.5		<2.5	<2.5	<2.5	<2.5		<2.5
1,2,3,6,7,8-HxCDD	0.1	<2.5		<2.5		<2.5		<2.5		<2.5		<2.5		<2.5		<2.5	<2.5	<2.5	<2.5		<2.5
Total HxCDD		<2.5		<2.5		<2.5		<2.5		<2.5		3.1		<2.5		<2.5	<2.5	<2.5	<2.5		<2.5
1,2,3,4,6,7,8-HpCDF	0.01	<2.5		8.9	0.089	7.8	0.078	<2.5		<2.5		6.3	0.063	<2.5		<2.5	<2.5	<2.5	<2.5		<2.5
1,2,3,6,7,8,9-HpCDF	0.01	<2.5		<2.5		<2.5		<2.5		<2.5		<2.5		<2.5		<2.5	<2.5	<2.5	<2.5		<2.5
Total HpCDF		<2.5		14.0		7.8		3.3		<2.5		6.3		<2.5		<2.5	<2.5	<2.5	<2.5		<2.5
1,2,3,4,6,7,8-HpCDD	0.01	12.0	0.12	35.0	0.35	60.0	0.6	<2.5		17	0.17	46.0	0.46	3.5	0.035	<2.5	<2.5	<2.5	<2.5		<2.5
Total HpCDD		19.0		56.0		89.0		<2.5		28		75.0		3.5		<2.5	<2.5	<2.5	<2.5		<2.5
OCDF	0.0003	8.9	0.00267	25.0	0.0075	41.0	0.0123	<5.0		11	0.0033	22.0	0.0066	<2.5		<5.0	<5.0	<5.0	<5.0		<5.0
OCDD	0.0003	280	0.084	800.0	0.24	820.0	0.246	13.0	0.004	300	0.09	580.0	0.174	58	0.0174	<5.0	<5.0	<5.0	29	0.0087	<5.0
Total Dioxin 2,3,7,8-TCDD Equivalence		0.20667		0.6865		1.2263		0.004		0.2633		0.7036		0.0524		ND	ND	ND	0.0087		ND

Notes:
Bold indicates concentration exceeds lowest screening level.
ND = Not Detected
WHO 2005 TEF = World Health Organization Toxicity Equivalency Factors (*The 2005 World Health Organization Re-Evaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-Like Compounds*)
EPA (1998) = *Approach for Addressing Dioxin in Soil at CERCLA and RCRA Sites*, OSWER Directive 9200.4-25, April 13, 1998.
IHSB SRGs = North Carolina Department of Environmental and Natural Resources Inactive Hazardous Sites Branch Health-Based Soil Remediation Goals
EPA Regional Screening Levels for Chemical Contaminants at Superfund Sites dated June 20, 2008
E = PCDE Interference
* = Estimated Maximum Possible Concentration

Table 3
Sample Summary Table
Removal Action
Forshaw Chemicals, Inc.
Charlotte, North Carolina
H&H Job No. FOR-001

						Post-Excavation Verification Samples					Treatment Verification Samples[1]				
Analytical Parameter	**EPA Method Number**	**Matrix**	**Container Type and Volume**	**Preservation**	**Holding Time**	Samples	Duplicates	Matrix Spike/Matrix Spike Duplicate	Rinse Blanks	Total	Samples	Duplicates	Matrix Spike/Matrix Spike Duplicate	Rinse Blanks	Total
Pentachlorophenol	8270	S	(2) 8 oz glass	Cool, 4°C	14d ext/40d analysis	15	1	1		17	16	4	4		24
Pentachlorophenol	8270	W	(2) 1 liter glass	Cool, 4°C	7d ext/40 d analysis				2	2				4	4
Dioxins/Furans	8280	S	(2) 4 oz glass	Cool, 4°C	30d ext/45 d analysis	15	1	1		17	16	4	4		24
Dioxins/Furans	8280	W	(2) 1 liter glass	Cool, 4°C	30d ext/45 d analysis				2	2				4	4
pH	9045	S	(1) 4 oz glass	Cool, 4°C	ASAP						16	4	4		

Notes:
[1] = Four samples will be collected per quarter plus QA/QC samples
d = days
ext = extraction
ASAP = as soon as possible



N

APPROXIMATE

0 2000 4000

SCALE IN FEET

U.S.G.S. QUADRANGLE MAP

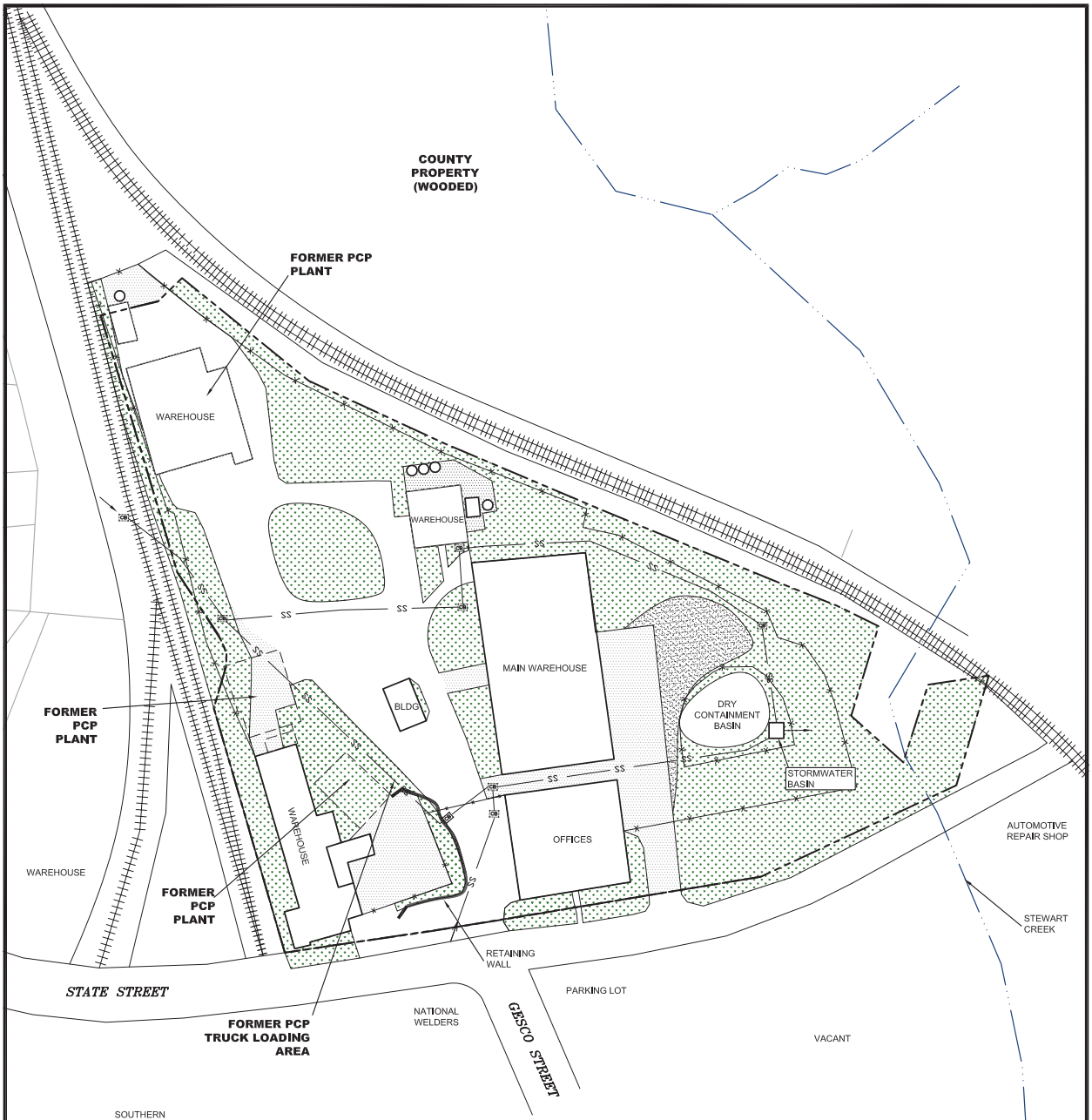
CHARLOTTE EAST, NC 1967
PHOTOREVISED 1988

QUADRANGLE
7.5 MINUTE SERIES (TOPOGRAPHIC)

TITLE	SITE LOCATION MAP
PROJECT	FORSHAW CHEMICALS, INC. CHARLOTTE, NORTH CAROLINA

Hart & Hickman
A Professional Corporation
2923 South Tryon Street-Suite 100
Charlotte, North Carolina 28203
704-586-0007 (p) 704-586-0373 (f)

DATE:	5-12-08	REVISION NO:	0
JOB NO:	For-001	FIGURE:	1



N

APPROXIMATE
0 100 200
SCALE IN FEET

LEGEND

- PROPERTY BOUNDARY
- GRASSY AREA
- PAVEMENT
- GRAVEL
- CATCH BASIN
- SS — APPROXIMATE STORMWATER CONVEYANCE SYSTEM LOCATION
- FENCE

TITLE

SITE MAP

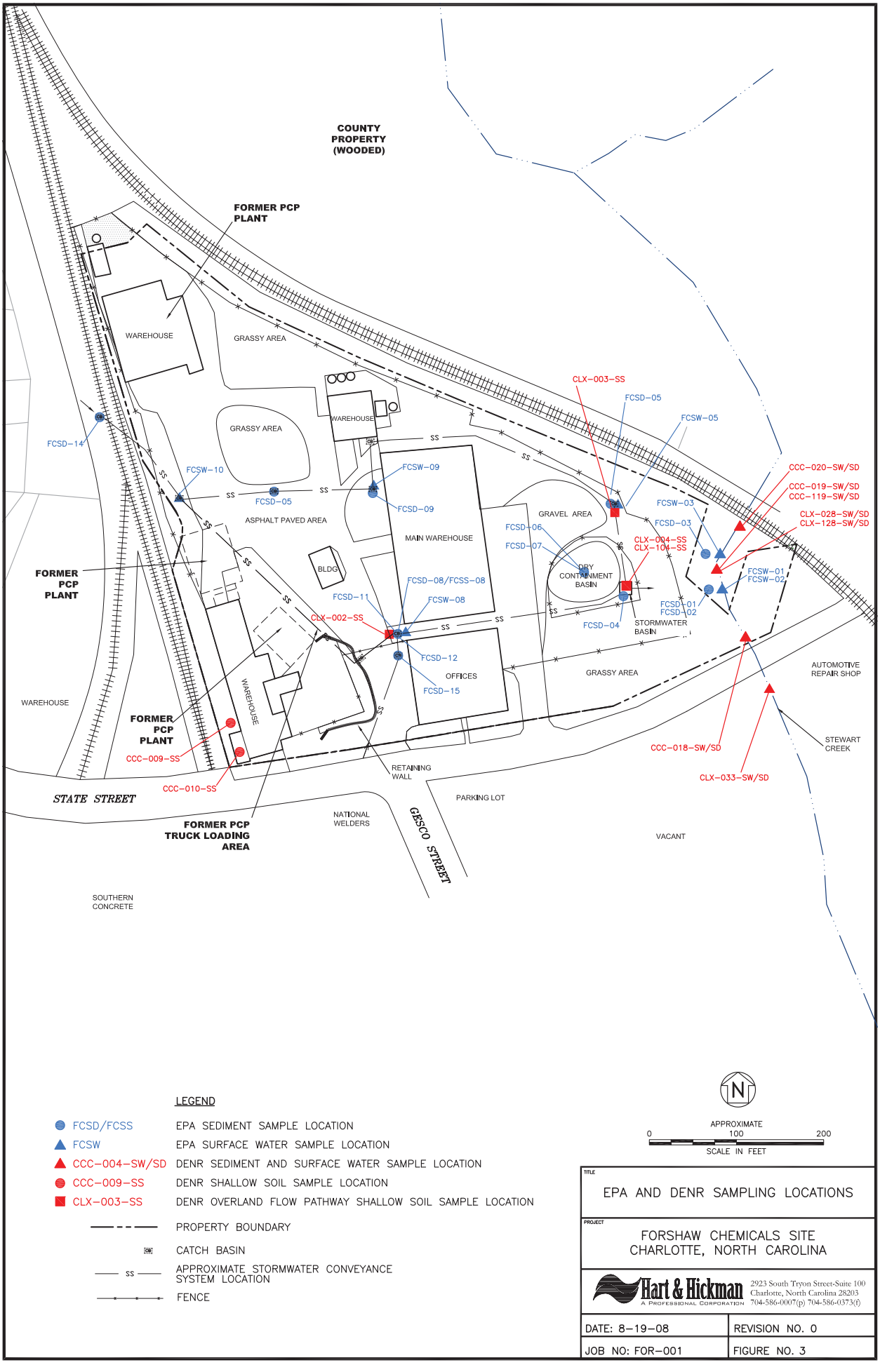
PROJECT

FORSHAW CHEMICALS SITE
CHARLOTTE, NORTH CAROLINA

Hart & Hickman
A PROFESSIONAL CORPORATION
2923 South Tryon Street-Suite 100
Charlotte, North Carolina 28203
704-586-0007(p) 704-586-0373(f)

DATE: 8-25-08	REVISION NO. 0
JOB NO: FOR-001	FIGURE NO. 2

S:\AAA-Master Projects\Forshaw Distribution - FORIRA Work Plan\Figures\FIG-02 Site Map.dwg, Model, 9/1/2009 4:27:02 PM



LEGEND

FCSD/FCSS	EPA SEDIMENT SAMPLE LOCATION
FCSW	EPA SURFACE WATER SAMPLE LOCATION
CCC-004-SW/SD	DENR SEDIMENT AND SURFACE WATER SAMPLE LOCATION
CCC-009-SS	DENR SHALLOW SOIL SAMPLE LOCATION
CLX-003-SS	DENR OVERLAND FLOW PATHWAY SHALLOW SOIL SAMPLE LOCATION
	PROPERTY BOUNDARY
CB	CATCH BASIN
SS	APPROXIMATE STORMWATER CONVEYANCE SYSTEM LOCATION
	FENCE

N

APPROXIMATE
0 100 200
SCALE IN FEET

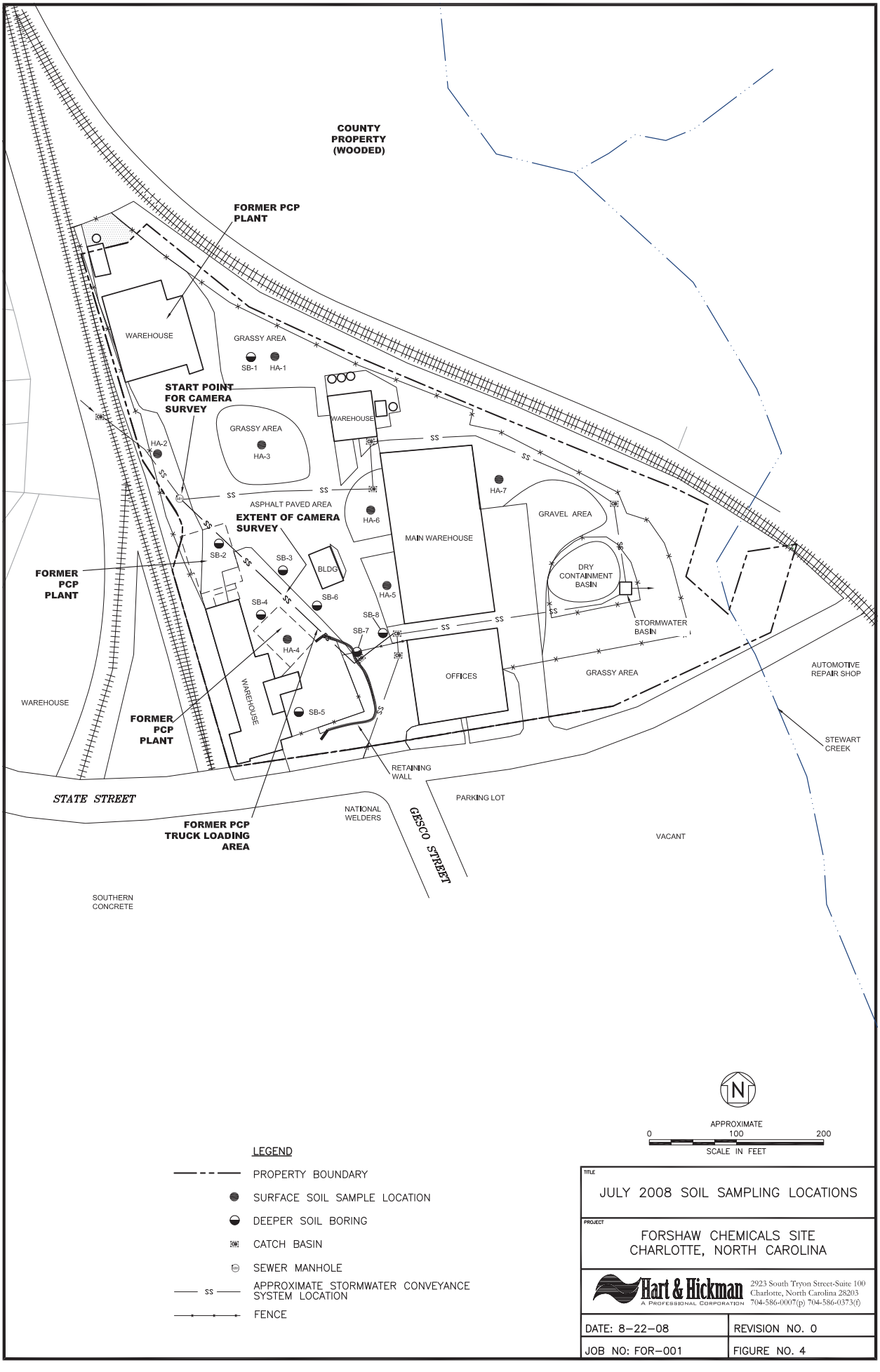
TITLE
EPA AND DENR SAMPLING LOCATIONS

PROJECT
FORSHAW CHEMICALS SITE
CHARLOTTE, NORTH CAROLINA

Hart & Hickman
A PROFESSIONAL CORPORATION
2923 South Tryon Street-Suite 100
Charlotte, North Carolina 28203
704-586-0007(p) 704-586-0373(f)

DATE: 8-19-08	REVISION NO. 0
JOB NO: FOR-001	FIGURE NO. 3

S:\AAA-Master Projects\Forshaw Distribution - FORSHA Work Plan\Figures\FIG-03 Historical Sample Locations.dwg, Model, 9/1/2009 4:27:30 PM



TITLE

JULY 2008 SOIL SAMPLING LOCATIONS

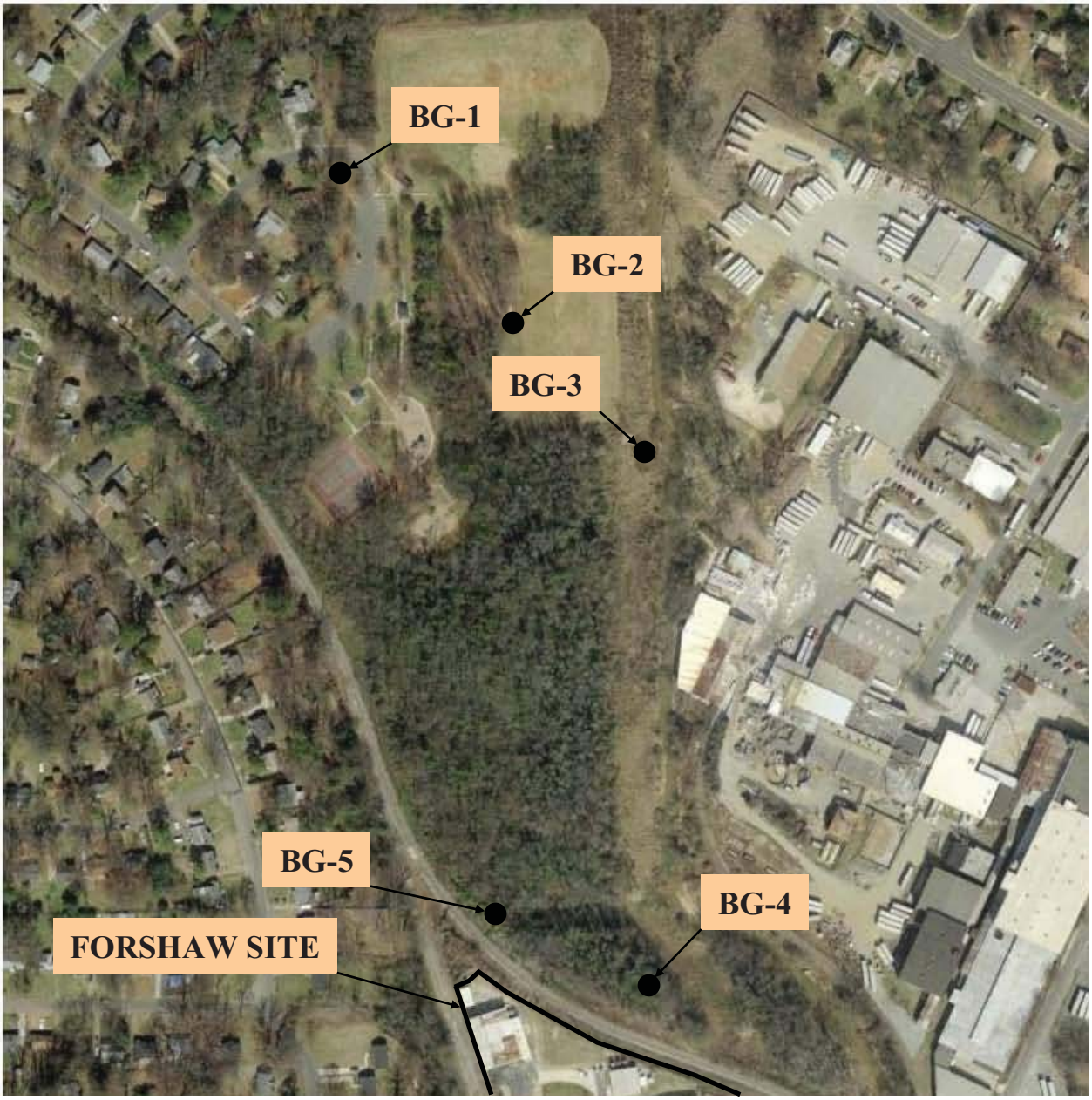
PROJECT

FORSHAW CHEMICALS SITE
CHARLOTTE, NORTH CAROLINA

Hart & Hickman
A PROFESSIONAL CORPORATION
2923 South Tryon Street-Suite 100
Charlotte, North Carolina 28203
704-586-0007(p) 704-586-0373(f)

DATE: 8-22-08	REVISION NO. 0
JOB NO: FOR-001	FIGURE NO. 4

S:\AAA-Master Projects\Forshaw Distribution - FORIRA Work Plan\Figures\FIG-04 Sample Locations.dwg, Model, 9/1/2009 4:27:50 PM



N

APPROXIMATE

0 300 600

SCALE IN FEET

LEGEND

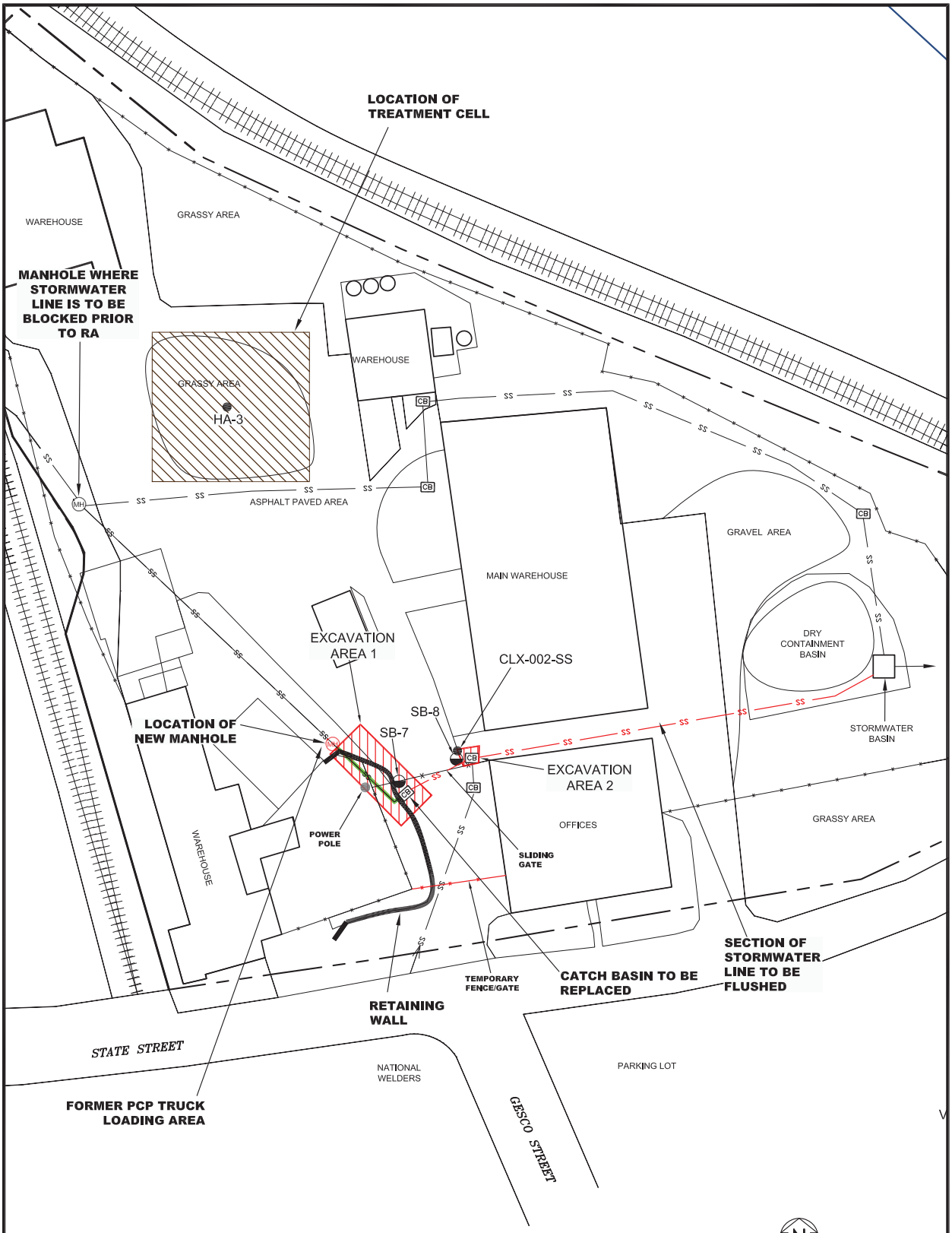
● BACKGROUND SAMPLE LOCATION

TITLE
JULY 2008 BACKGROUND SAMPLE LOCATIONS

PROJECT
FORSHAW CHEMICALS SITE
CHARLOTTE, NORTH CAROLINA

Hart & Hickman
A Professional Corporation
2923 South Tryon Street-Suite 100
Charlotte, North Carolina 28203
704-586-0007 (p) 704-586-0373 (f)

DATE:	8-5-08	REVISION NO:	0
JOB NO:	FOR-001	FIGURE:	5



LEGEND

- PROPERTY BOUNDARY
- RAILROAD
- BARBED WIRE FENCE
- APPROXIMATE STORMWATER CONVEYANCE SYSTEM LOCATION
- SECTION OF STORMWATER CONVEYANCE SYSTEM LINE TO BE FLUSHED
- SECTION OF STORMWATER CONVEYANCE SYSTEM LINE TO BE REPLACED
- APPROXIMATE EXCAVATION AREAS
- SURFACE SOIL SAMPLE LOCATION
- SUBSURFACE SOIL BORING LOCATION
- SEWER MANHOLE
- CATCH BASIN

N

APPROXIMATE
0 60 120
SCALE IN FEET

TITLE: REMOVAL ACTION MAP

PROJECT:
FORSHAW CHEMICALS SITE
SITE ID: NCN 000 409 865
650 STATE STREET
CHARLOTTE, NORTH CAROLINA

Hart & Hickman
A PROFESSIONAL CORPORATION
2923 South Tryon Street-Suite 100
Charlotte, North Carolina 28203
704-586-0007(p) 704-586-0373(f)

DATE: 06/10/09	REVISION NO. 0
JOB NO. FOR-001	FIGURE NO. 6

S:\AAA-Master Projects\Forshaw Distribution - FORSHA Work Plan\Figures\Figure 6 RA Map.dwg, ARF-ATT.1A, 9/1/2009 4:42:46 PM

Appendix A

EPA and DENR Sample Analytical Data Summary

Appendix A - Table 1
Summary of DENR Analytical Results
Forshaw Site
Charlotte, North Carolina
H&H Job No. FOR-001

Sample ID	CLX-002-SS	CLX-003-SS	CLX-004-SS	CLX-104-SS	CCC-009-SS	CCC-010-SS	CCC-018-SW	CCC-019-SW	CCC-119-SW	CLX-028-SW	CLX-128-SW	CLX-033-SW	CCC-018-SD	CCC-019-SD	CCC-119-SD	CLX-028-SD	CLX-128-SD	CLX-033-SD
Date	December-05	December-05	December-05	December-05	March-05	March-05	March-06	March-06	March-06	January-06	January-06	January-06	March-05	March-05	March-05	January-06	January-06	January-06
Sample Type	Shallow Soil	Shallow Soil	Shallow Soil	Shallow Soil	Shallow Soil	Shallow Soil	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Metals																		
Aluminum	6,600	18,000	7,100	3,700	4,277	6,627	U	U	U	U	U	123		4,458	4,759	9,700	11,000	6,500
Antimony																0.66	U	U
Arsenic	82	93	16	30	12.6	9.2	U	350	350	450	430	U		80.5	80.5	490	750	12
Barium	79	83	130	60	120	210	24	39.2	39.2	43.2	40	28		84	67	120	130	60
Berylium					0.74	1.2								0.29	0.22			
Cadmium	0.4	U	0.03	U	1.1	1								U	0.08			
Calcium	9,375	1,563	3,594	3,672	2,200	4,200	20,000	35,000	34,000	39,000	37,000	21,000		6,200	3,900	1,900	2,400	2,100
Chromium	14.73	41.86	10.08	17.83	15.5	12.4	3.3	U	U					30.2	17.8	23.0	27	28
Cobalt	7.4	21	12	11	1.8	3.5								8.8	8	32	20	26
Copper	287	31.15	22.95	31.15	9016	336				5.04	4.8	U		21.3	19.7	18	22	12
Iron	13,000	30,000	18,000	16,000	14,179	13,433	670	460	560	410	480	580		14,179	11,194	18,000.0	21,000	16,000
Lead	18.75	2.85	4.65	111.11	150	29								16	20	3	3.4	6.94
Magnesium	2,400	4,100	5,600	2,700	700	880	6,100	9,100	99,000	9,700	9,300	6,400		3,500	3,200	2,900	3,100	1,800
Manganese	435	613	460	331	62.1	121	94	75	76	110	100	94		677	290	530	650	980
Total Mercury	0.77	U	U	U	0.22	1.4							U	U	U			
Nickel	7.3	18	6.5	8.2	14	16								8.4	9.1	9.4	11	6
Potassium	1,100	1,100	3,900	1,100	28	38	2,097	2,016	2,016	2,419	2,419	2,097		840	950	10.29	12.58	600
Silver					0.23	U												
Sodium	1,200	14.16	18.88	710			8,300	8,700	8,700	11,000	11,000	11,000				7.86	9.04	5.51
Vanadium	30	100	45	38	16.4	25.4								40.3	32.1	62	69	37
Zinc	293.33	73.33	113.33	173.33	35.3	31.3	1.7	2.2	2.3	U	61	U		166.7	140	34	32	83
VOCs																		
n-Butylbenzene					0.29													
Bromomethane					0.026													
m,p-Xylenes					0.27													
o-Xylenes					0.15													
1,4-Dichlorobenzene					0.82													
1,1-Dichloroethylene														0.0071	0.0038			
Cis-1,2-Dichloroethene														0.0062	0.0033			
n-Propybenzene					0.12													
Trichloroethylene														0.017	0.0065			
1,1,1-Trichloroethane														0.0014	U			
1,2,4-Trimethylbenzene					0.18													
1,3,5-Trimethylbenzene					0.38													
SVOCs																		
2-Methylnaphthalene	59																	
Naphthalene	21																	
Phenanthrene	30																	
1,2-Dibromo-3-chloropropane					1.7													
1,2,4-Trichlorobenzene					1.1													
Pentachlorophenol	1,700	5.4	4.4	0.017	250			150	170	440	410	U		U	0.0009			
2,3,4,6-Tetrachlorophenol					6.7					13	12	U						
Pesticides																		
gamma-BHC (lindane)					2.036					0.06	0.06	U						
delta-BHC					2.2													
gamma-Chlordane	0.14		0.0073	0.0072	54									0.13	U	U	U	0.0029
alpha-Chlordane														0.058	U			
trans-Nonachlor					9.8													
alpha-Chlordane					17													
cis-Nonachlor					3													

Appendix A - Table 2
Summary of DENR Soil and Sediment Dioxin/Furan Analysis
Forshaw Site
Charlotte, North Carolina
H&H Job No. FOR-001

Sample ID Date Sample Type	2005 WHO TEFs	CLX-002-SS December-05 Shallow Soil		CLX-003-SS December-05 Shallow Soil		CLX-004-SS December-05 Shallow Soil		CLX-104-SS December-05 Shallow Soil		CCC-019-SD March-05 Sediment		CCC-119-SD March-05 Sediment		CLX-028-SD January-06 Sediment		CLX-128-SD January-06 Sediment		CLX-033-SD January-06 Sediment	
Dioxins/Furans (µg/kg)		raw	adjusted	raw	adjusted	raw	adjusted	raw	adjusted	raw	adjusted	raw	adjusted	raw	adjusted	raw	adjusted	raw	adjusted
2,3,7,8-Tetrachlorodibenzodioxin	1	0.044	0.044	U		0.015	0.015	U		0.021	0.021	0.013	0.013						
Tetrachlorodibenzodioxin (total)		U		0.0005		0.0091		U		0.026		0.012							
1,2,3,7,8-Pentachlorodibenzodioxin	1	5.5	5.5	0.000053	0.00053	0.091	0.091	0.016	0.016	0.160	0.160	0.120	0.12	U		0.000057	0.000057	0.000039	0.000039
Pentachlorodibenzodioxin (total)		1.9		U		0.052	0.052	0.016	0.016	0.290	0.290	0.069		0.0002		U		U	
1,2,3,4,7,8-Hexachlorodibenzodioxin	0.1	19	1.9	U		0.160	0.016	U		0.290	0.029	0.0078	0.00078	U		U		0.0026	0.00026
1,2,3,6,7,8-Hexachlorodibenzodioxin	0.1	190	19	0.0084	0.084	1.2	0.12	0.440	0.0440	0.930	0.093	1.4	0.14						
1,2,3,7,8,9-Hexachlorodibenzodioxin	0.1	53	5.3	0.0035	0.035	0.330	0.033	U		0.670	0.067	0.160	0.016						
Hexachlorodibenzodioxin (total)		53		0.0066		0.390		0.800		0.610		0.310		0.0024		U		0.0014	
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	0.01	10,000	100	0.490	0.0049	41	0.41	220	2.2	15	0.15	39	0.39	0.039	0.00039	0.056	0.0056	0.098	0.00098
Heptachlorodibenzodioxin (total)		1,500		0.083		5.7		30		2.3		4.9		0.011		0.014		0.017	
Octachlorodibenzodioxin	0.0003	12,000	0.36	0.920	0.000276	27	0.0081	1,900	0.57	120	0.036	160	0.048	1.1	0.00033	1.6	0.00048	2.1	0.00063
2,3,7,8-Tetrachlorodibenzofuran	0.1	U		U		0.002	0.0002	U		0.002	0.0002	0.002	0.0002	0		U		0.000031	0.0000031
Tetrachlorodibenzofuran (total)		1.0		0.00013		0.014	0.0014	U		0.021	0.0021	0.021		U		0.00019		U	
1,2,3,7,8-Pentachlorodibenzofuran	0.03	U		U		0.015	0.00045	U		0.020	0.0006	0.023	0.00069						
2,3,4,7,8-Pentachlorodibenzofuran	0.3	U		U		0.029	0.00870	0.015	0.0000045	0.039	0.0117	0.048	0.0144						
Pentachlorodibenzofuran (total)		U		0.00067		0.080		0.130		0.089		0.100		0.00028		0.00043		0.00037	
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	31	3.1	U		0.210	0.0210	0.077	0.0077	0.21	0.021	0.870	0.087						
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	16	1.6	U		0.140	0.0140	U		0.19	0.019	0.280	0.028						
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	6.3	0.6	U		0.047	0.0047	U		0.043	0.004	0.140	0.014						
2,3,4,7,8,9-Hexachlorodibenzofuran	0.1	32	3.2	U		0.250	0.0250	0.066	0.0066	0.28	0.028	0.490	0.049						
Hexachlorodibenzofuran (total)		56		0.0041		0.670		1.6		0.600		1.3		0.0004		0.00079		U	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	1,200	12	0.052	0.00052	6.7	0.0670	24	0.240	3	0.0300	5	0.05	U		0.004	0.00004	0.016	0.00016
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	140	1.4	0.0044	0.000044	0.740	0.0074	3.11	0.031	0.670	0.0067	0.880	0.0088						
Heptachlorodibenzofuran		590		0.022		3.2		13		1.2		2.9		U		0.002		0.0058	
Octachlorodibenzofuran	0.0003	6,600	1.98	0.250	0.000075	26	0.0078	180	0.054	14	0.0042	6.6	0.0018	0.005	0.0000015	0.018	0.0000054	0.072	0.0000216
Total Dioxin 2,3,7,8-TCDD Equivalence		156.01		0.13		0.90		3.19		0.97		0.98		0.0007215		0.0062		0.0020937	

Notes:
2005 WHO TEFs = 2005 World Health Organization Toxicity Equivalency Factors (*The 2005 World Health Organization Re-Evaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-Like Compounds*)

Appendix A - Table 3
Forshaw Chemical Site
Validated Analytical Results for Sediment Samples

Location ID	FCSD-01	FCSD-02	FCSD-03	FCSD-04	FCSD-05	FCSD-06	FCSD-07	FCSD-08	FCSD-09	FCSD-11	FCSD-12	FCSD-13	FCSD-14	FCSD-15	FCSS-08
Sample ID	FCSD-01	FCSD-02	FCSD-03	FCSD-04	FCSD-05	FCSD-06	FCSD-07	FCSD-08	FCSD-09	FCSD-11	FCSD-12	FCSD-13	FCSD-14	FCSD-15	FCSS-08
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	6/6/2007	6/6/2007	6/6/2007	6/6/2007	6/6/2007	6/7/2007	6/7/2007	6/7/2007	6/7/2007	6/7/2007	6/7/2007	6/7/2007	6/7/2007	6/7/2007	6/7/2007
Method / Parameter	1313601	1313602	1313615	1313603	1313604	1313605	1313606	1313607	1313609	1313610	1313611	1313612	1313613	1313614	1313608
Method / Parameter															
Metals, Total SW6010															
Arsenic	133	98.3	4.6	53.8	26.7	198	151	287	11.7	37.1	92.3	8.8	14.6	28.3	42.5
Semivolatile Organic Compounds SW8270															
Pentachlorophenol	1100 U	1000 U	1100 U	300 J	1200 U	110 J	970 U	6800	1000 U	560 J	510 J	1100 U	1100 U	2100	540 J
Dioxin/Furans SW8290															
1,2,3,4,6,7,8-HpCDD	3500 J	1880	7.13	33800	4760	25100	18300	60600 J	403	182000	283000 J	1810	678	123000 J	149000 J
1,2,3,4,6,7,8-HpCDF	577	336	351	5820	615	3100	3190	9740	120	44900	35300	371	126	15700	26800
1,2,3,4,7,8,9-HpCDF	29.4	28.2	12.3	555	59.8	285	252	721	9.63	3050	2660	35.1	12.9	899	1710
1,2,3,4,7,8-HxCDD	11.9	13.9	0.505 U	188	23	133	133	606	4.75	1860	1180	20.2	9.23	1240	1520
1,2,3,4,7,8-HxCDF	23.7	19.8	106	253	22.9	99.7	103	301	10.9	1500	1260	30.8	6.13 U	482	767
1,2,3,6,7,8-HxCDD	77	53.6	0.419 J	870	112	506	482	1330	12.6	7090	6330	60.1	24.4	3450	4710
1,2,3,6,7,8-HxCDF	15.5	13.8	19.8	172 J	19	80	88.3	349	4.74	1860	1380	13	4.27 J	657	981
1,2,3,7,8,9-HxCDD	31.6	33.5	0.823 J	399	52.6	267	228	1120	11	5900	3860	40.1	17.8	3190	4070
1,2,3,7,8,9-HxCDF	6.73	2.63 J	1.09 U	60.1	5.66	20.8	21.5 U	53.7	0.936 J	288	284	3.48 J	1.16 J	83	160
1,2,3,7,8-PeCDD	7.72	8.83	0.505 U	91.2	11.4	51.5	51.7 J	351	2.81 J	999	607	11.8	4.41 J	832	1030
1,2,3,7,8-PeCDF	4.79 U	1.69 U	1.97 U	25.3	2.13 U	10.5	14.6 U	36.2	0.869 J	139	141	2.2 J	0.743 J	57.6	96.7
2,3,4,6,7,8-HxCDF	20.8	19.4	4.98 U	256	28.6	127	133	484	5.43	2680	2050	17.3	5.95	1100	1470
2,3,4,7,8-PeCDF	6.84	3.38 J	3.76 U	50.4	4.78 J	25.2	24.9 U	64.2	2.03 J	247	255	5.71 J	3.55 J	132	182
2,3,7,8-TCDD	1.62	1.59	0.25 U	15.4 J	1.2	6.6	8.34 J	75.2 J	0.664 J	94	45.3	1.18 J	0.63 J	132 J	214 J
2,3,7,8-TCDF	1.03	0.604 U	0.253 U	4.97	0.804 U	6.07	8.04 U	5.19 J	0.355 J	17	20.4 J	1.01 J	0.617 J	8.34	14.4
OCDD	40900 J	22600 J	165	415000 J	60100 J	323000 J	252000 J	620000 J	4540 J	1690000 J	2370000 J	19300 J	7040 J	955000 J	1920000 J
OCDF	1700	1310	326 U	64100	3720	14300	12400	33900	610	34100	62500	1790	625	21600	41100
Total HpCDDs	6310	3040	14.8	50700	7490	41400	30100	101000	641	279000	431000	2910	1130	215000	257000
Total HpCDFs	1790	1120	404	27400	2460	12700	10600	32500	389	160000	120000	1220	441	44300	81500
Total HxCDDs	365	285	2.44	4460	464	2590	2390	10300	80.3	38300	28800	299	127	26900	32000
Total HxCDFs	759	400	200	6410	601	2630 J	3160	9510	124	54700	34900	324	109	18000	24700
Total PeCDDs	32.9	40	0.503	630	47.1	309	355	1880	10.4	3480	2490	38.4	20.5	3080	4440
Total PeCDFs	149 J	109	31.1	1150	122	551	511	2560 J	40.6	11300	11000	73.3	30.3	6120	7760 J
Total TCDDs	6.78	7.13	0.25 U	164	9.46	65.1	48.4	612	1.12	412	254	7.17	3.9	503	824
Total TCDFs	17.2	14.6	3.72	141	18.3	106	118	415	10.3	1190	1220	32.6	7.33	702	949
WHO-2005 TEQ	84.13385	56.76755	17.81935	888.266	113.9762	575.972	470.941	1776.215	16.05147	6107.5	6308.82	61.846	23.24499	3715.332	5034.171
Pesticides SW8081															
4,4'-DDD	4.2 U	NA	NA	NA	NA	3.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	4.2 U	NA	NA	NA	NA	13	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	1.4 J	NA	NA	NA	NA	31	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aldrin	2.2 U	NA	NA	NA	NA	2 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
alpha-BHC	2.2 U	NA	NA	NA	NA	2 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
alpha-Chlordane	4	NA	NA	NA	NA	30	NA	NA	NA	NA	NA	NA	NA	NA	NA
beta-BHC	2.4	NA	NA	NA	NA	6.4	NA	NA	NA	NA	NA	NA	NA	NA	NA
delta-BHC	2.2 U	NA	NA	NA	NA	2 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	4.1 J	NA	NA	NA	NA	62	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan I	2.2 U	NA	NA	NA	NA	1.1 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan II	4.2 U	NA	NA	NA	NA	3.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan sulfate	4.2 U	NA	NA	NA	NA	1.1 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin	4.2 U	NA	NA	NA	NA	4.9	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin Aldehyde	4.2 U	NA	NA	NA	NA	2.8 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin Ketone	4.2 U	NA	NA	NA	NA	3.9 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
gamma-BHC (Lindane)	2.2 U	NA	NA	NA	NA	2 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
gamma-Chlordane	7.5	NA	NA	NA	NA	42	NA	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor	0.77 J	NA	NA	NA	NA	0.75 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor Epoxide	0.76 J	NA	NA	NA	NA	7.7	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methoxchlor	22 U	NA	NA	NA	NA	4 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toxaphene	220 U	NA	NA	NA	NA	200 U	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
J = Analyte concentration is estimated
mg/kg = Milligrams per kilogram
NA = Not analyzed
ng/kg = Nanograms per kilogram
U = Analyte was analyzed for but not detected above the sample quantitation limit.
ug/kg = Micrograms per kilogram

Appendix B

Removal Action Schedule

APPENDIX B

REMOVAL ACTION SCHEDULE
FORSHAW CHEMICALS SITE
CHARLOTTE, NORTH CAROLINA

ID	Task Name	Duration	Start	Finish
1	Effective Date of AO	0 days	Mon 8/17/09	Mon 8/17/09
2	Work Plan Preparation	19 days	Mon 8/17/09	Fri 9/4/09
3	Submit Draft Work Plan to EPA	0 days	Tue 9/8/09	Tue 9/8/09
4	EPA Review of Work Plan	14 days	Wed 9/9/09	Tue 9/22/09
5	EPA Work Plan Approval	0 days	Wed 9/23/09	Wed 9/23/09
6	Subcontractor Selection and Scheduling	21 days	Wed 9/23/09	Tue 10/13/09
7	Mobilization to Site, Site Setup & Organization	1 day	Wed 10/14/09	Wed 10/14/09
8	Treatment Cell Excavation	3 days	Thu 10/15/09	Mon 10/19/09
9	Install Treatment Cell Bottom Liner	2 days	Tue 10/20/09	Wed 10/21/09
10	Removal and Disposal of Retaining Wall and Overburden	2 days	Thu 10/22/09	Fri 10/23/09
11	Remove Stormwater Line & Excavate/Stockpile Impacted Soils	3 days	Mon 10/26/09	Wed 10/28/09
12	Excavation Confirmation Sampling TAT	16 days	Thu 10/29/09	Fri 11/13/09
13	Stormwater Line Flush	2 days	Thu 10/29/09	Fri 10/30/09
14	Install Stormwater Line, Manhole, and Catch Basin	3 days	Mon 11/16/09	Wed 11/18/09
15	Backfill Excavation Areas & Compact Soils	2 days	Thu 11/19/09	Fri 11/20/09
16	Install Excavation Area Cover	1 day	Mon 11/23/09	Mon 11/23/09
17	Conduct Bench Scale Study	90 days	Mon 11/23/09	Sat 2/20/10
18	Evaluate Results of Bench Scale Study	4 days	Mon 2/22/10	Thu 2/25/10
19	Prepare Proposed Amendment Plan (Based on Bench Scale Study)	30 days	Fri 2/26/10	Thu 4/8/10
20	Submit Bench Scale Study Results and Proposed Amendment Plan to EPA	0 days	Thu 4/8/10	Thu 4/8/10
21	Obtain Amendment Ingredients and Schedule Contractor	30 days	Fri 2/26/10	Sat 3/27/10
22	Mobilization to Site for Soil Amendment and Treatment Cell Completion	1 day	Mon 3/29/10	Mon 3/29/10
23	Soil Amendment, Mixing, and Distribution in Treatment Cell	4 days	Tue 3/30/10	Fri 4/2/10
24	Completion of Treament Cell	2 days	Mon 4/5/10	Tue 4/6/10
25	Conduct Quarterly Sample Event #1	1 day	Thu 7/1/10	Thu 7/1/10
26	Conduct Quarterly Sample Event #2	1 day	Fri 10/1/10	Fri 10/1/10
27	Conduct Quarterly Sample Event #3	1 day	Mon 1/3/11	Mon 1/3/11
28	Conduct Quarterly Sample Event #4	1 day	Fri 4/1/11	Fri 4/1/11
29	Final Sample Event TAT and Review of Sample Data	19 days	Mon 4/4/11	Fri 4/22/11
30	Schedule Subcontractor and Mobilize to Site to Backfill Treatment Cell	11 days	Mon 4/25/11	Mon 5/9/11
31	Backfill & Compaction of Treatment Cell and Site Restoration	4 days	Tue 5/10/11	Fri 5/13/11
32	Work Completion	0 days	Fri 5/13/11	Fri 5/13/11
33	Final Report Preparation	30 days	Mon 5/16/11	Tue 6/14/11
34	Submit Final Report to EPA	0 days	Tue 6/14/11	Tue 6/14/11
35	Proposal for Post-Removal Site Control Preparation	60 days	Wed 6/15/11	Sat 8/13/11
36	Submit Proposal for Post-Removal Site Control	0 days	Mon 8/15/11	Mon 8/15/11

Appendix C

EPA Field Protocols

COPY

Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

Title: **Field Equipment Cleaning and Decontamination**

Effective Date: November 1, 2007	**Number:** SESDPROC-205-R1

Authors

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Signature: Donald Hunter Date: 11/02/07

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Approvals

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Revision History

This table shows changes to this controlled document over time. The most recent version is presented in the top row of the table. Previous versions of the document are maintained by the SESD Field Quality Manager.

History	Effective Date
SESDPROC-205-R1, *Field Equipment Cleaning and Decontamination*, replaces SESDPROC-205-R0. **General** Corrected any typographical, grammatical and/or editorial errors. **Title Page** Changed title for Antonio Quinones from Environmental Investigations Branch to Enforcement and Investigations Branch. Changed Bill Cosgrove's title from Acting Chief to Chief. **Section 1.3** Updated information to reflect that the procedure is located on the H: drive of the LAN. Clarified Field Quality Manager (FQM) responsibilities. **Section 1.5** Alphabetized and revised the referencing style for consistency. **Section 1.6.1** Corrected the title of the Safety, Health, and Environmental Management Program Procedures and Policy Manual.	November 1, 2007
SESDPROC-205-R0, *Field Equipment Cleaning and Decontamination*, Original Issue	February 05, 2007

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TABLE OF CONTENTS

Contents

1 General Information

1.1 Purpose

This document describes general and specific procedures, methods and considerations to be used and observed when cleaning and decontaminating sampling equipment during the course of field investigations.

1.2 Scope/Application

The procedures contained in this document are to be followed when field cleaning sampling equipment, for both re-use in the field, as well as used equipment being returned to the Field Equipment Center (FEC). On the occasion that SESD field investigators determine that any of the procedures described in this section are either inappropriate, inadequate or impractical and that other procedures must be used to clean or decontaminate sampling equipment at a particular site, the variant procedure will be documented in the field log book, along with a description of the circumstances requiring its use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and have been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the H: drive of the SESD local area network. The Field Quality Manager (FQM) is responsible for ensuring the most recent version of the procedure is placed on the H: drive and for maintaining records of review conducted prior to its issuance.

1.4 Definitions

Decontamination: The process of cleaning dirty sampling equipment to the degree to which it can be re-used, with appropriate QA/QC, in the field.

Field Cleaning: The process of cleaning dirty sampling equipment such that it can be returned to the FEC in a condition that will minimize the risk of transfer of contaminants from a site.

De-ionized water: Tap water that has been treated by passing through a standard de-ionizing resin column. At a minimum, the finished water should contain no detectable heavy metals or other inorganic compounds (i.e., at or above analytical detection limits)

as defined by a standard inductively coupled Argon Plasma Spectrophotometer (ICP) (or equivalent) scan. De-ionized water obtained by other methods is acceptable, as long as it meets the above analytical criteria. Organic-free water may be substituted for de-ionized water.

Organic-free water: Tap water that has been treated with activated carbon and de-ionizing units. At a minimum, the finished water must meet the analytical criteria of de-ionized water and it should contain no detectable pesticides, herbicides, or extractable organic compounds, and no volatile organic compounds above minimum detectable levels as determined by the Region 4 laboratory for a given set of analyses. Organic-free water obtained by other methods is acceptable, as long as it meets the above analytical criteria.

Soap: A standard brand of phosphate-free laboratory detergent, such as Luminox®.

Tap water: Water from any potable water supply. De-ionized water or organic-free water may be substituted for tap water.

Drilling Equipment: All power equipment used to collect surface and sub-surface soil samples or install wells. For purposes of this procedure, direct push is also included in this definition.

1.5 References

SESD Operating Procedure for Management of Investigation Derived Waste, SESDPROC-202, Most Recent Version

SESD Operating Procedure for Equipment Cleaning and Decontamination at the FEC, SESDPROC-206, Most Recent Version

United States Environmental Protection Agency (US EPA). 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. Region 4 Science and Ecosystem Support Division (SESD), Athens, GA

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version

1.6 General Precautions

1.6.1 Safety

Proper safety precautions must be observed when field cleaning or decontaminating dirty sampling equipment. Refer to the SESD Safety, Health and Environmental Management Program (SHEMP) Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASPs) for guidelines on safety precautions. These guidelines, however, should only be used

to complement the judgment of an experienced professional. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate. At a minimum, the following precautions should be taken in the field during these cleaning operations:

- When conducting field cleaning or decontamination using laboratory detergent, safety glasses with splash shields or goggles, and latex gloves will be worn.

- No eating, smoking, drinking, chewing, or any hand to mouth contact should be permitted during cleaning operations.

1.6.2 Procedural Precaution

Prior to mobilization to a site, the expected types of contamination should be evaluated to determine if the field cleaning and decontamination activities will generate rinsates and other waste waters that might be considered RCRA hazardous waste or may require special handling.

2 Introduction to Field Equipment Cleaning and Decontamination

2.1 General

The procedures outlined in this document are intended for use by field investigators for cleaning and decontaminating sampling and other equipment in the field. These procedures should be followed in order that equipment is returned to the FEC in a condition that will minimize the risk of transfer of contaminants from a site.

Sampling and field equipment cleaned in accordance with these procedures must meet the minimum requirements for the Data Quality Objectives (DQOs) of the study or investigation. Site-specific alterations to these procedures should be documented in the study plan. Deviations from these procedures should be documented in the field records.

Cleaning procedures for use at the Field Equipment Center (FEC) are found in SESD Operating Procedure for Equipment Cleaning and Decontamination at the FEC (SESDPROC-206).

2.2 Handling and Containers for Cleaning Solutions

Improperly handled cleaning solutions may easily become contaminated. Storage and application containers must be constructed of the proper materials to ensure their integrity. Following are acceptable materials used for containing the specified cleaning solutions:

- Soap must be kept in clean plastic, metal, or glass containers until used. It should be poured directly from the container during use.
- Tap water may be kept in tanks, hand pressure sprayers, squeeze bottles, or applied directly from a hose.
- De-ionized water must be stored in clean, glass or plastic containers that can be closed prior to use. It can be applied from plastic squeeze bottles.
- Organic-free water must be stored in clean glass or Teflon® containers prior to use. It may be applied using Teflon® squeeze bottles, or with the portable system.

2.3 Disposal of Cleaning Solutions

Procedures for the safe handling and disposition of investigation derived waste (IDW); including used wash water and rinse water are in SESD Operating Procedure for Management of Investigation Derived Waste (SESDPROC-202).

2.4 Sample Collection Equipment Contaminated with Concentrated Materials

Equipment used to collect samples of concentrated materials from investigation sites must be field cleaned before returning from the study. At a minimum, this should consist of washing with soap and rinsing with tap water. When the above procedure cannot be followed, the following options are acceptable:

1. Leave with facility for proper disposal;

2. If possible, containerize, seal and secure the equipment and leave on-site for later disposal;

3. Containerize, bag or seal the equipment so that no odor is detected and return to the SESD.

It is the project leader's responsibility to evaluate the nature of the sampled material and determine the most appropriate cleaning procedures for the equipment used to sample that material.

2.5 Sample Collection Equipment Contaminated with Environmental Media

Equipment used to collect samples of environmental media from investigation sites should be field cleaned before returning from the study. Based on the condition of the sampling equipment, one or more of the following options must be used for field cleaning:

1. Wipe the equipment clean;

2. Water-rinse the equipment;

3. Wash the equipment in detergent and water followed by a tap water rinse.

4. For grossly contaminated equipment, the procedures set forth in Section 2.4 must be followed.

Under extenuating circumstances such as facility limitations, regulatory limitations, or during residential sampling investigations where field cleaning operations are not feasible, equipment can be containerized, bagged or sealed so that no odor is detected and returned to the FEC without being field cleaned. If possible, FEC personnel should be

2 Introduction to Field Equipment Cleaning and Decontamination

2.1 General

The procedures outlined in this document are intended for use by field investigators for cleaning and decontaminating sampling and other equipment in the field. These procedures should be followed in order that equipment is returned to the FEC in a condition that will minimize the risk of transfer of contaminants from a site.

Sampling and field equipment cleaned in accordance with these procedures must meet the minimum requirements for the Data Quality Objectives (DQOs) of the study or investigation. Site-specific alterations to these procedures should be documented in the study plan. Deviations from these procedures should be documented in the field records.

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1. Leave with facility for proper disposal;

2. If possible, containerize, seal and secure the equipment and leave on-site for later disposal;

3. Containerize, bag or seal the equipment so that no odor is detected and return to the SESD.

It is the project leader's responsibility to evaluate the nature of the sampled material and determine the most appropriate cleaning procedures for the equipment used to sample that material.

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Equipment used to collect samples of environmental media from investigation sites should be field cleaned before returning from the study. Based on the condition of the sampling equipment, one or more of the following options must be used for field cleaning:

1. Wipe the equipment clean;

2. Water-rinse the equipment;

3. Wash the equipment in detergent and water followed by a tap water rinse.

4. For grossly contaminated equipment, the procedures set forth in Section 2.4 must be followed.

Under extenuating circumstances such as facility limitations, regulatory limitations, or during residential sampling investigations where field cleaning operations are not feasible, equipment can be containerized, bagged or sealed so that no odor is detected and returned to the FEC without being field cleaned. If possible, FEC personnel should be

notified that equipment will be returned without being field cleaned. It is the project leader's responsibility to evaluate the nature of the sampled material and determine the most appropriate cleaning procedures for the equipment used to sample that material.

2.6 Handling of Decontaminated Equipment

After decontamination, equipment should be handled only by personnel wearing clean gloves to prevent re-contamination. In addition, the equipment should be moved away (preferably upwind) from the decontamination area to prevent re-contamination. If the equipment is not to be immediately re-used it should be covered with plastic sheeting or wrapped in aluminum foil to prevent re-contamination. The area where the equipment is kept prior to re-use must be free of contaminants.

3 Field Equipment Decontamination Procedures

3.1 General

Sufficient equipment should be transported to the field so that an entire study can be conducted without the need for decontamination. When equipment must be decontaminated in the field, the following procedures are to be utilized.

3.2 Specifications for Decontamination Pads

Decontamination pads constructed for field cleaning of sampling and drilling equipment should meet the following minimum specifications:

- The pad should be constructed in an area known or believed to be free of surface contamination.
- The pad should not leak.
- If possible, the pad should be constructed on a level, paved surface and should facilitate the removal of wastewater. This may be accomplished by either constructing the pad with one corner lower than the rest, or by creating a sump or pit in one corner or along one side. Any sump or pit should also be lined.
- Sawhorses or racks constructed to hold equipment while being cleaned should be high enough above ground to prevent equipment from being splashed.
- Water should be removed from the decontamination pad frequently.
- A temporary pad should be lined with a water impermeable material with no seams within the pad. This material should be either easily replaced (disposable) or repairable.

At the completion of site activities, the decontamination pad should be deactivated. The pit or sump should be backfilled with the appropriate material designated by the site project leader, but only after all waste/rinse water has been pumped into containers for disposal. See SESD Operating Procedure for Management of Investigation Derived Waste (SESDPROC-202) for proper handling and disposal of these materials. If the decontamination pad has leaked excessively, soil sampling may be required.

3.3 "Classical Parameter" Sampling Equipment

"Classical Parameters" are analyses such as oxygen demand, nutrients, certain inorganics, sulfide, flow measurements, etc. For routine operations involving classical parameter analyses, water quality sampling equipment such as Kemmerers, buckets, dissolved oxygen dunkers, dredges, etc., may be cleaned with the sample water or tap water between sampling locations as appropriate.

Flow measuring equipment such as weirs, staff gages, velocity meters, and other stream gauging equipment may be cleaned with tap water between measuring locations, if necessary.

Note: The procedures described in Section 3.3 are not to be used for cleaning field equipment to be used for the collection of samples undergoing trace organic or inorganic constituent analyses.

3.4 Sampling Equipment used for the Collection of Trace Organic and Inorganic Compounds

For samples undergoing trace organic or inorganic constituent analyses, the following procedures are to be used for all sampling equipment or components of equipment that come in contact with the sample:

1. Clean with tap water and Luminox® soap using a brush, if necessary, to remove particulate matter and surface films. Equipment may be steam cleaned (Luminox® soap and high pressure hot water) as an alternative to brushing. Sampling equipment that is steam cleaned should be placed on racks or saw horses at least two feet above the floor of the decontamination pad. PVC or plastic items should not be steam cleaned.

2. Rinse thoroughly with tap water.

3. Rinse thoroughly with organic-free water and place on a clean foil-wrapped surface to air-dry.

4. All equipment must be wrapped with foil. If the equipment is to be stored overnight before it is wrapped in foil, it should be covered and secured with clean, unused plastic sheeting.

3.5 Well Sounders or Tapes

The following procedures are recommended for decontaminating well sounders (water level indicators) and tapes:

1. Wash with soap and tap water.
2. Rinse with tap water.
3. Rinse with de-ionized water.

3.6 Redi-Flo2® Pump

The Redi-Flo2® pump should be decontaminated prior to use and between each monitoring well. The following procedure is required:

CAUTION - Make sure the pump is not plugged in.

1. Using a brush, scrub the exterior of the pump, electrical cord and garden hose with soap and tap water. Do not wet the electrical plug.
2. Rinse with tap water.
3. Rinse with de-ionized water.
4. Place the equipment in a clean plastic bag.

To clean the Redi-Flo2® ball check valve:

1. Remove the ball check valve from the pump head. Check for wear and/or corrosion, and replace as needed.
2. Using a brush, scrub all components with soap and tap water.
3. Rinse with de-ionized water.
4. Replace the ball check valve to the Redi-Flo2® pump head.

3.7 Downhole Drilling Equipment

These procedures are to be used for drilling activities involving the collection of soil samples for trace organic and inorganic constituent analyses and for the construction of monitoring wells to be used for the collection of groundwater samples for trace organic and inorganic constituent analyses.

3.7.1 Introduction

Cleaning and decontamination of all equipment should occur at a designated area (decontamination pad) on the site. The decontamination pad should meet the specifications of Section 3.2 of this procedure.

Tap water brought on the site for drilling and cleaning purposes should be contained in a pre-cleaned tank.

A steam cleaner and/or high pressure hot water washer capable of generating a pressure of at least 2500 PSI and producing hot water and/or steam (200° F plus), with a soap compartment, should be obtained.

3.7.2 Preliminary Cleaning and Inspection

Drilling equipment should be clean of any contaminants that may have been transported from off-site to minimize the potential for cross-contamination. The drilling equipment should not serve as a source of contaminants. Associated drilling and decontamination equipment, well construction materials, and equipment handling procedures should meet these minimum specified criteria:

- All downhole augering, drilling, and sampling equipment should be sandblasted before use if painted, and/or there is a buildup of rust, hard or caked matter, etc., that cannot be removed by steam cleaning (soap and high pressure hot water), or wire brushing. Sandblasting should be performed prior to arrival on site, or well away from the decontamination pad and areas to be sampled.

- Any portion of the drilling equipment that is over the borehole (kelly bar or mast, backhoe buckets, drilling platform, hoist or chain pulldowns, spindles, cathead, etc.) should be steam cleaned (soap and high pressure hot water) and wire brushed (as needed) to remove all rust, soil, and other material which may have come from other sites before being brought on site.

- Printing and/or writing on well casing, tremie tubing, etc., should be removed before use. Emery cloth or sand paper can be used to remove the printing and/or writing. Most well material suppliers can provide materials without the printing and/or writing if specified when ordered. Items that cannot be cleaned are not acceptable and should be discarded.

- Equipment associated with the drilling and sampling activities should be inspected to insure that all oils, greases, hydraulic fluids, etc., have been removed, and all seals and gaskets are intact with no fluid leaks.

3.7.3 Drill Rig Field Cleaning Procedure

Any portion of the drill rig, backhoe, etc., that is over the borehole (kelly bar or mast, backhoe buckets, drilling platform, hoist or chain pulldowns, spindles, cathead, etc.) should be steam cleaned (soap and high pressure hot water) between boreholes.

3.7.4 Field Decontamination Procedure for Drilling Equipment

The following is the standard procedure for field cleaning augers, drill stems, rods, tools, and associated equipment. This procedure does not apply to well casings, well screens, or split-spoon samplers used to obtain samples for chemical analyses, which should be decontaminated as outlined in Section 3.4 of this procedure.

1. Wash with tap water and soap, using a brush if necessary, to remove particulate matter and surface films. Steam cleaning (high pressure hot water with soap) may be necessary to remove matter that is difficult to remove with the brush. Drilling equipment that is steam cleaned should be placed on racks or saw horses at least two feet above the floor of the decontamination pad. Hollow-stem augers, drill rods, etc., that are hollow or have holes that transmit water or drilling fluids, should be cleaned on the inside with vigorous brushing.

2. Rinse thoroughly with tap water.

3. Remove from the decontamination pad and cover with clean, unused plastic. If stored overnight, the plastic should be secured to ensure that it stays in place.

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Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

Title: **Soil Sampling**

Effective Date: November 1, 2007 | **Number:** SESDPROC-300-R1

Authors

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Signature: [signature] Date: 11/01/07

Revision History

This table shows changes to this controlled document over time. The most recent version is presented in the top row of the table. Previous versions of the document are maintained by the SESD Field Quality Manager.

History	Effective Date
SESDPROC-300-R1, *Soil Sampling*, replaces SESDPROC-300-R0. **General** Corrected any typographical, grammatical and/or editorial errors. **Title Page** Changed title for Antonio Quinones from Environmental Investigations Branch to Enforcement and Investigations Branch. **Section 1.3** Updated information to reflect that the procedure is located on the H: drive of the LAN. Clarified Field Quality Manager (FQM) responsibilities. **Section 1.4** Updated referenced operating procedures due to changes in title names. Alphabetized and revised the referencing style for consistency. **Section 1.5.1** Corrected the title of the Safety, Health, and Environmental Management Program Procedures and Policy Manual. **Section 1.5.2, 4th bullet** Added references to the CFR and IATA's Dangerous Goods Regulations. **Section 2.7** Updated referenced operating procedures due to changes in title names.	November 1, 2007
SESDPROC-300-R0, Soil Sampling, Original Issue	February 05, 2007

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TABLES

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Contents

1 General Information

1.1 Purpose

This document describes general and specific procedures, methods and considerations to be used and observed when collecting soil samples for field screening or laboratory analysis.

1.2 Scope/Application

The procedures contained in this document are to be used by field personnel when collecting and handling soil samples in the field. On the occasion that SESD field personnel determine that any of the procedures described in this section are either inappropriate, inadequate or impractical and that another procedure must be used to obtain a soil sample, the variant procedure will be documented in the field log book and subsequent investigation report, along with a description of the circumstances requiring its use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and have been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the H: drive of the SESD local area network. The Field Quality Manager (FQM) is responsible for ensuring the most recent version of the procedure is placed on the H: drive and for maintaining records of review conducted prior to its issuance.

1.4 References

International Air Transport Authority (IATA). Dangerous Goods Regulations, Most Recent Version

SESD Operating Procedure for Sample and Evidence Management, SESDPROC-005, Most Recent Version

SESD Operating Procedure for Logbooks, SESDPROC-010, Most Recent Version

SESD Operating Procedure for Field Sampling Quality Control, SESDPROC-011, Most Recent Version

SESD Operating Procedure for Field X-Ray Fluorescence (XRF) Measurement, SESDPROC-107, Most Recent Version

SESD Operating Procedure for Equipment Inventory and Management, SESDPROC-108, Most Recent Version

SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205, Most Recent Version

SESD Operating Procedure for Packaging, Marking, Labeling and Shipping of Environmental and Waste Samples, SESDPROC-209, Most Recent Version

Title 49 Code of Federal Regulations, Pts. 171 to 179, Most Recent Version

United States Environmental Protection Agency (US EPA). 1981. "Final Regulation Package for Compliance with DOT Regulations in the Shipment of Environmental Laboratory Samples," Memo from David Weitzman, Work Group Chairman, Office of Occupational Health and Safety (PM-273), April 13, 1981.

US EPA. 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. Region 4 Science and Ecosystem Support Division (SESD), Athens, GA

US EPA. Analytical Support Branch Laboratory Operations and Quality Assurance Manual. Region 4 SESD, Athens, GA, Most Recent Version

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version

1.5 General Precautions

1.5.1 Safety

Proper safety precautions must be observed when collecting soil samples. Refer to the SESD Safety, Health and Environmental Management Program (SHEMP) Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASP) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

1.5.2 Procedural Precautions

The following precautions should be considered when collecting soil samples.

- Special care must be taken not to contaminate samples. This includes storing samples in a secure location to preclude conditions which could

alter the properties of the sample. Samples shall be custody sealed during long-term storage or shipment.

- Collected samples are in the custody of the sampler or sample custodian until the samples are relinquished to another party.
- If samples are transported by the sampler, they will remain under his/her custody or be secured until they are relinquished.
- Shipped samples shall conform to all U.S. Department of Transportation (DOT) rules of shipment found in Title 49 of the Code of Federal Regulations (49 CFR parts 171 to 179), and/or International Air Transportation Association (IATA) hazardous materials shipping requirements found in the current edition of IATA's Dangerous Goods Regulations.
- Documentation of field sampling is done in a bound logbook.
- Chain-of-custody documents shall be filled out and remain with the samples until custody is relinquished.
- All shipping documents, such as air bills, bills of lading, etc., shall be retained by the project leader in the project files.

2 Special Sampling Considerations

2.1 Soil Samples for Volatile Organic Compounds (VOC) Analysis

If samples are to be analyzed for volatile organic compounds, they should be collected in a manner that minimizes disturbance of the sample. For example, when sampling with a bucket auger, the sample for VOC analysis should be collected directly from the auger bucket (preferred) or from minimally disturbed material immediately after an auger bucket is emptied into the pan. The sample shall be containerized by filling an En Core® Sampler or other Method 5035 compatible container. ***Samples for VOC analysis are not homogenized.*** Preservatives may be required for some samples with certain variations of Method 5035. Consult the method or the principal analytical chemist to determine if preservatives are necessary.

2.2 Soil Sampling (Method 5035)

The following sampling protocol is recommended for site investigators assessing the extent of volatile organic compounds (VOC's) in soils at a project site. Because of the large number of options available, careful coordination between field and laboratory personnel is needed. The specific sampling containers and sampling tools required will depend upon the detection levels and intended data use. Once this information has been established, selection of the appropriate sampling procedure and preservation method best applicable to the investigation can be made.

2.2.1 Equipment

Soil for VOC analyses may be retrieved using any of the SESD soil sampling methods described in Sections 3 through 8 of this procedure. Once the soil has been obtained, the En Core® Sampler, syringes, stainless steel spatula, standard 2-oz. soil VOC container, or pre-prepared 40 ml vials may be used/required for sub-sampling. The specific sample containers and the sampling tools required will depend upon the data quality objectives established for the site or sampling investigation. The various sub-sampling methods are described below.

2.2.2 Sampling Methodology - Low Concentrations (<200 ug/kg)

When the total VOC concentration in the soil is expected to be less than 200 µg/kg, the samples may be collected directly with the En Core® Sampler or syringe. If using the syringes, the sample must be placed in the sample container (40 ml pre-prepared vial) immediately to reduce volatilization losses. The 40 ml vials should contain 10 ml of organic-free water for an un-preserved sample or approximately 10 ml of organic-free water and a preservative. It is recommended that the 40 ml vials be prepared and weighed by the laboratory (commercial

sources are available which supply preserved and tared vials). When sampling directly with the En Core® Sampler, the vial must be immediately capped and locked

A soil sample for VOC analysis may also be collected with conventional sampling equipment. A sample collected in this fashion must either be placed in the final sample container (En Core® Sampler or 40 ml pre-prepared vial) immediately or the sample may be immediately placed into an intermediate sample container with no head space. If an intermediate container (usually 2-oz. soil jar) is used, the sample must be transferred to the final sample container (En Core® Sampler or 40 ml pre-prepared vial) as soon as possible, not to exceed 30 minutes.

NOTE: After collection of the sample into either the En Core® Sampler or other container, the sample must immediately be stored in an ice chest and cooled.

Soil samples may be prepared for shipping and analysis as follows:

En Core® Sampler - the sample shall be capped, locked, and secured in a plastic bag.

Syringe - Add about 3.7 cc (approximately 5 grams) of sample material to 40-ml pre-prepared containers. Secure the containers in a plastic bag. Do not use a custody seal on the container; place the custody seal on the plastic bag. Note: When using the syringes, it is important that no air is allowed to become trapped behind the sample prior to extrusion, as this will adversely affect the sample.

Stainless Steel Laboratory Spatulas - Add between 4.5 and 5.5 grams (approximate) of sample material to 40 ml containers. Secure the containers in a plastic bag. Do not use a custody seal on the container; place the custody seal on the plastic bag.

2.2.3 Sampling Methodology - High Concentrations (>200 ug/kg)

Based upon the data quality objectives and the detection level requirements, this high level method may also be used. Specifically, the sample may be packed into a single 2-oz. glass container with a screw cap and septum seal. The sample container must be filled quickly and completely to eliminate head space. Soils\sediments containing high total VOC concentrations may also be collected as described in Section 2.2.2, Sampling Methodology - Low Concentrations, and preserved using 10 ml methanol.

2.2.4 Special Techniques and Considerations for Method 5035

Effervescence

If low concentration samples effervesce from contact with the acid preservative, then either a test for effervescence must be performed prior to sampling, or the investigators must be prepared to collect each sample both preserved or un-preserved as needed, or all samples must be collected unpreserved.

To check for effervescence, collect a test sample and add to a pre-preserved vial. If preservation (acidification) of the sample results in effervescence (rapid formation of bubbles) then preservation by acidification is not acceptable, and the sample must be collected un-preserved.

If effervescence occurs and only pre-preserved sample vials are available, the preservative solution may be placed into an appropriate hazardous waste container and the vials triple rinsed with organic free water. An appropriate amount of organic free water, equal to the amount of preservative solution, should be placed into the vial. The sample may then be collected as an un-preserved sample. Note that the amount of organic free water placed into the vials will have to be accurately measured.

Sample Size

While this method is an improvement over earlier ones, field investigators must be aware of an inherent limitation. Because of the extremely small sample size and the lack of sample mixing, sample representativeness for VOC's may be reduced compared to samples with larger volumes collected for other constituents. The sampling design and objectives of the investigation should take this into consideration.

Holding Times

Sample holding times are specified in the Analytical Support Branch *Laboratory Operations and Quality Assurance Manual* (ASBLOQAM), Most Recent Version. Field investigators should note that the holding time for an un-preserved VOC soil/sediment sample is 48 hours. Arrangements should be made to ship the soil/sediment VOC samples to the laboratory by overnight delivery the day they are collected so the laboratory may preserve and/or analyze the sample within 48 hours of collection.

Percent Moisture

Samplers must ensure that the laboratory has sufficient material to determine percent moisture in the VOC soil/sediment sample to correct the analytical results to dry weight. If other analyses requiring percent moisture determination are

being performed upon the sample, these results may be used. If not, a separate sample (minimum of 2 oz.) for percent moisture determination will be required. The sample collected for Percent Moisture may also be used by the laboratory to check for preservative compatibility.

Safety

Methanol is a toxic and flammable liquid. Therefore, methanol must be handled with all required safety precautions related to toxic and flammable liquids. Inhalation of methanol vapors must be avoided. Vials should be opened and closed quickly during the sample preservation procedure. Methanol must be handled in a ventilated area. Use protective gloves when handling the methanol vials. Store methanol away from sources of ignition such as extreme heat or open flames. The vials of methanol should be stored in a cooler with ice at all times.

Shipping

Methanol and sodium bisulfate are considered dangerous goods, therefore shipment of samples preserved with these materials by common carrier is regulated by the U.S. Department of Transportation and the International Air Transport Association (IATA). The rules of shipment found in Title 49 of the Code of Federal Regulations (49 CFR parts 171 to 179) and the current edition of the IATA Dangerous Goods Regulations must be followed when shipping methanol and sodium bisulfate. Consult the above documents or the carrier for additional information. Shipment of the quantities of methanol and sodium bisulfate used for sample preservation falls under the exemption for small quantities.

The summary table on the following page lists the options available for compliance with SW846 Method 5035. The advantages and disadvantages are noted for each option. SESD's goal is to minimize the use of hazardous material (methanol and sodium bisulfate) and minimize the generation of hazardous waste during sample collection.

2.3 Dressing Soil Surfaces

Any time a vertical or near vertical surface is sampled, such as achieved when shovels or similar devices are used for subsurface sampling, the surface should be dressed (scraped) to remove smeared soil. This is necessary to minimize the effects of contaminant migration interferences due to smearing of material from other levels.

Table 1: Method 5035 Summary

OPTION	PROCEDURE	ADVANTAGES	DISADVANTAGES
1	Collect 2 - 40 mL vials with ~5 grams of sample and 1 - 2 oz., glass w/septum lid for screening, % moisture and preservative compatibility	Screening conducted by lab	Presently a 48 hour holding time for unpreserved samples Sample containers must be tared
2	Collect 3 En Core® Samplers; and 1 - 2 oz., glass w/septum lid for screening, % moisture and preservative compatibility	Lab conducts all preservation/preparation procedures	Presently a 48 hour holding time for preparation of samples
3	Collect 2 - 40 ml vials with 5 grams of sample and preserve w/methanol or sodium bisulfate and 1 - 2-oz., glass w/septum lid for screening, % moisture and preservative compatibility	High level VOC samples may be composited Longer holding time	Hazardous materials used in field Sample containers must be tared
4	Collect 1 - 2-oz., glass w/septum lid for analysis, % moisture and preservative compatibility	Lab conducts all preservation/preparation procedures	May have significant VOC loss

2.4 Special Precautions for Trace Contaminant Soil Sampling

- A clean pair of new, non-powdered, disposable gloves will be worn each time a different sample is collected and the gloves should be donned immediately prior to sampling. The gloves should not come in contact with the media being sampled and should be changed any time during sample collection when their cleanliness is compromised.
- Sample containers for samples suspected of containing high concentrations of contaminants shall be collected, handled and stored separately.
- All background samples shall be segregated from obvious high concentration or waste samples. Sample collection activities shall proceed progressively from the least suspected contaminated area to the most suspected contaminated area if sampling devices are to be reused. Samples of waste or highly contaminated media must not be placed in the same ice chest as environmental (i.e., containing low contaminant levels) or background samples.

- If possible, one member of the field sampling team should take all the notes and photographs, fill out tags, etc., while the other members collect the samples.
- Samplers must use new, verified certified-clean disposable or non-disposable equipment cleaned according to procedures contained in SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205), for collection of samples for trace metals or organic compound analyses.

2.5 Sample Homogenization

1. If sub-sampling of the primary sample is to be performed in the laboratory, transfer the entire primary sample directly into an appropriate, labeled sample container(s). Proceed to step 5.

2. If sub-sampling the primary sample in the field or compositing multiple primary samples in the field, place the sample into a glass or stainless steel homogenization container and mix thoroughly. Each aliquot of a composite sample should be of the same approximate volume.

3. All soil samples must be thoroughly mixed to ensure that the sample is as representative as possible of the sample media. ***Samples for VOC analysis are not homogenized.*** The most common method of mixing is referred to as quartering. The quartering procedure should be performed as follows:

   - The material in the sample pan should be divided into quarters and each quarter should be mixed individually.
   - Two quarters should then be mixed to form halves.
   - The two halves should be mixed to form a homogenous matrix.

   This procedure should be repeated several times until the sample is adequately mixed. If round bowls are used for sample mixing, adequate mixing is achieved by stirring the material in a circular fashion, reversing direction, and occasionally turning the material over.

4. Place the sample into an appropriate, labeled container(s) by using the alternate shoveling method and secure the cap(s) tightly. The alternate shoveling method involves placing a spoonful of soil in each container in sequence and repeating until the containers are full or the sample volume has been exhausted. Threads on the container and lid should be cleaned to ensure a tight seal when closed.

5. Return any unused sample material back to the auger, drill or push hole from which the sample was collected.

2.6 Quality Control

If possible, a control sample should be collected from an area not affected by the possible contaminants of concern and submitted with the other samples. This control sample should be collected as close to the sampled area as possible and from the same soil type. Equipment blanks should be collected if equipment is field cleaned and re-used on-site or if necessary to document that low-level contaminants were not introduced by sampling tools. SESD Operating Procedure for Field Sampling Quality Control (SESDPROC-011) contains other procedures that may be applicable to soil sampling investigations.

2.7 Records

Field notes, recorded in a bound field logbook, will be generated, as well as chain-of-custody documentation, as described in the SESD Operating Procedure for Logbooks (SESDPROC-010) and the SESD Operating Procedure for Sample and Evidence Management (SESDPROC-005).

3 Manual Soil Sampling Methods

3.1 General

These methods are used primarily to collect surface and shallow subsurface soil samples. Surface soils are generally classified as soils between the ground surface and 6 to 12 inches below ground surface. The most common interval is 0 to 6 inches, however the data quality objectives of the investigation may dictate another interval, such as 0 to 3 inches for risk assessment purposes. The shallow subsurface interval may be considered to extend from approximately 12-inches below ground surface to a site-specific depth at which sample collection using manual collection methods becomes impractical.

3.2 Spoons

Stainless steel spoons may be used for surface soil sampling to depths of approximately 6-inches below ground surface where conditions are generally soft and non-indurated and there is no problematic vegetative layer to penetrate.

3.2.1 Special Considerations When Using Spoons

- When using stainless steel spoons, consideration must be given to the procedure used to collect the volatile organic compound sample. If the soil being sampled is cohesive and holds its in situ texture in the spoon, the En Core® Sampler or syringe used to collect the sub-sample for Method 5035 should be plugged directly from the spoon. If, however, the soil is not cohesive and crumbles when removed from the ground surface for sampling, consideration should be given to plugging the sample for Method 5035 directly from the ground surface at a depth appropriate for the investigation Data Quality Objectives.
- When compositing, make sure that each composite location (aliquot) consist of equal volumes, i.e., same number of equal spoonfuls.
- If a thick, matted root zone is present at or near the surface, it should be removed before the sample is collected

3.3 Hand Augers

Hand augers may be used to advance boreholes and collect soil samples in the surface and shallow subsurface intervals. Typically, 4-inch stainless steel auger buckets with cutting heads are used. The bucket is advanced by simultaneously pushing and turning using an attached handle.

3.3.1 Surface Soil Sampling

When conducting surface soil sampling with hand augers, the auger buckets may be used with a handle alone or with a handle and extensions. The bucket is

advanced to the appropriate depth and the contents are transferred to the homogenization container for processing. Observe precautions for volatile organic compound sample collection found in Section 2.2.4, Special Techniques and Considerations for Method 5035.

3.3.2 Subsurface Soil Sampling

Hand augers are the most common equipment used to collect shallow subsurface soil samples. Auger holes are advanced one bucket at a time until the sample depth is achieved. When the sample depth is reached, the bucket used to advance the hole is removed and a clean bucket is attached. The clean auger bucket is then placed in the hole and filled with soil to make up the sample and removed.

The practical depth of investigation using a hand auger depends upon the soil properties and depth of investigation. In sand, augering is usually easily performed, but the depth of collection is limited to the depth at which the sand begins to flow or collapse. Hand augers may also be of limited use in tight clays or cemented sands. In these soil types, the greater the depth attempted, the more difficult it is to recover a sample due to increased friction and torqueing of the hand auger extensions. At some point these problems become so severe that power equipment must be used.

3.3.3 Special Considerations for Soil Sampling with the Hand Auger

- Because of the tendency for the auger bucket to scrape material from the sides of the auger hole while being extracted, the top several inches of soil in the auger bucket should be discarded prior to placing the bucket contents in the homogenization container for processing.
- Observe precautions for volatile organic compound sample collection found in Section 2.2.4, Special Techniques and Considerations for Method 5035. Collect the VOC sample directly from the auger bucket, if possible.
- Power augers, such as the Little Beaver®, and drill rigs may be used to advance boreholes to depths for subsurface soil sampling with the hand auger. They may not be used for sample collection. When power augers are used to advance a borehole to depth for sampling, care must be taken that exhaust fumes, gasoline and/or oil do not contaminate the borehole or area in the immediate vicinity of sampling.
- When a new borehole is advanced, the entire hand auger assembly must be replaced with a properly decontaminated hand auger assembly.

4 Direct Push Soil Sampling Methods

4.1 General

These methods are used primarily to collect shallow and deep subsurface soil samples. Three methods are available for use with either the Geoprobe® or the drill rig adapted with a hydraulic hammer. All methods involve the collection and retrieval of the soil sample within a thin-walled liner. The following sections describe each of the specific sampling methods that can be accomplished using direct push techniques, along with details specific to each method.

4.2 Large Bore® Soil Sampler

The Large Bore® (LB) sampler is a solid barrel direct push sampler equipped with a piston-rod point assembly used primarily for collection of depth-discrete subsurface soil samples. The sample barrel is approximately 30-inches (762 mm) long and has a 1.5-inch (38 mm) outside diameter. The LB® sampler is capable of recovering a discrete sample core 22 inches x 1.0 inch (559 mm x 25 mm) contained inside a removable liner. The resultant sample volume is a maximum of 283 ml.

After the LB® sample barrel is equipped with the cutting shoe and liner, the piston-rod point assembly is inserted, along with the drive head and piston stop assembly. The assembled sampler is driven to the desired sampling depth, at which time the piston stop pin is removed, freeing the push point. The LB® sampler is then pushed into the soil a distance equal to the length of the LB® sample barrel. The probe rod string, with the LB® sampler attached, is then removed from the subsurface. After retrieval, the LB® sampler is then removed from the probe rod string. The drive head is then removed to allow removal of the liner and soil sample.

4.3 Macro-Core® Soil Sampler

The Macro-Core® (MC) sampler is a solid barrel direct push sampler equipped with a piston-rod point assembly used primarily for collection of either continuous or depth-discrete subsurface soil samples. Although other lengths are available, the standard MC® sampler has an assembled length of approximately 52 inches (1321 mm) with an outside diameter of 2.2 inches (56 mm). The MC® sampler is capable of recovering a discrete sample core 45 inches x 1.5 inches (1143 mm x 38 mm) contained inside a removable liner. The resultant sample volume is a maximum of 1300 ml. The MC® sampler may be used in either an open-tube or closed-point configuration. Samples collected for chemical analyses must be collected with the closed-point configuration. If used for collection of soil for stratigraphic descriptions, the open-tubed configuration is acceptable.

4.4 Dual Tube Soil Sampling System

The Dual Tube 21 soil sampling system is a direct push system for collecting continuous core samples of unconsolidated materials from within a sealed outer casing of 2.125-inch (54 mm) OD probe rod. The samples are collected within a liner that is threaded onto the leading end of a string of 1.0-inch diameter probe rod. Collected samples have a volume of up to 800 ml in the form of a 1.125-inch x 48-inch (29 mm x 1219 mm) core. Use of this method allows for collection of continuous core inside a cased hole, minimizing or preventing cross-contamination between different intervals during sample collection. The outer casing is advanced, one core length at a time, with only the inner probe rod and core being removed and replaced between samples. If the sampling zone of interest begins at some depth below ground surface, a solid drive tip must be used to drive the dual tube assembly and core to its initial sample depth.

4.5 Special Considerations When Using Direct Push Sampling Methods

- *Liner Use and Material Selection* – Due to the mode of operation, the samples must be collected with a liner. Liners are available in the following materials: stainless steel, brass, cellulose acetate butyrate (CAB), PETG, polyvinyl chloride (PVC) and Teflon®. For the majority of environmental investigations conducted by EIB, either CAB or Teflon® liners are used. If samples are collected for organic compound analyses, Teflon® liners are required. CAB or PVC liners may be used if metals or other inorganic constituents are the object of the investigation.
- *Sample Orientation* – When the liners and associated sample are removed from the sample tubes, it is important to maintain the proper orientation of the sample. This is particularly important when multiple sample depths are collected from the same push. It is also important to maintain proper orientation to define precisely the depth at which an aliquot was collected. Maintaining proper orientation is typically accomplished using vinyl end caps. Convention is to place red caps on the top of the liner and black caps on the bottom to maintain proper sample orientation. Orientation can also be indicated by marking on the exterior of the liner with a permanent marker.
- *Core Catchers* – Occasionally the material being sampled lacks cohesiveness and is subject to crumbling and falling out of the sample liner. In cases such as these, the use of core catchers on the leading end of the sampler may help retain the sample until it is retrieved to the surface. Materials of construction for core catchers must be consistent with the type of liner used, i.e., if stainless steel liners are required, stainless steel core catchers must be used.
- *VOC Sample Collection* - Observe precautions for volatile organic compound sample collection found in Section 2.2.4, Special Techniques and Considerations for Method 5035.

5 Split Spoon/Drill Rig Methods

5.1 General

Split spoon sampling methods are used primarily to collect shallow and deep subsurface soil samples. All split spoon samplers, regardless of size, are basically split cylindrical barrels that are threaded on each end. The leading end is held together with a beveled threaded collar that functions as a cutting shoe. The other end is held together with a threaded collar that serves as the sub used to attach the spoon to the string of drill rod. Two basic methods are available for use, including the smaller diameter standard split spoon, driven with the drill rig safety hammer, and the larger diameter continuous split spoon, advanced inside and slightly ahead of the lead auger during hollow stem auger drilling. The following sections describe each of the specific sampling methods, along with details specific to each method.

5.2 Standard Split Spoon

A drill rig is used to advance a borehole to the target depth. The drill string is then removed and a standard split spoon is attached to a string of drill rod. Split spoons used for soil sampling must be constructed of stainless steel and are typically 2.0-inches OD (1.5-inches ID) and 18-inches to 24-inches in length. Other diameters and lengths are common and may be used if constructed of the proper material. After the spoon is attached to the string of drill rod it is lowered into the borehole. The drill rig safety hammer is then used to drive the split spoon into the soil at the bottom of the borehole. After the split spoon has been driven into the soil, filling the spoon, it is retrieved to the surface, where it is removed from the drill rod string and opened for sample acquisition.

5.3 Continuous Split Spoon

The continuous split spoon is a large diameter split spoon that is advanced into the soil column inside a hollow stem auger. Continuous split spoons are typically 3-inches to 5-inches in diameter and either 5-feet or 10-feet in length, although the 5-foot long samplers are most common. After the auger string has been advanced into the soil column a distance equal to the length of the sampler being used it is returned to the surface. The sampler is removed from inside the hollow stem auger and the threaded collars are removed. The split spoon is then opened for sampling.

5.4 Special Considerations When Using Split Spoon Sampling Methods

- Always discard the top several inches of material in the spoon before removing any portion for sampling. This material normally consists of borehole wall material that has sloughed off of the borehole wall after removal of the drill string prior to and during inserting the split spoon.
- Observe precautions for volatile organic compound sample collection found in Section 2.2.4, Special Techniques and Considerations for Method 5035.

6 Shelby Tube/Thin-Walled Sampling Methods

6.1 General

Shelby tubes, also referred to generically as thin-walled push tubes or Acker thin-walled samplers, are used to collect subsurface soil samples in cohesive soils and clays during drilling activities. In addition to samples for chemical analyses, Shelby tubes are also used to collect relatively undisturbed soil samples for geotechnical analyses, such as hydraulic conductivity and permeability, to support hydrogeologic characterizations at hazardous waste and other sites.

6.2 Shelby Tube Sampling Method

A typical Shelby tube is 30-inches in length and has a 3.0-inch OD (2.875 ID) and may be constructed of steel, stainless steel, galvanized steel, or brass. They also typically are attached to push heads that are constructed with a ball-check to aid in holding the contained sample during retrieval. If used for collecting samples for chemical analyses, it must be constructed of stainless steel. If used for collecting samples for standard geotechnical parameters, any material is acceptable.

To collect a sample, the tube is attached to a string of drill rod and is lowered into the borehole, where the sampler is then pressed into the undisturbed clay or silts by hydraulic force. After retrieval to the surface, the tube containing the sample is then removed from the sampler head. If samples for chemical analyses are needed, the soil contained inside the tube is then removed for sample acquisition. If the sample is collected for geotechnical parameters, the tube is typically capped, maintaining the sample in its relatively undisturbed state, and shipped to the appropriate geotechnical laboratory.

6.3 Special Considerations When Using Split Spoon Sampling Methods

Observe precautions for volatile organic compound sample collection found in Section 2.2.4, Special Techniques and Considerations for Method 5035.

7 Backhoe Sampling Method

7.1 General

Backhoes may be used in the collection of surface and shallow subsurface soil samples. The trenches created by excavation with a backhoe offer the capability of collecting samples from very specific intervals and allow visual correlation with vertically and horizontally adjacent material. If possible, the sample should be collected without entering the trench. Samples may be obtained from the trench wall or they may be obtained directly from the bucket at the surface. The following sections describe various techniques for safely collecting representative soil samples with the aid of a backhoe.

7.2 Scoop and Bracket Method

If a sample interval is targeted from the surface, it can be sampled using a stainless steel scoop and bracket. First a scoop and bracket are affixed to a length of conduit and is lowered into the backhoe pit. The first step is to take the scoop and scrape away the soil comprising the surface of the excavated wall. This material likely represents soil that has been smeared by the backhoe bucket from adjacent material. After the smeared material has been scraped off, the original stainless steel scoop is removed and a clean stainless steel scoop is placed on the bracket. The clean scoop can then be used to remove sufficient volume of soil from the excavation wall to make up the required sample volume.

7.3 Direct-From-Bucket Method

It is also possible to collect soil samples directly from the backhoe bucket at the surface. Some precision with respect to actual depth or location may be lost with this method but if the soil to be sampled is uniquely distinguishable from the adjacent or nearby soils, it may be possible to characterize the material as to location and depth. In order to ensure representativeness, it is also advisable to dress the surface to be sampled by scraping off any smeared material that may cross-contaminate the sample.

7.4 Special Considerations When Sampling with a Backhoe

- Do not physically enter backhoe excavations to collect a sample. Use either procedure 7.2, Scoop and Bracket Method, or procedure 7.3, Direct-From-Bucket Method to obtain soil for sampling.
- Smearing is an important issue when sampling with a backhoe. Measures must be taken, such as dressing the surfaces to be sampled (see Section 2.3), to mitigate problems with smearing.

- Paint, grease and rust must be removed and the bucket decontaminated prior to sample collection.
- Observe precautions for volatile organic compound sample collection found in Section 2.2.4, Special Techniques and Considerations for Method 5035.

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Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

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Revision History

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SESCPROC-010-R3, *Logbooks*, replaces SESDPROC-010-R2 This revision reflects the following changes: **General:** Updated referenced procedures to reflect most recent version. **Title Page:** Changed title for Antonio Quinones from Environmental Investigation Branch to Enforcement and Investigations Branch **Section 1.4** Alphabetized.	November 1, 2007
SESCPROC-010-R2, *Logbooks*, Replaces SESDPROC-010-R1 **General** The revision history in SESDPROC-010-R1 was incorporated using a hyperlink. In SESDPROC-010-R2, the hyperlink was removed and the revision history was incorporated into the document.	September 25, 2007
SESDPROC-010-R1, *Logbooks*, Replaces *Field Records (Logbooks)* SESDPROC-010-R0 This revision reflects the following changes: **General** Deleted all references to the SOSA. **Cover Page** Author was changed from Daniel Thoman to Laura Ackerman due to extensive re-writes by Laura Ackerman. Changed name of procedure from *Field Records (Logbooks)* to *Logbooks* **Section 1.1** Deleted last two sentences of first paragraph and first sentence of second paragraph for clarity. Changed examiner/analyst to field investigator.	August 10, 2007

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Section 1.2 Deleted second sentence. **Section 1.3** Updated to reflect that the official copy of the procedure resides on the H: drive rather than with the FQM. **Section 2.1** Deleted first paragraph for clarity. Reworded second sentence in second paragraph and deleted third sentence in second paragraph. Deleted second and third sentences in third paragraph. Added first and last sentences of third paragraph. **Section 2.2** Deleted "Ideally" at beginning of first paragraph. Added second and third sentences in first paragraph. Added requirement for drawing a diagonal line and initialing at the end of unfilled pages. Reworded fourth sentence. Added last sentence of first paragraph. Deleted second paragraph. Added "or signing" in third paragraph. Added requirement for downloading logged data while in the field. Added requirement for indicating end of project notes in the logbooks. Added requirement for signing across adhesive labels onto logbook page if applicable. **Section 2.3** Renamed Section 2.3. Added all text in Section 2.3. **Section 2.4** Reformatted bulleted list into separate subsections (2.4.1, 2.4.2, 2.4.3, and 2.4.4). Added "full name and initials" to items 5 and 6 in Section 2.4.1. Added items 3 – 8 and 14 in Section 2.4.3.	
SESDPROC-010-R0, Field Records (Logbooks), Original Issue	February 5, 2007

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Contents

1 General Information

1.1 Purpose

This procedure is to be used by field investigators when documenting pertinent and factual information in logbooks related to field investigations involving sampling and measurement procedures and/or other data collection events.

1.2 Scope/Application

This document describes the various types of information that should be included in the field log books used to document field investigations conducted by SESD.

1.3 Documentation/Verification

The procedures found within this document were prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and have been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the H: drive of the SESD local area network. The Field Quality Manager is responsible for ensuring the most recent version of the procedure is placed on the H: drive and for maintaining records of review conducted prior to its issuance.

1.4 References

SESD Operating Procedure for Control of Records, SESDPROC-002, Most Recent Version

USEPA Region 4 Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), November 2001

2 Field Records and Documentation Procedures

2.1 General

Dedicated logbooks will be used for all projects and by each sampling team associated with a project. Logbook entries should be objective, factual, and free of personal feelings or other terminology which might prove inappropriate. All aspects of sample collection and handling, as well as visual observations, should be documented.

Any deviations from the quality assurance project plan that occur while in the field will be noted in the logbook(s). Logbook entries that may be considered privileged or confidential information will be handled in accordance with the relevant sections of SESD Operating Procedure for Control of Records (SESDPROC-002). The logbooks will be placed in the SESD project file upon transmittal of the final report to the project requestor.

2.2 Field Data Integrity and Accountability

- Logbooks should be bound and each page in the logbook numbered and dated.
- Observations, data and calculations should be recorded at the time they are made.
- Unless prohibited by weather, pens with permanent ink should be used to record all data. When weather conditions do not make it feasible to use permanent ink, entries should be made using a non-smear lead pencil (e.g., 2H or 3H). The penciled entries should be repeated with a permanent ink pen as soon as possible after the original entry.
- Logbook entries should be legible and contain pertinent, accurate and inclusive documentation of project activities.
- Field investigators should draw a diagonal line and initial to indicate the conclusion of an entry at 1) the end of all entries for each day, and 2) at the end of unfilled pages.
- Upon completion of the field investigation, the end of project entries in the logbook should be clearly indicated. This may be accomplished by noting "End" on the last page of notes and dating and initialing the notation.
- In order to demonstrate continuity of the project and to preclude questioning of the integrity of the data collection process, pages should not be removed from bound logbooks under any circumstances.

- Data or other information that has been entered incorrectly will be corrected by drawing a line through the incorrect entry and **initialing or signing and dating** the lined-through entry. Under no circumstances should the incorrect material be erased, made illegible or obscured so that it cannot be read.

- If pre-printed adhesive labels are used in logbooks to facilitate organization of information entry, the field investigator who is responsible for taking notes should sign the label with the signature beginning on the label and ending on the page of the logbook book such that the label cannot be removed without detection.

2.3 Bound Forms

In order to facilitate accurate and complete documentation of many field sampling and measurement activities, bound forms may be used. The information in Section 2.4 below should be included with bound forms. The forms must be numbered using the page x of y format and bound prior to use in the field. At the conclusion of the project, the sample team leader should strike through any unused forms with a diagonal line that covers the entire page, and initial and date the page.

2.4 Logbook Entry Information

2.4.1 General Information Required in All Logbooks

The following information will be included either on the front cover or the first page of **all logbooks**:

1. Project name
2. Project location
3. Project identification number
4. Project leader (full name)
5. Sample team leader (full name) and initials
6. Sample team member(s) (full name) and initials.

2.4.2 Information Required for Sample Collection

In addition to the information listed in Section 2.4.1, the following information will be included in all logbooks when **samples** are collected:

1. Date and time of collection
2. Sample station identification
3. Method of collection
4. Number and type of containers
5. Sample collection equipment
6. SESD equipment identification number, if applicable

7. Physical description of sample
8. Matrix sampled
9. Sample team member duties (calibration, collection, deployment, etc.)
10. Sample preservation (including ice), if applicable
11. Indication of sample team member duties
12. Conditions that may adversely impact quality of samples, if applicable (rain, wind, smoke, dust, extreme temperature, etc.)
13. GPS coordinates (Non-logging GPS units), if applicable
14. Location of electronic data file backups, if applicable
15. Monitoring of condition of ice in coolers or sampler
16. Other pertinent information.

2.4.3 Information Required for Field Measurements

In addition to the information listed in Section 2.4.1, the following information will be included in all logbooks when **measurements** are conducted:

1. Date and time of measurement or deployment
2. Sample station identification
3. Sample measurement equipment
4. SESD sample measurement equipment identification number
5. Manufacturer name, lot number and expiration date of all buffers and standards*
6. Calibration information, including before and after calibration readings*
7. Meter end check information
8. Deployment depth and total depth, if applicable
9. Pinger identification number and frequency for deployed equipment, if applicable
10. Time of retrieval for deployed equipment, if applicable
11. Physical description of matrix
12. Sample team member duties (calibration, collection, deployment, etc.)
13. Measurement values for non-logging equipment
14. GPS coordinates (non-logging GPS units), if applicable
15. Location of electronic data file backups, if applicable
16. Ambient air temperature, where applicable
17. Conditions that may adversely impact quality of measurement (Ex. temperature extremes)
18. Maintenance performed, if applicable
19. Meter malfunctions, if applicable
20. Other pertinent information

* Entry of calibration information in logbooks is only required for calibrations conducted in the field. All calibrations conducted at the Field Equipment Center or SESD laboratory will be recorded in the appropriate equipment tracking logbook.

2.4.4 Additional Information for Inclusion

The following information may be included in logbooks as appropriate:

1. Maps/sketches
2. Photographic or videographic log
3. Process diagrams

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Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

Title: **Sample and Evidence Management**

Effective Date: November 1, 2007	**Number:** SESDPROC-005-R1

Authors

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Title: Environmental Scientist, Regional Expert
Signature: Art Masters Date: 11/6/07

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Revision History

This table shows changes to this controlled document over time. The most recent version is presented in the top row of the table. Previous versions of the document are maintained by the SESD Field Quality Manager.

History	Effective Date
SESDPROC-005-R1, *Sample and Evidence Management*, replaces SESDPROC-005-R0 **General** Updated referenced procedures to reflect most recent version. Replaced "shall" with "will". **Cover Page:** Changed title for Antonio Quinones from Environmental Investigation Branch to Enforcement and Investigations Branch. Changed Bill Cosgrove's title from Acting Chief to Chief. **Section 1.3** Updated information to reflect that procedure is located on the H: drive of the LAN. **Section 1.4** Added reference for the SESD Operating Procedure for Control of Records. Alphabetized and revised the referencing style for consistency. **Section 2.2.3** Added that Confidential Business Information will be handled in accordance with SESD Operating Procedure for Control of Records.	November 1, 2007
SESDPROC-005-R0, Sample and Evidence Management, Original Issue	February 05, 2007

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Contents

1 General Information

1.1 Purpose

This document describes general and specific procedures, methods and considerations to be used and observed by SESD field investigators when handling and managing samples and other types of evidence after their collection and during delivery to the laboratory.

1.2 Scope/Application

The procedures contained in this document are to be used by field investigators when handling and managing samples and other evidence collected to support SESD field investigations. On the occasion that SESD field investigators determine that any of the procedures described in this section are either inappropriate, inadequate or impractical and that another procedure must be used, the variant procedure will be documented in the field log book, along with a description of the circumstances requiring its use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and have been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the H: drive of the SESD local area network. The Field Quality Manager (FQM) is responsible for ensuring the most recent version of the procedure is placed on the H: drive and for maintaining records of review conducted prior to its issuance.

1.4 References

USEPA Region 4 Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), November 2001

SESD Operating Procedure for Control of Records, SESDPROC-002, Most Recent Version

SESD Operating Procedure for Packing, Marking, Labeling and Shipping of Environmental and Waste Samples, SESDPROC-209, Most Recent Version

2 Sample and Evidence Identification

2.1 Introduction

Sample identification, chain-of-custody records, receipt for sample records, and other field records will be legibly recorded with waterproof, non-erasable ink, unless otherwise specified. If errors are made in any of these documents, corrections will be made by crossing a single line through the error and entering the correct information. All corrections must be initialed and dated. If possible, all corrections should be made by the individual making the error.

Following are definitions of terms used in this section:

Field Investigator
Any individual who performs or conducts field sampling, observation and/or measurement activities in support of field investigations

Project Leader
The individual with overall responsibility for conducting a specific field investigation in accordance with this procedure

Field Sample Custodian
Individual responsible for identifying the sample containers and maintaining custody of the samples and the Chain-of-Custody Record

Sample Team Leader
An individual designated by the project leader to be present during and responsible for all activities related to the collection of samples by a specific sampling team

Sampler
The individual responsible for the actual collection of a sample

Transferee
Any individual who receives custody of samples subsequent to release by the field sample custodian

Laboratory Sample Custodian
Individual responsible for accepting custody of samples from the field sample custodian or a transferee

One individual may fulfill more than one of the roles described above.

Occasionally, it is necessary to obtain copies of recorder and/or instrument charts from facility owned analytical equipment, flow recorders, etc., during field investigations and inspections. Record the following information on copies of the charts:

- Starting and ending time(s) and date(s) for the chart;
- An instantaneous measurement of the media being measured by the recorder will be taken and entered at the appropriate location on the chart along with the date and time of the measurement; and
- A description of the location being monitored and other information required to interpret the data such as type of flow device, chart units, factors, etc.

The field investigator will indicate who the chart (or copy of the chart) was received from and enter the date and time, as well as the field investigator's initials.

Documents such as technical reports, laboratory reports, etc., should be marked with the field investigator's signature, the date, the number of pages, and from whom they were received. Documents that are claimed by a facility to be "confidential" and, therefore, potentially subject to the Confidential Business Information requirements, will be handled in accordance with SESD Operating Procedure for Control of Records (SESDPROC-002).

- The name of the individual who took the photograph or digital image.

When photographs are taken with a film camera, the film should be developed with the negatives supplied uncut, if possible. The identifying information that was recorded in the field logbook will be entered on the back of the prints.

When digital images are obtained during a field investigation, an electronic copy and a printed copy of the unaltered investigation-related images will be placed in the official files. For enforcement cases, it is imperative that the individual who took the image be identified in the field logbook in the event their testimony is required.

Video

When a video recording is used as evidence in an enforcement case, the following information should be recorded in a bound field logbook:

- The date and time that the video was recorded;
- A brief description of the subject of the video;
- The person recording the video.

An audio record may also be included in the video tape with the above logistical information, as well as a narrated description of the video record.

A label will be placed on the video media with the appropriate identifying information (i.e., project name, project number, date, location etc.). In the event testimony regarding a video recording is required for an enforcement case, one individual should be responsible for recording the video for each case. The original, unaltered recording will be placed in the official files.

2.2.3 Identification of Physical Evidence

Physical evidence, other than samples, will be identified, when possible, by recording the necessary information on the evidence. When samples are collected from vessels or containers which can be moved (drums for example), the vessel or container should be marked with the field identification or sample station number for future identification. The vessel or container may be labeled with an indelible marker (e.g., paint stick or spray paint). The vessel or container need not be marked if it already has a unique marking; however, these markings will be recorded in the bound field logbooks. In addition, it is suggested that photographs of any physical evidence (markings, etc.) be taken and the necessary information recorded in the field logbook.

Occasionally, it is necessary to obtain copies of recorder and/or instrument charts from facility owned analytical equipment, flow recorders, etc., during field investigations and inspections. Record the following information on copies of the charts:

- Starting and ending time(s) and date(s) for the chart;
- An instantaneous measurement of the media being measured by the recorder will be taken and entered at the appropriate location on the chart along with the date and time of the measurement; and
- A description of the location being monitored and other information required to interpret the data such as type of flow device, chart units, factors, etc.

The field investigator will indicate who the chart (or copy of the chart) was received from and enter the date and time, as well as the field investigator's initials.

Documents such as technical reports, laboratory reports, etc., should be marked with the field investigator's signature, the date, the number of pages, and from whom they were received. Documents that are claimed by a facility to be "confidential" and, therefore, potentially subject to the Confidential Business Information requirements, will be handled in accordance with SESD Operating Procedure for Control of Records (SESDPROC-002).

3 Chain-of-Custody Procedures

3.1 Introduction

Chain-of-custody procedures are comprised of the following elements: 1) maintaining custody of samples or other evidence, and 2) documentation of the chain-of-custody for evidence. To document chain-of-custody, an accurate record must be maintained to trace the possession of each sample, or other evidence, from the moment of collection to its introduction into evidence.

3.2 Sample Custody

A sample or other physical evidence is in custody if:

- It is in the actual possession of an investigator;
- It is in the view of an investigator, after being in their physical possession;
- It was in the physical possession of an investigator and then they secured it to prevent tampering; and/or
- It is placed in a designated secure area.

3.3 Documentation of Chain-of-Custody

The following are used to identify and demonstrate how sample integrity is maintained and custody is ensured.

Sample Identification
A stick-on sample label or a tag should be completed for each sample container using waterproof, non-erasable ink as specified in Section 2.2.1.

Sample Seals
If appropriate, samples should be sealed as soon as possible following collection using a custody seal with EPA identification. The sample custodian or project leader will write the date and their initials on the seal. Except for criminal investigations, the use of custody seals may be waived if field investigators keep the samples in their custody as defined in Section 3.2, from the time of collection until the samples are delivered to the laboratory analyzing the samples. Custody seals must always be used for criminal investigations.

Field Sample Custodian
The field sample custodian is the person designated by the project leader to receive and manage custody of samples while in the field, including labeling and custody sealing.

Chain-of-Custody Record

The field Chain-Of-Custody record is used to document the custody of all samples or other physical evidence collected and maintained by investigators. All physical evidence or samples will be accompanied by a Chain-Of-Custody Record. This form may be generated by the FORMS computer program (Section 5) or it may be a pre-printed multi-sheet carbonless form for hand entry of required information. The Chain-Of-Custody Record documents transfer of custody of samples from the sample custodian to another person, to the laboratory, or other organizational elements. The Chain-of-Custody Record will not be used to document the collection of split samples where there is a legal requirement to provide a receipt for samples (see Section 4, Receipt for Samples Form (CERCLA/RCRA/TSCA)). The Chain-Of-Custody Record also serves as a sample logging mechanism for the laboratory sample custodian. A separate Chain-of-Custody Record should be used for each final destination or laboratory used during the investigation.

All information necessary to fully and completely document the sample collection and required analyses must be recorded in the appropriate spaces to complete the field Chain-Of-Custody Record. Tag numbers are not required unless numbered "Criminal Tags" are used during an investigation. The following requirements apply to Chain-Of-Custody records generated by either the FORMS system or by hand entry on pre-printed forms:

- All sampling team leaders must sign in the designated signature block.
- One sample should be entered on each line and not be split among multiple lines.
- If multiple sampling teams are collecting samples, the sampling team leader's name should be clearly indicated for each sample.
- The total number of sample containers for each sample must be listed in the appropriate column. Required analyses should be entered in the appropriate location on the Chain-of-Custody Record.
- The field sample custodian, project leader or other designee, and subsequent transferee(s) should document the transfer of the samples listed on the Chain-of-Custody Record. Both the person relinquishing the samples and the person receiving them must sign the form. The date and time that this occurs should be documented in the proper space on the Chain-of-Custody Record. The exception to this requirement would be when packaged samples are shipped with a common carrier. Even though the common carrier accepts the samples for shipment, they do not sign the Chain-of-Custody Record as having received the samples.
- The last person receiving the samples or evidence will be the laboratory sample custodian or their designee(s).

The Chain-of-Custody Record is a uniquely identified document. Once the Record is completed, it becomes an accountable document and must be maintained in the project file. The suitability of any other form for chain-of-custody should be evaluated based upon its inclusion of all of the above information in a legible format.

If chain-of-custody is required for documents received during investigations, the documents should be placed in large envelopes, and the contents should be noted on the envelope. The envelope will be sealed and an EPA custody seal placed on the envelope such that it cannot be opened without breaking the seal. A Chain-Of-Custody Record will be maintained for the envelope. Any time the EPA seal is broken, that fact will be noted on the Chain-Of-Custody Record and a new seal affixed, as previously described in this section.

Physical evidence such as video tapes or other small items will be placed in an evidence bag or envelope and an EPA custody seal should be affixed so that they cannot be opened without breaking the seal. A Chain-Of-Custody Record will be maintained for these items. Any time the EPA seal is broken, that fact will be noted on the Chain-of-Custody Record and a new seal affixed.

EPA custody seals can be used to maintain custody of other items when necessary by using similar procedures as those previously outlined in this section.

Samples should not be accepted from other sources unless the sample collection procedures used are known to be acceptable, can be documented, and the sample chain-of-custody can be established. If such samples are accepted, a standard sample label containing all relevant information and the Chain-Of-Custody Record will be completed for each set of samples.

3.4 Transfer of Custody with Shipment

Transfer of custody is accomplished by the following:

- Samples will be properly packaged for shipment in accordance with the procedures outlined in SESD Operating Procedure for Packing, Marking, Labeling and Shipping of Environmental and Waste Samples (SESDPROC-209).

- All samples will be accompanied by the laboratory copy of the Chain-Of-Custody Record. If pre-printed forms are used, the white and pink sheets will be sent. If FORMs is used to generate the Chain-Of-Custody Record, the laboratory copy is identified with an "L" in the upper right corner. If multiple coolers are needed for shipment to a particular laboratory, the laboratory copy of the Chain-Of-Custody Record for the entire shipment is placed in a sealed plastic bag in one of the coolers. When shipping samples via common carrier, the "Relinquished By" box should be filled in; however, the "Received By" box should be left blank. The laboratory sample custodian is responsible for receiving custody of the samples and will fill in the "Received By" section of the Chain-of-Custody Record. One

copy of the Record will be provided to and retained by the project leader. After samples have been received and accepted by the laboratory, a copy of the Chain-of-Custody Record, with ASB sample identification numbers, will be transmitted to the project leader. This copy will become a part of the project file.

- If sent by mail, the package will be registered with return receipt requested. If sent by common carrier, an Air Bill should be used. Receipts from post offices and Air Bills will be retained as part of the documentation of the chain-of-custody. The Air Bill number or registered mail serial number will be recorded in the remarks section of the Chain-Of-Custody Record.

4 Receipt for Samples Form (CERCLA/RCRA/TSCA)

4.1 Introduction

Section 3007 of the Resource Conservation and Recovery Act (RCRA) of 1976 and Section 104 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) of 1980 require that a "receipt" for all facility samples collected during inspections and investigations be given to the owner/operator of each facility before the field investigator departs the premises. The Toxic Substances Control Act (TSCA) contains similar provisions. The laws do not require that homeowners or other off-site property owners be given this form.

4.2 Receipt for Samples Form

A Receipt for Samples form, using either the pre-printed form or one generated by the FORMS system, is to be used to satisfy the receipt for samples provisions of RCRA, CERCLA, and TSCA. The form also documents that split samples were offered and either "Received" or "Declined" by the owner/operator of the facility or site being investigated (if a sample is split with a facility, state regulatory agency, or other party representative, the recipient should be provided (if enough sample is available) with an equal weight or volume of sample). All information must be supplied in the indicated spaces to complete the Receipt for Samples form.

- The sampler(s) must sign the form in the indicated location

- Each sample collected from the facility or site must be documented in the sample record portion of the form. The sample station number, date and time of sample collection, composite or grab sample designation, whether or not split samples were collected (yes or no should be entered under the split sample column), a brief description of each sampling location, and the total number of sample containers for each sample must be entered.

- The bottom of the form is used to document the site operator's acceptance or rejection of split samples. The project leader must sign and complete the information in the "Split Samples Transferred By" section (date and time must be entered). If split samples were not collected, the project leader should initial and place a single line through "Split Samples Transferred By" in this section. The operator of the site must indicate whether split samples were received or declined and sign the form. The operator must give their title, telephone number, and the date and time they signed the form. If the operator refuses to sign the form, the sampler(s) should note this fact in the operator's signature block and initial this entry.

The Receipt for Samples form is an accountable document after it is completed. A copy of the form is to be given to the facility or site owner/operator. The original form must be maintained in the project files.

5 FORMS

The container labels and the Chain-of-Custody record should be generated using the FORMS computer program, a computer program designed to streamline the documentation required by SESD and/or the Contract Laboratory Program (CLP) for sample identification and chain-of-custody. When possible, FORMS should be used during all field investigations. Once the appropriate information is entered into the computer, FORMS will generate stick-on labels for the sample containers and will generate sample receipt forms and chain-of-custody records for the appropriate laboratory. The advantages to this system include faster processing of samples and increased accuracy. Accuracy is increased because the information is entered only once, and consequently, consistent for the bottle labels, sample receipt forms and chain-of-custody records. Operating instructions are available for use with the FORMS program.

Appendix D

Health and Safety Plan

Health and Safety Plan
Removal Action
Forshaw Chemicals, Inc. Site
650 State Street
Charlotte, North Carolina
Site ID NCN 000 409 865

H&H Job No. FOR-001

September 1, 2009

Revision 0

2923 South Tryon Street
Suite 100
Charlotte, NC 28203
704-586-0007

3334 Hillsborough Street
Raleigh, NC 27607
919-847-4241

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Removal Action
Forshaw Chemicals, Inc. Site
650 State Street
Charlotte, North Carolina

Emergency Contact Numbers

Site Contact:	Thomas Forshaw, III (Forshaw Chemicals, Inc.)	(704) 372-6790 (office) (800) 438-4534
Client Contacts:	Thomas Forshaw, III (Forshaw Chemicals, Inc.) David Franchina K&L Gates LLP)	(704) 372-6790 (office) (800) 438-4534 (704) 331-7543
Fire/Ambulance/Police:		911
Hospital:	Presbyterian Medical Center 200 Hawthorne Lane Charlotte, NC 28204 ***(See Hospital Route Map in Appendix A)***	(704) 384-4000
Poison Control:	National Poison Control Center Carolinas Poison Center	(800) 962-1250 (800) 848-6946
Emergency Response:	National Response Center CHEMTREC US EPA Emergency Response Team	(800) 424-8802 (800) 424-9300 (888) 481-0125
US EPA On-Scene Coordinator (OSC):	Stephen Ball US EPA Region 4	(404) 562-8528 (office) (404) 229-9513 (cell)
Project Coordinator (PC):	Steve Hart, PG Hart & Hickman, PC	(704) 586-0007 (office) (704) 576-0145 (cell)
On-Site Manager (OSM):	Scott Drury Hart & Hickman, PC	(704) 586-0007 (office) (704) 302-4407 (cell)
Site Health and Safety Officer:	Shannon Cottrill Hart & Hickman, PC	(704) 586-0007 (office) (704) 577-8810 (cell)
Removal Action Subcontractor (RAS) Safety Representative:	*(To be added)*	

Preparation Date: September 1, 2009

Health and Safety Plan
Removal Action
Forshaw Chemicals, Inc. Site
650 State Street
Charlotte, North Carolina

1.0 Introduction and Summary

1.1 Introduction

This site-specific Health & Safety Plan (HSP) has been prepared by Hart & Hickman, PC (H&H) for the time-critical removal action (RA) to be performed at the Forshaw Chemicals, Inc. site located in Charlotte, North Carolina. The HSP has been prepared in accordance with Section 16 of the *Administrative Settlement Agreement and Order on Consent for Removal Action* between the United States Environmental Protection Agency (EPA) and Forshaw Chemicals, Inc. (Forshaw) effective August 17, 2009 (Settlement Agreement).

This HSP was prepared by H&H for H&H employees. It is also intended to establish minimum health and safety protocols for selected Removal Action Subcontractors (RASs) working on the project. Each RAS is required to review this plan. If a RAS reviews this plan and approves it for their use, they should adopt it as their own in writing via a letter or cover page. The RAS may also create their own plan which has the equivalent or more stringent safety protocols. Significant deviations from the plan must be discussed with H&H.

This HSP focuses on minimizing worker exposure to impacted media at the site and protecting surrounding populations during the RA. This plan describes air monitoring, personal protective equipment (PPE), medical monitoring, emergency procedures, and site control which will be conducted at the site during the removal action. This plan does not focus on general construction safety practices such as backhoe safety, excavation safety, etc. RASs working on the project should establish safety protocols for general construction activities to be used during the project.

This HSP is valid for this project as described in Section 3.4. It is not to be used for other projects or subsequent phases of this project without the written consent of H&H.

1.2 Summary

The purpose of the RA is to remove and control the source of pentachlorophenol (PCP) and dioxins/furans which have been detected in the stormwater conveyance system at the site, and the prevention of off-site migration of these compounds to the adjacent Stewart Creek through the stormwater conveyance system. The purpose of this HSP is to minimize the potential for on-site worker exposure and to protect public health and safety during the RA activities.

Based upon previous assessments performed at the site, the primary compounds of concern at the facility include pentachlorophenol (PCP), dioxins/furans, and arsenic, with lower concentrations of pesticides. The exposures anticipated from these materials are expected to be minimal based on knowledge of current conditions at the subject facility. The level of disturbance posed by the RA activities is expected to create minimal exposure hazards.

Skin contact with potentially impacted soil or water will be minimized by wearing personal protective clothing (as described in Section 7.0). Inhalation of vapors during work activities will be minimized by air monitoring, engineering controls, and the use of respiratory protection if action levels (see Section 6.1) are exceeded. Ingestion of impacted materials will be minimized by good personal hygiene during decontamination (i.e., thoroughly washing face and hands with soap and water before eating or drinking).

The work zone will be monitored for volatile organics and dust. A Photoionization Detector (PID) will be used to monitor for vapors. In addition, a Microdust Pro will be used to monitor the work areas for airborne dust particulates, which may contain metals, dioxins/furans, pesticides/herbicides, and PCP. These hand-held direct-reading instruments will be used at periodic intervals to monitor in the immediate vicinity of the work area, as well as other upwind and downwind locations. Additional exposure monitoring and personal protective equipment criteria are found in Sections 6.0 and 7.0, respectively.

Work activities, potential risks, personal protective equipment and safety procedures will be reviewed and discussed at the start of each work day, or more frequently if dictated by a change

in site conditions or work activities. These site safety briefings ("tail-gate" safety meetings) will be documented and signed by attendees (see form in Appendix D).

2.0 Applicability

The purpose of this plan, which was developed specifically for operations at the Forshaw site, is to comply with Section 16 of the Settlement Agreement**;** assign responsibilities; establish personal protection standards and safety procedures; and provide for contingencies that may arise while operations are being conducted at the site. This plan complies with, but does not replace, Federal Health and Safety Regulations as set forth in 29 CFR 1910. This plan is to be used by H&H's personnel as a supplement to such rules, regulations, and guidance. The provisions of the plan are mandatory for all on-site H&H employees that may involve health and safety hazards.

Changing and/or unanticipated site conditions may require modification of this site safety plan in order to maintain a safe and healthful work environment. Proposed changes to this plan should be reviewed with the H&H Manager of Health and Safety (MH&S), or his designee, prior to their implementation. If this is not feasible, the Site Health and Safety Officer (SHSO) may modify the plan and record changes in the field log book. Under no circumstances will modifications to this plan conflict with Federal, state, or local health and safety regulations.

H&H will provide a copy of this Health and Safety Plan to the selected RASs in order to fulfill its obligation under 29 CFR 1910.120(b)(iv) to inform workers of site hazards. Each RAS is to provide a Health & Safety Plan that addresses the activities of its employees relative to this project.

3.0 Facility Background/Work Plan

3.1 Site Description

The Forshaw site is located at 650 State Street in Charlotte, Mecklenburg County, North Carolina. A site location map is provided as Figure 1 of the Removal Action Work Plan (all figures are located in the Removal Action Work Plan.). The Forshaw site consists of three land parcels totaling approximately 6 acres in area. The site contains six structures totaling approximately 52,000 square feet. The main warehouse building is located in the central portion of the property, and a two-story office building is located south of the main warehouse building. A site map is provided as Figure 2.

The Forshaw site is primarily used for the distribution of pesticide and herbicide products for use by commercial pest control companies. Pesticides and herbicides are stored and distributed from the main warehouse in the central portion of the site. The remaining buildings are used for limited warehouse, maintenance, and storage purposes. Other activities conducted at the site include retrofitting trucks with plastic tanks, pumps, and hoses for use by pest control companies. No repackaging, mixing, blending, or formulation of pesticide or herbicide products is performed on-site.

A stormwater conveyance system traverses portions of the property. Stormwater enters the site from off-site piping located west and south of the site and also enters stormwater catch basins on the property. Thus, the system conveys stormwater that is generated off-site as well as on-site. The approximate location of the stormwater system is indicated in Figure 2. The stormwater eventually discharges to Stewart Creek which borders the far eastern portion of the property. A containment basin is located in the eastern portion of the site which is designed for use as emergency secondary containment in the event of a major spill in the warehouse building.

The site is almost entirely fenced except for perimeter areas along railroad tracks and roads, and the far eastern portion of the site. Approximate surface areas covered with surface vegetation, pavement, and gravel are indicated in Figure 2.

Surrounding land usage is primarily commercial and industrial. The site is bordered to the south by vacant land, National Welders, and Southern Concrete Supply. The site is bordered to the west by railroad tracks and a warehouse, to the north by county-owned wooded land, and to the east by Stewart Creek, with a former textile mill located beyond Stewart Creek. The site and surrounding areas are zoned I-2 (industrial) except for the county-owned land which is zoned R-5 (residential). Municipal water and sewer are supplied to the site area.

3.2 Site History

Forshaw began PCP formulation operations at the site in 1970. Prior to use by Forshaw, the site was used by Leffler Concrete Block Company (Leffler), which operated a septic system construction and maintenance facility. In addition to building septic systems, Leffler would reportedly clean out septic systems and discharge the wastes into ponds and a city sewer infall on the property.

From approximately 1970 to 1986, Forshaw site operations included PCP formulation. From 1970 to approximately 1975, PCP formulation was conducted east of the southwestern warehouse in the approximate location indicated on Figure 2. From 1975 to approximately 1983, PCP formulation was moved to a location north of the southwestern warehouse as indicated in Figure 2. During these time periods, PCP truck loading and unloading was conducted east of the original PCP formulation area (see Figure 2). Forshaw ceased PCP formulation in 1986. From 1984 to 2003, Wood Protection Products, Inc. conducted PCP formulation in the warehouse located in the northwestern corner of the property and potentially other areas at the site.

Small batch formulation of the pesticides diazinon, chlordane, lindane, and dieldrin was also conducted at the site, primarily in and near the warehouse in the southwestern portion of the site. According to site personnel, no formulation of arsenic-based compounds has occurred on the property.

3.3 Previous Site Assessment Activities

In March 2005, during a Site Inspection (SI) for the adjacent Clorox site located west of the Forshaw property, the North Carolina Department of Environment and Natural Resources (DENR) collected two surface soil samples along the west side of the Forshaw property between the southwestern warehouse and the railroad tracks. The results of the soil sample analyses indicated the presence of PCP, arsenic, and pesticides.

In December 2005 and January 2006, an Expanded Site Inspection (ESI) was conducted at the Clorox site which included collection of samples on the Forshaw site. Sampling conducted at the Forshaw site included collection of soil samples along the overland flow path and surface water and sediment samples from the stormwater conveyance system. Sampling results indicated the presence of arsenic, PCP, and dioxins/furans in and near the stormwater conveyance system on the Forshaw site. The results of the SI and ESI sampling were presented in an Expanded Site Inspection report for Forshaw Chemicals, Inc. dated June 29, 2006. The ESI recommended further action under CERCLA.

In June 2007, EPA collected surface water and sediment samples from the stormwater conveyance system at the Forshaw site. The sampling confirmed the presence of concentrations of arsenic, PCP, and/or dioxins/furans in the stormwater system.

Based upon the results of the DENR and EPA sampling, a time-critical removal action (RA) to minimize the potential for off-site migration of the compounds detected in the stormwater conveyance system to the adjacent Stewart Creek and to minimize the potential for on-site worker exposure was considered by EPA.

Prior to the initiation of the RA, EPA determined that additional data would be collected to facilitate the contemplated RA. On June 13, 2008, H&H submitted a Sampling and Analysis Plan for the source assessment activities. The plan was approved by EPA in an e-mail dated June 18, 2008.

In July 2008, H&H advanced 20 soil borings at the site and at background locations on the county-owned property north of the site. On-site soil samples were collected from surficial unpaved areas and from locations along the stormwater conveyance system near the former PCP plants and former PCP truck loading area.

Based upon the results of the source assessment, H&H made the following summary and conclusions:

- The results of the surface soil sampling conducted by H&H did not indicate the presence of compounds in surface soils at the site that would pose a worker protection concern. Previous DENR sampling indicated one shallow soil sample (CLX-002-SS) west of the main warehouse with a dioxins/furans concentration above the industrial use screening level.

- Only one soil sample collected by H&H (SB-8 at 4-6 ft) contained an arsenic concentration above the EPA regional screening level (RSL) at a lifetime incremental cancer risk (LICR) of 10^{-4}. This sample is not located near a former PCP plant, and no PCP was detected in this location. As such, the presence of arsenic does not appear related to the former PCP plants and Forshaw operations. Surface soil in this area sampled by DENR indicated arsenic concentrations significantly below the EPA RSL. There is no evidence that arsenic is present at concentrations or locations that would present a worker protection concern in surface soil on the property.

- The highest concentrations of PCP and dioxins in the July 2008 source assessment soil samples were detected in sample SB-7 (collected at 5-7 ft below ground surface) in the

area of the former PCP truck loading area. In this sample, PCP was detected at a concentration of 3,070 mg/kg, and dioxins/furans were detected at a 2,3,7,8-TCDD equivalence of 19.18 µg/l. The presence of elevated levels of PCP and dioxins in this sample was consistent with field observations, which indicated the presence of black stained soil at a depth of approximately 6-7 ft below land surface (bls) in this area.

- The results of the camera survey did not provide any obvious indication of source material entering the stormwater conveyance system. However, the camera survey was limited by debris accumulations in some areas, which prevented a full inspection of the line. The line did not contain large accumulations of sediment except in some isolated areas where debris has accumulated.

- Based upon the results of the assessment activities, H&H concluded that the primary source of the compounds in the stormwater conveyance system at the site is located in the vicinity of former PCP truck loading area near sample SB-7, most likely in the black, stained soil in the area. In this area, it appears that water draining along the stormwater conveyance system has infiltrated impacted soil in the former truck loading area and mobilized compounds in soil. This water has infiltrated the storm drain and created impacted sediment in areas of sediment accumulation in the stormwater pipe. H&H also concluded that it was possible that exposed surface soil in the area of the catch basin west of the warehouse building near previous DENR soil sample CLX-002-SS may also be contributing to detections of dioxins/furans in the stormwater conveyance system.

The Source Assessment Report was submitted to EPA in September 2008. Based on the results of the source assessment, EPA and Forshaw entered into the Settlement Agreement for a time critical RA. In accordance with Section 16 of the Settlement Agreement, this RA site-specific Health and Safety Plan includes provisions to protect on-site workers and public health during the RA activities. This plan was prepared in accordance with EPA's Standard Operating Safety Guide and OSHA Part 1910.

3.4 Purpose and Scope of Work

The objectives of the RA are to remove and control the source of PCP and dioxins/furans which have been detected in the stormwater conveyance system at the site, prevent off-site migration of these compounds to the adjacent Stewart Creek through the stormwater conveyance system, minimize potential worker exposure at the site, and perform confirmation sampling. To achieve these objectives, H&H plans to excavate impacted soil near a portion of the stormwater conveyance system, replace a portion of the stormwater conveyance system with non-jointed pipe, flush and collect sediment from downstream portions of the stormwater line, treat the removed materials in an on-site treatment cell, conduct treatability and confirmation sampling, and conduct site restoration activities.

The primary site preparation activities will be conducted by the selected RAS and include the following tasks:

- Removing an approximate 80-ft section of the brick retaining wall and reported concrete debris located behind (southwest of) the remaining wall that overlies a portion of Excavation Area 1. Shoring may need to be installed after removal to provide protection of the excavation area from collapse of the exposed sidewall. H&H anticipates that the debris will be removed to its base depth (top of soil). The debris may be disposed off-site in a construction and demolition (C&D) or other suitable landfill or may be reused on-site as fill or for construction of a replacement retaining wall.
- Blocking off a stormwater conveyance pipe at the manhole (shown on Figure 6) that runs through Excavation Area 1 to prevent stormwater from going through the pipe during RA activities. During the time the pipe is blocked, stormwater will flow through the existing stormwater pipe which flows east of the manhole around the main warehouse to Stewart Creek.

- Procuring temporary fencing for placement around the soil treatment cell area. The temporary fencing will be erected after the placement of soil in the treatment area (see discussion below).

The primary site treatment cell construction, blending, transport, and placement activities will be conducted by the selected RAS or other qualified subcontractors and include the following task:

- Construction of an on-site treatment cell in the northern portion of the site (shown on Figure 6) by excavating a 100 square ft (sf) area to approximately 3 ft below land surface (bls) with a minimum 1:5 sidewall slope. Following excavation, the treatment cell will be lined with a minimum 10 mil polyethylene liner prior to placement of soil in the cell. Soils excavated for construction of the treatment cell will be stockpiled on-site for use as backfill of Excavation Areas 1 and 2. Initially, the treatment cell will be used for the stockpiling of soils from Excavation Areas 1 and 2 while the treatability study is conducted. Water and sediment recovered from the stormwater conveyance system alterations and flush (see discussion below) will be placed in the treatment cell with the stockpiled soils. The soil and water will be placed in the cell and covered in a manner which will prevent infiltration by rainwater.
- Amending the stockpiled soils from Excavation Areas 1 and 2 within the treatment cell in a pug mill or suitable blending alternative with the quantity of nutrients determined to be ideal based on the treatment study. Subsequently, the blended soils will be spread within the treatment cell to a height of approximately 2 to 3 ft above the bottom of the cell using a front end loader or other equipment that will not damage the treatment cell's bottom liner. Then, the treatment cell will be flooded with tap water until a free-standing water depth of 6-12 inches of water is achieved. Following flooding, the cell will be capped with a polyethylene or plastic liner that will be sealed to the bottom liner by folding over a portion of the cell liners and sealing them together. The sealed edges will then be buried in ditches surrounding the edge of the pit.
- Installing four evenly spaced cover vents/sample ports through the cover of the treatment cell to allow for collection of sample cores from the cell and periodic release of gas

(methane and carbon dioxide) produced by the biodegradation processes. The sample ports will consist of 5-foot pieces of 4-inch diameter polyvinyl chloride (PVC) pipe. The pipe will be inserted through the cover, the cover sealed around the pipe, and the end of the pipe positioned above the surface of the cell. The other end will be covered with a threaded PVC cap fitted with a check valve. The venting pipe will be attached to a vertical metal rod embedded in the soil adjacent to the cell.

- Modifying the fence (if necessary) around the treatment cell once construction of cell is complete so that adequate space exists about the edges of the cell for technicians to perform sampling and maintenance activities.

The primary site RA activities will be conducted by the selected RAS or other qualified subcontractors and include the following tasks:

- Excavating, loading, and transporting PCP and dioxin/furans impacted soil from Excavation Area 1 (shown on Figure 6) in the area of the PCP truck loading area to the treatment cell area in the northern portion of the site. H&H estimates that approximately 700 cubic yards (cy) of soil above the site cleanup goals (CGs) will be removed from this area (approximate dimensions of 60 ft by 30 ft by 10 ft deep). Soil removal from Excavation Area 1 will include the excavation of soil from the surface to approximately 7 to 10 feet bls.
- Removing a catch basin and an approximate 100 linear foot (lf) segment of 15-inch diameter stormwater conveyance pipe located in Excavation Area 1 (shown on Figure 6) during the removal of soil from Excavation Area 1. Sediment, soil, and debris from the removed portions of the pipe will be removed by power-washing and/or scraping the pipe within or over a containment pit. The sediment and water captured in the containment pit will be placed in the treatment cell with the stockpiled soils from the excavation areas, and the cleaned pipe and debris will be disposed of in a C&D or other suitable landfill.
- Installing a new manhole at the location of the northwest extent of the pipe replacement prior to the installation of the replacement stormwater conveyance pipe. The manhole will be installed to provide a transition from the existing pipe to the new non-jointed

pipe. In addition, the catch basin located with Excavation Area 1 will be replaced, and new non-jointed pipe will be installed between the new catch basin and the existing catch basin located within Excavation Area 2. After completing the stormwater conveyance system alterations, the areas around the new pipe will be backfilled as detailed below.

- Installing a new segment of non-jointed stormwater conveyance pipe starting at the new manhole (discussed above), running through Excavation Area 1, and ending at the catch basin in Excavation Area 2.
- Excavating, loading, and transporting dioxin/furans impacted soil from Excavation Area 2 (shown on Figure 6) in the grassed area around the catch basin southwest of the main warehouse to the treatment cell area in the northern portion of the site. H&H estimates that approximately 50 cy of soil above the site CGs will be removed from this area (approximate dimensions of 20 ft by 20 ft by 3 ft deep). Soil removal from Excavation Area 2 will include the excavation of soils from the surface to approximately 2 to 3 feet bls. The excavation will be expanded as necessary and practical to remove soil above the site CGs.
- Preserving a catch basin located within Excavation Area 2 that appears to be in good condition. If possible, this catch basin will be preserved and will remain in place during excavation activities. If during soil removal activities, it appears that this catch basin is in poor condition, it will be repaired or replaced.
- Clearing the pipe located between the catch basin in Excavation Area 2 and the stormwater basin discharge area (shown on Figure 6) of debris and sediment using a high pressure flush after completion the stormwater conveyance system alterations. H&H anticipates that water used to flush the pipe and sediment flushed from the pipe will be recovered at the stormwater basin discharge end of the segment and will be placed in the treatment cell with the stockpiled soils from Excavation Areas 1 and 2.
- Backfilling and grading Excavation Areas 1 and 2 upon confirmation that soils impacted above CGs have been adequately removed and after completion of the stormwater conveyance system alterations. H&H anticipates that the excavation areas will be backfilled, graded uniform with the surrounding area, and covered with asphalt or seeded to match the pre-excavation surface conditions. Forshaw may elect to replace the

removed retaining wall in Excavation Area 1. If the retaining wall is not replaced, measures will be taken to shore the soil behind the removed retaining wall west of Excavation Area 1. H&H anticipates that backfill will be obtained from soils excavated for construction of the on-site treatment cell and/or from imported clean fill soil. Fill will be placed in horizontal lifts of 10 to 12-inch thicknesses and bucket or track compacted. The asphalt thickness will be appropriate for use by vehicles operated at the site. The topsoil thickness and/or depth of seed placement, pound per acre application rate, and appropriate fertilizer will follow vendor recommendations. Subsequent site inspections will be conducted to evaluate whether additional follow-up maintenance is required.

After backfilling and surface covering of Excavation Areas 1 and 2 are completed, the following site restoration tasks will be completed by the selected RAS or other qualified subcontractor:

- Replacing the barbed wire fencing from the end of the sliding gate to the newly installed retaining wall or shored slope located southwest of Excavation Area 1.
- Removing the temporary fencing near State Street so that the use of the sliding gate may be resumed.
- Securing the treatment cell by a perimeter fencing with locking gate until the treatment cell receives closure.
- Removing the impediment installed to block off the stormwater conveyance system northwest of the excavation areas to allow stormwater to flow through the newly installed pipe segments.

H&H will provide environmental consulting and management services during the RA activities that will include the following tasks:

- observation, coordination, and inspection of the selected RAS's activities;
- treatability sample collection;
- post-excavation soil sample collection;
- perimeter and ambient air monitoring;
- quarterly treatment cell confirmation sampling and monitoring; and
- other tasks needed to support the RA activities.

After it is determined that CGs have been reached and EPA approval is obtained for closure of the treatment cell, the RAS or other qualified subcontractor will conduct the following tasks:

- Remove the treatment cell cover;
- Puncture the bottom liner of the treatment cell;
- Backfill the treatment cell level with the surrounding grade; and
- Restore and seed the surface of the treatment as detailed above.

4.0 Responsibilities

The provisions of the plan are mandatory for on-site H&H employees who are engaged in hazardous material management activities including, but not limited to, field investigations, soil sampling, and remediation activities. This plan has been developed under EPA's Standard Operating Safety Guide (PUB 9285.1-03, PB92-963414, June 1992**)** guidelines and complies with applicable regulations, including Occupational Safety and Health Administration (OSHA) standards (29 Code of Federal Regulations (CFR) 1910).

H&H will have site safety and health oversight and coordination responsibilities for H&H personnel. Each RAS will be held accountable for the safe and healthful performance of work by each of their employees, subcontractor, or support personnel who may enter the site.

4.1 Project Coordinator (H&H)

The Project Coordinator (PC) shall direct on-site operations. At the site, the PC, assisted by the Site Health and Safety Officer (SHSO), has primary responsibility for:

1. Seeing that appropriate personal protective equipment and monitoring equipment are available and properly utilized by on-site H&H personnel;

2. Establishing that H&H personnel are aware of the provisions of this plan, are instructed in the work practices necessary to ensure safety, and are familiar with planned procedures for dealing with emergencies;

3. Establishing that H&H on-site personnel have completed a minimum of 40 hours of health and safety training and have appropriate medical clearance as required by 29 CFR 1910.120, and have been fit tested for the appropriate respirators;

4. Seeing that H&H personnel are aware of the potential hazards associated with site operations;

5. Monitoring the safety performance of all H&H personnel to see that the required work practices are employed;

6. Correcting H&H work practices or conditions that may result in injury or exposure to hazardous substances;

7. Preparing accident/incident reports for H&H activities (see Section 13.0);

8. Seeing to the completion of Plan Acceptance forms by H&H personnel (see Appendix A);

9. Halting H&H site operations, if necessary, in the event of an emergency or to correct unsafe work practices; and

10. Reviewing and approving this project HSP.

4.2 Site Health and Safety Officer (H&H)

The Site Health and Safety Officer's (SHSO) responsibilities include:

1. Implementing the HSP, and reporting deviations from the anticipated conditions described in the plan to the PC, and, if necessary, the Manager of Health & Safety (MH&S).

2. Determining that monitoring equipment is used properly by H&H personnel and is calibrated in accordance with manufacturer's instructions or other standards, and that results are properly recorded and filed (see Appendix F)

3. Checking with the MH&S to see that assigned H&H personnel have current Fit-For-Duty medical and training authorizations.

4. Assuming any other duties as directed by the PC or MH&S.

5. Identifying all H&H personnel with special medical problems (e.g., allergies, perforated eardrum, etc.).

6. Conducting daily safety meetings and completes the Site Safety Briefing Report (see Appendix D).

7. Providing ongoing review of the protection level needs as project work is performed, and informs the PC of the need to upgrade/downgrade protection levels as appropriate.

8. Seeing that decontamination procedures listed in Section 9.0 are followed by H&H personnel.

9. Establishing monitoring of H&H personnel and recording results of exposure evaluations.

10. Halting H&H site operations, if necessary, in the event of an emergency or to correct unsafe work practices.

4.3 Manager, Health and Safety (H&H)

The Manager, Health & Safety (MH&S) shall:

1. Determine the need for periodic audits of the RA activities to evaluate compliance with this plan.

2. Provide health and safety support as requested by the SHSO and PC.

3. Prepare, review, and review the HSP.

4.4 Field Sampling Technicians (H&H)

Field sampling technicians involved in on-site investigations and operations are responsible for:

1. Taking reasonable precautions to prevent injury to themselves and to their fellow employees.

2. Performing only those tasks that they believe they can do safely, and immediately reporting any accidents and/or unsafe conditions to the SHSO or PC.

3. Implementing the procedures set forth in the HSP, and reporting deviations from the procedures described in the plan to the SHSO or PC for action.

4. Notifying the PC and SHSO of any special medical problems (i.e., allergies) and seeing that on-site H&H personnel are aware of any such problems.

5. Reviews project health and safety plan and signs acceptance form.

6. Halting H&H site operations, if necessary, in the event of an emergency or to correct unsafe work practices.

4.5 Removal Action Subcontractor's (RAS) Safety Representative

Each selected RAS is requested to designate a Safety Representative (SR), who is the RAS's supervisor. The SR is responsible for the safe and healthful performance of work by his or her work force and subcontractors. During the RAS's activities on-site, the SR will perform continuing work area inspections, and conduct safety meetings and safety orientations for

employees associated with their activities. The SR will attend periodic safety meetings with the SHSO. The SR will also investigate accidents exposures involving RAS personnel.

4.6 Removal Action Subcontractor's (RAS's) Personnel

The following minimum health and safety requirements will be expected from the selected RAS:

- RAS employees must have appropriate training [*i.e.*, either a 40-hour or 24-hour OSHA-required (29 CFR 1910.120) health and safety course for hazardous waste work, or certified equivalent training].

- RAS personnel working at hazardous waste sites must have had an annual physical and be certified "fit for duty" and "fit for respirator use," if necessary, by a qualified physician.

- The RAS must provide H&H with proof of OSHA training and a physical before site work may begin.

- On-site RAS personnel must have appropriate personal protective equipment (PPE) for the specific job. At a minimum, all on-site RAS personnel should have the following equipment:

  - Hard hat
  - Steel-toed safety boots
  - Leather or task work gloves
  - Chemical resistant gloves (if handling contaminated media)
  - Cotton coveralls (or equivalent)
  - Goggles/safety glasses/face shield
  - Hearing protection, (if working in the area of heavy equipment)
  - Respiratory protection

- Construction equipment must meet applicable safety standards and satisfy H&H's field inspection. Unsafe equipment or operations will necessitate shut down of the job.

Before field activities begin, the RAS must develop a health and safety plan and certify its compliance with 29 CFR 1910. H&H will provide a copy of its health and safety plan, but this is not a substitute for an independent plan by the subcontractor. The RAS must agree to comply with at least the minimum requirements of its own site-specific Health and Safety Plan, be responsible for the health and safety of its own employees, and sign the Subcontractor Statement of Compliance (see Appendix A) for on-site employees before site work begins. The selected RAS also must agree that it will take any additional measures it deems necessary to meet at least minimum applicable health and safety standards if unforeseen circumstances arise.

5.0 Job Hazard Analysis

The primary compounds of concern are PCP and dioxins/furans. Arsenic and several pesticides have also been detected at the site. While the exposures anticipated from these materials during sampling and remediation activities are expected to be minimal, and not all of the above contaminants are necessarily expected to be encountered at the site, the provisions of this plan are directed toward helping to ensure that potential exposures are minimized during site activities. When necessary, field sampling personnel will wear NIOSH-approved air-purifying respirators with combination HEPA and organic vapor filters as warranted by site conditions.

Other hazards include physical hazards due to lifting, use of tools and heavy equipment, construction equipment, excavation, and electrical hazards.

Physical hazards at this work site include those associated with:

- heat stress and cold stress;
- slip-trip-fall type of accidents;
- back injuries due to improper lifting;
- being caught in or struck by moving equipment; and
- electrocution or explosion hazards associated excavation activities.

5.1 Heat Stress and Cold Stress Recognition and Control

The wearing of Personal Protective Equipment (PPE) can place a worker at risk of developing heat stress. This can result in health effects ranging from transient heat fatigue to serious illness or death. Heat stress is caused by a number of interacting factors, including environmental conditions, clothing, work load, and the individual characteristics of the worker. Because heat stress is probably one of the most common (and potentially serious) illnesses at hazardous waste sites, regular monitoring and other preventive precautions are vital.

Heat stress monitoring should commence when personnel are wearing PPE, including Tyvek-type coveralls, and the ambient temperature exceeds 70°F. If standard work garments (cotton coveralls) are worn, monitoring should commence at 85°F. Heat stress monitoring and control guidance can be found in Appendix E.

Protection against cold stress should be initiated when temperatures drop below 45°F. Cold stress guidance is provided in Appendix E.

5.2 Chemical Hazards

From an occupational health standpoint, given that potential exposure to site personnel will be only for a short period of time (intermittent for several days), the levels of contaminants expected at the site should not represent a significant concern. Overviews of the hazards associated with exposure to the major potential compounds of concern are presented below in terms of the following types of occupational exposure limits:

- PEL - Permissible Exposure Limit
- C - Ceiling
- TLV - Threshold Limit Value
- TLV-STEL - Short Term Exposure Limit

OSHA Permissible Exposure Limits (PELs), ACGIH Threshold Limit Values (TLVs), and time weighted averages (TWAs) are defined as concentrations for an 8-hour work day, 40-hour work week to which almost all workers can be repeatedly exposed without suffering adverse health effects.

Short Term Exposure Limit (STEL) is defined as the concentration to which workers can be exposed for short time periods without irritation, tissue damage, or narcosis sufficient to likely

cause impairment of self-rescue or precipitate accidental injury. The STEL is a 15-minute time-weighted average that should not be exceeded at any time during the work day.

A ceiling value (c) is a concentration that should not be exceeded at any time in any work day. The current NIOSH immediately dangerous to life or health (IDLH) value is defined as the situation that poses a threat of exposure to airborne contaminants when that exposure is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment. The purpose of establishing an IDLH is to "ensure that the worker can escape from a given contaminated environment in the event of failure of the respiratory protection equipment." The following table summarizes the potential contaminants at the site and their respective TWA, STEL/ ceiling, and IDLH values.

Compound	Air TWA (ppm) (1)	Air STEL/Ceiling (ppm) (1)	IDLH (ppm) (1)
Arsenic and Inorganic Compounds	0.01 mg/m^3	NS	NS
Chlordane	0.5 mg/m^3	NS	500 mg/m^3
Diazinon	0.1 mg/m^3[IFV]	NS	NS
Dieldrin	0.25 mg/m^3	NS	Ca [50 mg/m^3]
Dioxins and Furans	NS	NS	NS
Lindane	0.5 mg/m^3	NS	50 mg/m^3
Pentachlorophenol (PCP)	0.5 mg/m^3	NS	2.5 mg/m^3
2,3,7,8,-TCDD (a dioxin)	NS	NS	NS

Ref: NIOSH Pocket Guide (September 2006) and ACGIH TVLs and BEIs (2009)

(1) Compound TWAs with units of mg/m^3 are based on dust exposure

NS = Not Specified

IFV = Inhalable fraction and vapor

CA = State of California IDLH

A brief description of these compounds including general symptoms or effects of exposure, chemical characteristics, vapor pressures, and ionization potentials (eVs) (if published) is provided below.

Arsenic and Inorganic Compounds (CAS 7440-38-2)

Arsenic is a naturally element and a known human carcinogen. Breathing high concentrations of inorganic arsenic can cause sore throat or irritated lungs. Ingestion of high levels of inorganic arsenic can result in death. Lower levels of arsenic can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of "pins and needles" in hands and feet. Acute exposure by inhalation or ingestion may cause a darkening of the skin and appearance of small "corns" or "warts" on the palms, soles, and torso. Skin contact with inorganic arsenic may cause redness and swelling. Several studies have shown that inorganic arsenic can increase the risk of lung, skin, bladder, liver, kidney, and prostate cancer.

Chlordane (CAS 57-74-9)

Chlordane is a mixture of cis-chlordane, trans-chlordane, and other complex chlorinated hydrocarbons including heptachlor and nonachlor. Chlordane is a colorless to amber to yellowish-brown viscous liquid with an aromatic, slightly pungent or irritating odor (similar to chlorine). Chlordane affects the nervous system, the digestive system, and the liver in humans. Symptoms of ingestion or inhalation of high concentrations of chlordane include headache, irritability, confusion, weakness, vision problems, vomiting, stomach cramps, diarrhea, and jaundice. Ingesting large amounts of chlordane may cause convulsions and death. NIOSH has determined that chlordane is not classifiable as to it carcinogenicity to humans.

Diazinon (CAS 333-41-5)

Diazinon is a colorless liquid insecticide with a faint ester-like odor (technical grade Diazinon may appear pale yellow to dark brown). Diazinon is mildly irritating to the eyes and the skin. This substance may cause effects on the nervous system, resulting in convulsions and respiratory depression. Diazinon is a cholinesterase inhibitor (vital for the transmission of nerve impulses);

however, the effects of may be delayed. Diazinon can be absorbed into the body by inhalation of its aerosol, or through the skin and by ingestion. If ingested, Diazinon can cause abdominal cramps or diarrhea.

Dieldrin (CAS 60-57-1)

Pure dieldrin appears as a white powder, white crystals or pale tan flakes with an odorless to mild chemical odor. Exposures to high doses of dieldrin may cause convulsions or death. Some workers exposed to moderate levels in the air for extended periods may experience headaches, dizziness, irritability, vomiting, and uncontrolled muscle movements. There is no conclusive evidence that dieldrin causes cancer in humans; however, the EPA has determined that dieldrin is probable human carcinogen.

Dioxins and Furans

Dioxins and furans is the abbreviated name for a family of toxic substances that all share a similar chemical structure. Dioxins, in their purest form, look like crystals or a colorless solid. Most dioxins and furans are not man-made or produced intentionally, but are created when other chemicals or products are made. Of all of the dioxins and furans, 2,3,7,8,-Tetrachlorodibenzo-p-dioxin (2,3,7,8,-TCDD) is considered the most toxic (see below). Dioxins and furans can cause a number of health effects. EPA has classified these compounds as probable human carcinogens.

Lindane (CAS 58-89-9)

Lindane is a pesticide which appears as a white to yellow crystalline powder with a slight musty odor. Symptoms of over-exposure to Lindane include irritation to the eyes, skin, nose, and throat; headache; nausea; clonic convulsions, respiratory difficulty; cyanosis, aplastic anemia; and muscle spasms. According to ACGIH, lindane is an A3 confirmed animal carcinogen with unknown relevance to humans.

Pentachlorophenol (PCP) (CAS 87-86-5)

Pure pentachlorophenol (PCP) is a colorless to white crystalline fungicide solid with a benzene-like odor. Impure PCP (the form usually found at hazardous waste sites) is dark gray to brown and exists as dust, beads, or flakes. Studies in workers show that exposure to high levels of PCP can cause the cells in the body to produce excess heat. When this occurs, a person may experience a very high fever, profuse sweating, and difficulty breathing. The body temperature can increase to dangerous levels, causing injury to various organs and tissues, and even death. Liver effects and damage to the immune system have also been observed in humans exposed to high levels of PCP for a long time. The EPA has determined that PCP is a probable human carcinogen and the International Agency for Cancer Research (IARC) considers it possibly carcinogenic to humans. Symptoms of exposure to PCP include irritation to the eyes, nose, and throat; sneezing and coughing; weakness or exhaustion; sweating; headache; dizziness; nausea; vomiting; difficult breathing; chest pain; high fever; and dermatitis.

2,3,7,8,-Tetrachlorodibenzo-p-dioxin (2,3,7,8,-TCDD) (CAS 1746-01-6)

2,3,7,8,-TCDD is a colorless to white crystalline solid with no distinguishable odor. It is formed as an unintentional by-product of incomplete combustion and may be released to the environment during the combustion of fossil fuels and wood, during the incineration of municipal and industrial wastes, and during the manufacture of certain chemicals. The major acute (short-term) effect from exposure to high levels of 2,3,7,8,-TCDD in air to humans is chloracne, a severe acne-like condition that can develop within months of the first exposure. Other signs or symptoms of over-exposure to this compound include irritation to the eyes, allergic dermatitis, porphyria, gastrointestinal disturbance, and possible reproductive (teratogenic effects). There are no published recommended exposure limits (RELs) for this compound. Therefore, exposure to this compound should be kept to minimum. EPA has classified 2,3,7,8-TCDD as a Group B2 probable human carcinogen.

The following potential exposures may exist at the site:

- Skin contact with contaminated materials (soil and water);
- Inhalation of vapors or particulates; and
- Ingestion of contaminated materials; especially if poor personal hygiene is practiced.

Skin contact with potentially contaminated soil or water will be minimized by the use of personal protective clothing (as described in Section 7.0). Inhalation of vapors or particulates during the sampling activities will be minimized by air monitoring and the use of engineering controls and respiratory protection if action levels (see Section 6.1) are exceeded. Ingestion of contaminated materials will be minimized by the use of appropriate personal hygiene procedures during decontamination (i.e., thoroughly washing face and hands with soap and water after leaving the work area and prior to eating or drinking).

5.3 Noise Hazards

The primary noise hazard during RA activities will be from excavation equipment and other mechanical equipment. Previous surveys indicate that such equipment may produce continuous noise at or above the action level of 85 dBA. All H&H personnel within 25 feet of operating equipment shall wear hearing protective devices (either muffs or plugs). Personnel will wash their hands with soap and water prior to inserting ear plugs to avoid initiating ear infections.

5.4 Underground Utilities (Pre-Excavation Protocol)

H&H will locate underground utility locations prior to the commencement of drilling or excavation activities. H&H will contact North Carolina ONE CALL Service to mark public utilities. Because investigative activities will be conducted in the active site areas, H&H will subcontract a private utility locator to mark buried lines within the specified or proposed work areas prior to initiating excavation activities.

5.5 Work Area Protection (Traffic Control)

The project is located at an active distribution facility. Areas of concern with regard to traffic control include the access drives located between the warehouses in the central and western portions of the property and near the main access drive to the facility in the southern portion of the property. Other areas are generally low traffic. In general, personnel working in areas of traffic concern will utilize safety vests as well as establishing a work zone in the area of the work task using cones and/or flagging.

5.6 Hazard Communication

The H&H Hazard Communication Program complies with the OSHA Hazard Communication Standard found in 29 CFR 1910.1200 and 29 CFR 1926.59, which applies to any chemical present in the workplace in such a manner that employees may be exposed under normal conditions of use or in a foreseeable emergency. Although waste materials are excluded from the OSHA requirement, decontamination chemicals for sampling apparatus and calibration standards (such as isobutylene gas) require Material Safety Data Sheets (MSDSs).

The principle of communicating the hazards of materials used in the workplace to employees applies broadly to firm-wide activities, from informational programs on the conduct of hazardous waste activities to the firm's insistence upon adequate safety and health training. It is also important for personnel to have an awareness of client concern for Hazard Communication due to Federal, state, and local regulations directly affecting certain client activities.

In order to comply with Hazard Communication Standard (29 CFR 1910.1200), H&H has determined that:

- Containers of hazardous chemicals must be appropriately labeled or tagged to identify the hazard and provide information on effects and appropriate protective measures.

- Labels, tags, or signs must be properly affixed and visible at all times while a hazard is present and removed promptly when the hazard no longer exists.

- Written information (MSDS) on hazardous chemicals in the workplace must be available to employees working with the substance.

- Appropriate MSDS will be available to any contractor or subcontractor employees working in H&H offices or laboratories or at construction, excavation, or other sites under H&H's control.

- Hazard Communication Training should be provided to H&H employees.

5.7 Heavy Equipment

Operation of heavy equipment, excavation, or other activities presents potential physical hazards to personnel. The following precautions should be observed whenever heavy equipment is in use:

- Personal protective equipment (PPE) such as steel-toed shoes, safety glasses or goggles, and hard hats should be worn whenever such equipment is present.

- Personnel should at all times be aware of the location and operation of heavy equipment, and take precautions to avoid getting in the way of its operation. Never assume that the equipment operator sees you; make eye contact and use hand signals to inform the operator of your intent.

- Never walk directly in back of, or to the side of, heavy equipment without the operator's knowledge.

- When an equipment operator must operate in tight quarters, the equipment contractor should provide a person to assist in guiding the operator's movements.

- Keep all non-essential personnel out of the work area.

- Heavy equipment that is used in the exclusion zone should remain in that zone until its task is completed. The equipment contractor should decontaminate such equipment in the designated equipment decontamination area as required.

5.8 Electrical Equipment/Lock Out-Tag Out

Maintenance or repair of equipment may involve electrical equipment. When working on electrical equipment, appropriate lock-out tag-out procedures shall be followed to ensure that the equipment is not energized. This procedure involves de-energizing the system at the control/breaker panel and then locking or tagging the panel to prevent inadvertently energizing the system during repair activities. H&H will follow manufacturer's recommendations for locking-out and tagging-out energized equipment.

6.0 Exposure Monitoring Plan

Heat stress, noise, and chemical exposures are site hazards which may require monitoring. Heat stress monitoring and prevention is addressed in Section 5.0. Noise levels will generally not be monitored; H&H personnel will wear hearing protection as described in Section 5.3. Chemical exposure monitoring is discussed below.

6.1 Chemical Exposure Monitoring

During site activities, procedures will be implemented to reduce visible dust at the site by wetting the work area during RA activities as necessary. Ambient volatile organic concentrations and dust levels will be monitored in the breathing zone of on-site personnel using an organic vapor analyzer (OVA) and a direct reading dust level meter. Work area monitoring will be performed immediately adjacent to excavation areas, soil handling, blending, and transportation areas, and other applicable areas when work is occurring. In addition, dust levels will be monitored upwind and downwind of the work area to minimize exposure to on-site workers and the public.

The field instrumentation described in this subsection has been specifically selected for the compounds that may be reasonably anticipated to be encountered during the course of this project. Selection factors include anticipated airborne concentrations, potential interferences, ionization potentials, instrument sensitivity, and occupational exposure limits. The action levels described below are established with the expectation that these specific instruments will be used. **Do not substitute instruments without the consent of the H&H MH&S**.

A Photoionization Detector (PID) will be used to monitor intermittently for organic vapors. A Casella Microdust Pro portable direct-reading monitor (or equivalent) will be used to monitor particulates. A summary of action levels and response criteria for organic vapors and total dust in the operator's breathing zone (OBZ) is presented in the tables that follow.

Action Levels and Response Criteria
ORGANIC VAPORS

PID Analyzer Reading*	Location	Time Period	Action
< 0.5 ppm	OBZ (work area, upwind and downwind)	----	Continue periodic monitoring, no respirators required.
> 0.5 ppm	OBZ (work area, upwind and downwind)	> 1 minute	Monitor OBZ; don protective clothing as described in Section 7.0; don full-face respirator with HEPA/organic vapor cartridges; establish work zones described in 8.1
> 10 ppm	OBZ (work area, upwind and downwind)	Instantaneous (> 5 seconds)	Stop work; move upwind while vapors dissipate; if elevated levels persist for more than 5 minutes, notify SHSO or PC.
> 20 ppm	OBZ (work area, upwind and downwind)	> 1 minute	Stop work; move upwind while vapors dissipate; if elevated levels persist, cover soil, evacuate upwind and notify SHSO or PC.

* Above background readings, see Section 6.2

Action Levels and Response Criteria
DUST

Microdust Pro Analyzer Reading*	Location	Time Period	Action
< 3.0 mg/m^3	OBZ (work area, upwind and downwind)	----	Continue periodic monitoring, no respirators required.
> 3.0 mg/m^3 or presence of visible dust	OBZ (work area, upwind and downwind)	> 1 minute	Stop work; move upwind; wet area to eliminate dust only after donning full face respirator with HEPA/organic vapor cartridges and protective clothing as described in Section 7.0; establish work zones described in 8.1 and decontamination area as described in Section 9.0; if dusty conditions persist notify SHSO or PC.

* Above background readings, see Section 6.2

6.2 Background Readings

All direct-reading instrument readings will be evaluated relative to background readings, not "meter zero". Prior to the start of work at each shift, and whenever there is a significant shift in wind direction, instrument readings will be obtained upwind of the site work zone in order to determine the level of "background" readings from local vehicle traffic, emissions from nearby operations unrelated to the site, etc. Site readings will be evaluated against these background readings (*i.e.*, if an action level is listed as 20 ppm, it is evaluated as 20 ppm above background).

6.3 Data Logging

Exposure monitoring data, including background readings, will be logged in the field log book. The results of daily instrument calibrations can either be logged on the form provided in the Appendices or in the field log book. Monitoring instruments will be calibrated in accordance with the manufacturer's instructions. Calibration should also be performed when inconsistent or erratic readings are obtained.

6.4 Dust Control

Airborne exposure could potentially occur to the compounds identified in Section 5.2 of this Plan during excavation operations. When the dust actions levels are exceeded, a dust suppression device (such as water truck or equivalent) will be used to apply a water mist to reduce dust generation. If the action levels continue to be exceeded even after application of water mist, work will stop until the conditions abate or appropriate additional protective procedures are established by H&H.

7.0 Personal Protective Equipment

Minimum Protective Equipment for H&H Site Personnel:

- Hardhat
- Safety glasses/goggles
- Steel-toed safety boots
- Leather or task work gloves

Work/Exclusion Zone Requirements:

- Hardhat
- Eye protection (face shield or safety goggles)
- Ear protection in vicinity of construction equipment
- Cotton coveralls (optional)
- Nitrile/latex/vinyl gloves (as needed for chemical protection)

If the analyzer reading is greater than the action level prescribed in Section 6.1 of this plan in the work area for more than one minute or if dusty conditions are present, add:

- Tyvek coveralls (use poly-coated Tyvek if significant liquid contact is expected)

If the analyzer reading is greater than the action level prescribed in Section 6.1 of this plan in the OBZ for more than one minute, add:

- Full-face respirator with combination organic vapor and HEPA cartridges pre-filters.

7.1 Limitations of Protective Clothing

The protective equipment ensembles selected for this project are anticipated to provide protection against the types and concentrations of hazardous materials that may potentially be encountered during field operations. However, no protective garment, glove or boot is resistant to all chemicals at any concentration; in fact, chemicals may continue to permeate or degrade a garment even after the source of contamination is removed.

In order to obtain optimum usage from PPE, the following procedures are to be followed by all H&H personnel:

- When using disposable coveralls, don a clean, new garment after each rest break or at the beginning of each shift;

- Inspect all clothing, gloves and boots both prior to and during use for:

  - Imperfect seams
  - Non-uniform coatings
  - Tears
  - Poorly functioning closures

- Inspect reusable garments, boots and gloves both prior to and during use for:

  - Visible signs of chemical permeation such as swelling, discoloration, stiffness or brittleness
  - Cracks or any signs of puncture or abrasion

- Reusable garments exhibiting such characteristics will be discarded.

7.2 Duration of Work Tasks

The duration of work tasks in which personnel use PPE ensembles that include chemical protective clothing (including uncoated Tyvek) will be established by the SHSO. Variables to be considered include ambient temperature and other weather conditions, the capacity of individual personnel to work in the required level of PPE in heat and cold, and the limitations of specific PPE ensembles. The minimum rest breaks are as follows:

- Fifteen minutes midway between shift startup and lunch
- Lunch break (30 to 60 minutes)
- Fifteen minutes midway between lunch and shift end

Rest breaks are to be taken in the support zone or other clean area after personnel have completed the decontamination process, including soap and water wash of hands and face. Additional rest breaks will be scheduled according to heat stress monitoring protocols as described in the Appendix E.

8.0 Site Control

8.1 General

The purpose of site control is to minimize potential contamination of workers, protect the public from the site's hazards, and prevent vandalism. Site control is especially important in emergency situations. When necessary, several site control procedures will be implemented to reduce worker and public exposure to chemical, physical, biological, and safety hazards.

Barricades and barricade tape should be used to delineate a work zone for safety purposes around the work area. The barriers should be set in a 25-foot radius (as practical) around the work area to provide sufficient maneuvering space for personnel and equipment. A short piece of barricade tape can be affixed to a secure upright to serve as a wind-direction tell-tale. A five-foot opening in the barricades at the support zone (upwind of the work area) will serve as the personnel and equipment entry and exit point. The personnel decontamination station will be established at this point if formal decontamination procedures are required (see Section 9.0). Entry to and exit from the work area will be made at this opening in order to control potential sources of contamination and leave contaminated soil and debris in the work area.

At the end of the shift, excavations must be secured. Decontamination fluids are to be handled in accordance with relevant regulations and instructions from the PC.

The PC or SHSO will determine an upwind evacuation area prior to each shift, and personnel will be notified of its location. A horn or other signaling device will be used to signal an evacuation in the event of an emergency. Three blasts of the horn will be the signal to immediately stop work and proceed to the evacuation area.

The SHSO will log site visitors in the field log book. The SHSO will provide site hazard and emergency action information to site visitors before they enter the site; this can be done by providing a copy of this site-specific Health and Safety Plan to the visitor.

8.2 Work Zones

If PID and/or dust readings exceed the first criteria in Section 6.1, requiring the use of chemical protective equipment, work zones will be established as described below.

- Exclusion Zone - a 25 foot (as practical) circle around the work area will be defined before work starts. The encircled area will constitute the "Exclusion Zone". This zone is where potentially hazardous contaminants and physical hazards to the workers will be contained. Full personal protection will be required in this area. Plastic sheeting (visqueen) and/or tarps may be used as necessary to control cuttings spilled to the ground during operations. The size of the Exclusion Zone may be altered to accommodate site conditions and to ensure contaminant containment.

- Contamination Reduction Zone (CRZ) - a corridor leading from the Exclusion Zone will be defined, and will lead from the work area to a break area. Decontamination activities will occur in the CRZ. A waste container will be placed at the end of the corridor so contaminated disposal equipment can be placed inside and covered. Surface/soil contamination in this area should be controlled using plastic sheeting. No H&H personnel will be permitted into the Contamination Reduction Zone or Exclusion Zone unless they are in compliance with the requirements of this Plan.

- Support Zone - a Support Zone, the outermost part of the site, must be defined for each field activity. Support equipment is located in this uncontaminated or clean area. Normal work clothes are appropriate within this zone. The location of this zone depends on factors such as

accessibility, wind direction (upwind of work area), and resources (i.e., roads, shelter, utilities).

9.0 Decontamination Procedures

The following steps will be followed whenever personnel leave the exclusion zone/work area (as appropriate):

1. Remove equipment, sample containers, and notes to the CRZ. Obtain decontamination solutions and decon shovels, auger flights, etc. by brushing them under a water rinse. A high-pressure steam cleaner may also be used for decon. Waste and spent decon solutions will be properly contained.
2. Scrub boots and gloves with a stiff bristle brush and water. Washtubs and chairs will be provided.
3. Remove outer gloves (and boot covers, if used).
4. Remove Tyvek coverall; discard in provided container.
5. Remove hardhat and eye protection.
6. Remove respirator.
7. Remove inner gloves.
8. Wash hands and face.

The decontamination area will be covered with plastic sheeting which will be replaced when torn or heavily soiled, and at the end of each shift.

Each worker will be responsible for cleaning, sanitizing and storing their own respirator in accordance with manufacturer's guidance (i.e., washing in warm water and detergent or sanitizing solution, air drying, and storing in a plastic storage bag; see Appendices). Cartridges will be changed when breakthrough occurs (detection of organic vapor odor while wearing the respirator) and at the end of each shift. Respirators will be kept in storage bags or boxes when not in use.

All spent decontamination fluids (rinse waters, etc.) shall be handled as directed by the PC and in accordance with relevant regulations.

9.1 Sanitation

Potable water will be made available at the site, either from a pressurized source or commercially available bottled water. Drinking cups will be supplied so personnel will neither drink directly from the source of water nor have to share drinking cups. Sources of non-potable water shall be clearly labeled as such.

On-site toilet facilities or transport to off-site toilet facilities will be used for sanitation. Washing facilities will be provided on site, and will be located in the decontamination area or the support area. Soap, clean water, wash basins and single-use towels will be available for personnel use.

9.2 Decontamination-Medical Emergencies

In the event of physical injury or other serious medical concerns, immediate first-aid is to be administered in lieu of further decontamination efforts.

9.3 Decontamination of Tools

When all work activities have been completed, contaminated tools used by H&H personnel will be either completely decontaminated or properly disposed.

It is expected that all tools will be constructed of non-porous, non-absorbent materials. This will aid the decontamination process. Any tool, or part of a tool, which is made of a

porous/absorbent material will be discarded and disposed of if it cannot be properly decontaminated.

10.0 Safe Work Practices

10.1 General

1. Eating, drinking, chewing gum or tobacco, and smoking are prohibited in the contaminated or potentially contaminated area or where the possibility for the transfer of contamination exists.

2. If established, all personnel will enter designated work areas only through the contamination reduction zone (CRZ). All personnel leaving an exclusion/work zone must exit through the CRZ and pass through the decontamination station as described in 9.0.

3. Personnel will wash their hands and face thoroughly with soap and water prior to eating, drinking or smoking.

4. Avoid contact with potentially contaminated substances. Do not walk through puddles, pools, mud, etc. Avoid, whenever possible, kneeling on the ground, leaning or sitting on equipment or ground. Do not place monitoring equipment on potentially contaminated surfaces (i.e., ground, etc.).

5. All field crew members should make use of their senses to alert them to potentially dangerous situations in which they should not become *involved (i.e.,* presence of strong, irritating or nauseating odors).

6. Only those vehicles and equipment required to complete work tasks should be permitted within the exclusion/work zone (drill rigs, excavators, and similar items). All non-essential vehicles should remain within the support zone.

7. Containers, such as drums, will be moved only with the proper equipment and will be secured to prevent dropping or loss of control during transport.

8. Field survey instruments, such as PIDs, will be covered with plastic or similar covering to minimize the potential for contamination.

9. No matches or lighters will be permitted in the work area/exclusion zone or contamination reduction zone.

10. Contaminated protective equipment, such as respirators, hoses, boots and disposable protective clothing, will not be removed from the work area/exclusion zone or decontamination area until it has been cleaned, or properly packaged and labeled.

11. Prevent, to the extent possible, spillages. In the event that a spillage occurs, contain liquid immediately if possible.

12. Prevent splashing of the contaminated materials.

13. Field crew members shall be familiar with the physical characteristics of investigations, including:

    - Wind direction in relation to contaminated area;
    - Accessibility to equipment and vehicles;
    - Communications;
    - Hot zone (areas of known or suspected contamination);
    - Site access; and
    - Nearest water sources.

14. The number of personnel and equipment in the contaminated area should be minimized but only to the extent consistent with workforce requirements of safe site operations.

15. Wastes generated during H&H and/or subcontractor activities at the site will be disposed as directed by the PC.

16. All personal protective equipment will be used as specified and required.

17. The buddy system will be used at all times when performing sampling for hazardous material when the first action level criteria has been exceeded or when working in remote areas.

18. Personnel are to immediately notify the SHSO or OSM if any indications potential explosions, or unusual conditions are observed.

19. No one wearing contact lenses or having a beard will be permitted in the work area if Level C or higher protection is required.

10.2 Sampling Practices

For all sampling activities, the following standard safety procedures shall be employed:

1. All sampling equipment should be cleaned before proceeding to the site.
2. At the sampling site, sampling equipment should be cleaned after each use.
3. Work in "cleaner" areas should be conducted first where practical.
4. All unauthorized personnel will remain outside exclusion zones at all times.

10.3 Health and Safety Equipment List

- Hardhats
- Safety glasses/goggles/face shield
- Ear plugs or muffs
- Tyvek and polycoated Tyvek coveralls

- Chemical resistant steel-toed boots
- Leather or task work gloves
- Nitrile gloves inner gloves
- Plastic sheeting (visqueen)
- 55 gal drums (for contaminated liquids)
- Barricade tape and barricades
- Wash tubs and scrub brushes
- Decontamination solution
- Folding chairs and canopy
- 5 or 10 gallon portable eyewash (if one is not available on-site)
- First Aid kit
- Drinking water
- Gatorade or similar drink
- Type ABC fire extinguishers
- Full-face respirators (NIOSH-approved)
- Organic vapor cartridges with HEPA particulate filters
- Photoionization Detector (PID) and calibration kit
- Casella Microdust Pro
- Compressed gas horn
- Duct tape

10.4 Buddy System

Workers will conduct hazardous site activities with a buddy who is able to:

1. Provide his or her partner with assistance.

2. Observe his or her partner for signs of chemical or heat exposure.

3. Periodically check the integrity of his or her partner's protective clothing.

4. Notify the site supervisor if emergency help is needed.

5. Prearrange hand signals or other emergency communication signals as prescribed in Section 11.3 of this Plan.

11.0 Emergency Response Plan

It is H&H's policy to evacuate personnel from areas involved in hazardous material emergencies and to summon outside assistance from agencies with personnel trained to deal with the specific emergency. This section outlines the procedures to be followed by H&H personnel in the event of a site emergency. These procedures are to be reviewed during the on-site safety briefings conducted by the SHSO.

In the event of a fire or medical emergency, the numbers at listed at the front of this Plan can be called for assistance.

Hospital

The nearest public hospital to the site is Presbyterian Medical Center located at 200 Hawthorne Lane in Charlotte, North Carolina. The phone number is (704) 384-4000. See the hospital route map in Appendix B for a map to the hospital.

Paramedics should be summoned in the event of a serious injury; they will arrange to transport the victim to the nearest appropriate facility. A first aid kit will be available at the site for use in case of minor injuries. If anyone receives a splash or particle in the eye, the portable eyewash will be used to irrigate the eye for 15 minutes. If direct contact with contaminants occurs, affected skin areas should be washed immediately with soap and water.

In the event of serious trauma or unknown chemical exposure, the employee should be stabilized by one group of employees while the emergency phone number list is consulted and an ambulance immediately requested.

Workers with suspected back or neck injuries are NOT to be moved until professional emergency assistance arrives.

11.1 Places of Refuge

In the event of a site emergency requiring evacuation, all personnel will evacuate to a pre-designated area located in the support zone, a safe distance from the exclusion zone boundary. The SHSO will designate the assembly area prior to the start of work.

11.2 Fire

Type ABC fire extinguishers will be available on-site to contain and extinguish small fires. The local fire department should be summoned (911) in the event of any fire on site. If it is safe to do so, site personnel may:

- Use fire fighting equipment available on-site to control or extinguish the fire.
- Remove or isolate flammable or other hazardous materials that may contribute to the fire.

11.3 Communication

A communication network must be set up to alert site personnel of emergencies and to summon outside emergency assistance. Where voice communication is not feasible an alarm system (i.e., sirens, horns, etc.) should be set up to alert employees of emergencies. Radio communication may also be used to communicate with personnel in the exclusion zone. Where phone service is not readily available, radios or portable phones should be used to communicate with outside agencies. Site personnel should be trained on the use of the site emergency communication network.

The following hand signals will be used by personnel in the event of an emergency:

Signal	Definition
Hands clutching throat	Out of air/can't breathe
Hands on top of head	Need assistance
Thumbs up	OK/I'm all right/I understand
Thumbs down	No/negative
Arms waving upright	Send back support
Grip partner's wrist	Exit area immediately

11.4 Safety Eyewash

A safety eyewash will be available at the site for the sole purpose of flushing foreign particles or contaminants out of eyes.

11.5 Incident Report

In the event of an injury or illness, work is to be stopped until the SHSO and the PC have determined the cause of the incident and have taken the appropriate action. Any injury or illness, regardless of severity, is to be reported on the accident report form (see Appendices).

11.6 Operation Shutdown

Under certain extreme hazardous situations any site personnel may request that site operations be temporarily suspended while the underlying hazard is corrected or controlled. All personnel have stop work authority if they believe that there is a danger that should be corrected immediately. During operation shutdown, all personnel will be required to stand upwind to

prevent exposure to fugitive emissions. The SHSO will have ultimate authority for operations restart.

11.7 Spill or Hazardous Materials Release

Small spills are immediately reported to the SHSO and are dealt with according to chemical manufacturers' recommended procedures. Spills or release of hazardous materials which result in human exposure or off-site environmental contamination are promptly reported by the SHSO to the proper authorities and appropriate measures are taken to contain and/or collect the material for approved storage and disposal.

11.8 Emergency Medical Treatment Procedures

Any person who becomes ill or injured in the Exclusion Zone must be decontaminated to the maximum extent possible. If the injury or illness is minor, full decontamination should be completed and first aid administered prior to transport. If the patient's condition is serious, at least partial decontamination should be completed (i.e., complete disrobing of the victim and redressing in clean coveralls or wrapping in a blanket). First aid should be administered while awaiting an ambulance or paramedics. All injuries and illnesses must be reported immediately to the SHSO and PC.

Personnel who are transported to a clinic or hospital for treatment should take with them information on the chemical(s) they have been exposed to at the site. This information is included in Section 5.2 of this Plan.

Any vehicle used to transport contaminated personnel will be treated and cleaned, as necessary.

11.9 Community Safety

There is a low potential for migration of chemicals from the site as a result of project activities. In the unlikely event that significant release of contaminants occur during the course of the field work appropriate actions will be taken to protect the public health and mitigate the contaminant release.

12.0 Training and Medical Surveillance

All H&H site personnel will have met the requirements of 29 CFR 1910.120 (e), including:

- Forty hours or initial off-site training or its recognized equivalent;
- Eight hours of annual refresher training for all personnel;
- Eight hours of supervisor training for personnel serving as SHSO;
- Three days of work activity under the supervision of a trained and experienced supervisor.

H&H site personnel are participating in medical surveillance programs that meet the requirements of 29 CFR 1910.120(f). The H&H MH&S will maintain current copies of training certificates and statements of medical program participation for all site personnel.

In addition, all H&H site personnel will review this Health and Safety Plan and sign a copy of the safety plan compliance agreement, which is found in the Appendices. The H&H MH&S will maintain these documents.

Prior to the start of operations at the site, the SHSO will conduct a site safety briefing, which will include all personnel involved in site operations. At this meeting, the SHSO will discuss:

- Contents of this site-specific Health and Safety Plan;
- Types of hazards at the site and means for minimizing exposure to them;
- The type of monitoring that will be performed;
- Action levels for upgrade and downgrade of personal protective equipment;
- Personal protective equipment that will be used;
- Decontamination protocol;
- Site control measures, including safe operating practices and communication;
- Location and use of emergency equipment; and
- Evacuation signals and procedures.

Subsequent site safety briefings will be conducted prior to each shift to review pertinent safety issues, discuss any problems, and outline safety aspects of the shift's tasks.

For each briefing, the SHSO will complete a Site Safety Briefing form (see Appendix D) and maintain them in the files.

13.0 Recordkeeping

The PC and SHSO are responsible for site recordkeeping. Prior to the start of work, they will review this plan; if there are no changes to be made, they will sign the approval form and forward a copy to the H&H MH&S.

H&H personnel will review the HSP and sign the plan acceptance form in Appendix A; copies of these forms will be forwarded to the H&H MH&S.

The SHSO will conduct a Site Safety Briefing in accordance with Section 12.0 prior to each shift and have all attendees sign the form in Appendices; copies will be forwarded to the H&H MH&S for filing.

Any accident or exposure incident will be investigated and the form in Appendix C will be completed and forwarded to the PC and H&H MH&S.

All instrument readings and calibrations, PPE use and changes, health and safety-related issues, and deviations from or problems with this HSP will be recorded in the field log or the appropriate form (if applicable).

14.0 Toxic Snake and Insect Bites and Plants

14.1 Poisonous Snakebites

Reactions from snakebite are aggravated by acute fear and anxiety. Other factors that affect the severity of local and general reaction from poisonous snakebite include: the amount of venom injected and the speed of absorption of venom into the victim's circulation; the size of the victim; protection from clothing, including shoes and gloves; quick antivenin therapy; and location of the bite.

First Aid Procedure

The objective of first aid is to reduce the circulation of blood through the bite area, to delay absorption of venom, to prevent aggravation of the local wound, and to sustain respiration.

The most important step is to get the snakebite victim to the hospital quickly. Meanwhile, take the following first aid measures:

1. Keep the victim from moving around.

2. Keep the victim as calm as possible and preferably in a lying position.

3. Immobilize the bitten extremity and keep it at or below heart level. If the victim can reach a hospital within 4 to 5 hours and if no symptoms develop, no further first aid measures need be applied.

4. If mild-to-moderate symptoms develop, apply a constricting band 2 to 4 inches above the bite, but not around a joint (the elbow, knee, wrist, or ankle) and not around the head, neck, or trunk. The band should be 3/4 to 1 1/2 inches wide, not thin like a rubber band. The band should be snug but loose enough for a finger to be slipped underneath. Watch out for

swelling. Loosen the band if it becomes too tight, but do not remove it. Periodically check the pulse in the extremity beyond the bite to insure that the blood flow has not stopped.

Several other factors must be considered in cases of snakebite:

- Shock. Keep the victim lying down and comfortable, and maintain his or her body temperature.

- Breathing and heartbeat. If breathing stops, give mouth-to-mouth resuscitation. If breathing stops and there is no pulse, perform cardiopulmonary resuscitation (CPR) if you have been trained to do so.

- Identifying the snake. If you can kill the snake without risk or delay, bring it to the hospital for identification, but exercise extreme caution in handling the snake.

- Cleaning the bitten area. You may wash the bitten area with soap and water and blot it dry with sterile gauze. You may apply dressings and bandages, but only for a short period of time.

- Medicine to relieve pain. Do not give the victim alcohol, sedatives, aspirin, or any medicine containing aspirin. Some painkillers, however, may be given. Consult a doctor or other medical personnel for specific medications that may be used.

- Snakebite kits. Keep a kit accessible for all outings in primitive areas or areas known or suspected to snake infested.

It is not recommended that cold compresses, ice, dry ice, chemical ice packs, spray refrigerants, or other methods of cold therapy be used in the first aid treatment of snakebite.

14.2 Poisonous Insect Bites

Spiders

Spiders in the United States are generally harmless, with two notable exceptions: the Black Widow spider (Latrodectus Mactans) and the Brown Recluse or violin spider (Lox Osceles Reclusa).

The symptoms of a Black Widow spider bite are: slight local reaction, severe pain produced by nerve toxin, profuse sweating, nausea, painful cramps in abdominal muscles, and difficulty in breathing and speaking. Victims recover in almost all cases, but an occasional death is reported. Symptoms are relatively similar for bites from the Brown Recluse.

Field personnel should exercise caution when lifting covers off manholes, sumps, etc., since Black Widow and Brown Recluse spiders can typically be found in these areas.

Scorpions

Scorpions inject venom through a stinger in the tail. In bites from the more dangerous species, there are marked systemic effects within 1 to 2 hours. Fatalities have been recorded.

The symptoms of a scorpion bite are: excruciating pain at the site of the sting, nausea and vomiting, abdominal pain, shock, and possible development of convulsions and coma.

General First Aid for Poisonous Insect Bites:

1. Minor Bites and Stings

- Cold applications.
- Soothing lotions, such as calamine.

2. Severe Reactions

- Give artificial respiration if indicated.
- Apply a constricting band above the injection site on the victim's arm or leg (between the site and the heart). Do not apply tightly. You should be able to slip your index finger under the band when it is in place.
- Keep the affected part down, below the level of the victim's heart.
- If medical care is readily available, leave the band in place; otherwise, remove it after 30 minutes.
- Apply ice contained in a towel or plastic bag, or cold cloths, to the site of the sting or bite.
- Give home medicine, such as aspirin, for pain.
- If the victim has a history of allergic reactions to insect bites or is subject to attacks of hay fever or asthma, or if he or she is not promptly relieved of symptoms, call a physician or take the victim immediately to the nearest location where medical treatment is available. In a highly sensitive person, do not wait for symptoms to appear, since delay can be fatal.
- In case of a bee sting, remove and discard the stinging apparatus and venom sac.

14.3 Tickborne Diseases

Lyme Disease

Lyme disease is an illness caused by a bacterium which may be transmitted by the bite of a tick (Ixodes Dammini), commonly referred to as the "Deer Tick". The tick is about the size of a sesame seed, as distinguished from the Dog Tick, which is significantly larger. The Deer Tick is principally found along the Atlantic coast, living in grassy and wooded areas, and feeds on mammals such as mice, shrews, birds, raccoons, opossums, deer, and humans. Not all ticks are infected with the bacterium, however. When an infected tick bites, the bacterium is passed into

the bloodstream of the host, where it multiplies. The various stages and symptoms of the disease are well recognized and, if detected early, can be treated with antibiotics.

Removal of ticks is best accomplished using small tweezers. Do not squeeze the tick's body. Grasp it where the mouth parts enter the skin and tug gently, but not firmly, until it releases its hold on the skin. Save the tick in a jar labeled with the date, body location of the bite, and the place where it may have been acquired. Wipe the bite thoroughly with an antiseptic and seek medical attention as soon as possible.

The illness typically occurs in the summer and is characterized by a slowly expanding red rash, which develops a few days to a few weeks after the bite of an infected tick. This may be accompanied by flu-like symptoms along with headache, stiff neck, fever, muscle aches, and/or general malaise. At this stage treatment by a physician is usually effective; but, if left alone, these early symptoms may disappear and more serious problems may follow. The most common late symptom of the untreated disease is arthritis. Other problems which may occur include meningitis and neurological and cardiac abnormalities. It is important to note that some people do not get the characteristic rash but progress directly to the later manifestations. Treatment of later symptoms is more difficult than early symptoms and is not always successful.

When in an area suspected of harboring ticks (grassy, bushy, or woodland area) the following precautions can minimize the changes of being bitten by a tick:

1. Wear long pants and long-sleeved shirts that fit tightly at the ankles and wrists.
2. Wear light colored clothing so ticks can be easily spotted.
3. Wearing tick repellents may be useful.
4. Inspect clothing frequently while in tick habitat.
5. Inspect your head and body thoroughly when you return from the field.
6. Remove any attached ticks by tugging with tweezers where the tick's mouth parts enter the skin. Do not squeeze or crush it.

Rocky Mountain Spotted Fever

In the eastern and southern United States this tickborne disease is transmitted by the infected Dog Tick (Dermacentor Variabilis). It is important to note that the Dog Tick is significantly larger than the Deer Tick. Nearly all cases of infection occur in the spring and summer, generally several days after exposure to infected ticks. The onset of illness is abrupt and often accompanied by high fever, headache, chills, and severe weakness. After the fourth day of fever, victims develop a spotted pink rash that usually starts on the hands and feet and gradually extends to most of the body. As with Lyme disease, early detection and treatment significantly reduces the severity of illness. The disease responds to antibiotic therapy with tetracycline or chloramphenicol.

Other Tickborne Diseases

Ticks transmit several other diseases, most of which are rare and occur only in specific areas. Babesiosis occurs mainly in the Cape Cod area and eastern Long Island. Colorado tick fever is similarly regional and occurs only among those who live or work at altitudes above 4,000 feet.

14.4 Poisonous Plants

Characteristic Reactions

The majority of skin reactions following contact with offending plants are allergic in nature and are characterized by general symptoms of headache and fever, itching, redness, and a rash.

Some of the most common and most severe allergic reactions result from contact with plants of the Poison Ivy group including Poison Oak and Poison Sumac. The most distinctive features of poison ivy and Poison Oak are their leaves, which are composed of three leaflets each. Both plants also have greenish-white flowers and berries that grow in clusters. Such plants produce a severe rash characterized by redness, blisters, swelling, and intense burning and itching. The victim can also develop a high fever and become very ill. Ordinarily, the rash begins within a few hours after exposure, but it may be delayed for 24 to 48 hours.

First Aid Procedure

1. Remove contaminated clothing.

2. Wash all exposed areas thoroughly with soap and water, followed by rubbing alcohol.

3. Apply calamine or other soothing skin lotion if the rash is mild.

4. Seek medical advice if a severe reaction occurs, or if there is a known history of previous sensitivity.

15.0 Medical Surveillance

29 CFR 1910.120 requires employers to institute a medical surveillance program for employees who are or may be exposed to hazardous substances at or above occupational exposure limits for more than 30 days per year. Since it is not feasible to monitor every employee at every potentially hazardous work site, H&H requires all employees whose work includes potential exposure to hazardous substances to participate in its medical surveillance program.

H&H has in effect a Medical Surveillance Program that allows the Medical Director to:

- Certify individuals to work at H&H sites as required by OSHA regulations;

- Establish a baseline against which any future changes in health or physical well being can be evaluated;

- Identify any underlying illnesses or conditions which might be aggravated by certain exposures or job activities; and

- Recognize any abnormalities, toxic reactions, or other changes at the earliest opportunity so that corrective measures may be taken.

No individual shall participate in H&H site activities in which a potential exposure or injury could occur unless the Medical Director has determined that the individual is medically qualified to perform field activities with potential for exposure to hazardous substances activities and medically qualified to use respiratory protection.

16.0 Forms

The following forms will be provided to the SHSO during final preparations for departure to the job site:

- Daily Instrument Calibration Checksheet
- Air Monitoring Data Sheet
- Plan Acceptance Form
- Accident/Exposure Report Form
- Site Safety Briefing Form.

All completed forms should be returned to the H&H MH&S for retention in project files.

Appendix A

Safety Plan Compliance Agreement

Appendix A

Safety Plan Compliance Agreement
for
Health and Safety Plan
Removal Action
Forshaw Chemicals, Inc.
650 State Street
Charlotte, North Carolina

I, _____, have received a copy of the Health and Safety Plan for the Project. I have reviewed the plan, understand it, and agree to comply with all of its provisions. I understand that I could be prohibited from working on the project for violating any of the health and safety requirements specified in the plan.

Signed: _____

(Signature) (Date)

Firm: Hart & Hickman, PC

Subcontractor

Statement of Compliance

This is to confirm that the employees listed below are qualified by virtue of training and experience to engage in field activities at the Forshaw Chemicals, Inc. Site in connection with Contract/Subcontract Agreement between Hart & Hickman, PC and _____ _____. Further, all said employees have been determined to be properly trained and medically fit to perform those activities prescribed by said contract and to use the respiratory protective equipment necessary to perform the job safely in accordance with 29 CFR 1910 and 1926 and any other Federal, State, or local requirements.

Employee Names

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

_____

Authorized Subcontractor Representative

_____

Printed Name

Appendix B

Hospital Route Map

Presbyterian HEALTHCARE

<Back

FROM 650 State St
Charlotte, NC 28208-4267

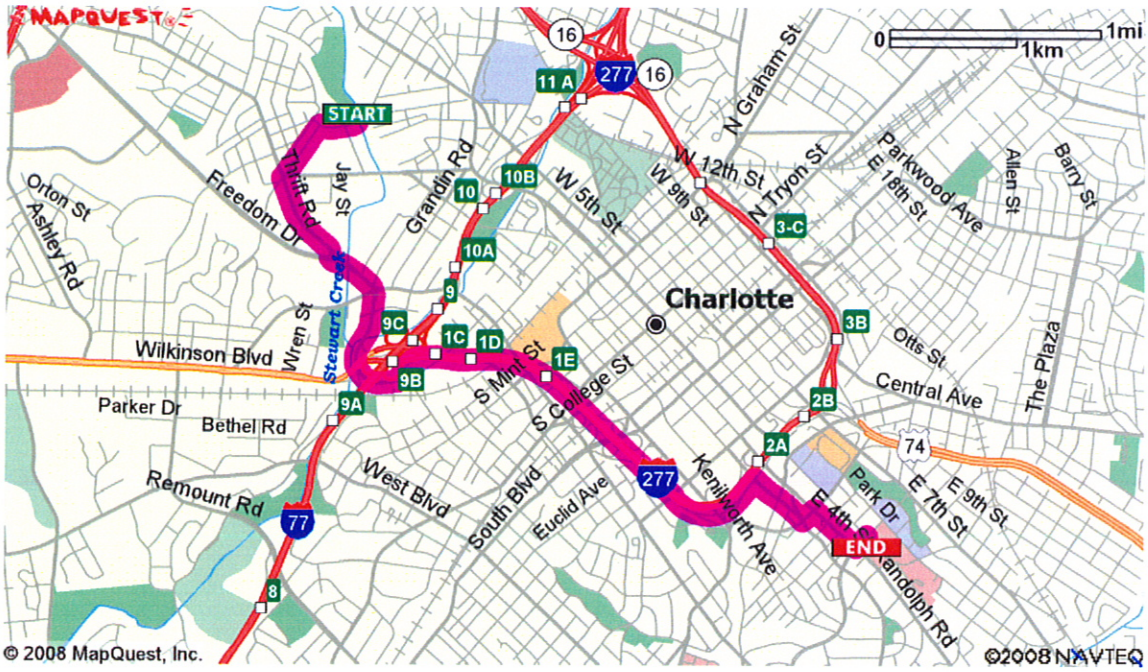
TO 200 Hawthorne Ln
Charlotte, NC 28204-2515

Directions	Distance
FROM 650 State St, Charlotte, NC 28208-4267	
1: Start out going WEST on STATE ST toward GESCO ST.	0.18 mi
2: Turn LEFT onto BERRYHILL RD.	0.30 mi
3: Turn LEFT onto THRIFT RD.	0.47 mi
4: Turn SLIGHT LEFT onto FREEDOM DR/NC-27 E. Continue to follow FREEDOM DR.	0.69 mi
5: FREEDOM DR becomes S CLARKSON ST.	0.13 mi
6: Merge onto I-277 N/US-74 E via the ramp on the LEFT.	1.58 mi
7: Take the THIRD ST/NC-16 S/FOURTH ST exit, EXIT 2A.	0.49 mi
8: Turn RIGHT onto E 3RD ST/NC-16 S.	0.30 mi
9: Turn LEFT onto CHARLOTTETOWNE AVE/INDEPENDENCE BLVD.	0.07 mi
10: Turn RIGHT onto E 4TH ST.	0.26 mi
11: Turn LEFT onto HAWTHORNE LN.	0.07 mi
TO 200 Hawthorne Ln, Charlotte, NC 28204-2515	

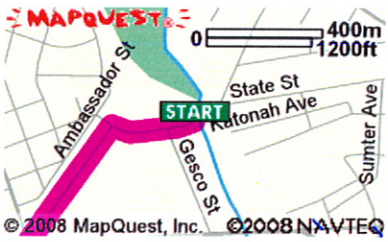
Estimated Driving Time: 9 mins

Total Distance: 4.54 mi

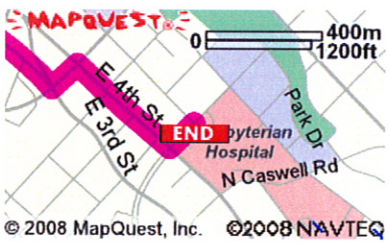
OVERVIEW MAP:



STARTING LOCATION:
650 State St
Charlotte, NC 28208-4267



DESTINATION:
200 Hawthorne Ln
Charlotte, NC 28204-2515



Appendix C

Accident/Exposure Report Form

Hart & Hickman
Accident/Exposure Report

EMPLOYEE NAME _____ DATE OF BIRTH _____

HOME ADDRESS _____ PHONE NO. _____

SEX: MALE__ FEMALE ___ JOB TITLE_____ SOC. SEC. NO. _____

OFFICE NO. _ OFFICE LOCATION _____ DATE OF HIRE _____

HOURS USUALLY WORKED: HOURS PER DAY _____ HOURS PER WEEK _____

TOTAL HOURS WEEKLY _____

WHERE DID ACCIDENT OR EXPOSURE OCCUR? (INCLUDE ADDRESS) _____

_____

COUNTY _____ ON EMPLOYER'S PREMISES? YES _____ NO _____

WHAT WAS EMPLOYEE DOING WHEN INJURED? BE SPECIFIC) _____

_____

_____

HOW DID THE ACCIDENT OR EXPOSURE OCCUR? (DESCRIBE FULLY) _____

_____

_____

_____

WHAT STEPS COULD BE TAKEN TO PREVENT SUCH AN OCCURRENCE? _____

_____

_____

OBJECT OR SUBSTANCE THAT DIRECTLY INJURED EMPLOYEE _____

_____

_____

DESCRIBE THE INJURY OR ILLNESS _____

PART OF BODY AFFECTED _____

NAME AND ADDRESS OF PHYSICIAN _____

_____

IF HOSPITALIZED, NAME AND ADDRESS OF HOSPITAL _____

_____

_____

DATE OF INJURY/ILLNESS _____ TIME OF DAY _____

LOSS OF ONE OR MORE DAY OR WORK? YES/NO_____

IF YES, DATE LAST WORKED _____

HAS EMPLOYEE RETURNED TO WORK? _____ IF YES, DATE RETURNED _____

DID EMPLOYEE DIE?_____ IF YES, DATE_____

COMPLETED BY (PRINT) _____

SIGNATURE _____

TITLE _____ DATE_____

AN ACCIDENT/EXPOSURE REPORT MUST BE COMPLETED BY THE SUPERVISOR OR SITE SAFETY OFFICER IMMEDIATELY UPON LEARNING OF THE INCIDENT. THE COMPLETED REPORT MUST BE IMMEDIATELY TRANSMITTED TO THE MANAGER, HEALTH & SAFETY.

Appendix D

Site Safety Briefings

Hart & Hickman

SITE SAFETY BRIEFINGS

JOB NAME _____ NUMBER _____

DATE _____ START TIME _____ COMPLETED _____

SITE LOCATION _____

TYPE OF WORK (GENERAL) _____

SAFETY ISSUES

TASK (THIS SHIFT) _____

_____

PROTECTIVE CLOTHING/EQUIPMENT _____

_____

CHEMICAL HAZARDS _____

_____

_____

PHYSICAL HAZARDS _____

_____

_____

CONTROL METHODS _____

_____

_____

SPECIAL EQUIPMENT/TECHNIQUES _____

_____

_____

NEAREST PHONE _____

HOSPITAL NAME/ADDRESS _____

SPECIAL TOPICS (INCIDENTS, ACTIONS TAKEN, ETC.) _____

_____

_____

ATTENDEES

PRINT NAME	SIGN NAME

MEETING CONDUCTED BY: _____

Appendix E

Heat Stress and Cold Stress Guidance

Heat Stress/Cold Stress

If site work is to be conducted during the winter, cold stress is a concern to the health and safety of personnel. With regard to the wearing of Tyvek suits, because such disposal clothing does not "breathe," perspiration does not evaporate and the suits can become wet. Wet clothes combined with cold temperatures can lead to hypothermia. If the air temperature is less than 40 degrees Fahrenheit (°F) and an employee perspires, the employee must change to dry clothes. The following section describes the signs and symptoms of cold stress, and Table 2 describes the signs and symptoms of heat stress.

Signs and Symptoms of Cold Stress

Incipient frostbite is a mild form of cold stress characterized by sudden blanching or whitening of the skin.

Chilblain is an inflammation of the hands and feet caused by exposure to cold moisture. It is characterized by a recurrent localized itching, swelling, and painful inflammation of the fingers, toes, or ears. Such a sequence produces severe spasms, accompanied by pain.

Second-degree frostbite is manifested by skin with a white, waxy appearance and the skin is firm to the touch. Individuals with this condition are generally not aware of its seriousness, because the underlying nerves are frozen and unable to transmit signals to warn the body. Immediate first aid and medical treatment are required.

Third-degree frostbite will appear as blue, blotchy skin. The tissue is cold, pale, and solid. Immediate medical attention is required.

Hypothermia develops when body temperature falls below a critical level. In extreme cases, cardiac failure and death may occur. Immediate medical attention is warranted when the following symptoms are observed:

- Involuntary shivering
- Irrational behavior
- Slurred speech
- Sluggishness.

Wearing PPE also puts a worker at a considerable risk of developing heat stress. Table 2 describes the signs and symptoms of heat stress. This can result in health effects ranging from heat fatigue to serious illness or death. Consequently, regular monitoring and other precautions are vital.

For workers wearing standard work clothes, recommendations for monitoring and work/rest schedules are those approved by ACGIH and NIOSH. Workers wearing semi-permeable PPE or impermeable PPE should be monitored when the temperature in the work area is above 70 F. To monitor the worker, the following should be measured:

- Heart rate--The radial pulse should be counted during a 30-second period as early as possible in the rest period.

  - If the heart rate exceeds 110 beats per minute at the beginning of the rest period, the next work cycle should be shortened by one third and the rest period should be kept the same.
  - If the heart rate still exceeds 110 beats per minute at the next rest period, the following work cycle should be shortened by one third.

- Oral temperature--A clinical thermometer (3 minutes under the tongue) or similar device should be used to measure the oral temperature at the end of the work period (before drinking).

- If the oral temperature exceeds 99.6^{o}F (37.6 degrees Celsius (^{o}C)), the next work cycle should be shortened by one third, without the rest period being changed.

- If the oral temperature still exceeds 99.6 F (37.6 °C) at the beginning of the next rest period, the following work cycle should be shortened by one third.

- A worker should not be permitted to wear a semipermeable or impermeable garment when his/her oral temperature exceeds 100.6 F (38.1 °C).

- Body water loss, if possible--Weight should be measured on a scale accurate to +/- 0.25 pound at the beginning and end of each work day to see if enough fluids are being taken to prevent dehydration. Weights should be taken while the employee wears similar clothing. The body water loss should not exceed 1.5 percent of total body weight loss in a workday.

Initially, the frequency of monitoring depends on ambient temperature. The length of the work cycle is determined by the frequency of physiological monitoring described above.

Proper training and preventive measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important, because once someone suffers from heat stroke or heat exhaustion, that person may be predisposed to additional heat injuries. To avoid heat stress, the following steps should be taken:

- Work schedules should be adjusted.

- Shelter (air-conditioned, if possible) or shaded areas should be provided to protect personnel during rest periods.

- Workers' body fluids should be maintained at normal levels to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat, i.e., 8 fluid ounces (0.23 liter) of water must be ingested for approximately every 8 ounces (0.23 kilogram) of weight lost. The normal thirst mechanism is not sensitive enough to ensure that enough water will be drunk to replace lost sweat. When heavy sweating occurs, the worker should be encouraged to drink more. The following strategies may be useful:

  - Water temperature should be maintained at 50°F to 60°F (10° to 15.6°C).
  - Small disposable cups that hold about 4 ounces (0.1 liter) should be provided.

Signs and Symptoms of Heat Stress

Heat rash may result from continuous exposure to heat or humid air.

Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:

- Muscle spasms
- Pain in the hands, feet, and abdomen.

Heat exhaustion occurs from increased stress on various body organs, including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:

- Pale, cool, and moist skin
- Heavy sweating
- Dizziness, fainting, and nausea.

Heat stroke is the most serious form of heat stress. Temperature regulation fails, and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury or death occurs. Competent medical help must be obtained. Signs and symptoms are:

- Red, hot, and unusually dry skin
- Lack of or reduced perspiration
- Dizziness and confusion
- Strong, PID pulse, and coma.

Have workers drink 16 ounces (0.5 liter) of fluid (preferably water or diluted drinks) before beginning work. Urge workers to drink a cup or two every 15 to 20 minutes, or at each monitoring break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per day are recommended, but more may be necessary to maintain body weight.
Encourage workers to maintain an optimal level of physical fitness. Where indicated, acclimatize workers to site work conditions.

Provide cooling devices to aid natural body heat exchange during prolonged work or severe heat exposure.

Train workers to recognize, identify, and treat heat stress.

Appendix F

Daily Instrument Calibration Check Sheet

Hart & Hickman
Daily Instrument Calibration Check Sheet

PROJECT NAME: _____

PROJECT NUMBER: _____

INSTRUMENT(S): _____

SERIAL NO(S): _____

Date	Pure Air (Y/N)	Calibration Gas (PPM)	Battery Check (Good/Bad)	Calibrated By:	Remarks

PROPER CALIBRATION OF INSTRUMENTS SHALL BE CONDUCTED IMMEDIATELY PRIOR TO SITE ACTIVITIES. USING FELT TIP PENS/MARKERS OR SIMILAR ITEMS IS NOT CONSIDERED PROPER CALIBRATION AND IS NOT ACCEPTABLE