

FINAL RCRA FACILITY INVESTIGATION REPORT
FOR THE
FRANKLIN STEEL COMPANY, INC.

Prepared For:

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Submitted To:

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LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---------------------|---|
| AOC | Administrative Order on Consent |
| AOCs | Area of Concern |
| ATSDR | Agency of Toxic Substances and Disease Registry |
| BAF | bioaccumulation factor |
| BERA | baseline ecological risk assessment |
| BCF | bioconcentration factor |
| bgs | below ground surface |
| B&N | Burgess & Niple, Inc. |
| BRA | Baseline Risk Assessment |
| CERCLA | Comprehensive Environmental Response Compensation and Liability Act |
| CLP | Contract Laboratory Protocol |
| cm/sec | centimeters per second |
| CLP | Contract Laboratory Protocol |
| CMS | Corrective Measures Study |
| COC | Contaminants of Concern |
| COPC | Contaminants of Potential Concern |
| DQO | Data Quality Objectives |
| ecoCOC | ecological Chemicals of Concern |
| ELCR | excess lifetime cancer risk |
| EPA | U.S. Environmental Protection Agency |
| ER-L | effects range-low |
| ERA | ecological risk assessment |
| ft. | feet |
| ft/sec | feet per second |
| gpd | gallons per day |
| gpd/ft | gallons per day per foot |
| gpd/ft ² | gallons per day per square foot |
| gpm | gallons per minute |
| HEAST | Health Effects and Assessment Summary Tables |
| HHRA | human health risk assessment |
| HI | Hazard Index |
| HQ | Hazard Quotient |
| IRIS | Integrated Risk Information System |
| J | estimated value |
| K | Hydraulic conductivity |
| K _d | distribution coefficient of organic carbon |
| K _{oc} | organic carbon partitioning coefficient |
| mcl | Maximum Contaminant Level |
| µg/kg | micorgrams per kilogram |
| µg/L | micrograms per liter |
| mg/kg | milligrams per kilogram |
| mg/L | milligrams per liter |
| mm | millimeters |
| msl | mean sea level |
| NAWQC | National Ambient Water Quality Criteria |
| NPDES | National Pollution Discharge and Elimination System |
| Ohio EPA | Ohio Environmental Protection Agency |
| OSWER | Office of Solid Waste and Emergency Response |
| ppb | part per billion |

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| ppm | part per million |
| PQL | Practical Quantitation Limit |
| PRG | preliminary remediation goal |
| QA | Quality Assurance |
| QA/QC | quality assurance/quality control |
| QC | Quality Control |
| RAGS | Risk Assessment Guidance for Superfund |
| RCRA | Resource Conservation and Recovery Act |
| RFI | RCRA facility investigation |
| RME | reasonable maximum exposure |
| RTECS | Registry of Toxic effects of Chemical Substances |
| SAIC | Science Applications International Corporation |
| SDG | Sample Delivery Group |
| SOW | Statement of Work |
| SVOC | Semi-Volatile Organic Compound |
| SWMU | Solid Waste Management Unit |
| TAL | Target Analyte List |
| TCL | Target Compound List |
| TCLP | Toxicity Characteristic Leaching Procedure |
| TSS | Total Suspended Solids |
| UCL | upper confidence limit |
| U.S. EPA | United States Environmental Protection Agency |
| UTL | upper tolerance limit |
| VOC | Volatile Organic Compound |
| WHP | Wellhead Protection |
| WWTP | Waste Water Treatment Plant |

RCRA FACILITY INVESTIGATION PART 1 AND PART 2 REPORT FOR THE FRANKLIN STEEL COMPANY, INC.

1.0 INTRODUCTION

This document presents the results of the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Part 1 (September 1993 through December 2002) and Part 2 (January 2003 through October 2006) conducted at the Franklin Steel Company, Inc. Part 1 of the RFI included an investigation of chemicals present in 10 Solid Waste Management Units (SWMUs) and Part 2 of the RFI included an investigation of the 12 new Areas of Concern (AOCs) at the facility. Utilizing the results of the site soil, sediment, surface water and groundwater sampling, a human health risk assessment (HHRA) and ecological risk assessment (ERA) was conducted to determine potential risks to human and ecological receptors. In addition, groundwater modeling was conducted for one chemical of concern identified in groundwater from the HHRA.

This report presents protection standards that were developed for chemicals of concern (COCs) identified in the HHRA and ERA. Finally, a summary is included that provides conclusions for the RFI Part I/Part II and recommendations for further actions at the site.

1.1 SITE DESCRIPTION

The Franklin Steel Company, Inc. owned and operated a drum reconditioning and recycling facility in the Gahanna Industrial Park, of Blacklick, Ohio between 1971 and 1997. The facility located at 1385 Blatt Blvd., Blacklick, Ohio 43004, operated under the business name of Columbus Steel Drum Company. In June 1997, the Franklin Steel Company sold the drum reconditioning business to Evans Industries, Inc. under the name of Evans Columbus, Corp. and continued the drum reconditioning operation. Evans Industries in turn sold the drum reconditioning business to the Queen City Barrel Company in January 2001, using the original Columbus Steel Drum Company name. Property ownership throughout the various business ownership changes was retained by the Franklin Steel Company until December 2007, when the property was sold to Container Recyclers, Inc., a subsidiary of Queen City Barrel and is doing business as Columbus Steel Drum.

The facility has been in operation since 1971. The Franklin Steel Company operations consist of drum reconditioning and recycling under SIC 7699. The facility reconditions open-head and closed-head drums. Prior to 1986, when drum inventory was at its peak, approximately 450,000 RCRA empty drums were stored at the site for processing. At that time, approximately 38 acres of property were utilized for drum storage and processing. The 38 acres consisted of two 10-acre drum storage areas and an 18-acre processing/drum storage area. Since 1988, only the 18-acre portion of property has been used for drum reconditioning operations and storage. Currently, there are approximately 56,000 drums stored on the ground with an additional 11,000 drums stored on semi-trailers.

A Part A RCRA permit application was filed in 1980 on the basis that a portion of drums received at the facility for reconditioning and recycling were manifested as containing hazardous waste, which would then be stored at the facility before being disposed of off-site at a commercial treatment, storage and disposal facility. The facility operated under interim status until October 1984 when its Part B RCRA permit became effective. Permitted units identified in the Part B included a hazardous waste underground storage tank (HWUST) and a hazardous waste container storage pad (HWSP). The facility ceased accepting drums containing hazardous materials on July 14, 1988 and submitted a closure plan to Ohio EPA on September 19, 1988. Closure certification for the HWUST and the HWSP was received from Ohio EPA on February 9, 1996. The facility is currently a large quantity generator of hazardous waste.

The facility processes approximately 4,000 to 6,000 empty closed-head and open-head drums per day. Closed-head drums are unloaded from trucks and are either temporarily stored in the yard or placed on a conveyor belt and transported to the process building. In the process building the drums are cleaned with a hot caustic solution, the paint is removed by a shot blaster, and the drums are repainted. Open head drums are unloaded from trucks and are either temporarily stored in the yard or transported by conveyor through a thermal oxidizer. Most of these drums are transported directly into the processing facility. However, some drums are temporarily staged on a concrete pad north and south of the conveyor. Once in the processing facility, they are shot blasted and repainted.

Associated with emergency response actions to specific incidents or site inspection activities, several sampling events were conducted at the site by the Ohio EPA and Franklin Steel Company, Inc. during the years 1979 through 1988. In the areas sampled, the presence of some solvents, heavy metals and semivolatile organic compounds were reported in surface soils, surface water and sediments at the site. Franklin Steel Company subsequently conducted remedial activities to address the areas of contamination in five different locations, as requested by Ohio EPA on December 11, 1987.

Ecology and Environment, Inc., under contract with the U.S. EPA, conducted a preliminary review/visual site inspection and preliminary assessment of the site in 1989 (Ecology and Environment, Inc. 1990). The preliminary review involved a review of state and federal file information relating to the facility. The visual inspection consisted of a facility representative interview, a walk-through of the facility to observe and document waste handling processes and facility conditions. The preliminary assessment of the facility was based on U.S. EPA guidelines and the completion of a potential hazardous waste site form. The preliminary assessment was used to evaluate the risk to the environment posed by the facility based on five pathways of contaminant migration: groundwater, surface water, air, fire and explosion, and direct contact. Ecology and Environment, Inc. concluded that the potential existed for inadequate containment of wastes at the facility. The former oxidizer unit and supporting SWMUs were identified as areas of concern. Ecology and Environment, Inc. recommended air sampling of the oxidizer unit and soil sampling around the oxidizer pit, lugger boxes, conveyer line, and drum storage areas.

1.2 SITE HISTORY

Franklin Steel Company, Inc. entered into an Administrative Order on Consent (AOC) with the Ohio EPA on June 23, 1992. The AOC requires in part that Franklin Steel perform an RFI to document whether or not there is contamination from any release of hazardous wastes and hazardous constituents at the facility and to determine the nature and extent of any such releases. There are 10 Solid Waste Management Units (SWMUs) that were considered under this investigation as well as 12 new AOCs. Figure 1 illustrates the location of each SWMU and AOCs.

SWMUs were divided into three contiguous areas (i.e., exposure units) for purpose of the evaluation. The exposure units defined for the Franklin Steel study area include:

Contiguous Area #1 (Exposure Unit 1) - Active Operations Area

- Facility operations (S101 – S108) surface soils (0-2 feet below ground surface (bgs))
- Truck Trailer Parking Lot surface (0-2 feet bgs)

Contiguous Area #2 (Exposure Unit 2) - Inactive Operations Area

- Historical drum storage (S109 and S201) surface (0-2 feet bgs)/subsurface soils (2 feet bgs to 10 feet bgs)

Contiguous Area #3 (Exposure Unit 3) - Unzinger's Ditch

- Downstream of Outfall sediment and surface water
- Upstream of the Outfall (i.e., holding ponds to outfall) sediment.

The separation of Exposure Units is based on the distinct separation of land use. The active operations area (i.e., Exposure Unit 1) consists of an area that has been involved in facility operations since conception and currently within use. The S109 and S201 areas (i.e., Exposure Unit 2) were used strictly for storage and staging of drums and/or equipment, i.e., this area has been used in the past yet is currently inactive.

The physical separation of Exposure Unit 3 (Unzinger's Ditch) sediment and surface water (i.e., downstream of East Broad Street) is based on observations regarding potential human use patterns and down gradient potential of impacts from the Franklin Steel facility operations. It should be noted that SWMU S110 (Hazardous Waste Underground Storage Tank) and S111 (Hazardous Waste Storage Pad) that were initially identified under the scope of the AOC, underwent closure activities under the RCRA program in 1992 and were not considered further under the RFI. Post-closure sampling at these units indicated small concentrations of constituents remained. However, closure risk assessment conducted to determine if the constituents remaining in soils around the unit were present at levels in compliance with RCRA health based closure standards indicated that concentrations were within acceptable risk ranges (SAIC, 1994a).

Phase I of the Franklin Steel RFI Part I was completed in 1994 with the submission of the *Franklin Steel Company, Inc. RCRA Facility Investigation Preliminary Assessment/Phase I* (SAIC, 1994b) report. Task 1 of the Phase II RFI Part I investigation commenced in January 1995 under the Ohio EPA approved *Final Work Plan for the Franklin Steel Company, Inc. Phase II RCRA Facility Investigation* (SAIC, 1994c) and included installation and sampling of groundwater monitoring wells and sampling of stream water and sediments both on and off the plant site. Additional soil boring sampling was conducted during a soils investigation at the proposed location of a new thermal oxidizer in the S108 Drum Storage Area during the Task 1 Phase II RFI Part I activities. These tasks were concluded at the end of February 1995.

Due to financial constraints, RFI Part I activities, as outlined in the *Final Work Plan for the Franklin Steel Company, Inc. Phase II RCRA Facility Investigation* (SAIC, 1994) were scaled back at Franklin Steel's request. At this time, Franklin Steel also requested an extension to the RFI schedule that was received in August 1996. The extension moved the completion date for the *Draft RFI Report* to October 23, 1998. SAIC developed the *Revised Amended Scope of Work for the Franklin Steel Company, Inc. Phase II RCRA Facility Investigation* (SAIC, 1995), which was subsequently approved by Ohio EPA. This document contained provisions for the screening of SWMUs S108, S109 and S201 to determine soil-boring locations.

The screening activity in SWMUs S109 and S201 was implemented in June 1996 and was conducted to determine soil-boring locations for these units. The screening for these SWMUs consisted of collecting surface soil samples at the locations originally proposed in the *Final Work Plan for the Franklin Steel Company, Inc. Phase II RCRA Facility Investigation* (SAIC, 1994c) and collecting a VOC sample from the 2.5-3 ft depth interval at those same locations which was analyzed using a modified SW-846 method for soil head space screening analysis. The results of this screening activity were summarized in *SWMU S109 and S201 Field Screening and Surface Soil Sampling Results for the Franklin Steel Company RCRA Facility Investigation* (SAIC, 1997).

SAIC conducted sampling in August and September 1997 at SWMUs S105, S106, S108 (only for surface soil metals, SVOCs and for VOCs at the 3-3.5 ft. depth), and in S109 and S201 (at sites determined by field screening). Results from the sampling at these SWMUs were presented in *Surface Soil/Boring Analytical Results from the Franklin Steel Co. Phase II Task 2 RCRA Facility Investigation* (SAIC, 1998a).

SAIC completed RFI Part 1 field investigations with the completion of SWMUs S107 and S108 (sampling based on the evaluation of surface soil for metals/SVOCs and VOCs at the 3-3.5 ft depth in March 1998). Additional groundwater wells and piezometers were installed in accordance with the *Work Plan for Additional Groundwater Monitoring for the Franklin Steel Company, Inc. Phase II RCRA Facility Investigation* (SAIC, 1998b). All of the additional wells were integrated into the quarterly groundwater-monitoring program at Franklin Steel.

As part of the RFI Part 1, Franklin Steel conducted quarterly groundwater sampling since 1993. Results as analyzed in the Draft RFI Report indicated there were minimal levels of constituents of concern (COC) in the groundwater (SAIC 2000). SAIC submitted *Proposed Reduction in Groundwater Monitoring Requirements for the RCRA Facility Investigation at the Franklin Steel Company, Inc., July 17, 2000*, to Ohio EPA (SAIC 2000). Ohio EPA reviewed the SAIC submittal mentioned above and included comments and recommendations to the groundwater reduction proposal (Ohio EPA letter September 8, 2000). As a result, Franklin Steel was authorized by Ohio EPA to conduct semiannual groundwater sampling and water level measurements for Ohio EPA recommended wells with respect to the RFI at the Franklin Steel facility. Semiannual groundwater sampling at the Franklin Steel facility started in April 2001.

Due to extensive construction activity/commercial development in the immediate area, the original background monitoring well S100-MW01 was properly plugged and abandoned in December 2001. Monitoring well S201-MW02 was severely damaged during the excavation for a sewer extension by the City of Gahanna, Ohio. The replacement for the damaged well, S201-MW02R, was installed in October 2003.

SAIC collected samples from the drainage system during Part I of the RFI to determine whether surface water discharges from the site were impacting environmental media. Additional samples were collected in April 1999, March and November 2000, and March and May 2001 to complement the existing RFI data and to determine if there are additional sources contributing to the constituents noted in surface water and sediment at the site. In September and November 2000, Ohio EPA conducted an investigation of Unzinger Ditch's aquatic life and water quality which is summarized in the report "Biological and Sediment Quality Study of Unzinger Ditch 2000." This report can be found at: <http://www.epa.state.oh.us/dsw/documents/Unzinger.pdf>.

Part 2 of the RFI was developed to do investigatory work for the 10 new Areas of Concern (AOCs) that were identified by the Ohio EPA by letter dated January 31, 2003 (Ohio EPA 2003). In March 2003, Ohio EPA collected samples of the holding pond's sediment, ash, soil, and oxidizer sludge to evaluate the current conditions at the site. Ohio EPA requested that Franklin Steel perform further investigation and analysis of the 10 new AOCs at the former Franklin Steel site under Section VII, Paragraph O, of the June 22, 1992 Director's Findings and Orders by letter dated December 20, 2004 (Ohio EPA 2004). Burgess & Niple, Inc. (B&N) prepared the approved *RCRA Facility Investigation – Part 2 Work Plan for the Franklin Steel Company, Revised October 6, 2006* (B&N 2006). In addition, the Part 2 investigation was revised and expanded by Ohio EPA to incorporate two additional AOCs (B&N 2006). Therefore, there were 12 new AOCs to be evaluated in the RFI Part 2.

The purpose of the investigatory activities outlined in the RFI Part 2 was to determine whether there is contamination from any releases of hazardous wastes and hazardous constituents as a result of operations that occurred at the 12 new AOCs. The RFI Part 2 was not designed to determine the full nature and extent of contamination, but rather document the highest potential contamination associated with each of the AOCs as

determined through field observation and subsequent sampling of the most heavily stained areas. B&N completed the RFI Part 2 field investigation activities in October 2006.

In addition, damaged monitoring well S101-MW01 was properly abandoned and replaced by monitoring well S101-MW01R in November 2006. S101-MW01R was constructed similar to S101-MW01. The monitoring well log for S101-MW01R is included in Appendix E. The Water Well Sealing Report for S101-MW01 is included in Appendix G.

1.3 PURPOSE OF THE INVESTIGATION

The purpose of the RFI, as defined in the AOC, is to document whether or not there is contamination from any releases of hazardous wastes and hazardous constituents at the facility, and, if so, to determine the nature and extent of the any such release. In addition to presenting this data, this RFI report includes a baseline human health risk assessment and a baseline ecological risk assessment. The purpose of these assessments is to estimate the potential impacts of detected contaminants on human and ecological receptors. It is also a purpose of this report to present protection standards for the identified contaminants in the various environmental media, as identified by the baseline human health and ecological risk assessments. These protection standards may be risk-based or regulatory-based contaminant concentrations.

The specific objectives of the RFI were to (1) conduct an investigation to define the site's potential impact on stream water and sediment, selected surficial soils and subsurface soils, and groundwater, (2) characterize the site-specific geology and hydrogeology, and (3) collect data to support the baseline risk assessments and, if necessary, a corrective measures study (CMS).

1.4 CONCEPTUAL APPROACH TO RCRA CORRECTIVE ACTION

As described above, the role of the RFI within the RCRA Corrective Action program is to determine the nature and extent of contamination at a facility. Analytical results reported above their respective protection standard will be further evaluated by baseline risk assessments, both human health and ecological, which quantify the risk associated with that contamination. Results of the risk assessments are compared to regulatory thresholds for acceptable and unacceptable risk, and if the contamination presents an unacceptable risk, preparation of a Corrective Measures Study would be required. The CMS would evaluate potential remedial action alternatives to mitigate the risk posed by the contamination.

1.5 ORGANIZATION OF THIS REPORT

Chapter 1 of this report includes a description of Franklin Steel Company, Inc. and the site's industrial operations. The regulatory history, background, purpose of the investigation, and conceptual approach to RCRA corrective actions are defined in this chapter.

Chapter 2 presents the physical setting of the Franklin Steel property. The regional and local geology and hydrogeology are discussed in this section. The hydrogeologic regime is emphasized in this section, as it is the basis for later sections.

Chapter 3 presents the Waste Characterization Data Sheets, which include the hazard classification, description of physical and chemical properties, and nature of migration and dispersal properties of each potential constituent of concern at the Franklin Steel site. The Waste Characterization Data Sheets are intended to provide the reader with a quick reference of the major physical/chemical properties of the potential constituents of concern at the site.

Chapter 4 describes the historical data used in the initial evaluation of the Franklin Steel site. For each SWMU and AOCs, it provides a description of the unit, potential contaminants and potential releases. A summary of the sampling conducted for the unit is provided and analytical results from the investigation are presented. Finally the analytical results for each SWMU and AOCs are discussed. Section 4.3 and Section 4.4 details the soil, sediment and surface water sampling results while Section 4.7 describes the groundwater results.

Chapter 5 describes the groundwater model that was applied to the Franklin Steel property. The groundwater model was used to gain a greater understanding of the physical processes involved in the fate and transport of the potential contaminants.

Chapter 6 describes the HHRA for the Franklin Steel SWMUs and AOCs. The HHRA was conducted to determine if the COCs found in the SWMUs and AOCs present an unacceptable risk to human health and to provide additional information to determine the need (if necessary) for remedial action within these units. The terms chemical of potential concern (COPC) and COC are used in this section and other sections of this report. The term COPC refers to a chemical that has been included in the HHRA based on its presence above background levels and its potential toxicity. The term COC refers to a COPC that has been identified in the HHRA as potentially posing unacceptable risk to human health.

Chapter 7 presents the ERA, which defines the likelihood of harmful effects on plants and animals and their habitats as a result of exposure to chemical constituents from the Franklin Steel site. A screening ERA for the exposure units at the Franklin Steel facility was conducted to evaluate the risk to plants, animals, and the environment from current and future exposure to contamination at the Franklin Steel exposure units. A baseline ERA was conducted on the screened ERA exposure units. The terms ecoCOPC and ecoCOC are used in this section and in other areas of the report. They are the equivalents of COPC and COC, but are for the ecological receptors evaluated in the ERA.

Chapter 8 addresses the protection standards that are developed for COCs identified in the HHRA and ecoCOCs identified in the ERA. These protection standards may be considered as site-specific preliminary remediation goals (PRGs) for potential remedial actions at the Franklin Steel facility.

Chapter 9 is the summary section for this RCRA Facility Investigation for Franklin Steel Company, Inc. It revisits the first four sections of the report by briefly describing the physical aspects the site, both environmental and chemical. Then the protection standards are discussed with regard to the risk assessments. The last portion describes the recommendations for further actions at the site.

1.6 REFERENCES

- Ecology and Environment, Inc. 1990. *Preliminary review/visual site inspection and preliminary assessment for Columbus Steel Drum, Blacklick, Ohio*. Prepared for the U.S. EPA. March 28, 1990.
- Ohio EPA. 2000. Letter from D. O'Toole, Jr. to Franklin Steel Company RE: Groundwater Monitoring Reduction. Unpublished September 8, 2000.
- SAIC. 1994a. *Columbus Steel Drum Hazardous Waste Underground Storage Tank and Hazardous Waste Storage Pad Risk Assessment*. June 27, 1994. (Submitted as Addendum to the Columbus Steel Drum Company Revised Part "B" Permit Closure Plan Risk Assessment).
- SAIC. 1994b. *Franklin Steel Company, Inc. RCRA Facility Investigation Preliminary Assessment/Phase I*. February 11, 1994.

- SAIC. 1994c. *Final Work Plan for the Franklin Steel Company, Inc. Phase II RCRA Facility Investigation.* October 3, 1994.
- SAIC. 1995. *Revised Amended Scope of Work for the Franklin Steel Company, Inc. Phase II RCRA Facility Investigation.* November 30, 1995.
- SAIC. 1997. *SWMU S109 and S201 Field Screening and Surface Soil Sampling Results for the Franklin Steel Company RCRA Facility Investigation.* February 1997.
- SAIC. 1998a. *Surface Soil/Boring Analytical Results from the Franklin Steel Co. Phase II Task 2 RCRA Facility Investigation.* January 28, 1998.
- SAIC. 1998b. *Work Plan for Additional Groundwater Monitoring for the Franklin Steel Company, Inc. Phase II RCRA Facility Investigation.* February 24, 1998.
- SAIC. 2000. *Proposed Reduction in Groundwater Monitoring Requirements for the RCRA Facility Investigation at the Franklin Steel Company, Inc.* July 17, 2000.

2.0 CHARACTERIZATION OF THE ENVIRONMENTAL SETTING

Franklin Steel Company is located at 1385 Blatt Boulevard in the City of Blacklick, Franklin County, Ohio. The location of the site, as shown on the Reynoldsburg, Ohio, Quadrangle, is presented in Figure 2.1 and is within the Gahanna Industrial Park. Franklin Steel is located along the border between the till plains section of the Central Lowlands Physiographic Province to the west and the western glaciated portion of the Allegheny Plateau Physiographic Province to the east. The site is located on one of the relatively flat to gently rolling step-terraces that typify the transitional nature of the two physiographic provinces.

2.1 REGIONAL GEOLOGY/HYDROGEOLOGY

Unconsolidated Quaternary deposits, mostly from the Pleistocene Wisconsinan glacial drift, overlying the Devonian and Mississippian shale and sandstones, are the principle subsurface materials in the area. The Mississippian formation consists of several shales and sandstones including the Berea Sandstone, a medium to fine-grained quartz sandstone, which appears to underlie at least a portion of the site. The Berea Sandstone bedrock in the region dips gently to the east or southeast. Preglacial valleys carved into underlying sandstones and shales form a pattern, which in the region surrounding the site, is quite different than the present surface topography. A water supply well field (Taylor Road Well Field), located approximately 3,500 ft. east-by-northeast of the offices of Franklin Steel, is situated at the confluence of a prominent buried valley, which trends north-northwest by south-southeast. The center of the buried valley is at least 200 ft. below ground surface (Eagon and Assoc., Inc. 1997).

Unconsolidated deposits fill the buried valleys with glacially-derived materials. The Pleistocene Wisconsinan glacial drift, which is the principle source of glacially transported material in this region, consists of till and glaciofluvial deposits. Till is an unconsolidated mixture of clay, silt, sand, gravel, and occasional cobbles and boulders. The till is often compact, fine-grained, and semi-consolidated, causing it to have low permeability and be a poor source of groundwater. In the center of the buried valley, where the water supply well field is located, the glaciofluvial deposits consist of very permeable sand and gravels. On the flanks of the buried valley, approximately where Franklin Steel is located, the permeable deposits grade laterally into thinner lenses of sand and gravel interbedded with thickening layers of clayey till. To the west of Franklin Steel where the buried valley wall emerges from the subsurface, relatively thin lenses of sand and gravel may cover the Devonian and Mississippian bedrock. According to the Ohio Department of Natural Resources' Ground Water Resources Map of this area, the yield of groundwater in the vicinity ranges from as much as 500 gallons per minute (gpm) (center of the buried valley) to less than 2 gpm (immediately west of the site). The potential groundwater capacity on Franklin Steel property is reported as possibly yielding between 5 and 25 gpm (ODNR, Revised 1993).

2.2 SITE GEOLOGY

The site geology is based on the observations that have been made on the soil boring logs collected during the various subsurface investigations. The investigation which occurred during March 1998, included the installation of eight 2-inch PVC groundwater monitoring wells/piezometers on the site. The installation of the groundwater wells and piezometers occurred in accordance with procedures outlined in the *RCRA Facility Investigation Work Plan, Franklin Steel Company* (ERM-Midwest, 1993). The boring logs from the March 1998 investigation and Part 2 investigation completed October 2006 are located in Appendix E.

As described in the previous section, a preglacial carved bedrock valley that was filled with glacial deposits exists in the area. The Franklin Steel Company site is situated near the western flank of the buried valley. The valley-fill consists of glacial outwash and till deposits that may have been laid down in a braided stream environment. In general, within braided stream environments, the more permeable and hydraulically conductive outwash deposits are located near the center of the preglacial valley, where the faster moving

channel flow tends to concentrate. Geologic cross-sections, Figures 2.2 through 2.5, of the site (constructed from boring logs collected during construction of the monitoring wells/piezometers both on and off site property) illustrate the quickly changing unconsolidated lithologies. Figure 2.6 details the plan-view location of the cross-sections. The further from the center of the buried valley the more till, or non-conductive glacial deposits, are found in the subsurface. The geological logs collected on site seem to indicate a braided stream environment may have deposited the sediments within the buried valley. This would account for quick facies changes, the inconsistencies of lithologies, and the relatively higher percentage of more permeable material nearer the center of the buried valley. Several locations have encountered large glacial erratics consisting of granite, limestone, sandstone, and shale.

2.3 SITE HYDROGEOLOGY

The site hydrogeologic description is based on the past investigations that have been conducted since the early 1990's. The latest round of intrusive investigations was conducted under the approved *Work Plan for Additional Groundwater Monitoring for the Franklin Steel Company, Inc. Phase II RCRA Facility Investigation* (SAIC, 1994b). A few changes were made in the field, which deviated from the Work Plan. The following describes the field changes as they pertain to the site hydrogeologic investigation:

- The proposed groundwater monitoring well and piezometer, S100-MW02D and S109-PZ03, were not installed. These boreholes did not encounter water-bearing zones at their prescribed total depth, so they were abandoned.
- The locations for proposed monitoring wells S109-MW05D and S109-MW07D were adjusted laterally after they both encountered a shallow glacial erratic that caused refusal. S109-MW05D was repositioned and nested with S109-PZ01. S109-MW07D was also repositioned to nest with S108-MW05, and was renamed as S108-MW06D.

The hydrogeologic setting underlying the facility consists primarily of glacial outwash and till ranging from well-sorted fine silt, clay and sand to poorly sorted fine to coarse gravel. The most consistent lithologic type found at the surface of the facility was a till-like silty-clay with varying amounts of sand, and gravel. Averaging approximately 11.5 feet thick, this upper-most layer appears to be impermeable as compared to the underlying sand or sand and gravel water bearing zone. Some of the boreholes drilled on site indicate the upper-most (surface soils) lithology consists of sporadic fill material, but the fill material does not extend any deeper than the impermeable silty-clay. Occasionally, thin (one or two inches) and apparently discontinuous lenses of sand were found in the upper-most portion of the capping silty-clay. These may have contained perched water at the time of drilling but are probably not significant in volume nor hydraulically connected to the underlying aquifer.

While drilling through the upper-most silty clay into the underlying more permeable zone, the first groundwater contact usually was encountered at this interface. Groundwater was encountered at various depths throughout the site ranging from 8 feet below ground surface (bgs) to 16 feet bgs. Composition of the saturated zone varied considerably. The lithology ranges from a fine-grained sand with some silt to a gravel (up to 40 mm) with some sand. Sometimes cobble and boulder size rocks were encountered. In most of the borings drilled on site, the upper-most portion of the permeable zone was saturated. In all of the borings drilled in March 1998, after wells or piezometers had been installed, the potentiometric surface rose above the top of the aquifer as is illustrated in the cross-sections (Figures 2.2 and 2.3). The average height above the base of the confining silty-clay surface that the groundwater rose was roughly 2.6 ft. This confined condition seems to increase from north to south, with the height of water above the base of the confining zone ranging from 0.1 ft. to 9.3 ft. in S100-PZ03 and S108-MW05, respectively.

There are two sets of paired, or nested, well/piezometers on the site. They are the S109-PZ01/S109-MW05D set and the S108-MW05/S108-MW06D set. The deeper well in both sets is screened at approximately 45 to 50 ft. deep, and the shallow wells are screened at approximately 21 to 11 ft. deep. During the March 1998 sampling event there was slight difference in the static groundwater levels between the shallow and the deep wells in both of the paired sets. In the S109-PZ01/S109-MW05D set and the S108-MW05/S108-MW06D set, the deeper screened wells had static groundwater levels lower by 0.15 and 0.56, respectively. This is despite the lack of evidence indicating that the so-called shallow and deep aquifers are separated by a confining or semi-confining layer. However, while both deep boreholes were being advanced the drilling operation was hindered with heaving sands coming up the hollow stem augers. This made precise description of the lithology nearly impossible while drilling in the heaving sands. The sampling event that occurred immediately after completion and development of the wells in March 1998 indicated the same pattern of either a slight vertical flow or a semi-confining layer separating the shallow and deep zones. Immediately to the northeast of SWMU S201 are two Jefferson Township monitoring wells, which are also nested pairs of shallow and deep wells. Franklin Steel sampled and measured the static groundwater levels in March and June 1998). These off-site nested pairs of wells have revealed very similar results as the two on-site nested pairs. That is, the difference in static levels between the deep and shallow wells range from 0.1 to 0.4 ft. and the deeper wells tend to have the lower static level.

2.3.1 Hydraulic Properties

There have been no hydraulic property testings done on the aquifer on the Franklin Steel Company site. However, at the Taylor Road Well Field, located approximately 3,500 ft. to the northeast, aquifer testing was conducted as part of a Wellhead Protection study (Eagon & Associates, 1997). A constant rate-pumping test was conducted on water supply well WSW-1 for about 70 hours at 600 gpm. An average transmissivity value of 105,500 gallons per day per foot (gpd/ft) was obtained from the test data. Hydraulic conductivity (K) is calculated by dividing transmissivity by the aquifer thickness (b). The thickness (b) of the aquifer is at about 30 ft. in WSW-1, and roughly 40 feet in WSW-2 and WSW-3. An average b value of 37 ft. was used to obtain a K value of 2,850 gpd/ft² (4.4×10^{-3} ft/sec).

During the *Franklin Steel Company, Inc RFI Preliminary Assessment/Phase I* (SAIC, 1994a) hydraulic conductivities were determined from several core samples. These conductivities ranged from a low 3.6×10^{-8} cm/sec (1.18×10^{-9} ft/sec) in the silty clay material to a much greater 1.9×10^{-1} cm/sec (6.2×10^{-4} ft/sec) in the poorly sorted gravel.

2.3.2 Groundwater Recharge and Discharge Areas

The sand and gravel aquifer is predominantly recharged by infiltration of rainfall through the near-surface deposits. Downward gradients between surface water bodies and the aquifer are indicated by ponded water elevations above 896.8 ft. mean sea level (msl) (Franklin County Auditor, 1996) just to the west of the Taylor Road Well Field and northwest of SWMU S201. Aquifer recharge rates of at least five inches per year have been estimated for the area. Thick units of fine silty sand, which underlie and overlie the aquifer in places provide significant additional storage and recharge capacity (Eagon & Associates, 1997).

According to the State of Ohio annual water withdrawal reports, the average daily water usage from the Taylor Road Well Field in 1994, 1995, 1996, and 1997 was 164,000 gpd, 130,000 gpd, 160,000 gpd, and 200,000 gpd, respectively. The Wellhead Protection (Eagon & Associates, 1997) projects the WHP area delineation based on average pumpage of 645,000 gallons per day (gpd), which is more than three times the current average withdrawal rate.

2.3.3 Groundwater Flow

Potentiometric Surface Maps, Figure 2.7 and Figure 2.8, show groundwater contours for the June 1998 and October 2007 groundwater level measurement. Groundwater flow at the Franklin Steel site and the immediately surrounding area appears to be in a north-northeasterly direction across the site towards the central portion of the buried valley. This is also in the general direction of the Taylor Road Well Field, which probably serves as the principle groundwater discharge point. Further to the east of the Taylor Road Well Field is the northeast/southwest aligned Blacklick Creek, which flows southward and may also serve as a groundwater discharge point. Data suggests that a groundwater ridge exists in the western part of the Franklin Steel site; roughly under the Reconditioning Plant and trending in a northwest - southeast direction. On the western side of the ridge, the groundwater flow is to the south. On the eastern side of the ridge the groundwater flows in to the southeast. There seems to be a groundwater depression, or discharge area, along the ditch that flows beside the railroad tracks between S107-PZ01 and S109-PZ04. Between S107-PZ01 and S108-MW05, the railroad ditch is on the south side of the tracks and between S108-MW05 and S109-PZ04 the ditch is on the north side of the tracks.

According to the June 1998 Potentiometric Surface Map (Figure 2.7), the easterly gradient drops 9 ft. over a distance of 2,070 ft. (4.3×10^{-3} ft/ft). Immediately to the east of the SWMU S201 the gradient becomes flatter, 5×10^{-4} ft/ft, closer to the central portion of the buried valley. The October 2007 Potentiometric Surface Map (Figure 2.8) also indicates groundwater flow in a easterly direction, dropping at a gradient of 4 ft. over a distance of 1,775 (2.0×10^{-3} ft/ft) feet and flattening out east of SMMU S201 (4.7×10^{-3} ft/ft).

2.3.4 Taylor Road Well Field

A "Delineation of the Wellhead Protection Area Taylor Road Well Field" (Eagon & Assoc., Inc. 1997) was prepared for the Jefferson Water and Sewer District. This document describes the surface topography and drainage, subsurface conditions, aquifer hydraulic properties, and the wellhead protection area for the wellfield. All information contained within this document appears consistent with the findings of this RFI report, excluding the determination of flow. The November 2006 groundwater sampling contour map indicates a groundwater flow in a north-northeasterly direction across the site.

2.4 REFERENCES

- Eagon & Associates, Inc. 1997.; *Delineation of the Wellhead Protection Area Taylor Road Well Field*.
- ERM-Midwest. 1993. *RCRA Facility Investigation Work Plan, Franklin Steel Company*.
- Franklin County Auditor's Office. 1996. *Geographic Information System Maps*, January 1996.
- Ohio Department of Natural Resources, (ODNR) Division of Water. 1993. *Groundwater Resources of Franklin County*; 1958, Revised 1993.
- Science Applications International Corporation (SAIC) 1994a. *Franklin Steel Company Inc. RFI Preliminary Assessment/Phase I*, 1994a.
- Science Applications International Corporation (SAIC) 1994b. *Work Plan for Additional Groundwater Monitoring for the Franklin Steel Company, Inc. Phase II RCRA Facility Investigation*, 1994b.

3.0 CHARACTERIZATION OF WASTES

3.1 INTRODUCTION

There are various hazardous and non-hazardous waste streams generated throughout the drum reconditioning process. The hazardous wastes include: caustic sludge (D002) generated by applying very hot sodium hydroxide to clean the residue of closed-head RCRA empty drums, oxidizer sludge (D006, D007, D008) generated by thermally cleaning residue of open-head RCRA empty drums via a drum reclamation furnace, waste oil (D001) generated by separating oils and solvents from the caustic sludge, and paint related wastes (D001, D005, D009, F002) such as paint booth sludge, paint contaminated cardboard and debris and paint line flush solvent that are generated during the exterior painting and interior lining of each drum. Non-hazardous waste streams include dibasic ester generated by a flow-in gasket machine, silicone generated by flushing drums previously containing silicone, and filter cake generated by using diatomaceous earth to filter out sludge generated by the pretreatment of industrial waste water. Additionally, the oxidizer sludge is occasionally determined to be non-hazardous as this waste stream is sampled and characterized for every disposal shipment.

A "Waste Characterization Data Sheet" has been prepared for each compound identified as a potential constituent of concern (Appendix A). The identification of constituents was based on a review of the waste characterization data for Franklin Steel SWMU related waste streams and an evaluation of constituents found during the RFI. The Waste Characterization Data Sheets include the hazard classification, description of physical and chemical properties, and nature of migration and dispersal properties of each constituent.

The Waste Characterization Data Sheets are interpreted to provide the reader with a quick reference of the major physical/chemical properties of the potential constituents of concern at the Franklin Steel site. The approach to the compilation of the data sheets is discussed below.

3.2 WASTE CHARACTERIZATION DATA SHEETS

The primary objective in the characterization of wastes was to describe their properties by reviewing published literature and Internet databases. The primary sources of information were government sponsored databases and reviews and Material Safety Data Sheets (Vermont SIRI MSDS Archive). These and other references provide physical and chemical properties, National Fire Protection Association hazardous classifications, and exposure limits.

3.3 REFERENCES

ACGIH, 1997. *Threshold Limit Values for Chemical Substances and Physical Agents Biological Exposures Indices*. 6th ed. ACGIH, Cincinnati, OH.

Agency for Toxic Substances and Disease Registry, 1998. Tox FAQs. HTML version: <http://atsdr1.atsdr.cdc.gov:8080/toxfaq.html>.

Dan Woodard, MD and Ralph Stuart, CIH, 1998 (maintained by). Vermont SIRI Safety Information on the Internet: Vermont SIRI MSDS Archive. HTML version: <http://hazard.com/msds/index.html>.

National Institute for Occupational Safety and Health (NIOSH), 1998. *Pocket Guide to Chemical Hazards*. HTML version: <http://www.cdc.gov/niosh/npg/pgdstart.html>.

National Institute for Occupational Safety and Health (NIOSH), 1998. *International Chemical Safety Cards*. HTML version: <http://www.cdc.gov/niosh/ipcs/icstart.html>.

National Institute of Environmental Health Sciences National Toxicology Program, 1998. *NTP Chemical Health & Safety Data*. HTML version: http://ntp-db.niehs.nih.gov/Main_pages/Chem-HS.HTML.

Open Data Solutions, Inc., 1998. *EPA Fact sheets for Regulated Chemicals*. Alexandria, VA. HTML version: <http://mail.odsnet.com/TRIFacts/>.

R. J. Lewis (revised by), 1992. *Sax's Dangerous Properties of Industrial Materials*. 8th ed. Volume 1, 2, 3. Van Nostrand Reinhold, NY.

4.0 TECHNICAL APPROACH TO UNIT INVESTIGATIONS

4.1 INTRODUCTION

Franklin Steel conducted a Phase I RFI in 1993 to perform a preliminary assessment of the site's potential impact on local environmental media. Information collected during this initial phase was the basis for the second phase of the RFI (Phase II). The purpose of the Phase II RFI was to refine the assessments of each SWMU by collecting additional samples. Based on the October 1998 DRAFT RFI, a Final RFI Report for the Franklin Steel was submitted on August 21, 2000. Since this time, various revisions have been made as reflected in the December 21, 2001, December 20, 2002, November 21, 2003, and April 2007 submittals of the RFI Report.

In letters dated April 28, 2003 and October 23, 2003, Ohio EPA determined that Franklin Steel's current Phase II RFI process was to be revised and divided into two parts, Part 1 and Part 2. The RFI Part 1 would present the results and findings of the investigation of the 10 SWMUs. The RFI Part 2 would summarize the findings of the investigation of the 12 new AOCs. This RFI Report incorporates both Part 1 and Part 2.

Data from both Part 1 and Part 2 of the RFI were pooled and used to perform a HHRA and ERA baseline risk assessment (BRA) for the site and to support development of corrective measures, where warranted.

Samples were collected from surface and subsurface soils, sediment, surface water, and groundwater. The sampling, laboratory analysis, and data validation was conducted in accordance with the protocols set forth in the Ohio EPA approved *Franklin Steel Company, Inc. Phase I RFI Work Plan* (ERM-Midwest, 1993) and the *Final Work Plan for the Franklin Steel Company, Inc. Phase II RCRA Facility Investigation* (SAIC, 1994) as amended by *Revised Amended Scope of Work for the Franklin Steel Company, Inc. Phase II RCRA Facility Investigation* (SAIC, 1995). Samples were analyzed for all or a combination of the Target Compound List (TCL) and Target Analyte List (TAL) VOCs, SVOCs, and metals. Samples were analyzed by Quanterra Incorporated (formerly Wadsworth Alert Laboratories), Severn Trent Laboratories (STL), or TestAmerica Analytical Testing Corporation (TestAmerica). The TCL/TAL compound lists are shown in Table 4.1. Data summaries are provided in Tables 4.3.1 through 4.3.11 of this report.

All data analyzed for Part 1 of the RFI and for all groundwater monitoring events up to December 2004 were subjected to data validation procedures. The National Functional Guidelines for Organic Data Review (U.S. EPA, Revised, June 1991) and Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses (U.S. EPA, Revised, January 1993) were used as the data validation basis for Franklin Steel sample data. Franklin Steel samples were analyzed by the appropriate SW-846 methodologies and reported by sample delivery groups (SDGs) in a "Contract Laboratory Protocol (CLP)- like" full data package. Where technical differences occurred between the CLP and SW-846 methods or Quality Control (QC) criteria, SW-846 guidance was applied. The "CLP-like" data package made use of information summary forms and a prescribed order for all sample related documents, which facilitated the review process so that neat and well-organized deliverables were consistently produced.

During the data validation process, 100% of all summarized information was reviewed (CLP Organic Forms 1-7 and Inorganic Forms 1-14) and considered in qualification of the data. Also, as a spot check against transcription errors, roughly 10% of the data was recalculated to verify that results were correctly calculated from the raw data collected during the RFI Part 1. This included checking some QC results such as System Monitoring Compounds (formerly surrogates) and matrix spike recoveries per the Quality Assurance/Quality Control Manual (TestAmerica, 2004). Furthermore, a data validation report was included as Appendix C of the May 2006 and November 2006 Groundwater Results Reports.

Quality Assurance (QA) codes for data validation and their definitions are listed in Table 4.1.1. These codes are listed with the analytical results for each sample in the data summaries (Tables 4.3.1 through 4.3.11).

Two of the most common data qualifiers reported in the RFI data are “J” and “B”. According to Table 4.1.1, a “J” qualifier indicates an estimated value. This flag is used either when estimating a concentration for tentatively identify compounds (TIC) where a 1:1 response is assumed, or when the mass spectral data indicate the presence of a compound that meets the identification criteria but the result is less than the sample quantitation limit but greater than zero. The assignment of a “J” flag can be the result of any number of QC conditions noted during the validation process including, but not limited to: matrix interference, calibration data, holding times, etc. Also the “J” qualifier may have been placed on an organic result by the lab due to the value being between the reporting limit and the constituent method detection limit (MDL).

According to Table 4.1.1., a “B” qualifier for an organic compound is used when the analyte is found in the associated blank as well as in the sample. It indicates possible/probable blank contamination and warns that data user to take appropriate action. This flag must be used for a TIC as well as for a positively identified TCL compound.

A “B” qualifier for an inorganic compound is used when the reported value was obtained from a reading that was less than the Contract Required Detection Limit (CRDL) but greater than or equal to the Instrument Detection Limit (IDL), if the analyte was analyzed for but not detected, a “U” must be entered.

The overall assessment for all organic and inorganic data is that the data is of high quality as few results were flagged R (rejected) during the validation process. The majority of qualifications was typical and does not impact data usability.

4.2 TECHNICAL APPROACH

Data collected during the Phase I investigation were used to develop a Work Plan that would define the full nature and extent of contamination at the site. In 1995 the original Phase II Work Plan was re-scoped, and the *Revised Amended Scope of Work for the Franklin Steel Company, Inc. Phase II RCRA Facility Investigation* (SAIC, 1995) was published.

The *Revised Amended Scope of Work for the Franklin Steel Company, Inc. Phase II RCRA Facility Investigation* (SAIC, 1995) contains a complete discussion of the technical approach to field sampling taken at the ten SWMUs of this site. The number and location of samples, the sample collection methods, and justification for the proposed methods are contained in this document.

The *RCRA Facility Investigation – Part 2 Work Plan for the Franklin Steel Company, Revised October 6, 2006* (B&N, 2006) details the site environmental investigatory work that was conducted in the 12 new AOCs that were identified by Ohio EPA. The chemical information gained as a result of the Part 2 Work Plan was intended to supplement the RFI –Part 1.

4.3 SWMU INVESTIGATIONS AND RESULTS

The sections below present the sampling results for the 10 SWMUs that were investigated. Included in the discussion is a description of each unit, the potential contaminants and mechanisms for release of those contaminants, a summary of the investigation, presentation of the analytical results, and a discussion and interpretation of the results.

For presentation purposes, inorganics results discussed include copper, cyanide, nickel, zinc and the eight RCRA metals, plus any constituent identified to be problematic through the risk assessment process. Numerous SVOCs, primarily polynuclear aromatic hydrocarbons (PAHs) were detected in sediments and

soils at the Franklin Steel site. To simplify presentation, PAHs are discussed as a chemical group. Other SVOCs are discussed individually. In most cases, data is discussed for the surface to 5 ft. depth interval, the 5-10 ft. depth interval and the depth interval at or below 10 ft.

4.3.1 SWMU S100 - Background

This section represents a discussion of the background concentrations of chemical constituents. Soil results discussed include the seven background metals, SVOC and VOC samples from this RFI (S100-SS01 through S100-SS07) and the 16 RCRA metals samples collected by SEA (SEA 29 through SEA 44) for RCRA closure activities. Sediment results discussed include five background metals, SVOC, and VOC samples from this RFI (S101-SD14, S108-SD04, S201-SD03, S201-SD04, and BN-SD-3). Surface water results discussed include four background metals, SVOC, and VOC samples from this RFI (S101-SW14, S201-SW03, S201-SW04, and BN-SW-3). Groundwater results discussed include 76 background metals, SVOCs and VOC samples from this RFI (Jefferson Township Wells MW-1D, MW-1S, MW-3D, MW-3S, and S107-MW-02). Thus, a total of 108 samples were used for the bases of the soil, sediment, surface water and groundwater background evaluation. Background sample locations are indicated on Figures 1, 2, and 3. It shall be noted, all background data, derived background calculations and justifications based on the use of background data will be further discussed in the revised human health risk assessment (please refer to Section 6.0).

4.3.1.1 Analytical Results – Background Soil

Summarized analytical results for the background soil sampling are presented in the sections below. Table 4.3.1 is a summary of all detected analytical results.

4.3.1.1.1 Background Soils

Inorganics

Aluminum was detected in seven background soil samples at concentrations ranging from 7,850 J mg/kg (S100-SS03) to 14,900 J mg/kg (S100-SS01). The average concentration of aluminum in the background soil samples is 10,232 mg/kg.

Antimony was not detected in any background soil samples.

Arsenic was detected in all 23-background soil samples at concentrations ranging from 3.69 mg/kg (SEA-44) to 28.54 mg/kg (SEA-32). The average concentration of arsenic in the background soil samples is 15.00 mg/kg.

Barium was detected in all 23-background soil samples at concentrations ranging from 50.88 mg/kg (SEA-29) to 252.12 mg/kg (SEA-38). The average concentration of barium in the background soil samples is 131 mg/kg.

Cadmium was detected in only seven background soil samples at concentrations ranging from 0.76 J mg/kg (S100-SS07) to 1.7 mg/kg (S100-SS01). The average concentration of cadmium in the background soil samples is 1.66 mg/kg.

Chromium was detected in all 23-background soil samples at concentrations ranging from 11.9 mg/kg (S100-SS03) to 20.6 mg/kg (S100-SS01). The average concentration of chromium in the background soil samples is 16 mg/kg.

Copper was detected in only seven background soil samples at concentrations ranging from 13.1 mg/kg (S100-SS04 and S100-SS05) to 30.4 mg/kg (S100-SS01). The average concentration of copper in the background soil samples is 23.2 mg/kg.

Cyanide was not detected in any of the background soil samples.

Lead was detected in all 23-background soil samples at concentrations ranging from 13.87 mg/kg (SEA-29) to 31.20 mg/kg (SEA-30). The average concentration of lead in the background soil samples is 22.50 mg/kg.

Mercury was detected in only four background soil samples at concentrations ranging from 0.02 mg/kg (SEA-34) to 0.05 mg/kg (SEA-44). The average concentration of mercury in the background soil samples is 0.03 mg/kg.

Nickel was detected in only seven background soil samples at concentrations ranging from 12.0 mg/kg (S100-SS03) to 35.0 mg/kg (S100-SS07). The average concentration of nickel in the background soil samples is 24.6 mg/kg.

Selenium was detected in 22 background soil samples at concentrations ranging from 0.48J mg/kg (S100-SS06) to 9.89 mg/kg (SEA-32). The average concentration of selenium in the background soil samples is 5.28 mg/kg. One sample result of 870 mg/kg (SEA-36) was excluded from the database due to the abnormally elevated concentration compared to all other background sample results. The SEA-36 sample was considered an anomaly and suspect of validity, therefore, excluded from background calculations.

Silver was detected in only one background soil sample (SEA-34) at a concentration of 0.72 mg/kg. The average concentration of silver in the background soil samples is 0.51 mg/kg.

Zinc was detected in only seven background soil samples at concentrations ranging from 57.9 mg/kg (S100-SS01) to 110 mg/kg (S100-SS07). The average concentration of zinc in the background soil samples is 91.1 mg/kg.

SVOCs

Di-n-butylphthalate was the only SVOC detected in the background samples. Di-n-butylphthalate was detected in four samples at concentrations ranging from 42 J $\mu\text{g}/\text{kg}$ (S100-SS06) to 63 $\mu\text{g}/\text{kg}$ (S100-SS01).

VOCs

VOCs were not detected in any of the background soil samples.

4.3.1.2 Analytical Results – Background Sediment

Summarized analytical results for the background sediment sampling (i.e., S101-SD14, S108-SD04, S201-SD03, S201-SD04 and BN-SD3) are presented in the sections below. Table 4.3.1 is a summary of all detected analytical results.

Inorganics

Aluminum was detected in all of the background sediment samples. The highest concentrations of aluminum were detected at S201-SD04 (16,400 mg/kg) and S201-SD03 (15,700 mg/kg). Concentrations of aluminum at other sediment sample locations ranged 1,040 mg/kg (S101-SD14) to 8,490 mg/kg (BN-SD3).

Arsenic concentrations exhibited no discernable distribution pattern. Arsenic was detected in all of the background sediment samples. Concentrations were detected ranging from 3.6 mg/kg (S101-SD14) to 21.2 mg/kg (S201-SD04). The lowest concentration of arsenic (3.6 mg/kg at S101-SD14) was detected in the sediment of Blacklick Creek.

Barium was detected in all of the background sediment samples. Concentrations were detected ranging from a maximum of 171 mg/kg (BN-SD3) to a minimum of 9.8 B mg/kg (S101-SD14).

Cadmium was detected in three of the five background sediment samples. Cadmium ranged in concentration from 1.2 mg/kg at S108-SD04 to 2.3 mg/kg at S201-SD03.

Chromium was detected in all of the background sediment samples collected. The highest detected concentrations were detected in sample S201-SD04 (23.7 mg/kg) and S201-SD03 (21.1 mg/kg). The concentrations detected in the remaining background samples ranged from 2.0 mg/kg (S101-SD14) to 12.4 mg/kg (BN-SD3).

Copper was detected in all of the background sediment samples collected. The highest detected concentrations were detected in sample S201-SD03 (33.8 mg/kg) and BN-SD3 (27.5 mg/kg). The concentrations detected in the remaining background samples ranged from 2.5 mg/kg (S101-SD14) to 27.4 mg/kg (S201-SD4).

Cyanide concentrations exhibited no discernable distribution pattern. Cyanide was detected in one of the five samples at a concentration of 0.209 mg/kg (BN-SD3).

Lead was detected in all five background sediment samples collected. Concentrations ranged from 2.7 mg/kg at sample location S101-SD14 to a high of 34.2 mg/kg at sample location SS108-SD04.

Mercury was detected in three of the five background sediment samples collected. Mercury concentrations were detected at concentrations ranging from 0.007 mg/kg (S101-SD14) to 0.084 mg/kg in BN-SD3). Mercury was not detected in background samples S201-SD03 nor S201-SD04.

Nickel was detected in all of the background sediment samples collected. The highest detected concentrations were detected in sample S201-SD04 (42.2 mg/kg) and S201-SD03 (38.3 mg/kg). The concentrations detected in the remaining background samples ranged from 4.1 mg/kg (S101-SD14) to 28.2 mg/kg (BN-SD3).

Selenium was detected in only one of the five background samples at a concentration of 1.3 mg/kg (S108-SD04).

Silver was detected in only one of the five background samples at a concentration of 0.19 mg/kg (BN-SD3).

Zinc was detected in all of the background sediment samples collected. The highest detected concentrations were detected in sample S201-SD03 (138 mg/kg) and BN-SD3 (133 mg/kg). The concentrations detected in the remaining background samples ranged from 23 mg/kg (S101-SD14) to 124 mg/kg (S108-SD4).

SVOCs

Concentrations of SVOCs were detected in two of the five background samples collected. Fluoranthene was detected at a concentration of 42J $\mu\text{g}/\text{kg}$ and 55 $\mu\text{g}/\text{kg}$ in background sediment samples S101-SD14 and S108-SD04, respectively. One sample collected from sample location S108-SD04 detected only the SVOC bis(2-ethylhexyl)phthalate at a concentration of 110 $\mu\text{g}/\text{kg}$. Benzo(b)fluoranthene was detected at a concentration of 380 $\mu\text{g}/\text{kg}$ at S108-SD04. Pyrene was detected at a concentration of 40 $\mu\text{g}/\text{kg}$ at sample location S108-SD04. No SVOC concentrations were detected in samples S201-SD03, S201-SD04 nor BN-SD3.

VOCs

Acetone was detected in background sediment sample locations S201-SD03, S201-SD04 and BN-SD3 at a range of 4.7 $\mu\text{g}/\text{kg}$ to 7.9 $\mu\text{g}/\text{kg}$. Various other VOCs (i.e., 26) were detected in background sediment sample location BN-SD3. Detections of VOCs were sporadic with concentrations ranging from 0.00016 $\mu\text{g}/\text{kg}$ (dibromochloromethane) to 0.121 $\mu\text{g}/\text{kg}$ (methylene chloride).

4.3.1.3 Analytical Results – Background Surface Water

Summarized analytical results for the background surface water sampling are presented below. Table 4.3.1 illustrates all detected analytical result.

Inorganics

Aluminum was detected in three of four samples. Aluminum concentrations ranged from 0.13 mg/L (S101-SW-14) to 1.14 mg/L (S201-SW-04).

Antimony was detected in one of four samples. Antimony was detected at a concentration of 0.00026 mg/L (S101-SW-14).

Arsenic was detected in one of four samples. Arsenic was detected at a concentration of 0.0031 mg/L (S101-SW-14).

Barium was detected in all four samples. Concentrations ranged from a high of 0.089 mg/L (S101-SW-14) to a low of 0.054 mg/L (S201-SW-03).

Beryllium was only detected in background sample S101-SW-14 at a concentration of 0.00071 mg/L.

Cadmium was only detected in background surface water sample S101-SW-14 at a concentration of 0.000055 mg/L.

Calcium was detected in all four samples. Concentrations ranged from a high of 70.3 mg/L (BN-SW-3) to a low of 49 mg/L (S101-SW-14).

Chromium was only detected in background sample S201-SW-04 at a concentration of 0.0014 mg/L.

Cobalt was only detected in background sample S201-SW-04 at a concentration of 0.0010 mg/L.

Copper was detected in two of four background surface water samples. Copper concentrations were detected at a high of 0.01 mg/L in sample S101-SW-14 and a low of 0.0089 mg/L in sample S201-SW-03.

Cyanide was detected at a concentration of 0.0035 mg/L in background sample S201-SW-04. All other sample locations were non-detect for cyanide.

Iron was detected in all four samples. Concentrations ranged from a high of 2.9 mg/L (BN-SW-3) to a low of 0.16 mg/L (S101-SW-14).

Lead was detected in one of four background surface water sample locations. Background sample location BN-SW-3 detected a lead concentration of 0.0012 mg/L.

Magnesium was detected in all four samples. Concentrations ranged from a high of 23.4 mg/L (BN-SW-3) to a low of 13.9 mg/L (S101-SW-14).

Manganese was detected in three of the four samples. Concentrations ranged from a high of 0.242 mg/L (S201-SW-04) to a low of 0.013 mg/L (S101-SW-14).

Mercury was detected at background surface water sample location BN-SW-3 at a concentration of 0.000037 mg/L. Mercury was not detected in any other background surface water locations.

Nickel was detected at background surface water sample location BN-SW-3 at a concentration of 0.0047 mg/L. Nickel was not detected in any other background surface water locations.

Potassium was detected in two of the five surface water samples at a concentrations of 2.8 mg/L and 5.5 at locations S101-SW-14 and S201-SW-03, respectively.

Selenium was detected at background surface water sample location BN-SW-3 at a concentration of 0.0027 mg/L. Selenium was not detected in any other background surface water locations.

Sodium was detected in all four samples. Concentrations ranged from a high of 43 mg/L (BN-SW-3) to a low of 22.5 mg/L (S101-SW-14).

Thallium was detected at background surface water sample location BN-SW-3 at a concentration of 0.00066 mg/L. Zinc was not detected in any other background surface water locations.

Vanadium was detected at background surface water sample location BN-SW-3 at a concentration of 0.0044 mg/L. Zinc was not detected in any other background surface water locations.

Zinc was detected at background surface water sample location BN-SW-3 at a concentration of 0.022 mg/L. Zinc was not detected in any other background surface water locations.

SVOCs

Eighteen different SVOCs, were detected in background surface water sample BN-SW-3. The compounds 2-methylnapthalene (<2.3 µg/L), 4-methylphenol (<2.2 µg/L), acenaphthene (<1.0 µg/L), acenaphthylene (<1.0 µg/L), anthracene (<0.82 µg/L), benzo(a)anthracene (<0.92 µg/L), benzo(a)pyrene (<0.90 µg/L), benzo(b)fluoranthene (<0.78 µg/L), benzo(k)fluoranthene (<0.89 µg/L), chrysene (<0.94 µg/L), dibenz(a,h)fluoranthene (7.5 µg/L), di-n-butyl phthalate (<3.2 µg/L), fluoranthene (<0.96 µg/L), isophorone (<2.0 µg/L), phenanthrene (0.96 µg/L), phenol (<2.6 µg/L), pyrene (0.93 µg/L) and bis(2-ethylhexyl)phthalate (<0.8 µg/L) were all detected.

VOCs

Only four VOCs were detected in background surface water samples collected from BN-SW-3. The compounds 2-butanone (1.0 µg/L), 4-methyl-2-pentanone (0.76 µg/L), acetone 26 µg/L) and chloroform (0.24 µg/L) were all detected.

4.3.1.4 Analytical Results – Background Ground Water

Summarized analytical results for the background ground water sampling are presented below. Table 4.3.1 illustrates all detected analytical result.

Inorganics

Aluminum was detected in all 76 background samples. Aluminum concentrations ranged from 0.029 mg/L (JEFF-MW1D) to 2.9 mg/L (S107-MW02). The average concentration for background aluminum is 0.17 mg/L.

Antimony was detected in all 76 background samples. Concentrations ranged from 0.005 mg/L to <0.06 mg/L. The average concentration is 0.026 mg/L.

Arsenic was detected all 76 background samples with concentrations ranging from 0.009 in background well JEFF-MW1D to 0.008 mg/L in S107-MW02. The average arsenic concentration for background samples is 0.0045 mg/L.

Barium was detected all 76 background samples with concentrations ranging from 0.02 mg/L in background well JEFF-MW1D to 0.54 mg/L in S107-MW02. The average barium concentration for background samples is 0.12 mg/L.

Beryllium was detected all 76 background samples with concentrations ranging from <0.0005 mg/L in background well JEFF-MW1D to 0.25 mg/L in S107-MW02. The average beryllium concentration for background samples is 0.010 mg/L.

Cadmium was detected all 76 background samples with concentrations ranging from <0.0001 mg/L in background well JEFF-MW1D to 0.0026 mg/L in S107-MW02. The average cadmium concentration for background samples was 0.0022 mg/L.

Calcium was detected all 76 background samples with concentrations ranging from 2.5 mg/L in background well JEFF-MW1D to 715 mg/L in S107-MW02. The average calcium concentration for background samples was 197 mg/L.

Chromium was detected all samples with concentrations ranging from <0.001 mg/L in background well JEFF-MW1D to <0.005 mg/L in all remaining sample locations.

Cobalt was detected all 76 background samples with concentrations ranging from 0.0015 mg/L in background well JEFF-MW1D to 0.0027 mg/L in S107-MW02. Average cobalt concentration for background samples is 0.021 mg/L.

Copper was detected all 76 background samples with concentrations ranging from <0.0025 mg/L in background well JEFF-MW1D to 0.018 mg/L in S107-MW02. Average copper concentration for background samples is 0.011 mg/L.

Iron was detected all 76 background samples with concentrations ranging from 0.044 mg/L in background well JEFF-MW1D to 16.4 mg/L in S107-MW02. Average iron concentration for background samples is 1.8 mg/L.

Lead was detected all 76 background samples with concentrations ranging from <0.0005 mg/L in background well JEFF-MW1D to 0.0042 mg/L in S107-MW02. Average iron concentration for background samples is 0.001 mg/L.

Magnesium was detected all 76 background samples with concentrations ranging from 2.5g/L in background well JEFF-MW1D to 100 mg/L in S107-MW02. Average magnesium concentration for background samples is 43.8 mg/L.

Manganese was detected all 76 background samples with concentrations ranging from <0.0075 mg/L in background well JEFF-MW1D to 3.3 mg/L in S107-MW02. Average manganese concentration for background samples is 0.44 mg/L.

Mercury was detected all 76 background samples with concentrations ranging from <0.000032 mg/L in background well JEFF-MW1D to <0.00023 mg/L in S107-MW02. Average mercury concentration for background samples is 0.000099 mg/L.

Nickel was detected all 76 background samples with concentrations ranging from 0.0025 mg/L in background well JEFF-MW1D to 0.28 mg/L in S107-MW02. Average nickel concentration for background samples is 0.027 mg/L.

Potassium was detected all 76 background samples with concentrations ranging from 0.89 mg/L in background well JEFF-MW1D to 6.9 mg/L in S107-MW02. Average potassium concentration for background samples is 2.1 mg/L.

Selenium was detected at a concentration of <0.0025 mg/L in all background wells excluding S107-MW02. Background well S107-MW02 indicated a concentration range of 0.0038 mg/L to 0.005 mg/L. Average Selenium concentration for background samples is 0.0025 mg/L.

Sodium was detected all 76 background samples with concentrations ranging from 2.5 mg/L in background well JEFF-MW1D to 122 mg/L in S107-MW02. Average sodium concentration for background samples is 23.2 mg/L.

Thallium was detected at a concentration <0.00003 in background well JEFF-MW1D and ranged to <0.0013 mg/L in S107-MW02. Thallium concentration averaged <0.0009 mg/L for background samples.

Vanadium was detected at a concentration <0.00011 in background well JEFF-MW1D and ranged to <0.025 mg/L for all remaining back ground wells. Vanadium concentration averaged <0.024 mg/L for background samples.

Zinc was detected all 76 background samples with concentrations ranging from 0.0073 mg/L in background well JEFF-MW1D to 0.16 mg/L in S107-MW02. Average zinc concentration for background samples is 0.036 mg/L.

SVOCs

Two different SVOCs, were detected in background ground water samples. Compounds pyrene (ranged from 0.01 µg/L to 2.5 µg/L) and bis(2-ethylhexyl)phthalate (ranging from 1.5 µg/L to 10 in S107-MW02) were all detected.

VOCs

Only five VOCs were detected in background ground water samples. The compounds 1,1-dichloroethane (<2.5 µg/L), carbon disulfide (ranging from <2.5 µg/L to 2.6 µg/L), chloroethane (ranging from 0.23 µg/L to 2.5 µg/L, toluene (ranging from 0.14 µg/L to 0.25 µg/L), and vinyl chloride (ranging from 0.27 µg/L to 0.5 µg/L) were all detected.

Table 4.3.1 is a summary of all detected analytical results.

4.3.2 SWMU S101 - Stormwater Drainage System

4.3.2.1 Unit Description

SWMU S101 includes samples collected from selected areas of the stormwater drainage system at Franklin Steel and additional surface water and sediment at locations in the vicinity of Franklin Steel. This includes the Outfall 002, Siphon Dam, Unzinger's Ditch and Blacklick Creek. Surface water drainage (i.e., excluding Outfall 002) pathways at the facility are depicted on the detailed topographic map provided in Figure 2 and Figure 3. Storm water is collected through a series of storm sewers that drain in a southeast direction across the facility. The storm sewers connect to an in-line series of three holding ponds divided by two siphon dams.

The holding ponds and siphon dams are located on the southeast corner of the active portion of the property. The siphon dam outfall is a National Pollution Discharge and Elimination System (NPDES) permitted sampling location, number 4IN00108001. Outfall 002, located on the north side of the on-site factory building collects storm water and diverts flow via a drainage ditch between SWMU's S109 and S201, which bypasses the holding ponds. Samples are collected from the permitted outfall on a monthly basis with extended parameters analyzed on a semiannual basis.

Once storm water passes through the outfall, it travels approximately 50 ft. to a catch basin. After entering the catch basin, storm water is directed primarily southeastward along a 15-inch drainage tile that empties into Unzinger's Ditch. During periods of heavy precipitation, stormwater is also directed along another drainage tile to Unzinger's Ditch adjacent to SWMU S109. Unzinger's Ditch trends north-south and is a tributary to Blacklick Creek. The confluence of Unzinger's Ditch and Blacklick Creek is located approximately 2,250 feet south of the 15-inch drainage tile outfall at Unzinger's Ditch.

As required by the NPDES permit, surface drainage earthwork was conducted to collect and control surface water drainage on the eastern portion of the facility. These activities were completed by November 1998. An earthen berm was constructed from the northeast corner of SWMU S108 that runs south along the eastern boundary and wraps back westward on the south end of SWMU S108 to collect and divert surface water runoff from migrating off site bypassing the siphon dam outfall. An additional drain was constructed in the southeast corner of SWMU S108, which connects to the siphon dam to help control the buildup of surface water runoff that is collected with the addition of the earthen berm.

4.3.2.2 Potential Contaminants

Ohio EPA has periodically collected surface water and sediment samples from the holding ponds, the siphon dam outfall, and Unzinger's Ditch since 1979. Ohio EPA concluded, based on data compiled from the sampling events, that surface water run-off from the facility was potentially having an adverse impact on waters of the state. Thus, an NPDES permit was issued on March 2, 1992 and became effective April 1, 1992.

Data collected by Ohio EPA during 1980 indicated that water in the holding pond contained elevated concentrations of chromium, lead, zinc, phenol, and cyanide. Sediment from Unzinger's Ditch was also sampled downstream of the outfall of the drainage tile, and analyses indicated elevated concentrations of cadmium, chromium, lead, zinc, and phenol.

Samples were collected by Ohio EPA again in 1985, and in addition to the constituents mentioned above, several VOCs, SVOCs, and other metals were reported in the holding pond water. These organic constituents were attributed to an overflow of caustic sludge (ERM-Midwest, 1993).

Two samples were collected by Ohio EPA personnel at the field tile outfall of Unzinger's Ditch on September 8, 1988. The samples were designated for analysis of VOCs and SVOCs. Only cis-1,2-dichloroethane (2.8 µg/L) and trichloroethene (2.0 µg/L) were reported in the analyses.

4.3.2.3 Potential Releases

Storm runoff from all areas of the Franklin Steel site could potentially impact the holding ponds and drainage ditches of SWMU S101. A reported spill in 1980 indicated that 15,000 to 20,000 gallons of hazardous waste sludge caused by an overflow of the caustic clarifier system flowed into Unzinger's Ditch. A reported overflow of oxidizer sludge in 1995 may also have introduced contaminants to this unit.

4.3.2.4 Summary of Investigation

Samples were collected from the drainage system during RFI Part 1 - Phase I and II activities to determine whether surface water discharges from the site were impacting environmental media. Additional samples were collected in 1999, 2000, 2001, and 2006 to complement the existing RFI data and to determine if there are additional sources contributing to the constituents noted in surface water and sediment at the site. Only four samples for sediment were analyzed for VOCs (SAIC, January and February 1995). In 1993 three sediment and two surface water samples were collected. Two sediment and two surface-water samples were collected from Unzinger's Ditch, one located up-stream of the outfall of the drainage tile and the other downstream. The third sediment sample was collected from the holding pond. During the RFI Part 1 - Phase II, four additional surface water and sediment samples were collected. Two soil borings and a groundwater monitoring well were also installed. In 1999, 11 additional locations were sampled. Sediment was collected at all locations and surface water samples were collected at eight locations, three locations were dry. Ten additional sediment samples were collected from within Unzinger's Ditch in 2000 (five in March and five in November). Ohio EPA collected five sediment samples from Unzinger Ditch in November 2000. Seven additional sediment samples were collected in 2001 (four from within Unzinger's Ditch in March and three from within the NPDES-permitted onsite siphon dam holding ponds in May). Ohio EPA collected one sediment sample from the holding pond in March 2003. Two additional sediment and surface water samples were collected by B&N in 2006 near previous sample locations. These sample locations are indicated in the table below.

SWMU S101 SAMPLING SUMMARY

| SURFACE SOIL | SOIL BORING | WELL/ PIEZOMETER | SEDIMENT | SURFACE WATER |
|--------------|-------------|------------------|------------------------|------------------------|
| -- | -- | S101-MW01 | S101-SD01 ¹ | S101-SW01 ¹ |
| -- | S101-SB02 | -- | S101-SD02 ² | S101-SW02 ² |
| -- | S101-SB03 | -- | S101-SD03 ¹ | -- |
| -- | -- | -- | S101-SD04 | S101-SW04 |
| -- | -- | -- | S101-SD05 | S101-SW05 |
| -- | -- | -- | S101-SD06 | S101-SW06 |
| -- | -- | -- | S101-SD07 | S101-SW07 |
| -- | -- | -- | S101-SD08 ² | S101-SW08 ² |
| -- | -- | -- | S101-SD09 ² | -- |
| -- | -- | -- | S101-SD10 ² | S101-SW10 ² |
| -- | -- | -- | S101-SD11 ² | S101-SW11 ² |
| -- | -- | -- | S101-SD12 ² | -- |
| -- | -- | -- | S101-SD13 ² | S101-SW13 ² |
| -- | -- | -- | S101-SD14 ² | S101-SW14 ² |
| -- | -- | -- | S101-SD15 ³ | -- |
| -- | -- | -- | S101-SD16 ² | S101-SW16 ² |
| -- | -- | -- | S101-SD17 ² | S101-SW17 ² |
| -- | -- | -- | S101-SD18 ² | S101-SW18 ² |
| -- | -- | -- | S101-SD19 ⁴ | -- |
| -- | -- | -- | S101-SD20 ⁴ | -- |
| -- | -- | -- | S101-SD21 ⁴ | -- |
| -- | -- | -- | S101-SD22 ⁴ | -- |
| -- | -- | -- | S101-SD23 ⁴ | -- |
| -- | -- | -- | S101-SD24 ⁵ | -- |
| -- | -- | -- | S101-SD25 ⁵ | -- |
| -- | -- | -- | S101-SD26 ⁵ | -- |
| -- | -- | -- | S101-SD27 ⁵ | -- |
| -- | -- | -- | S101-SD28 ⁵ | -- |
| -- | -- | -- | S101-SD29 ⁶ | -- |
| -- | -- | -- | S101-SD30 ⁶ | -- |
| -- | -- | -- | S101-SD31 ⁶ | -- |
| -- | -- | -- | S101-SD32 ⁶ | -- |
| -- | -- | -- | S101-SD33 ⁷ | -- |
| -- | -- | -- | S101-SD34 ⁷ | -- |
| -- | -- | -- | S101-SD35 ⁷ | -- |
| -- | -- | -- | BN-SD-1 ⁸ | BN-SW-1 ⁸ |
| -- | -- | -- | BN-SD-2 ⁸ | BN-SW-2 ⁸ |

Note: Sediment sample S101-SD14 and surface water sample S101-SW14 are part of the site's background data set.

¹ Sampling (or well/piezometer installation) associated with Phase I RFI Part 1

² 1999 additional background data sampling

³ Non-RFI samples collected at incorrect location

⁴ March 23, 2000 additional sediment sampling within Unzinger's Ditch

⁵ November 1, 2000 additional sediment sampling within Unzinger's Ditch

⁶ March 26, 2001 additional sediment sampling within Unzinger's Ditch

⁷ May 22, 2001 additional sediment sampling within the onsite NPDES-permitted siphon dam holding pond

⁸ October 25, 2006 additional sediment sampling within Unzinger's Ditch performed by B&N

In order to properly construct the additional drain located in the southeast corner of SWMU S108 required by the NPDES permit, the sediment buildup in the siphon dam holding ponds was removed. This occurred by using a large backhoe capable of reaching the bottom of each holding pond and placing the sediment into several 30 yd³ roll-off boxes whereby the sediment was fully characterized using El Corp Laboratories for TCLP analysis. Analytical results passed TCLP screening and showed the sediment to be non-hazardous allowing the sediment to be used as surface fill material onsite.

4.3.2.5 Analytical Results

Discussions of the analytical results for the soil, sediment, and surface water sampling are presented in the sections below. Five soil samples were collected from two discrete soil-sampling locations, 39 sediment samples from 36 discrete sediment-sampling locations (Note: S101-SD15 was collected from an incorrect location and is therefore not included in this sample count or in Table 4.3.2), and 16 surface water samples from 16 discrete surface water-sampling locations. Groundwater sampling results are presented in Section 4.7. Due to insufficient sample volume, one sample (S101-SB03 at 10-11 ft.) was not analyzed for metals or SVOCs. Table 4.3.2 and Table 4.3.2A contain a summary of all detected analytical results.

4.3.2.5.1 Soils

Inorganics

As a general note; all samples were not analyzed for inorganics at or below the 6 ft. depth interval.

Aluminum was detected in 2 of 2 samples in the surface to 5 ft. depth interval at concentrations of 12,700 (S101-SB02) and 18,400 mg/kg (S101-SB03). Concentrations of aluminum were detected in 2 of 2 samples in the 5-6 ft. depth interval at 16,000 (S101-SB02) and 23,400 mg/kg (S101-SB03).

Antimony was detected in one sample in the surface to 5 ft. depth interval at a concentration of 5.8J mg/kg (S101-SB02).

Arsenic concentrations exhibited a decrease with depth. Arsenic was detected in 2 of 2 samples in the surface to 5 ft. depth interval at concentrations of 26.5 (S101-SB03) and 11 mg/kg (S101-SB02). Concentrations of arsenic were detected in the 5-6 ft. depth interval at 8.5 (S101-SB02) and 5.4 mg/kg (S101-SB03).

Barium concentrations exhibited a decrease with depth. Barium was detected in 2 of 2 samples in the surface to 5 ft. depth interval at 295 (S101-SB02) and 276 mg/kg (S101-SB-03). Concentrations of barium were detected in 2 of 2 samples in the 5-6 ft. depth interval at 177 (S101-SB03) and 114 mg/kg (S101-SB02).

Cadmium concentrations exhibited a decrease with depth. Cadmium was detected in 2 of 2 samples in the surface to 5 ft. depth interval at 3.8J (S101-SB02) and 1.7 mg/kg (S101-SB03), but was not detected at or below the 5 ft. depth interval.

Chromium concentrations exhibited a decrease with depth. Chromium was detected in 2 of 2 samples in the surface to 5 ft depth interval at 48.1 J (S101-SB02) and 25.4 J mg/kg (S101-SB-03). Concentrations of chromium were detected in 2 of 2 samples in the 5-6 ft. depth interval at 23.3J (S101-SB02) and 23.3 J mg/kg (S101-SB03).

Cyanide was not detected in any samples at SWMU S101.

Lead concentrations exhibited a decrease with depth. Lead was detected in 2 of 2 samples in the surface to 5 ft. depth interval at 167 J (S101-SB02) and 35.0J mg/kg (S101-SB-03). Concentrations of lead were detected in 2 of 2 samples in the 5-6 ft. depth interval at 13.6 J (S101-SB03) and 10.0 J mg/kg (S101-SB02).

Mercury concentrations exhibited a decrease with depth. Mercury was detected in 2 of 2 samples in the surface to 5 ft. depth interval at 0.14 (S101-SB02) and 0.11 mg/kg (S101-SB-03). Concentrations of mercury were detected in 2 of 2 samples in the 5-6 ft. depth interval at 0.061 (S101-SB02) and 0.050 mg/kg (S101-SB03).

Selenium was detected in one sample in the surface to 5 ft. depth interval at a concentration of 0.52 mg/kg (S101-SB02).

Silver was not detected in any samples at SWMU S101.

SVOCs

SVOCs were detected in only two samples at SWMU S101. Six SVOCs were detected at S101-SB02 in the surface to 5 ft. depth interval, including butylbenzylphthalate (220 µg/kg), di-n-butylphthalate (720 µg/kg), fluoranthene (48 µg/kg), phenanthrene (42 µg/kg), pyrene (48 µg/kg), and bis(2-ethylhexyl) phthalate (1,400 µg/kg). Two SVOCs were detected in the surface to 5 ft. depth interval at S101-SB03. They were butylbenzylphthalate (230 µg/kg) and bis(2-ethylhexyl) phthalate (1,100 µg/kg). No SVOCs were detected at or below the 5 ft. depth interval.

VOCs

VOCs were detected in only one sample near the pond at SWMU S101. Concentrations of 2-butanone (44 µg/kg) and acetone (70 µg/kg) were detected at the 10-11 ft depth interval in S101-SB03.

4.3.2.5.2 Sediment

The likely source of the constituents observed at this unit within the sediment is stormwater drainage runoff. SWMU S101 receives runoff from two principle areas, the active plant and the inactive northeast area of the property, in the vicinity of SWMU S201. Based on this information, it would be expected that constituents observed at this unit would exhibit their highest concentrations in the sediment of the holding pond (S101-SD03) and at the pond's outlet (S101-SD04 and S101-SD08). Samples collected from S101-SD19 may indicate contamination from the siphon dam. Samples collected from S101-SD05 may also indicate contamination running off from the northeast property. Results from locations S101-SD01, S101-SD02, S101-SD06, S101-SD07, S101-SD13, S101-SD16, S101-SD17, and S101-SD18 are also useful; however, a railroad, roadways, and the industrial complex near Unzinger's Ditch are other potential sources of the constituents observed. Results from locations S101-SD09, S101-SD10, S101-SD11, S101-SD12, S101-SD16, S101-SD26, and S101-SD27 may indicate whether additional sources are contributing to the constituents. These samples were also collected much further from the plant.

Inorganics

Aluminum was detected in all of the sediment samples at SWMU S101. The highest concentrations of aluminum were detected at S101-SD05 (13,500 mg/kg) and S101-SD30 (13,000 mg/kg). Concentrations of aluminum at other sediment sample locations ranged 1,490 mg/kg (S101-SD23) to 10,800 mg/kg (S101-SD28).

Antimony was detected in 20 sediment samples at SWMU S101. Antimony was detected at concentrations ranging between 0.45 mg/kg (S101-SD23) and 18.9 mg/kg (S101-SD25).

Arsenic concentrations exhibited no discernable distribution pattern. Arsenic was detected in all of the sediment samples at SWMU S101. Concentrations were detected ranging from 3.0 mg/kg (S201-SD02) to 37.7 mg/kg (S101-SD21).

Barium was detected in all of the sediment samples at SWMU S101. The highest concentrations of barium were detected in the sediment of the pond's outfall (760 mg/kg at S101-SD19) and just beyond the 15-inch tile outfall (1,250 mg/kg at S101-SD25 and 695 mg/kg at S101-SD24). Concentrations of barium at the other sediment sample locations ranged from a maximum of 561 mg/kg (S101-SD03) to a minimum of 23 mg/kg (S101-SD13).

Cadmium was detected in 31 of 39 sediment samples. Cadmium was detected at its highest concentrations (11.4 mg/kg at S101-SD35 and 10.1 mg/kg at S101-SD34) in the onsite NPDES-permitted siphon dam. A concentration of 10.1 mg/kg was also detected at S101-SD25 in the sediment immediately down stream from the 15-inch tile outfall. The concentration of cadmium in the remaining sediment samples ranged from non-detect (eight locations) to 9.1 mg/kg (S101-SD24).

Chromium was detected in all of the sediment samples collected within SWMU S101. The highest detected concentrations were in the ponds outfall sediment (101 mg/kg at S101-SD19) and just beyond the 15-inch tile outfall (164J and 133J mg/kg at S101-SD25 S101-SD24, respectively). The concentrations detected in the remaining sediment samples ranged from 1.6 mg/kg (S101-SD29) to 69.3J mg/kg (S101-SD03).

Cyanide concentrations exhibited no discernable distribution pattern. Cyanide was detected in three of the 39 sediment samples collected within SWMU S101 in concentrations of 0.63 mg/kg (S101-SD08), 0.79J mg/kg (S101-SD03), and 0.84 mg/kg (S101-SD04).

Lead was detected in all 39 sediment samples collected within SWMU S101. Concentrations were greatest at S101-SD25 (775 mg/kg) and S101-SD24 (656 mg/kg) just south of the 15-inch tile outfall. The concentrations of lead detected in the remaining samples ranged from 9.3 (S101-SD16) to 385 J mg/kg (S101-SD03).

Mercury was detected in 33 of 39 sediment samples collected within SWMU S101. Mercury concentrations were detected in the pond sediment (0.27 mg/kg at S101-SD03), at the pond's outfall (0.15 mg/kg at S101-SD19), and beyond the 15-inch tile outfall (0.57 mg/kg at S101-SD25 and 0.36 mg/kg at S101-SD24). The concentrations in the remaining sediment samples ranged from non-detect at six locations to 0.33 mg/kg (S101-SD30). Mercury was not detected at the following six sediment locations: S101-SD01, S101-SD02, S101-SD05, S101-SD06, S101-SD07 and S101-SD23.

Selenium concentrations exhibited no discernable distribution pattern. Selenium was detected in 29 of 39 sediment samples collected within SWMU S101 in concentrations ranging from 0.35J (S101-SD03) to 14.4 mg/kg (BN-SD-2) just south of the 15-inch tile outfall.

Silver was detected in 14 of 39 sediment samples collected within SWMU S101 at concentrations ranging between 0.146 J mg/kg (BN-SD-1) and 167B mg/kg (S101-SD31).

SVOCs

Concentrations of SVOCs were detected in 38 of 39 samples collected within SWMU S101. The sample located farthest from the plant (S101-SD14) detected only one SVOC (fluoranthene at 42J $\mu\text{g}/\text{kg}$); however, this sample location is not in the same drainage system as Franklin Steel and is consider a background sample. Samples collected at two other locations (S101-SD24 and S101-SD25) detected only the SVOC bis(2-ethylhexyl)phthalate but at the two highest detected concentrations (620,000 $\mu\text{g}/\text{kg}$ and 400,000 $\mu\text{g}/\text{kg}$, respectively). It is noted that the laboratory diluted these two samples in order to bring the high concentrations of bis(2-ethylhexyl)phthalate to within the instrument calibration range, which has a potential to mask other low concentration SVOCs (including PAHs, which were detected in the next sample locations above and below samples S101-SD24 and S101-SD25) that may have been present in these two samples. Bis(2-ethylhexyl)phthalate was also detected at a concentration of 100,000 $\mu\text{g}/\text{kg}$ at S101-SD07. Low concentrations of SVOCs were detected at sample locations S101-SD12 and S101-SD27. No SVOC

concentration was detected in S101-SD32, located upstream from the 15-inch tile outfall. The sediment of the onsite NPDES-permitted holding ponds contained several SVOCs, including PAHs (sediment samples S101-SD03, S101-SD04, and S101-SD08). Additional sediment samples S101-SD33 through S101-SD35 were collected in May 2001 from the north side of the holding ponds and reported higher concentrations of SVOCs compared to previous sediment samples S101-SD03, S101-SD04, and S101-SD08 which were collected in 1993, 1995, and 1999, respectively.

In March 2003, Ohio EPA collected one sediment sample (CSD-ASH001) from the northwest (entrance) end of Pond #1. The sample was analyzed for metals, SVOCs, VOCs and TCLP. Metals analysis indicated elevated concentrations of cadmium, chromium, lead and zinc. SVOCs results indicated elevated concentrations of fluorine, phenanthrene, anthracene, fluoranthene, pyrene, chrysene, phthalate and benzo(a)pyrene. Various VOCs were detected, however, all were below representative PRG limits. TCLP analysis was either non-detect or below representative regulatory limits.

The tables below present a subset of the SVOC data for 24 selected locations.

| Constituent | SD01 µg/kg | SD03 µg/kg | SD04 µg/kg | SD06 µg/kg | SD07 µg/kg | SD08 µg/kg |
|----------------------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Benzo(a)pyrene | 1,400 | 130J | 110.00 J | 4,800 | ND | 130J |
| Butylbenzylphthalate | 160J | 220J | ND | ND | ND | 72J |
| Chrysene | 2,000 | 200J | 170.00 J | 5,900 | ND | 130J |
| Fluoranthene | 5,300 | 440J | 260.00 J | 13,000 | 1,800 J | 220J |
| Pyrene | 2,700 | 200J | 250.00 J | 6,600 | 1,200 J | 170J |
| bis(2-Ethylhexyl)phthalate | 330J | 3,500 | 1,200 | 4,000 | 100,000 | 600 |

| Constituent | SD09 µg/kg | SD10 µg/kg | SD11 µg/kg | SD12 µg/kg | SD13 µg/kg | SD16 µg/kg |
|----------------------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Benzo(a)pyrene | 510 | 340 | 230J | ND | 580 | 930 |
| Butylbenzylphthalate | ND | ND | ND | ND | 160J | ND |
| Chrysene | 610 | 400 | 270J | 52.00 J | 890 | 1,400 |
| Fluoranthene | 390 | 550 | 480 | 74.00 J | 2,100 | 3,400 |
| Pyrene | 420 | 380 | 330 | 53.00 J | 1,400 | 2,200 |
| bis(2-Ethylhexyl)phthalate | ND | 61J | ND | ND | 450 | ND |

| Constituent | SD17 µg /kg | SD18 µg /kg | SD24 µg /kg | SD25 µg /kg | SD27 µg /kg | SD29 µg /kg |
|----------------------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Benzo(a)pyrene | 810 | 670 | ND | ND | ND | ND |
| Butylbenzylphthalate | 52J | ND | ND | ND | ND | ND |
| Chrysene | 1,100 | 860 | ND | ND | ND | ND |
| Fluoranthene | 2,600 | 1,800 | ND | ND | 63 J | ND |
| Pyrene | 1,700 | 1,300 | ND | ND | ND | ND |
| bis(2-Ethylhexyl)phthalate | 690 | 180J | 620,000 | 400,000 | 120 J | 3,200 |

| Constituent | SD30 µg /kg | SD31 µg /kg | SD32 µg /kg | SD33 µg /kg | SD34 µg /kg | SD35 µg /kg |
|----------------------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Benzo(a)pyrene | ND | ND | ND | ND | ND | 1,700 J |
| Butylbenzylphthalate | ND | ND | ND | ND | ND | 2,100 J |
| Chrysene | ND | ND | ND | 1,100 J | 300 J | 2,000 J |
| Fluoranthene | ND | 630 J | ND | 2,400 J | 680 J | 5,700 |
| Pyrene | ND | 640 J | ND | 1,600 J | 430 J | 4,300 |
| bis(2-Ethylhexyl)phthalate | 13,000 | 7,800 | ND | 12,000 | 6,600 | 17,000 |

ND - Non-detect

VOCs

VOCs were detected sporadically in the sediment samples collected from SWMU S101. Fifteen of the 39 samples collected within SWMU S101 had detections of VOCs in sediment. 2-Butanone, toluene, ethylbenzene, xylene, acetone, trichloroethene and tetrachloroethene were detected in a few of the sediment samples, at concentrations ranging from 4J (tetrachloroethene at S101-SD03) to 28,000 µg/kg (xylene at S101-SD35). Only six sediment samples contained three or more VOCs. The sediment sample collected at S101-SD06 contained 2-butanone, acetone, and toluene at concentrations of 4.3J, 22J, and 6.8J µg/kg, respectively. Methylene chloride was the only VOC detected in sediment samples BN-SD-1 and BN-SD-2, however, both detections were reported with an A-01 laboratory data qualifier which are considered suspect and likely due to contamination from improper storage conditions by the laboratory.

The sediment sampled from the onsite NPDES-permitted holding ponds contained mostly toluene (max detection 1,500 µg/kg at S101-SD35), ethylbenzene (max detection 6,300 µg/kg at S101-SD35), and xylene (max detection 28,000 µg/kg at S101-SD35) with lower concentrations of VOCs including 1,2-dichloroethene (8J µg/kg) and trichloroethene (8J µg/kg).

4.3.2.5.2.1 Sediment Removal

Full TCLP composite samples were collected from sediment removed from the bottom of each holding pond within SWMU S101 during earthwork required under the NPDES permit and analyzed at El Corp Laboratories. All detectable constituents were found to be below the threshold limit for hazardous waste disposal. The results of these analytical samples can be found in Appendix F and are summarized below.

Arsenic was detected in all four samples. Concentrations detected ranged from 0.006 mg/L (Box 3) to 0.57 mg/L (Box 2).

Barium was detected in all four samples. Concentrations detected ranged from 1.13 mg/L (Box 4) to 1.46 mg/L (Box 2).

Cadmium was detected in all four samples. Concentrations detected ranged from 0.003 mg/L (Boxes 1, 3, and 4) to 0.081 mg/L (Box 3).

Chloroform was detected in three of the four samples. Concentrations ranged from non-detected (Box 2) to 0.218 mg/L (Box 4).

Chromium was detected in all four samples. Concentrations ranged from 0.026 mg/L (Box 3) to 0.407 mg/L (Box 2).

Lead was detected in all four samples. Concentration ranged from 0.255 mg/L (Box 1) to 0.465 mg/L (Box 3).

Mercury was detected in three of four samples. Concentrations ranged from non-detected (Box 2) to 0.0009 mg/L (Box 4).

Silver was detected in all four samples. Concentrations ranged from 0.0018 mg/L (Box 1) to 0.0046 mg/L (Box 4).

4.3.2.5.3 Surface Water

The surface water samples were collected at the same locations as the sediment samples. During the time the sediment samples were collected, three locations contained no water: S101-SD09, S101-SD12, and S101-SD15. Also a water sample was not collected at the holding pond corresponding to sediment location S101-SD03. A water sample was collected in the holding pond corresponding to sediment location S101-SD08. VOC analysis was completed for ten of the remaining sixteen sample locations. Water samples were collected from all other sediment-sampling locations. The water samples were always collected before collecting sediment samples. Samples were collected in order of their stream location, with the farthest downstream location being collected first, then progressing upstream to the farthest upstream locations.

Inorganics

Aluminum was detected in 15 of 16 samples. Aluminum concentrations ranged from 0.05 mg/L (BN-SW-2) to 4.54 mg/L (S101-SW01).

Antimony was detected in 4 of 16 samples. Antimony was detected at concentrations of 0.0168 mg/L (S101-SW01), 0.0243 mg/L (S101-SW02), 0.000217 J (BN-SW-1), and 0.000278 J (BN-SW-2).

Arsenic was detected in 8 of 16 samples. The maximum concentration was 0.0168 mg/L (S101-SW01). In the other water samples where arsenic was detected, concentrations ranged from 0.00184 mg/L (BN-SW-2) to 0.0083 mg/L (S101-SW04).

Barium was detected in all 16 samples. Concentrations ranged from a high of 0.339 mg/L (S101-SW01) to a low of 0.0637 mg/L (BN-SW-2). The majority of the lower concentrations of barium occurred at the sampling locations farthest away from the plant S101-SW18 (0.076B mg/L), S101-SW17 (0.078B mg/L), and S101-SW06 (0.079 mg/L).

Cadmium was not detected in any of the surface water samples.

Chromium was detected in four samples. Samples collected from locations S101-SW01, S101-SW02, S101-SW08, and BN-SW-2 contained chromium at concentrations of 0.0118, 0.0144, 0.019 mg/L, and 0.00103 mg/L, respectively.

Cyanide was detected in three samples, S101-SW01, S101-SW02, and S101-SW08. The concentrations of cyanide in these samples were 0.005, 0.0295, and 0.050J mg/L, respectively.

Lead was not detected in the surface water samples collected from the following locations: S101-SW05, S101-SW06, S101-SW11, S101-SW13, S101-SW16, and S101-SW18. At the remaining nine locations, lead concentrations ranged from 0.027 mg/L (S101-SW08) to 0.000780 J mg/L (BN-SW-2).

Mercury was detected at locations S101-SW01, S101-SW02, S101-SW17, and BN-SW-2. The concentration of mercury at these locations was 0.0002 mg/L, 0.0002 mg/L, 0.000099 mg/L, and 0.0000193 J mg/L, respectively.

Selenium was not detected in any of the surface water samples. Silver was detected at only one location, S101-SW02, at a concentration of 0.0045 mg/L.

SVOCs

SVOCs were detected most frequently in the surface water samples collected from S101-SW04, S101-SW07 and S101-SW08. Seven different SVOCs, most of them PAH compounds, were detected in sample S101-SW07. Benzo(a)pyrene (1.1 µg/L), benzo(b)fluoranthene (2.2 µg/L), benzo(k)fluoranthene (1.2 µg/L), chrysene (2.7 µg/L), fluoranthene (7.5 µg/L), phenanthrene (4.4 µg/L), and pyrene (5.6 µg/L) were all detected. Bis(2-ethylhexyl)phthalate was detected in two surface water samples, S101-SW01 (8 µg/L) and S101-SW02 (2 µg/L). Butyl benzyl phthalate was detected at location S101-SW18 at a concentration of 2.8J µg/L and di-n-butyl phthalate was detected at location S101-SW10. 2-Methylphenol was detected at concentrations of 15J µg/L and 4.6J µg/L at locations S101-SW04 and S101-SW10, respectively. 4-Methylphenol was detected at concentrations of 2J µg/L, 39J µg/L, and 8.1J µg/L at locations S101-SW01, S101-SW04, and S101-SW08, respectively. Phenol (3J µg/L at S101-SW01, 33J µg/L at S101-SW04, and 61 µg/L at S101-SW08), isophorone (120 µg/L at S101-SW04 and 7.1 µg/L at S101-SW08), and phenanthrene (6.6J µg/L at S101-SW04) were also detected.

VOCs

VOCs were detected in surface water samples collected from four of the eight locations where VOCs were collected. However, in three of these samples, only one VOC was detected. 4-Methylphenol was detected at S101-SW01 at 2 µg/L, and acetone was detected at two locations, S101-SW06 and S101-SW07, at concentrations of 6.0 and 8.4 µg/L, respectively.

Three VOC compounds were detected at location S101-SW04. Concentrations of 2-butanone (350 µg/L at S101-SW04 and 1.6J µg/L at S101-SW06), 4-methyl-2-pentanone (50J µg/L at S101-SW04), and acetone (810J µg/L at S101-SW04, 6.0J µg/L at S101-SW06, and 8.4J µg/L at S101-SW07) were detected.

4.3.2.6 Discussion

The soil samples collected around the holding pond indicate that the surface soils from the ground surface to 5 ft. depth interval may have been impacted with inorganic and SVOC constituents. The subsurface data indicate that these constituents not to have leached significantly into the subsurface. VOCs do not appear to be a concern in the soils from 0 to 5 feet bgs.

The sediment and surface water data indicate that metals and volatile constituents may be present within the storm runoff system and that these constituents may have caused the elevated concentrations, in the onsite NPDES-permitted holding ponds (S101-SD03 and S101-SD04), at the holding pond's outfall (S101-SD19) and just south of the 15-inch tile outfall (S101-SD24 and S101-SD25). The metals data consistently suggest that the greatest impact occurs at these locations and the VOC data also support this (S101-SD03). The surface water sampling results also show that the greatest concentration of VOCs occur within the holding ponds (S101-SW04).

The SVOC data indicate that the stormwater runoff system may contribute SVOC constituents to the sediment of the holding pond. However, the greatest concentrations of SVOCs, including PAHs, occur at the holding pond outfall (S101-SD19) and just beyond the 15-inch tile (S101-SD24 and S101-SD25) in Unzinger's Ditch. The concentrations of SVOCs in the pond sediment are much less, as shown in Table 4.3.2. Note that concentrations of PAHs also occur at stream locations not directly affected by plant runoff. It is anticipated that roadways, a railroad, and a large industrial park complex to the southeast of the Franklin Steel site contribute to the occurrence of PAHs in this area.

4.3.3 SWMU S102 - Sanitary Sewer Lines and Valve Pit

4.3.3.1 Unit Description

The facility operates a wastewater pretreatment system (WWTP) on-site. The system is, as defined by the design engineering firm, a state of the art wastewater treatment facility designed to remove solids, metals and oil and grease from the wastewater generated at the plant prior to discharge to the City of Columbus sanitary sewer system. All process waters are treated by the WWTP.

A valve was installed during the May 1988 WWTP installation that connects a floor drain within the caustic-wash room to the WWTP. The valve is located south of the caustic-wash room. On August 8, 1988, cloudy brown water was observed in the valve pit by an Ohio EPA inspector during a routine inspection.

A Franklin Steel representative indicated that the cloudy brown water in the valve pit may have been discharged from an open sewer line during installation of the WWTP (CSD, 10/13/1988). The floor drain was installed in the building at the time of construction in 1985 to provide an outlet for non-contact cooling water for any machines in the building. The floor in the caustic-wash room is sloped such that drainage in this area returns to a steel-lined sump via steel-lined trench drains at the perimeter of the caustic-wash room (CSD, 11/30/88). Fluids in these trenches are collected in a 1,000-gallon sump, where they are pumped via polyurethane hose to the caustic clarifier system.

4.3.3.2 Potential Contaminants

Runoff from the floor of the caustic-wash room and other wastewater streams transport chemicals and suspended solids to the WWTP. Breaches in the containment of the valve pit and other components of the transport system potentially could introduce those contaminants to the local environmental media.

4.3.3.3 Potential Releases

There are no known or documented releases from this unit.

4.3.3.4 Summary of Investigation

One surface soil sample was collected south of the caustic wash room during the Phase I RFI sampling in October 1993. The RFI Part 1 Phase II sampling consisted of two soil borings, also installed on the south side of the caustic wash room with one soil boring located on either side of the valve pit. These sample locations are shown in the table below.

| SWMU S102 SAMPLING SUMMARY | | | | |
|----------------------------|-------------|------------------|----------|---------------|
| SURFACE SOIL | SOIL BORING | WELL/ PIEZOMETER | SEDIMENT | SURFACE WATER |
| S102-SS01 ¹ | S102-SB01 | -- | -- | -- |
| -- | S102-SB02 | -- | -- | -- |

¹Sampling (or well/piezometer installation) associated with Phase I of the RFI Part I

4.3.3.5 Analytical Results

A discussion of the analytical results for the soil sampling is presented in the sections below. Ten soil samples were collected from three discrete sampling locations. This includes three samples from the surface to 5 ft. depth interval, two from the 5-10 ft. depth interval and five at or below the 10 ft. depth interval. A summary of all detected analytical results is located in Table 4.3.3.

Inorganics

Aluminum concentrations exhibited no definite trend with depth. Aluminum was detected in 3 of 3 samples in the surface to 5 ft depth interval at concentrations ranging from 1,460 mg/kg (S102-SB01) to 12,500 mg/kg (S102-SB02). Concentrations of aluminum were detected in 2 of 2 samples in the 5-10 ft depth interval at concentrations of 12,600 mg/kg (S102-SB01) and 13,100 mg/kg (S102-SB02). Concentrations were detected in 5 of 5 samples at or below the 10 ft. level ranging from 3,570 mg/kg (S102-SB02) to 14,000 mg/kg (S102-SB01).

Antimony concentrations exhibited a decrease with depth. Antimony was detected in 2 of 3 samples in the surface to 5 ft depth interval at concentrations of 3.7 J mg/kg (S102-SS01) and 2.1 mg/kg (S102-SB02). Antimony was not detected at or below the 5 ft depth interval.

Arsenic concentrations generally increase with depth, with the highest concentration occurring in the 10-11 ft interval at S102-SB02 (32.9 mg/kg). Arsenic was detected in 3 of 3 samples in the surface to 5 ft depth interval at concentrations ranging from 3.6 mg/kg (S102-SB02) to 9.0J mg/kg (S102-SS01). Concentrations of arsenic were detected in 2 of 2 samples in the 5-10 ft depth interval at concentrations of 22.4 mg/kg (S102-SB01) and 20.6 mg/kg (S102-SB02). Concentrations were detected in 5 of 5 samples at or below the 10 ft depth interval ranging from 8.9 mg/kg (S102-SB02) to 32.9 mg/kg (S102-SB02).

Barium concentrations exhibited no definite trend with depth. Barium was detected in 3 of 3 samples in the surface to 5 ft depth interval at concentrations ranging from 55.9 mg/kg (S102-SB01) to 139 mg/kg (S102-SB02). Concentrations of barium were detected in 2 of 2 samples in the 5-10 ft depth interval at concentrations of 120 mg/kg (S102-SB01) and 116 mg/kg (S102-SB02). Concentrations were detected in 5 of 5 samples at or below the 10 ft depth interval ranging from 32.7 mg/kg (S102-SB02) to 329 mg/kg (S102-SB02).

Cadmium concentrations generally decreased with depth. Cadmium was detected in 2 of 3 samples in the surface to 5 ft depth interval at concentrations of 0.57 mg/kg (S102-SB02) and 1.3J mg/kg (S102-SS01). Concentrations of cadmium were detected in 2 of 2 samples in the 5-10 ft depth interval at concentrations of 0.62 mg/kg (S102-SB01) and 0.57 mg/kg (S102-SB02). Concentrations were detected in only one sample at or below the 10 ft depth interval at 1.4 mg/kg (S102-SB02).

Chromium concentrations did not exhibit a definite trend with depth. Chromium was detected in 3 of 3 samples in the surface to 5 ft depth interval at concentrations ranging from 6.4 mg/kg (S102-SB01) to 26.6 mg/kg (S102-SS01). Concentrations of chromium were detected in 2 of 2 samples in the 5-10 ft. depth interval at concentrations of 18.3 mg/kg (S102-SB01) and 17.9 mg/kg (S102-SB02). Concentrations were detected in 5 of 5 samples at or below the 10 ft depth interval ranging from 7.8 mg/kg (S102-SB02) to 19.3 mg/kg (S102-SB01).

Copper concentrations did not exhibit a definite trend with depth. Copper was detected in 3 of 3 samples in the surface to 5 ft depth interval at concentrations ranging from 11.10 mg/kg (S102-SB01) to 28.10 mg/kg (S102-SB02). Concentrations of copper were detected in 2 of 2 samples in the 5-10 ft. depth interval at concentrations of 25.0 mg/kg (S102-SB02) and 31.30 mg/kg (S102-SB01). Concentrations were detected in 5 of 5 samples at or below the 10 ft depth interval ranging from 16.10 mg/kg (S102-SB02) to 18.10 mg/kg (S102-SB01).

Cyanide was not identified in any samples at SWMU S102.

Concentrations of lead exhibited a general decrease with depth. Lead was detected in 3 of 3 samples in the surface to 5 ft depth interval at concentrations ranging from 16.9 mg/kg (S102-SB01) to 301J mg/kg (S102-SS01). Concentrations of lead were detected in 2 of 2 samples in the 5-10 ft depth interval at concentrations of 58.7 mg/kg (S102-SB01) and 23.3 mg/kg (S102-SB02). Concentrations were detected in 5 of 5 samples at or below the 10 ft. depth interval ranging from 8.6 mg/kg (S102-SB02) to 23.3 mg/kg (S102-SB02).

Mercury concentrations did not show a definite trend with depth. Mercury was detected in 2 of 3 samples in the surface to 5 ft. depth interval at concentrations of 0.011J mg/kg (S102-SB01) and 0.042J mg/kg (S102-SB02). Concentrations of mercury were detected in 2 of 2 samples in the 5-10 ft depth interval at concentrations of 0.035J mg/kg (S102-SB01) and 0.032J mg/kg (S102-SB02). Concentrations were detected in only one sample at or below the 10 ft depth interval (0.028J mg/kg at S102-SB02).

Nickel concentrations did not show a definite trend with depth. Nickel was detected in 3 of 3 samples in the surface to 5 ft. depth interval at concentrations of 11.1 J mg/kg (S102-SB01) and 34.5 mg/kg (S102-SB02). Concentrations of nickel were detected in 2 of 2 samples in the 5-10 ft depth interval at concentrations of 32.8J mg/kg (S102-SB01) and 48.6J mg/kg (S102-SB01). Concentrations were detected in 5 of 5 samples at or below the 10 ft depth interval ranging from 19.8 mg/kg at S102-SB02 to 22.40 mg/kg at S102-SB01.

Selenium was detected in only 2 out of 11 samples. Selenium was detected at or below the 10 ft. depth interval, at a concentration of 1.9 mg/kg (S102-SB01) and 0.54 mg/kg (S102-SB02).

Silver was detected in one sample at SWMU S102. Silver was detected in the surface to 5 ft. depth interval at a concentration of 0.52 mg/kg (S102-SS01).

Zinc concentrations did not show a definite trend with depth. Zinc was detected in 3 of 3 samples in the surface to 5 ft. depth interval at concentrations of 34.0 mg/kg (S102-SB01) and 162J mg/kg (S102-SS01). Concentrations of zinc were detected in 2 of 2 samples in the 5-10 ft depth interval at concentrations of 111 mg/kg (S102-SB01) and 119 mg/kg (S102-SB02). Concentrations were detected in 5 of 5 samples at or below the 10 ft depth interval ranging from 66.4 mg/kg at S102-SB02 to 73.2 mg/kg at S102-SB01.

SVOCs

Several SVOCs were detected at SWMU S102 in the surface to 5 ft. depth interval, but none were detected at or below the 5 ft. depth interval. Only bis(2-ethylhexyl)phthalate was detected consistently. Butylbenzyl phthalate was detected at a concentration of 66J $\mu\text{g}/\text{kg}$ (S102-SS01) and 75J $\mu\text{g}/\text{kg}$ (S102-SB01). Di-n-octylphthalate was detected at a concentration of 34J $\mu\text{g}/\text{kg}$ (S102-SS01). Pyrene (43J $\mu\text{g}/\text{kg}$ at S102-SB02) and di-n-butylphthalate (1400 $\mu\text{g}/\text{kg}$ at S102-SS01) were also detected.

Bis(2-ethylhexyl)phthalate was detected in 5 of 10 samples at concentrations ranging from 120 J (S102-SB01 in the surface to 5 ft. depth interval) to 670 $\mu\text{g}/\text{kg}$ (S102-SB01 in the surface to 5 ft depth interval). Four of these detections occurred in the surface to 5 ft. depth interval; one occurred in the 5-10 ft. depth interval; and one at or below the 10 ft. depth interval.

VOCs

VOCs were detected sporadically and at low concentrations from the soil samples taken from SWMU S102. 2-Butanone and acetone were the only two VOCs frequently detected (2-butanone in 3 of 10 samples and acetone in 6 of 10 samples). Ethylbenzene was detected in one sample (25 $\mu\text{g}/\text{kg}$ at S102-SB01 in the 5 - 10 ft. depth interval), methylene chloride in two samples (3.1J $\mu\text{g}/\text{kg}$ at S102-SB01 and 2.9J $\mu\text{g}/\text{kg}$ at S102-SB01, both at or below the 10 ft. depth interval), tetrachloroethene in one sample (2.5J $\mu\text{g}/\text{kg}$ at 2.5J at S102-SB02 in the surface to 5 ft. depth interval), and total xylenes in one sample (2.6J $\mu\text{g}/\text{kg}$ at S102-SB02 in the surface to 5 ft. depth interval). There was no definite distribution exhibited with depth for these concentrations.

Concentrations of 2-butanone did not exhibit a definite trend with depth. 2-Butanone was not found in any samples in the surface to 5 ft. depth interval. Concentrations of 2-butanone were detected in one sample in the 5-10 ft. depth interval (10J $\mu\text{g}/\text{kg}$ at S102-SB02). Concentrations were detected in 2 of 5 samples at or below the 10 ft. depth interval at concentrations of 8.0J $\mu\text{g}/\text{kg}$ (S102-SB01) and 10J (S102-SB02).

Acetone was detected in 6 of 10 samples. Acetone was detected in the surface to 5 ft depth interval only once (56 $\mu\text{g}/\text{kg}$ at S102-SS01), twice in the 5-10 ft. depth interval (56 $\mu\text{g}/\text{kg}$ at S102-SS01 and 70 $\mu\text{g}/\text{kg}$ at S102-SB02), and four times at or below the 10 ft. depth interval (between 19J $\mu\text{g}/\text{kg}$ at S102-SB01 and 46 $\mu\text{g}/\text{kg}$ at S102-SB01).

4.3.3.6 Discussion

There is no strong evidence for impact to soil at SWMU S102 by inorganic constituents. Most of the RCRA metals were not detected (barium, cadmium, chromium, mercury) or they are infrequently detected (selenium, silver). Lead and arsenic were the only two inorganics that appear to demonstrate a distribution trend, with arsenic concentrations increasing with depth and lead concentrations decreasing with depth. A comparison against background inorganic concentrations is necessary to determine if the levels detected are above those normally expected of the ten samples which contained arsenic, one is above the highest background reading for arsenic and of the ten samples which contained lead, three are above the highest background reading for lead. The presence of anthropogenic shallow fill material in the industrial area of the plant make it difficult to determine whether waste management practices were the source of the constituents.

Bis(2-ethylhexyl)phthalate was detected in 5 of 10 samples at concentrations ranging from 120 to 670 $\mu\text{g}/\text{kg}$. Other SVOCs were detected sporadically. Bis(2-ethylhexyl)phthalate was the only SVOC whose presence in the soil at SWMU S102 is consistent.

Several VOCs were detected, but only 2-butanone and acetone were detected frequently. All VOCs detected were found at extremely low concentrations. There is no evidence that acetone and 2-butanone were used in the operations at this unit.

4.3.4 SWMU S103 - Shot Blast Dust Collector

4.3.4.1 Unit Description

Two operative shot blast dust collector systems are located near the northeast corner of the plant building. The northern collector system is a triple unit and is used for the lids and rings. The southern collector system, a double unit, is used for the open head drums. Both systems contain cyclones and storage sheds used to contain filled dust bags prior to off-site recycling. These dust collectors have been used continuously at the site since operation began in 1971. A third dust collector (single unit) system located on the southwest side of the reconditioning plant, ceased operation in the mid-1980s and was decommissioned and replaced by the double unit in 1985. However, the current operator of the reconditioning facility has returned this single unit back into the manufacturing operations of the site.

The used shot is sold as a substitute for a recycled commercial product. The shot blast dust is considered by the Ohio EPA to be a recycled solid waste and is therefore exempt from hazardous waste regulation (Ohio EPA, 4/11/90).

4.3.4.2 Potential Contaminants

Metals are the primary potential contaminants from the operations of the shot blast dust collector. Contamination of soil from lead and non-RCRA metals such as zinc and iron may be of particular concern at this site.

During an inspection of the facility on March 20, 1987, one surface soil sample was collected in the shot blast dust area ("Hot Spot" Location 5) on the northeast corner of the drum reconditioning building (Figure 1). Analytical results are summarized below:

| <u>Constituent</u> | <u>Hot Spot 5</u> |
|--------------------|-------------------|
| EP Toxic Lead | 8,220 µg/kg |
| Lead | 3,760 mg/kg |
| Chromium | 717 mg/kg |
| Cadmium | 82.2 mg/kg |
| Arsenic | 3.1 mg/kg |
| Mercury | 0.029 mg/kg |
| Selenium | 16.0 mg/kg |
| Zinc | 2,820 mg/kg |
| Barium | 3,830 mg/kg |

4.3.4.3 Potential Releases

There are no known or documented releases from this unit.

4.3.4.4 Summary of Investigation

One surface soil sample was collected from the southeast corner of the northern collection unit during the Phase I of RFI Part 1 in October 1993. During the RFI Part 1 Phase II fieldwork, three soil borings were installed at the unit. All three borings were located near the northern collection unit. Samples were collected at the surface (0 to 2 feet bgs) and every five feet bgs until refusal or groundwater was encountered. These sample locations from SWMU S103 are shown in the table below.

| SWMU S103 SAMPLING SUMMARY | | | | |
|----------------------------|-------------|-----------------|----------|---------------|
| SURFACE SOIL | SOIL BORING | WELL/PIEZOMETER | SEDIMENT | SURFACE WATER |
| S103-SS01 ¹ | S103-SB01 | -- | -- | -- |
| -- | S103-SB02 | -- | -- | -- |
| -- | S103-SB03 | -- | -- | -- |

¹ Sampling (or well/piezometer installation) associated with Phase I RFI Part 1

4.3.4.5 Analytical Results

A discussion of the analytical soil sampling results is presented in the sections below. Thirteen soil samples were collected from the four discrete sampling locations. Samples collected during Phase I of RFI Part 1 (S103-SS01 at 0- 1 ft. and 2-3 ft.) were not analyzed for SVOC and VOCs. A summary of all detected analytical results is contained in Table 4.3.4.

Inorganics

Aluminum concentrations exhibited no definite trend with depth. Concentrations were detected in 5 of 5 samples in the surface to 5 ft. depth interval ranging from 5,720 J mg/kg (S103-SS01) to 11,000 mg/kg (S103-SB01). Concentrations of aluminum were detected in 3 of 3 samples in the 5-10 ft. depth interval ranging from 10,500 mg/kg (S103-SB01) to 15,600 mg/kg (S103-SB03). Concentrations were detected in 5 of 5 samples at or below the 10 ft. depth interval ranging from 3,770 mg/kg (S103-SB03) to 13,800 mg/kg (S103-SB02).

Antimony concentrations exhibited a decrease with depth. Antimony was detected in 4 of 5 samples in the surface to 5 ft depth interval at concentrations ranging from 9.70J mg/kg (S103-SS01) to 25.3 mg/kg (S103-SB02). Concentrations of antimony were not detected at or below the 5 ft depth interval.

Arsenic concentrations exhibited no definite trend with depth. Arsenic was detected in 4 of 5 samples in the surface to 5 ft. depth interval ranging from 10.8 mg/kg (S103-SB03) to 21.9 mg/kg (S103-SB01). Concentrations of arsenic were detected in 3 of 3 samples in the 5-10 ft. depth interval ranging from 901 mg/kg (S103-SB01) to 16.9 mg/kg (S103-SB03). Concentrations were detected in 5 of 5 samples at or below the 10 ft. depth interval ranging from 11.9 mg/kg (S103-SB02) to 20.7 mg/kg (S103-SB03).

Concentrations of barium appeared to decrease with depth. Barium was detected in 5 of 5 samples in the surface to 5 ft. depth interval ranging from 159 mg/kg (S103-SB01) to 1,090 mg/kg (S103-SB03). Concentrations of barium were detected in 3 of 3 samples in the 5-10 ft. depth interval ranging from 111 mg/kg (S103-SB01) to 183 mg/kg (S103-SB02). Concentrations were detected in 5 of 5 samples at or below the 10 ft. depth interval ranging from 67.6 mg/kg (S103-SB02) to 220 mg/kg (S103-SB02).

Cadmium concentrations exhibited no definite trend with depth. Cadmium was detected in 4 of 5 samples in the surface to 5 ft. depth interval ranging from 0.51 mg/kg (S103-SB01) to 12.8 mg/kg (S103-SB03). Concentrations of cadmium were detected in 1 of 3 samples in the 5-10 ft. depth interval at 0.58 mg/kg (S103-SB02). Concentrations were detected in 5 of 5 samples at or below the 10 ft. depth interval ranging from 0.50 mg/kg (S103-SB01) to 1.5 mg/kg (S103-SB03).

Chromium concentrations exhibited a decrease with depth. Chromium was detected in 5 of 5 samples in the surface to 5 ft. depth interval ranging from 20.1J mg/kg (S103-SB01) to 205J mg/kg (S103-SB02). Concentrations of chromium were detected in 3 of 3 samples in the 5-10 ft. depth interval ranging from 14.6J mg/kg (S103-SB01) to 23.2J mg/kg (S103-SB02). Concentrations were detected in 5 of 5 samples at or below the 10 ft. depth interval ranging from 9.2J mg/kg (S103-SB03) to 30.9J mg/kg (S103-SB02).

Copper concentrations exhibited a decrease with depth. Copper was detected in 4 of 5 samples in the surface to 5 ft. depth interval ranging from 33.5J mg/kg (S103-SB01) to 206 mg/kg (S103-SB03). Concentrations of copper were detected in 3 of 3 samples in the 5-10 ft. depth interval ranging from 11.6 mg/kg (S103-SB01) to 24.3 mg/kg (S103-SB02). Concentrations were detected in 5 of 5 samples at or below the 10 ft. depth interval ranging from 27.9 mg/kg (S103-SB03) to 42.6 mg/kg (S103-SB02).

Cyanide was not detected in any samples at SWMU S103.

Lead concentrations generally exhibited a decrease with depth. Lead was detected in 5 of 5 samples in the surface to 5 ft. depth interval ranging from 36.2J mg/kg (S103-SB01) to 1,110J mg/kg (S103-SB02). Concentrations of lead were detected in 3 of 3 samples in the 5-10 ft. depth interval ranging from 18.3J mg/kg (S103-SB01) to 64.8J mg/kg (S103-SB02). Concentrations were detected in 5 of 5 samples at or below the 10 ft. depth interval ranging from 16.0J mg/kg (S103-SB03) to 66.3J mg/kg (S103-SB02).

Mercury concentrations generally exhibited a decrease with depth. Concentrations of mercury were found in all of the samples at SWMU S103 except in S103-SS01. Detections were in a narrow concentration range from 0.032 mg/kg (S103-SB03 at or below the 10 ft. depth interval) to 0.11 mg/kg (S103-SB03 in the surface to 5 ft. depth interval).

Nickel concentrations exhibited no definite trend with depth. Nickel was detected in 3 of 5 samples in the surface to 5 ft. depth interval ranging from 39.8 mg/kg (S103-SB01) to 58.8 mg/kg (S103-SB03). Concentrations of nickel were detected in 3 of 3 samples in the 5-10 ft. depth interval ranging from 15.9 mg/kg (S103-SB01) to 21.7 mg/kg (S103-SB02). Concentrations were detected in 5 of 5 samples at or below the 10 ft. depth interval ranging from 29.6 mg/kg (S103-SB02) to 51.8 mg/kg (S103-SB01).

Selenium concentrations exhibited no definite trend with depth. Selenium was detected in 3 of 5 samples in the surface to 5 ft. depth interval at concentrations ranging from 0.86 mg/kg (S103-SB01) and 4.6 mg/kg (S103-SB03). Concentrations of selenium were detected in 3 of 3 samples in the 5-10 ft. depth interval ranging from 0.85 mg/kg (S103-SB03) to 0.88 mg/kg (S103-SB01 and SB02). Concentrations were detected in 4 of 5 samples at or below the 10 ft. depth interval ranging from 0.92 mg/kg (S103-SB03) to 2.5 mg/kg (S103-SB02).

Silver was not detected in any samples at SWMU S103.

Zinc concentrations exhibited a decreasing trend with depth. Zinc was detected in 4 of 5 samples in the surface to 5 ft. depth interval ranging from 144 mg/kg (S103-SB01) to 1,214 mg/kg (S103-SB03). Concentrations of zinc were detected in 3 of 3 samples in the 5-10 ft. depth interval ranging from 69.9 mg/kg (S103-SB01) to 131J mg/kg (S103-SB02). Concentrations were detected in 5 of 5 samples at or below the 10 ft. depth interval ranging from 110 mg/kg (S103-SB03) to 198 mg/kg (S103-SB02).

SVOCs

Bis(2-ethylhexyl)phthalate was detected in 2 of 5 samples in the surface to 5 ft. depth interval at concentrations of 990 µg/kg (S103-SB02) and 3,000 µg/kg (S103-SB03). Concentrations were also detected in S103-SB03 in both the 5 - 10 ft. depth interval and at or below the 10 ft. depth interval in concentrations of 570 and 45 µg/kg, respectively.

The only other SVOC detected was butylbenzylphthalate. Concentrations of butylbenzylphthalate were detected in the surface to 5 ft. depth interval at concentrations of 130J µg/kg (S103-SB02) and 170J µg/kg (S103-SB03).

VOCs

VOCs were only detected in S103-SB02 in the 5-10 ft. depth interval. 2-Butanone and toluene were detected in this sample at concentrations of 12J and 5.1J µg/kg, respectively.

4.3.4.6 Discussion

The probable constituents of concern at a shot blast dust collector are metals. Soil sampling in the area would not be expected to reveal organic contamination, and the results of the VOC and SVOC sampling support this. Only bis(2-ethylhexyl)phthalate was frequently detected and this SVOC is ubiquitous in the plant area.

The inorganic data strongly suggest a surface soil impact in the vicinity of the shot blast dust collector. Several of the RCRA metals described above exhibit concentration profiles that suggest surface deposition of metals on the surface of the soil. The highest concentrations of barium, cadmium, chromium, lead, and mercury all occur in the 0-1 ft. interval. Only arsenic and selenium did not exhibit a similar trend. Silver was not detected at SWMU S103.

There is also evidence that the metal contamination is localized within the top 12 inches of soil. Three of the metals (cadmium, lead, and mercury) that are concentrated at the surface do not exhibit a decreasing trend below the 0-1 ft. interval. Evidence of a decreasing trend below the 0-1 ft. interval, such as exhibited by chromium and barium, may be explained by differences in soil leaching characteristics.

4.3.5 SWMU S104 - Former Shot Blast Dust Storage Area

4.3.5.1 Unit Description

Prior to the construction of storage sheds that contain the shot dust bags, the shot blast dust was stored in drums near the northern property boundary, just east of the lids and rings dust collector. This area is not currently used for storing shot blast dust.

4.3.5.2 Potential Contaminants

The potential contaminants at SWMU S104 are the same as those at SWMU S103. Metals are the primary potential contaminants of shot blast dust. Spills or unsealed containers could have released metal constituents into the soil at this unit.

4.3.5.3 Potential Releases

There are no known or documented releases from this unit.

4.3.5.4 Summary of Investigation

One surface soil sample was collected during the Phase I RFI Part I activities in 1993. The two soil borings were advanced during RFI Part I Phase II.

| SWMU S104 SAMPLING SUMMARY | | | | |
|----------------------------|-------------|------------------|----------|---------------|
| SURFACE SOIL | SOIL BORING | WELL/ PIEZOMETER | SEDIMENT | SURFACE WATER |
| S104-SS01 ¹ | S104-SB01 | -- | -- | -- |
| -- | S104-SB02 | -- | -- | -- |

¹ Sampling (or well/piezometer installation) associated with Phase I RFI Part I

4.3.5.5 Analytical Results

A discussion of the analytical results for the soil sampling is presented in the sections below. Nine soil samples were collected from the three discrete sampling locations. Samples collected during Phase I of RFI Part I (S104-SS01 at 0-1 ft. and 2-3 ft.) were not analyzed for SVOC and VOCs. During RFI Part I Phase II investigations, samples were analyzed for metals only, unless a reading above background concentrations was registered while screening a sample with an Organic Vapor Analyzer. In this case (only at S104-SB01 at 5-6 ft.) the sample was analyzed for SVOC and VOC. A summary of all detected analytical results is found in Table 4.3.5.

Inorganics

Aluminum concentrations did not exhibit a distribution trend with depth. Aluminum was detected in 4 of 4 samples in the surface to 5 ft. depth interval at concentrations ranging from 7,700 mg/kg (S104-SB02) to 19,200 mg/kg (S104-SB01). Concentrations of aluminum were detected in 2 of 2 samples in the 5-10 ft. depth interval at 9,970 mg/kg (S104-SB01) and 9,620 mg/kg (S104-SB02). Concentrations were detected in 3 of 3 samples at or below the 10 ft. depth interval ranging from 4,660 mg/kg (S104-SB01) to 6,660 mg/kg (S104-SB02).

Antimony concentrations exhibited a decrease with depth. Antimony was detected in 3 of 4 samples in the surface to 5 ft depth interval at concentrations ranging from 3.1J mg/kg (S104-SB01) to 10.5J mg/kg (S104-SB02). Concentrations of antimony were not detected at or below the 5 ft depth interval.

Arsenic concentrations did not exhibit a distribution trend with depth. Arsenic was detected in 4 of 4 samples in the surface to 5 ft. depth interval at concentrations ranging from 9.5 mg/kg (S104-SB02) to 16.1 J mg/kg (S104-SS01). Concentrations of arsenic were detected in 2 of 2 samples in the 5-10 ft. depth interval at 12.8 mg/kg (S104-SB01) and 16.7 mg/kg (S104-SB02). Concentrations were detected in 3 of 3 samples at or below the 10 ft depth interval ranging from 15.2 mg/kg (S104-SB01) to 19.6 mg/kg (S104-SB01).

Barium concentrations exhibited a definite decreasing trend with depth. Barium was detected in 4 of 4 samples in the surface to 5 ft. depth interval ranging from 108 J mg/kg (S104-SS01) to 615 mg/kg (S104-SB02). Concentrations of barium were detected in 2 of 2 samples in the 5-10 ft. depth interval at 111 mg/kg (S104-SB01) and 132 mg/kg (S104-SB02). Concentrations were detected in 3 of 3 samples at or below the 10 ft. depth interval ranging from 63.1 mg/kg (S104-SB01) to 87.6 mg/kg (S104-SB01).

Cadmium generally exhibited a decrease with depth. Cadmium was detected in 3 of 4 samples in the surface to 5 ft. depth interval at concentrations ranging from 1.6 mg/kg (S104-SB01) to 4.1 mg/kg (S104-SB02). Concentrations of cadmium were detected in 1 of 2 samples in the 5-10 ft. depth interval at 0.66 mg/kg (S104-SB02). Concentrations were detected in 3 of 3 samples at or below the 10 ft. depth interval ranging from 0.49 mg/kg (S104-SB01) to 0.84 mg/kg (S104-SB02).

Chromium concentrations exhibited a definite decreasing trend with depth. Chromium was detected in 4 of 4 samples in the surface to 5 ft. depth interval ranging from 33.3 mg/kg (S104-SB01) to 97.90J mg/kg (S104-SS01). Concentrations of chromium were detected in 2 of 2 samples in the 5-10 ft. depth interval at 13.6 mg/kg (S104-SB01) and 15.6 mg/kg (S104-SB02). Concentrations were detected in 3 of 3 samples at or below the 10 ft. depth interval ranging from 7.9 mg/kg (S104-SB01) to 12.4 mg/kg (S104-SB02).

Copper concentrations exhibited a definite decreasing trend with depth. Copper was detected in 4 of 4 samples in the surface to 5 ft. depth interval ranging from 27.5 mg/kg (S104-SS01) to 108 mg/kg (S104-SS01). Concentrations of copper were detected in 2 of 2 samples in the 5-10 ft. depth interval at 17.0 mg/kg (S104-SB01) and 30.6 mg/kg (S104-SB02). Concentrations were detected in 3 of 3 samples at or below the 10 ft. depth interval ranging from 21.8 mg/kg (S104-SB02) to 23.6 mg/kg (S104-SB01).

Cyanide was not detected in any samples at SWMU S104.

Lead concentrations exhibited a decreasing trend with depth. Lead was detected in 4 of 4 samples in the surface to 5 ft. depth interval ranging from 26.1 J mg/kg (S104-SS01) to 810.0 J mg/kg (S104-SS01). Concentrations of lead were detected in 2 of 2 samples in the 5-10 ft. depth interval at 26.1 J mg/kg (S104-SB01) and 18.5 J mg/kg (S104-SB02). Concentrations were detected in 3 of 3 samples at or below the 10 ft. depth interval ranging from 9.8J mg/kg (S104-SB02) to 17.3 J mg/kg (S104-SB01).

Mercury concentrations generally exhibited a decreasing trend with depth. Mercury was detected in 3 of 4 samples in the surface to 5 ft. depth interval ranging from 0.085 mg/kg (S104-SB01) to 1.00 mg/kg (S104-SS01). Concentrations of mercury were detected in 2 of 2 samples in the 5-10 ft. depth interval at 0.089 mg/kg (S104-SB01) and 0.051 mg/kg (S104-SB02). Concentrations were detected in 3 of 3 samples at or below the 10 ft. depth interval ranging from 0.019 mg/kg (S104-SB01) to 0.030 mg/kg (S104-SB01).

Nickel concentrations generally exhibited a decreasing trend with depth. Nickel was detected in 4 of 4 samples in the surface to 5 ft. depth interval ranging from 22.3 mg/kg (S104-SS01) to 48.9 mg/kg (S104-SS01). Concentrations of nickel were detected in 2 of 2 samples in the 5-10 ft. depth interval at 16.7 mg/kg (S104-SB01) and 38.0 mg/kg (S104-SB02). Concentrations were detected in 3 of 3 samples at or below the 10 ft. depth interval ranging from 19.3 mg/kg (S104-SB02) to 38.4 mg/kg (S104-SB01).

Selenium was detected in three of the soil samples at S104. Concentrations of selenium were detected at S104-SB02 in both the surface to 5 ft. depth interval (0.70 mg/kg) and at or below the 10 ft. depth interval (1.5 mg/kg). Selenium was also detected at S104-SS01 in the surface to 5 ft. depth interval (0.74 J mg/kg).

Silver was not detected in any samples at SWMU S104.

Zinc concentrations generally exhibited a decreasing trend with depth. Zinc was detected in 4 of 4 samples in the surface to 5 ft. depth interval ranging from 111 mg/kg (S104-SS01) to 740 mg/kg (S104-SS01). Concentrations of zinc were detected in 2 of 2 samples in the 5-10 ft. depth interval at 73.5 mg/kg (S104-SB01) and 117 mg/kg (S104-SB02). Concentrations were detected in 3 of 3 samples at or below the 10 ft. depth interval ranging from 57.0 mg/kg (S104-SB02) to 101 mg/kg (S104-SB01).

SVOCs

SVOCs were only detected in the surface to 5 ft. depth interval at two locations, S104-SB01 and S104-SB02. At S104-SB01, butylbenzylphthalate and bis(2-ethylhexyl)phthalate were detected at concentrations of 280 and 1,000 µg/kg, respectively. Several SVOCs were detected at S104-SB02. Butylbenzylphthalate and bis(2-ethylhexyl)phthalate were detected at this location as well, but in addition, low concentrations of fluoranthene, isophorone, phenanthrene, and pyrene were detected, ranging in concentrations of 41J (phenanthrene) to 81J µg/kg (isophorone). No SVOCs were found at or below the 5 ft depth interval.

VOCs

Only one VOC concentration was detected at SWMU S104. 2-Butanone was detected in the 5-10 ft. depth interval at a concentration of 12J µg/kg (S104-SB01).

4.3.5.6 Discussion

As with the shot blast dust collector at S103, the principle constituents of concern at this unit are metals. SVOCs and VOCs were detected very infrequently. One exception to this trend occurred at location S104-SB02 where several SVOCs were detected in the surface soil.

The inorganic data strongly suggest a surface soil impact in the vicinity of the former shot blast storage area. As with SWMU S103, several of the RCRA metals exhibit concentration profiles that suggest surface deposition of metals on the surface of the soil. The highest concentrations of barium, cadmium, chromium, lead, and mercury all occur in the surface to 5 ft. depth interval. Only arsenic and selenium did not exhibit a similar trend. (Silver was not detected at S104). This is the same trend for the same metals described in SWMU S103.

4.3.6 SWMU S105 - Former Caustic Rinse System and Caustic Sludge Holding Tank

4.3.6.1 Unit Description

Information regarding the former caustic rinse system and caustic sludge holding tank was provided during discussions with facility personnel. Prior to the installation of the WWTP, Franklin Steel Company operated a caustic rinse system that included a caustic sludge holding tank. The holding tank was located just south of the dust collectors and north of the caustic-wash room. The tank was removed after the WWTP was placed on line.

4.3.6.2 Potential Contaminants

The caustic rinse solution was based on sodium hydroxide. Potential contaminants include constituents associated with the exterior painted surfaces of drums and any residual substances that may have been in the inside of the drums prior to reconditioning.

4.3.6.3 Potential Releases

There are no known or documented releases from this unit.

4.3.6.4 Summary of Investigation

One soil boring was installed during Phase I of RFI Part 1. Two samples were collected, one from the surface to 5 ft. depth interval and the other from the 13-15 ft. interval. Three more soil borings were installed during the RFI Part 1 Phase II in 1997 and a groundwater well was installed in March 1998. Ten additional samples were collected from the three Phase II soil borings. The sample locations from SWMU S105 are shown in the table below.

| SWMU S105 SAMPLING SUMMARY | | | | |
|----------------------------|------------------------|-----------------|----------|---------------|
| SURFACE SOIL | SOIL BORING | WELL/PIEZOMETER | SEDIMENT | SURFACE WATER |
| -- | S105-SB01 ¹ | S105-MW01 | -- | -- |
| -- | S105-SB02 | -- | -- | -- |
| -- | S105-SB03 | -- | -- | -- |
| -- | S105-SB04 | -- | -- | -- |

Sampling (or well/piezometer installation) associated with Phase I RFI Part 1

4.3.6.5 Analytical Results

A discussion of the analytical results for the soil sampling is presented in the sections below. Twelve soil samples were collected from the four discrete sampling locations. A summary table of all detected analytical results is found in Table 4.3.6. Groundwater sampling results are presented in Section 4.7.

Inorganics

Aluminum concentrations exhibited no apparent trend with depth. Aluminum was detected in 4 of 4 samples in the surface to 5 ft. depth interval ranging from 2,320 mg/kg (S105-SB02) to 11,000 mg/kg (S105-SB03). Concentrations of aluminum were detected in 3 of 3 samples in the 5-10 ft. depth interval ranging from 8,320 mg/kg (S105-SB02) to 10,500 mg/kg (S105-SB04). Aluminum was detected in 5 of 5 samples at or below the 10 ft. depth interval ranging from 3,500 mg/kg (S105-SB01) to 9,920 mg/kg (S105-SB04).

Antimony concentrations exhibited a decrease with depth. Antimony was detected in 1 of 5 samples in the surface to 5 ft depth interval at a concentration of 10.5J mg/kg (S105-SB02). Antimony was not detected at or below the 5 ft depth interval.

Arsenic concentrations exhibited no definite trend with depth. Arsenic was detected in 4 of 4 samples in the surface to 5 ft. depth interval ranging from 3.3 mg/kg (S105-SB04) to 20 mg/kg (S105-SB03). Concentrations of arsenic were detected in 3 of 3 samples in the 5-10 ft. depth interval ranging from 11.9 mg/kg (S105-SB02) to 22.4 mg/kg (S105-SB04). Arsenic was detected in 5 of 5 samples at or below the 10 ft. depth interval ranging from 7.6J mg/kg (S105-SB01) to 48 mg/kg (S105-SB04).

Barium concentrations exhibited no apparent trend with depth. Barium was detected in 4 of 4 samples in the surface to 5 ft. depth interval ranging from 58.5 mg/kg (S105-SB02) to 3,860 mg/kg (S105-SB04). Concentrations of barium were detected in 3 of 3 samples in the 5-10 ft. depth interval ranging from 93.0 mg/kg (S105-SB02) to 278 mg/kg (S105-SB03). Barium was detected in 5 of 5 samples at or below the 10 ft. depth interval ranging from 46.1 mg/kg (S105-SB04) to 254 mg/kg (S105-SB04).

Cadmium concentrations exhibited no apparent trend with depth. Cadmium was detected in 3 of 4 samples in the surface to 5 ft. depth interval ranging from 0.49 mg/kg (S105-SB02) to 79.1 mg/kg (S105-SB04). Concentrations of cadmium were detected in 3 of 3 samples in the 5-10 ft. depth interval ranging from 0.47 mg/kg (S105-SB02) to 1.6 mg/kg (S105-SB03). Cadmium was detected in 4 of 5 samples at or below the 10 ft. depth interval ranging from 0.50 mg/kg (S105-SB04) to 2.4 mg/kg (S105-SB04).

Chromium concentrations exhibited no apparent trend with depth. Chromium was detected in 4 of 4 samples in the surface to 5 ft. depth interval ranging from 15.0 mg/kg (S105-SB01) to 461 mg/kg (S105-SB04). Concentrations of chromium were detected in 3 of 3 samples in the 5-10 ft depth interval ranging from 20.6 mg/kg (S105-SB04) to 35.2 mg/kg (S105-SB03). Chromium was detected in 5 of 5 samples at or below the 10 ft. depth interval ranging from 9.8 mg/kg (S105-SB04) to 38.7 mg/kg (S105-SB01).

Copper concentrations exhibited no apparent trend with depth. Copper was detected in 4 of 4 samples in the surface to 5 ft. depth interval ranging from 24.9 mg/kg (S105-SB02) to 436 mg/kg (S105-SB04). Concentrations of copper were detected in 3 of 3 samples in the 5-10 ft depth interval ranging from 30.2 mg/kg (S105-SB02) to 48.6 mg/kg (S105-SB03). Copper was detected in 5 of 5 samples at or below the 10 ft. depth interval ranging from 19.5 mg/kg (S105-SB04) to 24.6 mg/kg (S105-SB03).

Cyanide was detected in one sample. Cyanide was detected at or below the 10 ft. depth interval at a concentration of 0.69J mg/kg (S105-SB01).

Lead concentrations exhibited no apparent trend with depth. Lead was detected in 4 of 4 samples in the surface to 5 ft. depth interval ranging from 13.2 mg/kg (S105-SB01) to 4,070 mg/kg (S105-SB04). Concentrations of lead were detected in 3 of 3 samples in the 5-10 ft. depth interval ranging from 18.9J mg/kg (S105-SB02) to 86.9J2 mg/kg (S105-SB03). Lead was detected in 5 of 5 samples at or below the 10 ft depth interval ranging from 10.1 mg/kg (S105-SB04) to 92.4 mg/kg (S105-SB04).

Mercury concentrations exhibited no apparent trend with depth. Mercury was detected in 3 of 4 samples in the surface to 5 ft. depth interval ranging from 0.051 mg/kg (S105-SB03) to 0.41J mg/kg (S105-SB04). Concentrations of mercury were detected in 3 of 3 samples in the 5-10 ft. depth interval ranging from 0.043 mg/kg (S105-SB02) to 0.074J mg/kg (S105-SB04). Mercury was detected in 4 of 5 samples at or below the 10 ft. depth interval ranging from 0.020J mg/kg (S105-SB04) to 0.059 mg/kg (S105-SB04).

Nickel concentrations exhibited no apparent trend with depth. Nickel was detected in 4 of 4 samples in the surface to 5 ft. depth interval ranging from 27.0 mg/kg (S105-SB02) to 257 mg/kg (S105-SB04). Concentrations of nickel were detected in 3 of 3 samples in the 5-10 ft. depth interval ranging from 29.7 mg/kg (S105-SB02) to 44.7 mg/kg (S105-SB03). Nickel was detected in 5 of 5 samples at or below the 10 ft. depth interval ranging from 22.3 mg/kg (S105-SB01) to 55.4 mg/kg (S105-SB04).

Selenium concentrations exhibited a general increase with depth. Selenium was detected in only 1 of 4 samples in the surface to 5 ft. depth interval at 9.0 mg/kg (S105-SB04). Concentrations of selenium were not detected in the 5-10 ft. depth interval. Selenium was detected in 4 of 5 samples at or below the 10 ft. depth interval ranging from 0.54 mg/kg (S105-SB04) to 1.5 mg/kg (S105-SB04).

Silver was detected in one sample. Silver was detected in the surface to 5 ft. depth interval at a concentration of 2.7 mg/kg (S105-SB04). This sample location in the surface to 5 ft. depth interval exhibited higher concentrations for all of the RCRA metals.

Zinc concentrations exhibited a general decreasing trend with depth. Zinc was detected in 4 of 4 samples in the surface to 5 ft. depth interval ranging from 62.9 mg/kg (S105-SB02) to 5,680 mg/kg (S105-SB04). Concentrations of zinc were detected in 3 of 3 samples in the 5-10 ft. depth interval ranging from 79.0 mg/kg (S105-SB02) to 260J mg/kg (S105-SB03). Zinc was detected in 5 of 5 samples at or below the 10 ft. depth interval ranging from 72.4 mg/kg (S105-SB01) to 107J mg/kg (S105-SB04).

SVOCs

SVOCs were detected at several soil borings and at various depth intervals. The only SVOC that was detected frequently at SWMU S105 was bis(2-ethylhexyl)phthalate. Bis(2-ethylhexyl)phthalate was detected in 8 of 12 samples at concentrations ranging from 47J $\mu\text{g}/\text{kg}$ (S105-SB04 at or below the 10 ft. depth interval) to 2,000 $\mu\text{g}/\text{kg}$ (S105-SB01 at or below the 10 ft. depth interval).

The sample collected from S105-SB01 at or below the 10 ft depth interval contained many semivolatile contaminants, including many PAHs. Twenty-two separate SVOC constituents were detected in that sample at concentrations ranging from 67 $\mu\text{g}/\text{kg}$ (benzo(g,h,i)perylene) to 2,600 $\mu\text{g}/\text{kg}$ (naphthalene).

Three other samples contained several SVOCs. The sample collected from S105-SB02 in the 5-10 ft. depth interval contained four different SVOCs ranging in concentration from 160 µg/kg (phenol) to 1,100 µg/kg (bis(2-ethylhexyl)phthalate). The sample collected from S105-SB04 in the surface to 5 ft. depth interval contained seven different SVOCs ranging in concentration from 50 µg/kg (fluoranthene) to 1,600 µg/kg (bis(2-ethylhexyl)phthalate). The sample collected from S105-SB03 at or below the 10 ft. depth interval contained five different SVOCs ranging in concentration from 41 µg/kg (fluoranthene) to 290 µg/kg (bis(2-ethylhexyl)phthalate).

VOCs

VOCs were primarily detected in samples S105-SB01 (at or below the 10 ft. depth interval), S105-SB02 (5-10 ft. depth interval), and S105-SB03 (at or below the 10 ft. depth interval). Lower concentrations of VOCs were sporadically detected, such as 2-butanone (7.8J µg/kg in S105-SB04 at or below the 10 ft. depth interval) and acetone (21 µg/kg in S105-SB04 at or below the 10 ft. depth interval).

Seven VOC compounds were detected in sample S105-SB03 at or below the 10-11 ft. depth interval. Their concentrations ranged from 11 µg/kg (methylene chloride) to 440 µg/kg (acetone).

Four VOC compounds were detected in sample S105-SB02 in the 5-10 ft. depth interval. Concentrations ranged from 1,700 µg/kg (chlorobenzene) to 93,000 µg/kg (total xylenes). Ethylbenzene and toluene were also detected in concentrations of 22,000 and 27,000 µg/kg, respectively.

Five VOC compounds were detected in sample S105-SB01 at or below the 10 ft. depth interval. Concentrations ranged from 1,200J µg/kg (tetrachloroethene) to 140,000 µg/kg (total xylenes). Chlorobenzene, ethylbenzene and toluene were also detected in concentrations of 3,900 µg/kg, 40,000 µg/kg, and 40,000 µg/kg, respectively.

4.3.6.6 Discussion

The inorganic analysis reveals that metal concentrations are homogeneously distributed in the soil at S105. This suggests that activities involving inorganic constituents at the Former Caustic Rinse System and Caustic Sludge Holding Tank have not impacted the soil in the area. The exception to this is the single high-metal sample taken at S105-SB04 in the surface to 5 ft. depth interval. This sample was collected at a location adjacent to the drum conveyance line. The metals detected in this sample may have originated from the conveyance line rather than the caustic rinse system.

The SVOC data do not demonstrate a pattern or suggest a particular source. A variety of SVOCs were detected primarily in four samples: S105-SB01 (at or below the 10 ft. depth interval), S105-SB02 (5-10 ft. depth interval), S105-SB03 (at or below the 10 ft. depth interval), and S105-SB04 (surface to 5 ft. depth interval). The S105-SB01 sample contained 22 different SVOCs. Based on these data, it is not possible to identify the source of the SVOC contamination at the unit. The only SVOC that was frequently detected was bis(2-ethylhexyl)phthalate. This chemical is frequently detected in other active plant process areas and was detected at SWMU S105 in 8 of 12 samples.

The VOC data were distributed similarly to the SVOC data. The VOCs detected were concentrated in samples S105-SB01 (at or below the 10 ft. depth interval), S105-SB02 (5-10 ft. depth interval), and S105-SB03 (at or below the 10 ft. depth interval). These are three of the four samples in which the SVOCs were detected. The sample collected from the S105-SB01 location contained total xylenes at 140,000 µg/kg and ethylbenzene and toluene at 40,000 µg/kg. The sample collected from the S105-SB02 location contained similarly high concentrations of VOCs.

4.3.7 SWMU S106 - OXIDIZER SYSTEM

4.3.7.1 Unit Description

The former Oxidizer System includes the following structures: former thermal oxidizer, former oxidizer pit, former lugger box storage area, concrete storage pad, conveyor line from oxidizer and former sludge pile area. Each of these structures or units is linked to the thermal oxidizing process.

In 1995 and 1996, a new oxidizer was constructed and the existing oxidizer is now only used for drum preparation. The old oxidizer formerly accepted open head drums on a conveyor belt for cleaning via thermal oxidation. Once the drums entered the oxidizer building, they were rotated from an upright to an upside down position, and then placed on a conveyor. Any residue remaining in the empty drums was oxidized as the drums pass through the unit. A resultant sludge was accumulated in the quench basin (oxidizer pit) that underlined the conveyor line.

The oxidizer sludge was dredged from the quench basin and placed in a specially designed lugger box for dewatering. The sludge was dewatered by gravity as the lugger box was situated on a sloping concrete pad. The concrete pad sloped eastward, toward the oxidizer pit. Once the specially designed lugger box was full, the dewatered oxidizer sludge was transferred from the dewatering lugger box into conventional lugger boxes, samples were collected for disposal characterization and the lugger boxes were covered with tarps. These filled lugger boxes were then shipped off-site for appropriate disposal.

The concrete pad and lugger box system for managing oxidizer sludge was installed in 1985. Prior to that date, the oxidizer sludge was piled on the ground in the general area of the concrete pad. The sludge was not contained. This sludge pile was removed from the facility and disposed off-site periodically.

Each shipment of oxidizer sludge was tested for hazardous characteristics. Non-hazardous oxidizer sludge was shipped to a solid waste facility. If the oxidizer sludge failed the Toxicity Characteristic Leaching Procedure test, it was manifested and shipped off-site for treatment and disposal to a treatment, storage and disposal facility licensed to accept the waste.

The oxidizer was a permitted air source, number N001, identified as CSD 111000 Oxidizer. It was controlled by an afterburner and operated at a minimum temperature of 1,400° F.

Once the drums were processed in the oxidizer, they continued on the conveyor line into the reconditioning building. If any oxidized material from the drums remained in the drums after passing through the oxidizer, oxidized material was loosened and fell onto the concrete pad as the drums continued on the conveyor line.

4.3.7.2 Potential Contaminants

During an inspection on March 20, 1987, Ohio EPA and Franklin Steel personnel jointly collected two surface soil samples in the oxidizer area from "hot spot" sample locations 6 (Hot Spot 3) and 7 (Hot Spot 4) (Figure 1). Sample location 6 was collected west of the oxidizer and south of sludge loading area. The surface soil sample from location 7 was collected west of the oxidizer and north of the sludge pit loading area, adjacent to the lugger box. Analytical results are summarized below (Ohio EPA, 12/11/87; Ohio EPA, 6/23/92):

| <u>Constituent</u> | <u>Sample 6 (Hot Spot 3)</u> | <u>Sample 7 (Hot Spot 4)</u> |
|--------------------|------------------------------|------------------------------|
| EP Toxic Lead | 5,110 µg/kg | 11,600 µg/kg |
| Lead | 1,410 mg/kg | NA |
| Chromium | 279 mg/kg | NA |
| Cadmium | 26.9 mg/kg | NA |
| Arsenic | 3.6 mg/kg | NA |
| Selenium | 13.0 mg/kg | NA |
| Ethanol | 75.0 mg/kg | NA |
| Propanol | 215 mg/kg | NA |
| Toluene | 77.0 mg/kg | NA |

NA = Not Analyzed

These areas, referred to as “hot spots”, were excavated and removed by the facility and properly disposed. Confirmatory soil sampling was conducted jointly by Ohio EPA and facility personnel in March 1988.

As mentioned above, composite samples of oxidizer sludge were collected from the lugger boxes and analyzed prior to off-site shipment for appropriate disposal.

No other data from environmental media in the area of the oxidizer operations have been collected and reported.

4.3.7.3 Potential Releases

Potential releases include spills of oxidizer sludge during sludge pit removal and sludge pit over flow and handling operations.

4.3.7.4 Summary of Investigation

The following table summarizes RFI investigations at SWMU S106.

| SWMU S106 SAMPLING SUMMARY | | | | |
|-----------------------------------|--------------------------|-------------------------|-----------------|------------------------|
| SURFACE SOIL | SOIL BORING | WELL/ PIEZOMETER | SEDIMENT | SURFACE WATER |
| S106-SS01 ¹ | S106-SB01 ^{1,2} | S108-MW04 ³ | -- | S106-SW01 ¹ |
| S106-SS02 ² | S106-SB02 | -- | -- | -- |
| S106-SS03 ¹ | S106-SB03 | -- | -- | -- |
| -- | S106-SB04 | -- | -- | -- |
| -- | S106-SB05 | -- | -- | -- |
| -- | S106-SB06 | -- | -- | -- |
| -- | S106-SB07 | -- | -- | -- |

¹ Sampling (or well/piezometer installation) associated with Phase I RFI Part 1.

² Groundwater collected from drilling augers during soil boring installation.

³ Located immediately down gradient of the old oxidizer in SWMU S108.

4.3.7.5 Analytical Results

A discussion of the analytical results for the soil and surface water sampling is presented in the sections below. A summary table of all detected analytical results is found in Table 4.3.7. Groundwater results are presented in Section 4.7.

4.3.7.5.1 Soils

Inorganics

Concentrations of aluminum exhibited no definite trend. Concentrations of aluminum were detected in all 22 soil samples. Aluminum was found at concentrations between 924 mg/kg (S106-SS01) and 16,400J mg/kg (S106-SS01) in samples collected from the surface to 5 ft depth interval of SWMU S106. Concentrations of aluminum at the 5-10 ft depth interval ranged from 3,830 mg/kg (S106-SB02) to 29,900 mg/kg (S106-SB05). Concentrations below the 10 ft depth interval ranged from 6,050 mg/kg (S106-SB05) to 10,800 mg/kg (S106-SB02).

Concentrations of antimony exhibited no definite trend. Concentrations of antimony were detected in 8 of 11 soil samples at the surface to 5 ft depth interval at concentrations between 5.8J mg/kg (S106-SB04) and 61.4J mg/kg (S106-SS02). Concentrations of antimony detected in 3 of 6 soil samples at the 5-10 ft depth interval ranged between 2.6J mg/kg (S106-SB04) and 7.5 mg/kg (S106-SB02). Concentrations of antimony were detected in 1 of 4 soil samples below the 10 ft depth interval at a concentration of 2.9J mg/kg (S106-SB03).

Concentrations of arsenic exhibited a general increase with depth. Concentrations of arsenic were detected in all 22-soil samples. Arsenic was found in concentrations between 1.7J mg/kg (S106-SS02) and 23.6J mg/kg (S106-SB01) in samples collected from the surface to 5 ft depth interval of SWMU S106. Concentrations of arsenic at the 5-10 ft depth interval ranged from 6.6 mg/kg (S106-SB02) to 16.6 mg/kg (S106-SB03). Concentrations below the 10 ft depth interval ranged from 20.7 mg/kg (S106-SB03) to 45.1 mg/kg (S106-SB05).

Concentrations of barium exhibited a general decrease with depth. Concentrations of barium were detected in all 22 soil samples. Barium was found in concentrations of between 125 mg/kg (S106-SB01) and 4,130J mg/kg (S106-SS02) in samples collected from the surface to 5 ft depth interval of SWMU S106. Concentrations of barium at the 5-10 ft depth interval ranged from 130 mg/kg (S106-SB03 and S106-SB07) to 520 mg/kg (S106-SB02). Concentrations below the 10 ft depth interval ranged from 44.7 mg/kg (S106-SB05) to 188 mg/kg (S106-SB02).

Concentrations of cadmium exhibited a decrease with depth. Concentrations of cadmium were detected in 10 of 11 soil samples at the surface to 5 ft depth interval at concentrations between 0.82 mg/kg (S106-SB07) and 47.7J mg/kg (S106-SS02). Concentrations of cadmium detected in 7 of 7 soil samples at the 5-10 ft depth interval ranged between 1.0J mg/kg (S106-SB07) and 25.3 mg/kg (S106-SB02). Concentrations of cadmium detected in 4 of 4 soil samples below the 10 ft depth interval ranged from 0.70 mg/kg (S106-SB02) to 1.8J mg/kg (S106-SB05).

Concentrations of chromium exhibited a decrease with depth. Concentrations of chromium were detected in all 22 soil samples. Chromium was detected at concentrations between 5.6J mg/kg (S106-SB07) and 1,120J mg/kg (S106-SS02) in samples collected from the surface to 5 ft. depth interval of SWMU S106. Concentrations of chromium at the 5-10 ft. depth interval ranged between 15.1J mg/kg (S106-SB07) and 39.5 mg/kg (S106-SB02). Concentrations of chromium detected below the 10 ft. depth interval ranged from 10.7J mg/kg (S106-SB05) to 17.1 mg/kg (S106-SB02).

Concentrations of copper exhibited a decrease with depth. Concentrations of copper were detected in all 22 soil samples. Copper was detected at concentrations between 0.74J mg/kg (S106-SS01) and 835J mg/kg (S106-SS02) in samples collected from the surface to 5 ft. depth interval of SWMU S106. Concentrations of copper at the 5-10 ft. depth interval ranged between 23.6J mg/kg (S106-SB07) and 50.5 mg/kg (S106-SB02). Concentrations of copper detected below the 10 ft. depth interval ranged from 25.8 mg/kg (S106-SB07) to 36.1 mg/kg (S106-SB05).

Concentrations of cyanide were detected in 4 of 11 soil samples at the surface to 5 ft. depth interval at concentrations between 0.34 mg/kg (S106-SS02) and 1.4 mg/kg (S106-SS03). Cyanide was not detected in any soil samples below the 5 ft. depth interval at SWMU S106.

Concentrations of lead exhibited a decrease with depth. Concentrations of lead were detected in all 22 soil samples. Lead was found in concentrations of between 12.1J mg/kg (S106-SB07) and 4,310J mg/kg (S106-SS03) in samples collected from the surface to 5 ft. depth interval of SWMU S106. Concentrations of lead at the 5-10 ft. depth interval ranged between 13.9J mg/kg (S106-SB07) and 362 mg/kg (S106-SB02). Concentrations below the 10 ft. depth interval ranged from 17.9J mg/kg (S106-SB03) to 32.5 mg/kg (S106-SB02).

Concentrations of mercury exhibited a decrease with depth. Concentrations of mercury were detected in 7 of 11 soil samples at the surface to 5 ft. depth interval at concentrations between 0.064 mg/kg (S106-SB07) and 0.78 mg/kg (S106-SB03). Concentrations of mercury detected in 7 of 7 soil samples at the 5-10 ft. depth interval ranged between 0.032J mg/kg (S106-SB02) and 0.17 mg/kg (S106-SB04). Concentrations of mercury detected in 4 of 4 soil samples below the 10 ft. depth interval ranged from 0.031 mg/kg (S106-SB03) to 0.066J mg/kg (S106-SB02).

Concentrations of nickel exhibited a decrease with depth. Concentrations of nickel were detected in 11 of 11 soil samples at the surface to 5 ft. depth interval at concentrations between 8.5 mg/kg (S106-SB07) and 99.7 mg/kg (S106-SS03). Concentrations of nickel detected in 7 of 7 soil samples at the 5-10 ft. depth interval ranged between 19.10 mg/kg (S106-SB02) and 66.7 mg/kg (S106-SB05). Concentrations of nickel detected in 4 of 4 soil samples below the 10 ft. depth interval ranged from 29.1 mg/kg (S106-SB07) to 49.1 mg/kg (S106-SB03).

Concentrations of selenium were found in a limited number of results and exhibited a decrease with depth. Concentrations of selenium were detected in 7 of 11 soil samples at the surface to 5 ft. depth interval at concentrations between 0.60 mg/kg (S106-SB04) and 4.5J mg/kg (S106-SB03). Concentrations of selenium detected in 1 of 7 soil samples at the 5-10 ft. depth interval were 0.59 mg/kg (S106-SB02). Concentrations of selenium were detected in 2 of 4 soil samples below the 10 ft. depth interval at 1.3 mg/kg (S106-SB03) and 2.4 mg/kg (S106-SB05).

Concentrations of silver were found in a limited number of results and exhibited a decrease with depth. Concentrations of silver were detected in 5 of 11 soil samples at the surface to 5 ft. depth interval at concentrations between 1.4 mg/kg (S106-SB02) and 20.2 mg/kg (S106-SS03). Concentrations of silver were detected in 3 of 7 soil samples at the 5-10 ft. depth interval between 0.31 mg/kg (S106-SB04) and 1.2 mg/kg (S106-SB07). Concentrations of silver were not detected below the 10 ft. depth interval.

Concentrations of zinc exhibited a decrease with depth. Concentrations of zinc were detected in 11 of 11 soil samples at the surface to 5 ft. depth interval at concentrations between 30.0 mg/kg (S106-SB07) and 6,740 mg/kg (S106-SS03). Concentrations of zinc detected in 7 of 7 soil samples at the 5-10 ft. depth interval ranged between 106 mg/kg (S106-SB07) and 630 mg/kg (S106-SB02). Concentrations of nickel detected in 4 of 4 soil samples below the 10 ft. depth interval ranged from 137 mg/kg (S106-SB02) to 159 mg/kg (S106-SB02).

SVOCs

SVOCs were analyzed in 15 of 22 samples from 10 locations in SWMU S106. The number and concentration of SVOC constituents decreased with depth, with the majority of constituents appearing in samples from the surface to 5 ft. depth interval. The primary SVOCs detected were PAHs and phthalates.

Concentrations of PAHs exhibited a decrease with depth. Concentrations of PAHs were detected in 8 of 11 soil samples at the surface to 5 ft. depth interval between 40J µg/kg (benzo(a)pyrene at S106-SB02) and 350 µg/kg (fluoranthene at S106-SB02). Only one boring had PAHs at detectable concentrations at the 5-10 ft. depth interval. PAHs were found in S106-SB06 between 87J µg/kg (benzo(k)fluoranthene) and 290 µg/kg (benzo(b)fluoranthene). No PAHs were detected below the 10 ft. depth interval.

Concentrations of phthalates exhibited a decrease with depth. Concentrations of butyl benzyl phthalate were found in 4 of 11 samples from the surface to 5 ft. depth interval between 84J µg/kg (S106-SB03) and 8,000J µg/kg in S106-SB06). Concentrations of butyl benzyl phthalate were detected in 1 of 8 samples from the 5-10 ft. depth interval (1,900 µg/kg in S106-SB06). Concentrations of butyl benzyl phthalate were not detected in soil samples below the 10 ft. depth interval.

Concentrations of bis(2-ethylhexyl)phthalate were detected in 10 of 11 samples from the surface to 5 ft. depth interval between 240J µg/kg (S106-SB02) and 86,000 µg/kg (S106-SB06). Concentrations of bis(2-ethylhexyl)phthalate were detected in 5 of 7 samples from the 5-10 ft. depth interval between 79J µg/kg (S106-SB04) and 8,400 µg/kg (S106-SB06). Concentrations of bis(2-ethylhexyl)phthalate were not detected in soil samples below the 10 ft. depth interval.

The only other SVOCs detected in surface soil samples at SWMU S106 were 2-methylnaphthalene (61 µg/kg in S106-SS01), N-nitrosodiphenylamine (73 µg/kg in S106-SS01, 130 µg/kg in S106-SB05) and isophorone (95J µg/kg in S106-SS02).

VOCs

VOCs were found in 18 of 22 samples from 10 locations in S106. The number and concentration of VOC constituents decreased with depth. The primary VOCs detected included 2-butanone, acetone, ethylbenzene, methylene chloride, toluene, and xylenes. 1,2-Dichloroethene, 4-methyl-2-pentanone, benzene, chlorobenzene, tetrachloroethene, and vinyl chloride were also detected in 1 or 2 samples.

Concentrations of 2-butanone were detected in 2 of 11 samples from the surface to 5 ft. depth interval at concentrations between 81J µg/kg (S106-SB06) and 140J µg/kg (S106-SB05). Concentrations of 2-butanone were detected in 3 of 7 samples from the 5-10 ft. depth interval between 29J µg/kg (S106-SB03 and S106-SB05) and 34 µg/kg (S106-SB04). 2-Butanone was not detected below the 10 ft. depth interval.

Concentrations of acetone were detected in 5 of 11 samples from the surface to 5 ft. depth interval at concentrations between 32J µg/kg (S106-SB04) and 1,100J µg/kg in (S106-SS01). Acetone was detected in 6 of 7 samples from the 5-10 ft. depth interval between 15J µg/kg (S106-SB07) and 150J µg/kg (S106-SB03 and S106-SB04). Acetone was detected in 4 of 4 samples below the 10 ft. depth interval at concentrations between 20J µg/kg (S106-SB02) and 49J µg/kg (S106-SB03).

Concentrations of ethylbenzene were detected in 4 of 11 samples from the surface to 5 ft. depth interval between 69J µg/kg (S106-SS01) and 1,200 µg/kg (S106-SB05). Ethylbenzene was detected in 1 of 7 samples from the 5-10 ft. depth interval at a concentration of 12J µg/kg (S106-SB05). Ethylbenzene was detected in only 1 of 4 samples below the 10 ft. depth interval at a concentration of 5.8J µg/kg (S106-SB05).

Concentrations of methylene chloride were detected in 3 of 11 samples from the surface to 5 ft. depth interval between 4J µg/kg (S106-SS03) and 42J µg/kg (S106-SS02). Methylene chloride was detected in 1 of 4 samples below the 10 ft. depth interval at a concentration of 3.2J µg/kg (S106-SB03). Methylene chloride was not detected in the 5-10 ft. depth interval.

Concentrations of toluene were detected in 5 of 11 samples from the surface to 5 ft. depth interval between 3J µg/kg (S106-SS01) and 1,700 µg/kg (S106-SB06). Concentrations of toluene were detected in 2 of 7 samples from the 5-10 ft. depth interval at 3.0J µg/kg (S106-SB06) and 7.1J µg/kg (S106-SB05). Toluene was detected in only 1 of 4 samples below the 10 ft. depth interval at a concentration of 3.4J µg/kg (S106-SB05).

Concentrations of xylenes were detected in 5 of 11 samples from the surface to 5 ft. depth interval between 5J µg/kg (S106-SS01) and 3,400 µg/kg (S106-SB06). Concentrations of xylenes were detected in 2 of 7 samples from the 5-10 ft. depth interval between 2.7J µg/kg (S106-SB04) and 19J µg/kg (S106-SB05). Xylenes were detected in only 1 of 4 samples below the 10 ft. depth interval at a concentration of 11J µg/kg (S106-SB05).

1,2-Dichloroethene was detected in only 1 of 22 samples (9.0J µg/kg in S106-SB05 at 5-10 ft. depth interval). 4-Methyl-2-pentanone was detected in only 1 of 24 samples (87 µg/kg in S106-SS01 at surface to 5 ft. depth interval). Benzene was detected in only 1 of 22 samples (12 µg/kg in S106-SB06 at 5-10 ft. depth interval). Chlorobenzene was detected in only 1 of 22 samples (62 µg/kg in S106-SB06 at surface to 5 ft. depth interval). Tetrachloroethene was detected in 2 of 22 samples (5J µg/kg in S106-SS03 and 29J µg/kg in S106-SB07, at the surface to 5 ft. depth interval). Vinyl chloride was detected in only 1 of 22 samples (4.0J µg/kg in S106-SB05 at the 5-10 ft. depth interval).

4.3.7.6 Discussion

The concentration and dispersion of chemicals generally decreases with depth. An exception to this was the RCRA metal barium. The highest concentrations of barium were in five surface soil samples (between 994 mg/kg in S106-SB06 and 4130J mg/kg in S106-SS02) and one 5-10 ft. sample (520 mg/kg in S106-SB02). Chromium was detected in all 22 soil samples at concentrations between 5.6J mg/kg (S106-SB07) and 1,120J mg/kg (S106-SS02) at a depth of 5 ft. Chromium concentrations at the 5-10 ft. depth interval ranged between 15.1J mg/kg (S106-SB07) and 39.5 mg/kg (S106-SB02) and below the 10 ft. depth interval from 10.7J mg/kg (S106-SB05) to 17.1 mg/kg (S106-SB02). Lead analysis indicated a decrease in concentration with depth. Lead was found in concentrations of between 12.1J mg/kg (S106-SB07) and 4,310J mg/kg (S106-SS03) in samples collected from the surface to a 5 ft. depth. Lead concentrations at a 5-10 ft. depth ranged between 13.9J mg/kg (S106-SB07) and 362 mg/kg (S106-SB02) and below the 10 ft. depth ranged from 17.9J mg/kg (S106-SB03) to 32.5 mg/kg (S106-SB02).

The largest number of SVOCs, including PAHs and phthalates, are reported in surface soil samples at locations S106-SS01, S106-SS02, S106-SS03, S106-SB02, S106-SB05, and S106-SB06. S106-SB06 also exhibited several SVOCs at the 5-10 ft. interval. Other sampling locations have only one or two contaminants. One widespread constituent is bis(2-ethylhexyl)phthalate. Concentrations of bis(2-ethylhexyl)phthalate were found in 15 of 22 samples, mostly in the surface to 5 ft. depth interval.

Most of the VOC concentrations found were at sample locations S106-SB05 and S106-SB06 at all depth intervals. The highest concentrations found at these two locations were at the surface. In addition, groupings of VOCs were found in the surface to 5 ft. depth interval at S106-SS01 and S106-SS02. The rest of the sampling locations contained very little VOCs.

4.3.8 SWMU S107 - DRUM STORAGE AREA # 1

4.3.8.1 Unit Description

Drum Storage Area #1 (SWMU S107) is located south of the WWTP building. Only part of this area is currently used for drum storage. The employee parking lot area, located on the west side of this unit, south of the gravel access road was used during the late 1980s for drum storage when operations were at their peak. The facility presently stores approximately one month of drums to be processed in the active portion of SWMU S107..

Closed head drums are stored in SWMU S107. The drums are stacked pyramid fashion and end to end on their sides in long rows. The drum storage area is not paved.

During construction of the facility, flyash and foundry sand was used as backfill material. The flyash came from the City of Columbus Spring Street Power Plant and the foundry sand came from the former Claycraft facility. The fill material exists intermixed with surface soil within SWMU S107, not as a discernable separate matrix. As such, it was not considered a separate environmental medium, but rather as part of the existing soil matrix. Since SWMU S107 has been characterized using a grid sampling system, the fill material, as part of the soil matrix, has also been characterized.

4.3.8.2 Potential Contaminants

No samples had been collected from environmental media within SWMU S107 prior to the RFI.

4.3.8.3 Potential Releases

There are no known or documented releases from this unit.

4.3.8.4 Summary of Investigation

The following table summarizes RFI investigations at SWMU S107.

| SWMU S107 SAMPLING SUMMARY | | | | |
|----------------------------|------------------------|--------------------------|----------|---------------|
| SURFACE SOIL | SOIL BORING | WELL/ PIEZOMETER | SEDIMENT | SURFACE WATER |
| S107-SS01 ¹ | S107-PZ01 ¹ | S107-PZ01 ^{1,2} | -- | -- |
| S107-SS02 ¹ | S107-SB03 | S107-MW02 | -- | -- |
| S107-SS03 ¹ | S107-SB04 | -- | -- | -- |
| S107-SS04 ¹ | S107-SB05 | -- | -- | -- |
| S107-SS05 ¹ | S107-SB06 | -- | -- | -- |
| -- | S107-SB07 | -- | -- | -- |
| S100-SS08 ³ | S107-SB08 | -- | -- | -- |
| S100-SS09 ³ | S107-SB09 | -- | -- | -- |
| -- | S107-SB10 | -- | -- | -- |
| -- | S107-SB11 | -- | -- | -- |
| -- | S107-SB12 | -- | -- | -- |
| -- | S107-SB13 | -- | -- | -- |
| -- | S107-SB14 | -- | -- | -- |

¹ Sampling (or well/piezometer installation) associated with Phase I RFI Part 1.

² Groundwater collected from drilling augers during soil boring installation.

³ Surficial sample of black cinder-like fill material from City of Columbus Spring Street coal-burning power plant.

4.3.8.5 Analytical Results

A discussion of the analytical results for the soil sampling is presented in the sections below. Fifty-two soil samples were collected from 19 locations at SWMU S107. A summary of all detected analytical results is contained in Table 4.3.8. Groundwater sampling results are presented in Section 4.7.

Inorganics

Concentrations of aluminum exhibited a general increase with depth. Concentrations of aluminum were detected in all 52-soil samples. Aluminum was found in concentrations of between 612 mg/kg (S107-SB09) and 22,400 J mg/kg (S107-SS03) in samples collected from the surface to 5 ft. depth interval of SWMU S107. Concentrations of aluminum at the 5-10 ft. depth interval ranged from 2,650 mg/kg (S107-SB13) to 10,500 mg/kg (S107-SB06). Concentrations below the 10 ft. depth interval ranged from 4,920 mg/kg (S107-SB10) to 14,800 mg/kg (S107-SB03).

Concentrations of antimony exhibited a general decrease with depth. Concentrations of antimony detected in 16 of 24 soil samples at the surface to 5 ft. depth interval ranged between 1.9J mg/kg (S107-SS02) and 90.1J mg/kg (S107-SB07). Concentrations of antimony were detected in 1 of 13 soil samples at the 5-10 ft. depth interval at a concentration of 2.7J mg/kg (S107-SB12). Concentrations of antimony detected in 2 of 13 soil samples below the 10 ft. depth interval ranged from 5.5J mg/kg (S107-SB14) to 7.0J mg/kg (S107-SB07).

Concentrations of arsenic exhibited a general increase with depth. Concentrations of arsenic were detected in all 52-soil samples. Arsenic was found in concentrations of between 2.2 mg/kg (S107-SB09) and 56.1J mg/kg (S107-SS02) in samples collected from the surface to 5 ft. depth interval of SWMU S107. Concentrations of arsenic at the 5-10 ft. depth interval ranged from 3.9 mg/kg (S107-SB13) to 49.5 mg/kg (S107-SB12). Concentrations below the 10 ft. depth interval ranged from 8.3 mg/kg (S107-SB03) to 29.9 mg/kg (S107-SB04).

Concentrations of barium exhibited a general decrease with depth. Concentrations of barium were detected in all 52-soil samples. Barium was found in concentrations of between 44.4J mg/kg (S107-SB14) and 5,400 mg/kg (S107-SB12) in samples collected from the surface to 5 ft. depth interval of SWMU S107. Concentrations of barium at the 5-10 ft. depth interval ranged from 45.8 mg/kg (S107-SB12) to 263J mg/kg (S107-SB13). Concentrations below the 10 ft. depth interval ranged from 43.8 mg/kg (S107-SB04) to 138J mg/kg (S107-SB13).

Concentrations of cadmium exhibited a general decrease with depth. Concentrations of cadmium detected in 12 of 22 soil samples at the surface to 5 ft. depth interval ranged between 0.96J mg/kg (S107-SB14) and 38.6 mg/kg (S107-SB10). Concentrations of cadmium detected in 9 of 13 soil samples at the 5-10 ft. depth interval ranged from 0.58 mg/kg (S107-SB11) to 1.8 mg/kg (S107-SB06). Concentrations of cadmium detected in 8 of 13 soil samples below the 10 ft. depth interval ranged from 0.57 mg/kg (S107-SB05) to 4.9J mg/kg (S107-SB14).

Concentrations of chromium exhibited a decrease with depth. Concentrations of chromium were detected in all 52-soil samples. Chromium was detected in concentrations of between 6.3J mg/kg (S107-SB09) and 135J mg/kg (S107-SB07) in samples collected from the surface to 5 ft. depth interval of SWMU S107. Concentrations of chromium at the 5-10 ft. depth interval ranged between 9.1J mg/kg (S107-SB12) and 39.8J mg/kg (S107-SB13). Concentrations below the 10 ft. depth interval ranged from 9.4J mg/kg (S107-SB09) to 52.4J mg/kg (S107-SB14).

Concentrations of copper exhibited a general decrease with depth. Concentrations of copper were detected in all 52-soil samples. Copper was detected in concentrations of between 5.1 mg/kg (S107-SB09) and 409 mg/kg (S107-SB07) in samples collected from the surface to 5 ft. depth interval of SWMU S107. Concentrations of copper at the 5-10 ft. depth interval ranged between 18.4 mg/kg (S107-SB06) and 41.1 mg/kg (S107-SB03). Concentrations below the 10 ft. depth interval ranged from 23.4 mg/kg (S107-SB13) to 45.8 mg/kg (S107-SB07).

Cyanide was found in two samples in SWMU S107. Cyanide was found in concentrations of 1.2 mg/kg (S107-SS04) and 0.84 mg/kg (S107-SB10) in samples collected from the surface to 5 ft. depth interval of SWMU S107. No detectable concentrations of cyanide were observed below the 5 ft. depth interval.

Concentrations of lead exhibited a decrease with depth. Concentrations of lead were detected in all 52-soil samples. Lead was found in concentrations of between 9.0J mg/kg (S107-SB09) and 878 mg/kg (S107-SB07) in samples collected from the surface to 5 ft. depth interval of SWMU S107. Concentrations of lead at the 5-10 ft. depth interval ranged between 8.0 mg/kg (S107-SB06) and 139J mg/kg (S107-SB13). Concentrations below the 10 ft. depth interval ranged from 10.5J mg/kg (S107-SB08) to 183J mg/kg (S107-SB14).

Concentrations of mercury exhibited a decrease with depth. Concentrations of mercury were detected in 11 of 22 soil samples at the surface to 5 ft. depth interval at concentrations between 0.036 mg/kg (S107-SB05) and 41.4 mg/kg (S107-SS04). Concentrations of mercury detected in 9 of 13 soil samples at the 5-10 ft. depth interval ranged between 0.034 mg/kg (S107-SB11) and 0.072 mg/kg (S107-SB13). Concentrations of mercury detected in 8 of 13 soil samples below the 10 ft. depth interval ranged from 0.030 mg/kg (S107-SB05) to 0.18 mg/kg (S107-SB14).

Concentrations of nickel were detected in 22 of 22 soil samples at the surface to 5 ft. depth interval at concentrations between 5.3 mg/kg (S107-SB09) and 24.4 mg/kg (S107-SS05). Concentrations of nickel detected in 13 of 13 soil samples at the 5-10 ft. depth interval ranged between 20.8 mg/kg (S107-SB06) and 58.4 mg/kg (S107-SB12). Concentrations of nickel detected in 13 of 13 soil samples below the 10 ft. depth interval ranged from 28.6 mg/kg (S107-SB09) to 50.1 mg/kg (S107-SB14).

Concentrations of selenium exhibited a general decrease with depth. Concentrations of selenium were detected in 12 of 22 soil samples at the surface to 5 ft. depth interval at concentrations between 0.25J mg/kg (S107-SS01) and 4.5J mg/kg (S107-SS04). Concentrations of selenium detected in 7 of 13 soil samples at the 5-10 ft. depth interval ranged between 0.57 mg/kg (S107-SB03) and 3.0 mg/kg (S107-SB06). Concentrations of selenium detected in 9 of 13 soil samples below the 10 ft. depth interval ranged from 0.64 mg/kg (S107-SB10) to 2.3 mg/kg (S107-SB04 and S107-SB07).

Concentrations of silver were found in a limited number of results. Concentrations of silver were detected in 5 of 22 soil samples at the surface to 5 ft. depth interval at concentrations between 0.51 mg/kg (S107-SS04) and 1.1 mg/kg (S107-SS03). Silver was not detected in any samples below the 5 ft. depth interval of SWMU S107.

Concentrations of zinc exhibited a decreasing trend with depth. Concentrations of zinc were detected in 22 of 22 soil samples at the surface to 5 ft. depth interval at concentrations between 23.1 mg/kg (S107-SB09) and 2,100 mg/kg (S107-SB07). Concentrations of zinc detected in 13 of 13 soil samples at the 5-10 ft. depth interval ranged between 62.0 mg/kg (S107-SS08) and 195 mg/kg (S107-SB12). Concentrations of zinc detected in 13 of 13 soil samples below the 10 ft. depth interval ranged from 67.1 mg/kg (S107-SB05) to 363 mg/kg (S107-SB07).

Pesticides/PCBs

The polychlorinated biphenyl (PCB), Aroclor-1254, was found in concentrations of 44 µg/kg (S107-SB04) and 1,000 µg/kg (S107-SB10) in samples collected from the surface to 5 ft. depth interval of SWMU S107. PCBs were not detected in any of the samples below the surface to a 5 ft. depth interval.

The pesticide, delta-BHC, was found in one sample at a concentration of 3.5J µg/kg (S107-SB12) at a depth of 8-9 ft. Pesticides were not detected in any other samples collected at SWMU S107.

SVOCs

SVOCs were identified in 31 of 52 samples from 19 locations in S107. The number and concentration of SVOC constituents decreased with depth, with a majority of constituents appearing in samples from the surface to 5 ft. depth interval. The primary SVOCs detected were PAHs and phthalates.

Concentrations of PAHs exhibited a general decrease with depth. PAHs were found in concentrations of between 43J $\mu\text{g}/\text{kg}$ (pyrene at S107-SB05) to 10,000J $\mu\text{g}/\text{kg}$ (fluoranthene and pyrene at S107-SS05) in samples collected from the surface to 5 ft. depth interval of SWMU S107. Four borings (S107-SB08, S107-SB12, S107-SB13, and S107-SB14) had PAHs at detectable concentrations below the 5-10 ft. depth interval. Concentrations of PAHs at the 5-10 ft. depth interval ranged from 70 $\mu\text{g}/\text{kg}$ (phenanthrene at S107-SB08) to 670J $\mu\text{g}/\text{kg}$ (naphthalene at S107-SB13). PAHs were only detected in one boring, S107-SB14, below the 10 ft. depth interval. Concentrations of PAHs at S107-SB14 ranged from 45J $\mu\text{g}/\text{kg}$ (naphthalene) to 87J $\mu\text{g}/\text{kg}$ (benzo(b)fluoranthene).

Bis(2-ethylhexyl)phthalate was detected in surface soils <5 feet at concentrations ranging from 52.0J $\mu\text{g}/\text{kg}$ at S107-SS03 to an elevated concentration of 1,300,000 $\mu\text{g}/\text{kg}$ (S107-SB11). Only four sample locations (i.e., S107-SS05, S107-SS04, S107-SB11 and S107-SB07) exhibited elevated concentration. Bis(2-ethylhexyl)phthalate results indicated a general decrease with depth in the S107 sample area. Low concentrations of SVOCs were detected at sample locations S107-SB03, S107-SB05, S107-SB09, S107-SB10, S107-SB11 and S107-SS01.

VOCs

VOCs were detected in 39 of 52 samples from 19 locations in S107. The number and concentration of VOC constituents decreased with depth. The primary VOCs detected included 1,1,1-trichloroethane, 1,1-dichloroethane, 1,2-dichloroethene, 2-butanone, chlorobenzene, ethylbenzene, methylene chloride, tetrachloroethene, toluene, trichloroethene, and xylenes. 1,1,2-Trichloroethane, 1,1-dichloroethene, 4-methyl-2-pentanone, carbon disulfide, chloroform, chloromethane, styrene, and vinyl chloride were also detected in 1 or 2 samples.

Concentrations of 1,1,1-trichloroethane were detected in 3 of 22 samples from the surface to 5 ft. depth interval between (7 $\mu\text{g}/\text{kg}$ in S107-SS04 and 48 $\mu\text{g}/\text{kg}$ in S107-SS05) and in 1 of 13 samples below the 10 ft. depth (13J $\mu\text{g}/\text{kg}$ in S107-SB07). Trichloroethene was not found in the 5-10 ft. depth interval.

Concentrations of 1,1-dichloroethane were detected in 4 of 22 samples from the surface to 5 ft. depth interval (between 3J $\mu\text{g}/\text{kg}$ in S107-SS04 and 580J $\mu\text{g}/\text{kg}$ in S107-SB07) and in 2 of 13 samples from the 5-10 ft. depth interval (13 $\mu\text{g}/\text{kg}$ in S107-SB07 and 1.7J $\mu\text{g}/\text{kg}$ in S107-SB11). 1,1-Dichloroethane was found in 2 of 13 samples below the 10 ft. depth interval (1.5J $\mu\text{g}/\text{kg}$ in S107-SB09 and 180J $\mu\text{g}/\text{kg}$ in S107-SB07).

Concentrations of 1,2-dichloroethene were detected in 4 of 22 samples from the surface to 5 ft. depth interval (between 3J $\mu\text{g}/\text{kg}$ in S107-SS04 and 1,200J $\mu\text{g}/\text{kg}$ in S107-SB12) and in 1 of 13 samples from the 5-10 ft. depth interval (1.6J $\mu\text{g}/\text{kg}$ in S107-SB07). 1,2-Dichloroethene was found in only 1 sample below the 10 ft. depth interval (6.3J $\mu\text{g}/\text{kg}$ in S107-SB07).

Concentrations of 2-butanone were detected in 8 of 22 samples from the surface to 5 ft. depth interval (between 3J $\mu\text{g}/\text{kg}$ in S107-SS04 and 30J $\mu\text{g}/\text{kg}$ in S107-SS05) and in 1 of 13 samples from the 5-10 ft. depth interval (15J $\mu\text{g}/\text{kg}$ in S107-SB08). 2-Butanone was found in only 1 sample below the 10 ft. depth interval (18J $\mu\text{g}/\text{kg}$ in S107-SB14).

Concentrations of chlorobenzene were detected in 2 of 22 samples from the surface to 5 ft. depth interval (23J $\mu\text{g}/\text{kg}$ in S107-SS05 and 120J $\mu\text{g}/\text{kg}$ in S107-SB11) and in 1 of 13 samples from the 5-10 ft. depth interval (0.43J $\mu\text{g}/\text{kg}$ in S107-SB11). Chlorobenzene was found in only 1 sample below the 10 ft. depth interval (5.2J $\mu\text{g}/\text{kg}$ in S107-SB07).

Concentrations of ethylbenzene were detected in 10 of 22 samples from the surface to 5 ft. depth interval (between 2.8J $\mu\text{g}/\text{kg}$ in S107-SB13 and 21,000 $\mu\text{g}/\text{kg}$ in S107-SB12) and in 1 of 13 samples from the 5-10 ft. depth interval (51 $\mu\text{g}/\text{kg}$ in S107-SB12). Ethylbenzene was found in only 1 sample below the 10 ft. depth interval (74 $\mu\text{g}/\text{kg}$ in S107-SB07).

Concentrations of methylene chloride were detected in 15 of 22 samples from the surface to 5 ft. depth interval (between 1.9J $\mu\text{g}/\text{kg}$ in S107-SB09 and 1,300J $\mu\text{g}/\text{kg}$ in S107-SB12) and in 6 of 13 samples from the 5-10 ft. depth interval (between 1.9J $\mu\text{g}/\text{kg}$ in S107-SB03 and 12 $\mu\text{g}/\text{kg}$ in S107-SB07). Methylene chloride was found in 6 of 13 samples below the 10 ft. depth interval (between 2.4J $\mu\text{g}/\text{kg}$ in S107-SB13 and 140 $\mu\text{g}/\text{kg}$ in S107-SB07).

Concentrations of tetrachloroethene were detected in 5 of 22 samples from the surface to 5 ft. depth interval (between 1.2J $\mu\text{g}/\text{kg}$ in S107-SB08 and 120J $\mu\text{g}/\text{kg}$ in S107-SB07) and in 1 of 13 samples at or below the 10 ft. depth interval (4.0J $\mu\text{g}/\text{kg}$ in S107-SB07). Tetrachloroethene was not detected in the 5-10 ft. depth interval.

Concentrations of toluene were detected in 10 of 22 samples from the surface to 5 ft. depth interval (between 0.51J $\mu\text{g}/\text{kg}$ in S107-SB10 and 310,000 $\mu\text{g}/\text{kg}$ in S107-SB12) and in 7 of 13 samples from the 5-10 ft. depth interval (between 0.7J $\mu\text{g}/\text{kg}$ in S107-SB03 and 110J $\mu\text{g}/\text{kg}$ in S107-SB12). Toluene was found in 4 of 13 samples below the 10 ft. depth interval (between 0.41J $\mu\text{g}/\text{kg}$ in S107-SB08 and 450 $\mu\text{g}/\text{kg}$ in S107-SB07).

Concentrations of xylenes were detected in 9 of 22 samples from the surface to 5 ft. depth interval (between 1.2J $\mu\text{g}/\text{kg}$ in S107-SB14 and 720,000 $\mu\text{g}/\text{kg}$ in S107-SB12) and in 7 of 13 samples from the 5-10 ft. depth interval (between 1.3J $\mu\text{g}/\text{kg}$ in S107-SB10 and 310J $\mu\text{g}/\text{kg}$ in S107-SB12). Xylenes were found in 3 of 13 samples below the 10 ft. depth interval (between 0.96J $\mu\text{g}/\text{kg}$ in S107-SB13 and 810 $\mu\text{g}/\text{kg}$ in S107-SB14).

1,1,2-Trichloroethane was detected in one soil sample (10 $\mu\text{g}/\text{kg}$ in S107-SS05 at surface to 5 ft. depth interval). 1,1-Dichloroethene was detected in one soil sample (2.9J $\mu\text{g}/\text{kg}$ in S107-SB07 at below the 10 ft. depth interval). 4-Methyl-2-pentanone was detected in one soil sample (16J $\mu\text{g}/\text{kg}$ in S107-SB13 at surface to 5 ft. depth interval). Benzene was detected in 1 of 13 samples from the 5-10 ft. depth interval (0.56J $\mu\text{g}/\text{kg}$ in S107-SB08) and in 1 of 13 samples below the 10 ft. depth interval (8.2J $\mu\text{g}/\text{kg}$ in S107-SB07), but there were no detections in the surface to 5 ft. depth interval. Carbon disulfide was detected in 1 of 24 samples from the surface to 5 ft. depth interval (7.6J $\mu\text{g}/\text{kg}$ in S107-SB11) and in 1 of 13 samples in the 5-10 ft. depth interval (0.50J $\mu\text{g}/\text{kg}$ in S107-SB08), but there were no detections below the 10 ft. depth interval. Chloroform was detected in 1 of 24 samples from the surface to 5 ft. depth interval (1.6J $\mu\text{g}/\text{kg}$ in S107-SB14) and in 1 of 13 samples in the 5-10 ft. depth interval (1.9J $\mu\text{g}/\text{kg}$ in S107-SB13), but there were no detections below the 10 ft. depth interval. Chloromethane was detected in one soil sample (860J $\mu\text{g}/\text{kg}$ in S107-SB07 at surface to 5 ft. depth interval). Styrene was detected in one soil sample (5.3J $\mu\text{g}/\text{kg}$ in S107-SB13 at surface to 5 ft. depth interval). Vinyl chloride was detected in one soil sample (0.63J $\mu\text{g}/\text{kg}$ in S107-SB12 at 5-10 ft. depth interval).

4.3.8.6 Discussion

The concentration of chemicals generally decreases with depth. Of the eight RCRA metals, barium and lead are found in higher concentrations, however, none of these concentrations were reported above their respective protection standard. All of these are found from the surface to 5 ft. depth interval. Barium is found in S107-SB08 at 501 J mg/kg, S107-SB10 at 479 J mg/kg, S107-SB11 at 508 J mg/kg, and S107-SB12 at 5,400 mg/kg. Barium was also found at or below the 10 ft. depth interval in S107-SB14 (432J mg/kg). Lead

was found in surface soil at S107-SS04 at 472 J mg/kg, S107-SB07 at 878 mg/kg, S107-SB10 at 531 J mg/kg, S107-SB12 at 453 J mg/kg, and at the fill material sample S100-SS09 at 228 J mg/kg.

Elevated levels of PCBs (i.e., Aroclor 1254) were detected at a concentration of 44 µg/kg (S107-SB04) and 1,000 µg/kg (S107-SB10) in samples collected from the surface to a depth of 5 ft. within SWMU S107. However, PCBs were not detected in any of the samples below the 5 ft. depth interval. Pesticide, delta-BHC, was found in one sample at a concentration of 3.5J µg/kg (S107-SB12) at a depth of 8-9 ft bgs. However, no pesticides were detected in any other samples collected at SWMU S107.

Concentrations of SVOCs, including PAHs and phthalates, are found almost exclusively at the surface with only a few exceptions. Higher concentrations of SVOCs found at the surface include sample locations S107-SS04, S107-SS05, S107-SB07, S107-SB08, S107-SB11, S107-SB12, S017-SB13, and S107-SB14. There are three sample locations with higher concentrations in the 5-10 ft. depth interval (S107-SB11, S107-SB12, and S107-SB13). Other sample locations report only low SVOC concentrations. One widespread contaminant is bis(2-ethylhexyl)phthalate. Concentrations of bis(2-ethylhexyl)phthalate were found in 31 of 52 samples, mostly in the surface to 5 ft. depth interval. Several SVOCs and PAHs were detected within the fill material sample S100-SS09.

VOCs are present in samples throughout the Drum Storage Area #1, but in relatively low concentrations. A large number of VOCs were identified at the surface in S107-SS04, S107-SS05, S107-SB11, S107-SB12, and S107-SB13. In the 5-10 ft. depth interval, several VOCs were detected at S107-SB08 and at or below the 10 ft. depth interval, several VOCs were detected at S107-SB07. Although most concentrations found were relatively low, there were two exceptions (S107-SB07 and S107-SB12 from surface to 5 ft. depth interval). Ethylbenzene (4,700 µg/kg), toluene (7,400 µg/kg), trichlorethene (690 µg/kg) and total xylenes (19,000 µg/kg) were detected in surface soil at S107-SB07. Concentrations of ethylbenzene (210,000 µg/kg), methylene chloride (1,300 µg/kg), toluene (310,000 µg/kg), and total xylenes (720,000) were detected in surface soil at S107-SB12. No VOCs were detected in the fill material samples S100-SS08 or S100-SS09.

4.3.9 SWMU S108 - DRUM STORAGE AREA # 2

4.3.9.1 Unit Description

Drum Storage Area #2 (SWMU S108) is an active drum storage area located east of SWMUs S106 and S107. Both open head and closed head drums are or have been stored in this area. In addition to drums awaiting processing, drums that have been oxidized and are awaiting reconditioning are also temporarily stored on a concrete pad in the northwest portion of this SWMU. The drums awaiting processing are stacked pyramid fashion and end to end on their sides in long rows. This portion of the drum storage area is not paved. Oxidized drums awaiting reconditioning are mostly stacked in an upright fashion on a concrete pad.

During construction of the facility, flyash and foundry sand was used as backfill material in this area. The flyash came from the City of Columbus Spring Street Power Plant and the foundry sand came from the former Claycraft facility. The fill material exists intermixed with surface soil within SWMU S108, not as a discernable separate matrix. As such, it was not considered a separate environmental medium, but rather as part of the existing soil matrix. Since SWMU S108 has been characterized using a grid sampling system, the fill material, as part of the soil matrix, has also been characterized.

A drainage ditch is located between SWMUs S108 and S109. The drainage ditch receives storm water from the north side of the active operations area via Outfall 002. In this area, the drainage ditch flows southward toward the existing railroad tracks. The sediment and surface water of the drainage ditch may have been adversely impacted by stormwater runoff from SWMUs S108 and S109.

4.3.9.2 Potential Contaminants

On March 20, 1987, Ohio EPA inspectors observed two locations with discolored soils within SWMU S108 and collected two surface soil samples. "Hot spot" sample location 1 was located east of and near the bend in gravel road in the northeast quadrant of SWMU S108 (Figure 1). "Hot spot" sample location 2 was located directly east of sample location 1, between the high-tension wires and the drainage ditch. Analytical results of the sampling effort are summarized below:

| <u>Constituent</u> | <u>Hot Spot 1</u> | <u>Hot Spot 2</u> |
|--------------------|-------------------|-------------------|
| Toluene | 890.0 mg/kg | 195 mg/kg |
| Xylene | 1,125 mg/kg | 252 mg/kg |
| Mineral Spirits | NR | 2,043 mg/kg |
| Chromium | 7,130 mg/kg | 559 mg/kg |
| Lead | 6,650 mg/kg | 4,430 mg/kg |
| Cadmium | 17.9 mg/kg | 40.6 mg/kg |
| Selenium | NR | 4.8 mg/kg |
| Arsenic | NR | 6.5 mg/kg |
| EP Tox Lead | 5,990 mg/kg | NR |
| EP Tox Chromium | 990 mg/kg | NR |

NR = Not Reported

Removal actions on Hot Spots 1 and 2 were completed in 1988. The extent of any contamination that may be the result of other potential past releases from SWMU S108 was not determined during this past investigation.

4.3.9.3 Potential Releases

There are no known or documented releases from this unit.

4.3.9.4 Summary of Investigation

Approach

In accordance with the *Revised Amended Scope of Work for the Franklin Steel Company, Inc. Phase II RCRA Facility Investigation* (SAIC, 1995), a surface soil laboratory sample was collected from 0-1 ft. for metals and SVOCs and a laboratory sample was collected from 3 to 3.5 ft. for VOCs at each of the locations. Samples were collected using a hand auger.

As outlined in the SOW, any metal, SVOC or VOC result at a level exceeding the Practical Quantitation Limit (PQL) for a hazardous waste constituent will be further evaluated using soil boring sampling with the following exception:

- If a VOC result exceeds the PQL at the 3 to 3.5 ft. level, a VOC sample will not be collected at 5 ft. from surface, but will be collected at the 10 ft. interval and at intervals thereafter according to procedures outlined in the *Final Work Plan for the Franklin Steel Company, Inc. Phase II RCRA Facility Investigation* (SAIC 1994).

It is important to note that if one constituent exceeded the PQL within a group of constituents (e.g., metal, SVOC, or VOC), then the entire associated group of constituents will be analyzed in future soil sampling for that sampling interval within S108. In other words, for example, if bis(2-ethylhexyl)phthalate is the only SVOC detected in a sample, subsequent samples for that depth would include the entire suite of constituents in the SVOC group.

Three sediment and surface water samples were collected from the drainage ditch located between SWMUs S108 and S109. A background sediment sample (S108-SD04) was collected from the area north of Blatt Boulevard.

| SWMU S108 SAMPLING SUMMARY | | | | |
|----------------------------|------------------------|--------------------------|------------------------|---------------|
| SURFACE SOIL | SOIL BORING | WELL/PIEZOMETER | SEDIMENT | SURFACE WATER |
| S108-SS01 ¹ | S108-PZ01 ¹ | S108-PZ01 ^{1,3} | S108-SD01 | S108-SW01 |
| S108-SS02 ¹ | S108-PZ02 ¹ | S108-PZ02 ^{1,3} | S108-SD02 | S108-SW02 |
| S108-SS03 ¹ | OX-SS01 ² | S108-MW03 | S108-SD03 | S108-SW03 |
| S108-SS04 ¹ | OX-SS02 ² | S108-MW04 | S108-SD04 ⁵ | -- |
| -- | OX-SS03 ³ | S108-MW05 | -- | -- |
| S100-SS10 ⁴ | OX-SS04 ² | S108-MW06D | -- | -- |
| S100-SS11 ⁴ | OX-SS05 ² | -- | -- | -- |
| S100-SS12 ⁴ | OX-SS06 ² | -- | -- | -- |
| S100-SS13 ⁴ | S108-SB05 | -- | -- | -- |
| S100-SS14 ⁴ | S108-SB06 | -- | -- | -- |
| -- | S108-SB07 | -- | -- | -- |
| -- | S108-SB08 | -- | -- | -- |
| -- | S108-SB09 | -- | -- | -- |
| -- | S108-SB10 | -- | -- | -- |
| -- | S108-SB11 | -- | -- | -- |
| -- | S108-SB12 | -- | -- | -- |
| -- | S108-SB13 | -- | -- | -- |
| -- | S108-SB14 | -- | -- | -- |
| -- | S108-SB15 | -- | -- | -- |
| -- | S108-SB16 | -- | -- | -- |
| -- | S108-SB17 | -- | -- | -- |
| -- | S108-SB18 | -- | -- | -- |
| -- | S108-SB19 | -- | -- | -- |
| -- | S108-SB20 | -- | -- | -- |
| -- | S108-SB21 | -- | -- | -- |
| -- | S108-SB22 | -- | -- | -- |
| -- | S108-SB23 | -- | -- | -- |
| -- | S108-SB24 | -- | -- | -- |
| -- | S108-SB25 | -- | -- | -- |
| -- | S108-SB26 | -- | -- | -- |

¹ Sampling (or well/piezometer installation) associated with Phase I RFI Part I.

² Conducted as part of the New Oxidizer soils investigation.

³ Groundwater collected from drilling augers during soil boring installation.

⁴ Surficial sample of black cinder-like fill material from City of Columbus Spring Street coal-burning power plant.

⁵ Sample S108-SD04 were sampled as background.

4.3.9.5 Analytical Results

A discussion of the analytical results for the soil, sediment, and surface water are presented in the sections below. One hundred and seven soil samples were collected from 37 locations at SWMU S108. A summary table of all detected analytical results is found in Table 4.3.9. Groundwater sampling results are presented in Section 4.7.

4.3.9.5.1 Soil

Inorganics

Concentrations of aluminum exhibited no definite trend. Concentration of aluminum were detected in 35 of 48 soil samples at the surface to 5 ft. depth interval at concentrations ranging between 3,090 mg/kg (S108-SB11) and 16,600 mg/kg (S108-SB14). Concentrations of aluminum detected in 48 of 50 soil samples at the 5-10 ft. depth interval ranged between 5,860 mg/kg (S108-SB19) and 22,900 mg/kg (S108-SB16). Concentrations of aluminum detected in 5 of 9 soil samples below the 10 ft. depth interval ranged from 5,410 mg/kg (S106-SB10) to 8,840 mg/kg (S108-SB24).

Concentrations of antimony exhibited a general decrease with depth. Concentrations of antimony were detected in 27 of 48 soil samples at the surface to 5 ft. depth interval between 1.9J mg/kg (S108-SB20) and 74.6J mg/kg (S108-SB15). Antimony was detected in 1 of 50 soil samples at the 5-10 ft. depth interval at a concentration of 6.7J mg/kg (S108-SB13). Antimony was detected in 1 of 9 soil samples below the 10 ft. depth interval at a concentration of 2.9J mg/kg (S108-SB10).

Concentrations of arsenic exhibited a general increase with depth with the highest concentrations found in the 5-10 ft. depth interval. Concentrations of arsenic were detected in 29 of 48 soil samples at the surface to 5 ft. depth interval at concentrations between 6.2 mg/kg (S108-SB16) and 26.2 mg/kg (S108-SB14). Concentrations of arsenic detected in 47 of 50 soil samples at the 5-10 ft. depth interval ranged from 9.8 mg/kg (S108-SB25) to 53.6 mg/kg (S108-SB06). Concentrations of arsenic detected in 5 of 9 soil samples below the 10 ft. depth interval ranged from 14.2 mg/kg (S108-SB26) to 36.8 mg/kg (S108-SB10).

Concentrations of barium exhibited a general decrease with depth. Concentrations of barium were detected in 37 of 48 soil samples at the surface to 5 ft. depth interval at concentrations between 61.5J mg/kg (S108-SS04) and 1,660J mg/kg (S108-SS23). Concentrations of barium detected in all 50 soil samples at the 5-10 ft. depth interval ranged from 35.2J mg/kg (S108-SB05) to 449J mg/kg (S108-SB10). Concentrations of barium detected in all 9 soil samples below the 10 ft. depth interval ranged from 32.4J mg/kg (OX-SS01) to 184J mg/kg (OX-SS05).

Concentrations of cadmium exhibited a decrease with depth. Concentrations of cadmium were detected in 28 of 48 soil samples at the surface to 5 ft. depth interval at concentrations between 0.48 mg/kg (S108-SS03) and 46.0J mg/kg (S108-SS15). Concentrations of cadmium detected in 28 of 50 soil samples at the 5-10 ft. depth interval ranged between 0.63 mg/kg (S108-SB21) and 4.8 mg/kg (S108-SB10). Concentrations of cadmium detected in 5 of 9 soil samples below the 10 ft. depth interval ranged from 0.58 mg/kg (S108-SB24) to 1.7 mg/kg (S108-SB10).

Concentrations of chromium exhibited a decrease with depth. Concentrations of chromium were detected in 32 of 48 soil samples at the surface to 5 ft. depth interval at concentrations between 15.8J mg/kg (S100-SS10) and 313 mg/kg (S108-SS15). Concentrations of chromium detected in 48 of 50 soil samples at the 5-10 ft. depth interval ranged between 9.70 mg/kg (S108-SB19) and 71.8J mg/kg (S108-SB13). Concentrations of chromium detected in 5 of 9 soil samples below the 10 ft. depth interval ranged from 8.90J mg/kg (S108-SB10) to 15.6J mg/kg (S108-SB26).

Concentrations of copper exhibited a decrease with depth. Concentrations of copper were detected in 32 of 48 soil samples at the surface to 5 ft. depth interval at concentrations between 10.2 mg/kg (S108-SS01) and 531 mg/kg (S108-SS01). Concentrations of copper detected in 48 of 50 soil samples at the 5-10 ft. depth interval ranged between 21.4 mg/kg (S108-SB25) and 45.5 mg/kg (S108-SB17). Concentrations of copper detected in 5 of 9 soil samples below the 10 ft. depth interval ranged from 23.3 mg/kg (OX-SS01) to 34.0 mg/kg (S108-SB10).

Concentrations of cyanide were found in 21 of 48 samples collected at the surface to 5 ft. depth interval of SWMU S108, but were not found in any samples below the 5 ft. depth interval. Cyanide ranged from 0.45 mg/kg (S108-SS03) to 4.0 mg/kg (S108-SB23) at the surface to 5 ft. depth interval.

Concentrations of lead exhibited a decrease with depth. Concentrations of lead were detected in 36 of 48 soil samples at the surface to 5 ft. depth interval at concentrations between 16.2J mg/kg (S108-SS02) and 1,840 mg/kg (S108-SS15). Concentrations of lead detected in 49 of 50 soil samples at the 5-10 ft. depth interval ranged between 10.3J mg/kg (S108-SB25) and 271.0 mg/kg (S108-SB13). Concentrations of lead detected in all 9 soil samples below the 10 ft. depth interval ranged from 10.5 mg/kg (OX-SS01) to 31.2 mg/kg (S108-SB10).

Concentrations of mercury exhibited a decrease with depth. Concentrations of mercury were detected in 24 of 48 soil samples at the surface to 5 ft. depth interval at concentrations between 0.04 mg/kg (S108-SS25) and 0.27 mg/kg (S108-SS02). Concentrations of mercury detected in 45 of 50 soil samples at the 5-10 ft. depth interval ranged between 0.03 mg/kg (S108-SB11) and 0.09 mg/kg (S108-SB11). Concentrations of mercury detected in 4 of 9 soil samples below the 10 ft. depth interval ranged from 0.024 mg/kg (S108-SB09) to 0.045 mg/kg (S108-SB10 and S108-SB26).

Concentrations of nickel were detected in 34 of 48 soil samples at the surface to 5 ft. depth interval at concentrations between 0.14 mg/kg (S108-SS18) and 54.5 mg/kg (OX-SS06). Concentrations of nickel detected in 47 of 50 soil samples at the 5-10 ft. depth interval ranged between 23.7 mg/kg (S108-SB05) and 65.6 mg/kg (S108-SB10). Concentrations of nickel detected in 5 of 9 soil samples below the 10 ft. depth interval ranged from 32.7 mg/kg (S108-SB09) to 44.3 mg/kg (S108-SB10).

Concentrations of selenium exhibited a slight decrease with depth. Concentrations of selenium were detected in 20 of 48 soil samples at the surface to 5 ft. depth interval at concentrations of between 0.19J mg/kg (S108-SS02) and 4.30 mg/kg (S108-SS15). Concentrations of selenium detected in 41 of 50 soil samples at the 5-10 ft. depth interval ranged between 0.56 mg/kg (S108-SB23) and 2.9 mg/kg (S108-SB05). Concentrations of selenium detected in 5 of 9 soil samples below the 10 ft. depth interval ranged from 0.70 mg/kg (S108-SB24) to 2.8 mg/kg (S108-SB10).

Concentrations of silver were found in a limited number of results. Concentrations of silver were detected in 4 of 48 soil samples at the surface to 5 ft. depth interval at concentrations between 0.53 mg/kg (S108-SS06) and 1.6 mg/kg (S108-SS02). No detectable concentrations of silver were observed in the 5-10 ft. depth interval or below the 10 ft. depth interval.

Concentrations of zinc exhibited a decrease with depth. Concentrations of nickel were detected in 45 of 48 soil samples at the surface to 5 ft. depth interval at concentrations between 50.2mg/kg (S108-SS01) and 2,070 mg/kg (S108-SS17). Concentrations of zinc detected in 49 of 50 soil samples at the 5-10 ft. depth interval ranged between 74.2 mg/kg (OX-SS04) and 184 mg/kg (S108-SB06). Concentrations of zinc detected in 9 of 9 soil samples below the 10 ft. depth interval ranged from 63.6 mg/kg (OX-SS03) to 150 mg/kg (S108-SB10).

Pesticides/PCBs

PCB Aroclor-1254, was found in concentrations of 450 µg/kg (S108-SS08) and 840 µg/kg (S108-SS09) in samples collected from the surface to 5 ft. depth interval of SWMU S108. PCBs were not detected in any of the samples below the surface to a 5 ft. depth interval. The pesticide, methoxychlor, was found in one sample at a concentration of 44 µg/kg (S108-SS19) at a surface depth of 0-1 ft. Pesticides were not detected in any other samples collected at SWMU S108.

SVOCs

SVOCs were detected in 50 of 107 samples from 37 locations in SWMU S108. The number and concentration of SVOC constituents decreased with depth, with the majority of constituents appearing in samples from the surface to 5 ft. depth interval. The primary SVOCs detected were PAHs and phthalates.

Concentrations of PAHs generally exhibited a decrease with depth. Concentrations of PAHs were detected in 20 of 48 soil samples at the surface to 5 ft. depth interval at concentrations between 38J $\mu\text{g}/\text{kg}$ (fluorene at S108-SS03) and 770 $\mu\text{g}/\text{kg}$ (fluoranthene at S108-SS03). Concentrations of PAHs detected in 3 of 50 soil samples at the 5-10 ft. depth interval ranged between 41J $\mu\text{g}/\text{kg}$ (pyrene at S108-SB21) and 9,900 $\mu\text{g}/\text{kg}$ (pyrene at S108-SB09). PAHs were not found below the 10 ft. depth interval in soil samples collected at SWMU S108.

Concentrations of phthalates generally exhibited a decrease with depth. Concentrations of butyl benzyl phthalate were found in 30 of 48 samples from the surface to 5 ft. depth interval (41J $\mu\text{g}/\text{kg}$ in S108-SB24 and 9,200J $\mu\text{g}/\text{kg}$ in S108-SB14) and in 2 of 50 samples from the 5-10 ft. depth interval (62J $\mu\text{g}/\text{kg}$ in S108-SB08 and 3700J $\mu\text{g}/\text{kg}$ in S108-SB13). Butyl benzyl phthalate was not found below the 10 ft. depth interval.

Concentrations of bis(2-ethylhexyl)phthalate were found in 34 of 48 samples from the surface to 5 ft. depth interval (between 290J $\mu\text{g}/\text{kg}$ in S108-SB24 and 230,000 $\mu\text{g}/\text{kg}$ in S108-SB18) and in 4 of 50 samples from the 5-10 ft. depth interval (between 52J $\mu\text{g}/\text{kg}$ in S108-SB25 and 43,000 $\mu\text{g}/\text{kg}$ in S108-SB13). Three samples had concentrations of bis(2-ethylhexyl)phthalate at or below the 10 ft. depth interval (between 62J $\mu\text{g}/\text{kg}$ in S108-SB26 and 87J $\mu\text{g}/\text{kg}$ in S108-SB08).

Concentrations of phenols were detected in 7 of 48 soil samples at the surface to 5 ft. depth interval at concentrations between 130J $\mu\text{g}/\text{kg}$ (2,4-dimethylphenol in S108-SB25) to 4,400 $\mu\text{g}/\text{kg}$ (phenol in S108-SB25). Concentrations of phenols were detected in only one of 50 soil samples at the 5-10 ft. depth interval at 72J $\mu\text{g}/\text{kg}$ (S108-SB26).

All other SVOCs were generally identified in surface soil samples with a few in the 5-10 ft. range in SWMU S108 including 2-methylnaphthalene (130J $\mu\text{g}/\text{kg}$ in S108-SS02, 230J $\mu\text{g}/\text{kg}$ in S108-SS03, 100J $\mu\text{g}/\text{kg}$ in S108-SB25, 44J $\mu\text{g}/\text{kg}$ in OX-SS05, and 440J in S100-SS14), dibenzofuran (270J $\mu\text{g}/\text{kg}$ in S108-SB13) and isophorone (in 7 samples in concentrations between 73J $\mu\text{g}/\text{kg}$ in S108-SS02 and 3,400 $\mu\text{g}/\text{kg}$ in S108-SB17).

Additional Sampling of S108-SB13 for SVOCs

As part of the effort to finalize unresolved issues regarding the Franklin Steel RFI and in accordance with the Ohio EPA letter dated December 12, 2000, three additional soil samples were collected on January 16, 2001 at S108-SB13 for SVOC analysis to further determine the extent of near-surface SVOC concentrations detected at this location during RFI sampling activities. During RFI sampling activities conducted on 3/14/1998, concentrations of benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene were detected at elevated concentrations in soil within the 7-8 ft. depth interval at concentrations of 6,200 $\mu\text{g}/\text{kg}$, 5,100 $\mu\text{g}/\text{kg}$, and 5,900 $\mu\text{g}/\text{kg}$, respectively.

Results from the January 16, 2001 sampling activity indicate that the SVOC bis(2-ethylhexyl)phthalate was detected in the 2-3 and 5-6 ft. depth intervals at concentrations of 840 and 380 $\mu\text{g}/\text{kg}$, respectively. No other SVOC concentrations were detected in these depth intervals and no SVOC concentrations were detected in the 3-4 ft. depth interval.

VOCs

VOCs were detected in 36 of 107 samples from 37 locations in SWMU S108. The number and concentration of VOC constituents decreased with depth. The primary VOCs detected included 1,1-dichloroethane, 1,2-dichloroethene, 2-butanone, acetone, carbon disulfide, ethylbenzene, tetrachloroethene, and xylenes. Benzene, chloroethane, chloromethane, trichloroethene, toluene, and vinyl chloride were also detected in 1 or 2 samples.

Concentrations of 1,1-dichloroethane were detected in 2 of 48 samples from the surface to 5 ft. depth interval (6.0 µg/kg in S108-SS01 and 27 µg/kg in S108-SS01) and in 4 of 50 samples from the 5-10 ft. depth interval (between 3.0J µg/kg in S108-SB06 and 61J µg/kg in S108-SB25). Concentrations of 1,1-dichloroethane were not detected below the 10 ft. depth interval.

Concentrations of 1,2-dichloroethene were detected in 7 of 48 samples from the surface to 5 ft. depth interval (95 µg/kg in S108-SS01 and 270 µg/kg in S108-SS01) and in 3 of 50 samples from the 5-10 ft. depth interval (between 2.5J µg/kg in S108-SB06 and 68J µg/kg in S108-SB25). Concentrations of 1,2-dichloroethene were not detected below the 10 ft. depth interval.

Concentrations of 2-butanone were detected in 3 of 48 samples from the surface to 5 ft. depth interval (between 7J µg/kg in S108-SS01 and 29 µg/kg in S108-SB08), in 1 of 50 samples from the 5-10 ft. depth interval (14J µg/kg in S108-SB23), and in 1 of 9 samples below the 10 ft. depth interval (6J µg/kg in OX-SS02).

Concentrations of acetone were detected in 9 of 48 samples from the surface to 5 ft. depth interval (between 3J µg/kg in S108-SS03 and 250 µg/kg in S108-SB21) and in 7 of 50 samples from the 5-10 ft. depth interval (between 9J µg/kg in S108-SB06 and 110 µg/kg in S108-SB23). Concentrations of acetone were detected in 1 of 9 samples below the 10 ft. depth interval (13J µg/kg in S108-SB09).

Concentrations of carbon disulfide were detected in 11 of 48 samples from the surface to 5 ft. depth interval (between 0.58J µg/kg in S108-SB07 and 3.7J µg/kg in S108-SB18) and in 1 of 50 samples from the 5-10 ft. depth interval (0.99J µg/kg in S108-SB09). Concentrations of carbon disulfide were not detected below the 10 ft. depth interval.

Concentrations of ethylbenzene were detected in 4 of 48 samples from the surface to 5 ft. depth interval (between 2J µg/kg in S108-SS03 and 3,500J µg/kg in S108-SB23) and in 2 of 50 samples from the 5-10 ft. depth interval (15J µg/kg in S108-SB23 and 74J µg/kg in S108-SB25). Concentrations of ethylbenzene were not detected below the 10 ft. depth interval.

Concentrations of tetrachloroethene were detected in 3 of 48 samples from the surface to 5 ft. depth interval (between 9 µg/kg in S108-SS01 and 300 µg/kg in S108-SS01) and in 1 of 50 samples from the 5-10 ft. depth interval (6.3J µg/kg in S108-SB25). Tetrachloroethene was not detected below the 10 ft. depth interval.

Concentrations of toluene were found in 3 of 48 samples from the surface to 5 ft. depth interval (between 3J µg/kg in S108-SS01 and 6,500 µg/kg in S108-SB23). Concentrations of toluene were not detected below the 5 ft. depth interval.

Concentrations of xylenes were detected in 6 of 48 samples from the surface to 5 ft. depth interval (between 10 µg/kg in S108-SS03 and 320,000 µg/kg in S108-SB23) and in 2 of 50 samples from the 5-10 ft. depth interval (0.95J µg/kg in S108-SB13 and 45J µg/kg in S108-SB25). Concentrations of xylenes were not detected below the 10 ft. depth interval.

Benzene was detected in 2 of 50 samples from the 5-10 ft. depth interval (3.6J µg/kg in S108-SB23 and 2.7J µg/kg in S108-SB25), but not in the surface to 5 ft. depth interval or below the 10 ft. depth interval.

Chloroethane was detected in 2 of 50 samples from the 5-10 ft. depth interval (3.0J µg/kg in S108-SB21 and 12 µg/kg in S108-SB25), but not in the surface to 5 ft. depth or below the 10 ft. depth intervals.

Chloromethane was detected in 1 of 50 samples from the 5-10 ft. depth interval (12J µg/kg in S108-SB25), but not in the surface to 5 ft. depth or below the 10 ft. depth intervals.

Trichloroethene was detected in 1 of 48 samples from the surface to 5 ft. depth interval (16 µg/kg in S108-SS01) and in 1 of 50 samples from the 5-10 ft. depth interval (12J µg/kg in S108-SB25), but not below the 10 ft. depth interval.

Vinyl chloride was detected in 1 of 50 samples from the 5-10 ft. depth interval (33 µg/kg in S108-SB15), but not in the surface to 5 ft. depth or below the 10 ft. depth intervals.

4.3.9.5.2 Sediment

Inorganics

Aluminum concentrations in the sediment of this unit ranged from 10,300 mg/kg (S108-SD02) to 20,300 J mg/kg (S108-SD03). There is no apparent pattern to the distribution of aluminum.

Concentrations of arsenic were greatest at S108-SB03 (33.8 mg/kg). The concentrations of arsenic at the other sediment sample locations were 12.8 mg/kg (S108-SD01), and 14.9 mg/kg (S108-SD02).

Barium was detected at its highest concentration at S108-SD03 (341 J mg/kg). The concentrations in the remaining sediment samples were 215 J mg/kg (S108-SD01), and 207 J mg/kg (S108-SD02).

The concentration of cadmium ranged from 2.0 mg/kg in S108-SD03 to 6.7 mg/kg in S108-SD01.

The concentration of chromium ranged from 22.4 mg/kg in S108-SD03 to 41.1 mg/kg (S108-SD01).

Lead concentrations ranged from 38.5 (S108-SD03) to 154 mg/kg (S108-SD01).

Concentrations of mercury were not detected at the mouth of the drainage ditch from S108-SD01 to S108-SD03. The concentrations of mercury ranged from 0.170 mg/kg (S108-SD02) to 0.27 mg/kg (S108-SD01).

Antimony, cyanide, selenium, and silver were not detected in any of the sediment samples collected at SWMU S108.

SVOCs

The sediment sample farthest downstream (S108-SD03) did not contain any SVOCs. PAHs were detected in sediment samples S108-SD01 and S108-SD02 in concentrations ranging from 67 J µg/kg (anthracene at S108-SD02) to 3,300 µg/kg (fluoranthene at S108-SD01). Butylbenzylphthalate was detected at a concentration of 110 J µg/kg in S108-SD01. Bis(2-ethylhexyl)phthalate was detected at concentrations of 500 J µg/kg (S108-SD02) and 1,000 µg/kg (S108-SD01). Carbazole was detected at a concentration of 130 J µg/kg (S108-SD02) and 170 µg/kg (S108-SD01). No other SVOCs were detected in sediment samples collected at SWMU S108.

VOCs

Acetone was the only VOC detected in sediment samples collected at SWMU S108. Acetone was detected at S108-SD01 and S108-SD02 at concentrations of 425 µg/kg and 17J µg/kg, respectively.

4.3.9.5.3 Surface Water

Inorganics

Aluminum concentrations in the surface water ranged from 310 mg/kg (S108-SW01) to 3900 mg/kg (S108-SW02).

Barium concentrations in the surface water were generally consistent in all three samples. Concentrations ranged from 84 mg/kg (S108-SW02) to 140 mg/kg (S108-SW03).

Lead was detected in only one surface water sample (S108-SW03) at a concentration of 22 mg/kg.

Antimony, arsenic, cyanide, cadmium, mercury, selenium, and silver were not detected in any of the surface water samples collected at SWMU S108.

SVOCs

Fluoranthene was the only SVOC detected in surface water at SWMU S108. Fluoranthene was detected at a concentration of 1.4J µg/kg at S108-SW03. No other SVOCs were detected in surface water samples at SWMU S108.

VOCs

VOCs were not detected in the surface water samples collected at SWMU S108.

4.3.9.6 Discussion

The concentration of soil contaminants generally decreases with depth, although there are a few notable exceptions. Of the eight RCRA metals, barium, cadmium, chromium, and lead were detected at higher concentrations than the rest of the locations at sampling locations S108-SS11, S100-SS12, S100-SS13, S100-SS14, S108-SS01, S108-SS04, S108-SS06, S108-SS08, S108-SS10, S108-SS15, S108-SS16, S108-SS17, S108-SS18, S108-SS19, S108-SS21, and S108-SS23 at a depth of 0-1 ft. The concentrations for the four metals listed are higher in almost all cases at sample location S108-SS15.

Concentrations of PCB Aroclor 1254 at levels of 450 µg/kg (S108-SS08) and 840 µg/kg (S108-SS09) were detected in surface soils at SWMU S108. PCBs were not detected in any of the samples below the surface at depths greater than 5 ft.

The largest groupings of SVOCs in the soil samples including PAHs and phthalates were detected at sample locations S100-SS11, S100-SS12, S100-SS13, S100-SS14, S108-SS02, S108-SS03, S108-SS04, S108-SB09, S108-SS11, S108-SS12, S108-SS13, S108-SS14, S108-SS15, S108-SS18, S108-SS20, S108-SS25 and S108-SS26. The majority of these are surface to 5 ft. depth interval soil concentrations.

One noted exceptions is S108-SB13 where concentrations of SVOCs are found from 7 - 8 ft. However, during the January 16, 2001 resample of S108-SB13, bis(2-ethylhexyl)phthalate was the only SVOC detected at concentrations of 840 µg/kg (2-3 ft. depth interval), nondetect (3-4 ft. depth interval), and 380 J µg/kg (5-6 ft. depth interval). The three additional soil samples collected at this location are adequate to determine the extent of near-surface SVOC concentrations. The results indicate that elevated SVOC concentrations only

exist at the 7-8 ft. depth interval as described in Section 4.3.9.5.1 above. Only one SVOC, bis(2-ethylhexyl)phthalate was detected at the near surface.

Other sample locations have only one or two constituents. One widespread constituent is bis(2-ethylhexyl)phthalate. Concentrations of bis(2-ethylhexyl)phthalate were detected at 32 of 48 sample locations in the surface to 5 ft. depth interval.

Most of the VOC concentrations detected were at the surface at sample locations S108-SS01 and S108-SB21. Sample S108-SB23, exhibited elevated concentrations of ethylbenzene (3,500 mg/L) and total xylenes (320,000 mg/L) at a depth of 3-4 ft.. One exception is sample location S108-SS03 where both xylenes and ethylbenzene were detected at the surface at 12,000 µg/kg and 3,100 µg/kg, respectively.

The three sediment sample locations at SWMU S108 have a homogeneous distribution of inorganic constituents, but not SVOCs or VOCs. Similar inorganic constituents were detected in all three sediment samples at SWMU S108. Fifteen different SVOCs and one VOC were detected in S108-SD01 and S108-SD02, but there were no SVOCs or VOCs detected in S108-SD03.

The three surface water samples at SWMU S108 have a homogeneous distribution of inorganic constituents. Similar inorganic constituents were detected in all three surface water samples at SWMU S108. There were no SVOCs or VOCs detected in any of the three surface water samples except for fluoranthene, which was detected at a concentration of 1.4J µg/L (S108-SD03).

4.3.10 SWMU S109 - DRUM STORAGE AREA # 3

4.3.10.1 Unit Description

Former Drum Storage Area #3 (SWMU S109) was used from approximately 1985 to 1988 for storage of open head and closed head drums awaiting processing. SWMU S109 was located east of and adjacent to SWMU S108. The drums were stacked pyramid fashion and end to end on their sides in long rows. The drum storage area was not paved.

4.3.10.2 Potential Contaminants

No samples have been collected from environmental media prior to the RFI.

4.3.10.3 Potential Releases

There are no known or documented releases from this unit.

4.3.10.4 Summary of Investigation

The following table summarizes RFI investigations at SWMU S109.

| SWMU S109 SAMPLING SUMMARY | | | | |
|----------------------------|------------------------|--------------------------|----------|---------------|
| SURFACE SOIL | SOIL BORING | WELL/PIEZOMETER | SEDIMENT | SURFACE WATER |
| S109-SS01 ¹ | S109-PZ01 ¹ | S109-PZ01 ^{1,4} | -- | -- |
| S109-SS02 ¹ | S109-PZ02 ¹ | S109-PZ02 ^{1,4} | -- | -- |
| S109-SS03 ¹ | S109-SB03 | S109-PZ02 ^{1,4} | -- | -- |
| S109-SS04 ¹ | S109-SB04 | S109-PZ03 ³ | -- | -- |
| S109-SS05 ² | S109-SB05 | S109-PZ04 | -- | -- |
| S109-SS06 ² | S109-SB06 | S109-MW05D | -- | -- |
| S109-SS07 ² | S109-SB07 | S109-MW06 | -- | -- |
| S109-SS08 ² | S109-SB08 | -- | -- | -- |
| S109-SS09 ² | -- | -- | -- | -- |
| S109-SS10 ² | -- | -- | -- | -- |
| S109-SS11 ² | -- | -- | -- | -- |
| S109-SS12 ² | S109-SB12 ³ | -- | -- | -- |
| S109-SS13 ² | -- | -- | -- | -- |
| S109-SS14 ² | -- | -- | -- | -- |
| S109-SS15 ² | -- | -- | -- | -- |
| S109-SS16 ² | -- | -- | -- | -- |
| S109-SS17 ² | -- | -- | -- | -- |
| S109-SS18 ² | -- | -- | -- | -- |

¹ Sampling (or well/piezometer installation) associated with Phase I RFI Part 1.

² Sampling of surface soils associated with SWMU S109 and S201 field screening and surface soils sampling. Note that several surface soil samples are associated with soil boring locations.

³ Soil boring associated with abandonment of S109-PZ03. Soil description data only, no sample analytical data collected.

⁴ Groundwater collected from drilling augers during soil boring installation.

4.3.10.5 Analytical Results

A discussion of the analytical results for the soil sampling is presented in the sections below. Thirty-eight soil samples were collected from 24 locations. Soil samples were collected in accordance with the *Revised Amended Scope of Work for the Franklin Steel Company, Inc. Phase II RCRA Facility Investigation (SAIC, 1995)*. A summary of all detected analytical results is contained in Table 4.3.10. Groundwater sampling results are presented in Section 4.7.

4.3.10.5.1 Soils

Inorganics

Concentrations of aluminum exhibited a general decrease with depth. Aluminum was detected in all 38 soil samples collected at SWMU S109. Aluminum was detected in concentrations of between 8,120 J mg/kg (S109-SS01) and 17,500 mg/kg (S109-SS09) in samples collected from the surface to 5 ft. depth interval of SWMU S109. Concentrations of aluminum at the 5-10 ft. depth interval ranged from 3,970 mg/kg (S109-SB04) to 11,500 mg/kg (S109-SB09). Concentrations below the 10 ft. depth interval ranged from 3,730 mg/kg (S109-SB08) to 13,600 mg/kg (S109-SB10).

Concentrations of arsenic exhibited a general increase with depth. Arsenic was detected in all 38 soil samples collected at SWMU S109. Arsenic was detected in concentrations of between 7.6 J mg/kg (S109-SS08) and 20.5 J mg/kg (S109-SS04) in samples collected from the surface to 5 ft. depth interval of SWMU S109. Concentrations of arsenic at the 5-10 ft. depth interval ranged from 13.3 mg/kg (S109-SB10) to 77.9 mg/kg (S109-SB07). Concentrations below the 10 ft. depth interval ranged from 5.1 mg/kg (S109-SB08) to 30.9 mg/kg (S109-SB03).

Additional Sampling of S109-SB07 for Arsenic

During RFI sampling activities conducted on 8/12/1997, elevated levels of arsenic were detected at S109-SB07 within the 5-6 ft. depth interval at a concentration of 77.9 mg/kg; and in the 8-9 ft. depth interval at a concentration of 24.7 mg/kg. In accordance with the Ohio EPA letter dated December 12, 2000, two additional soil samples were collected for arsenic analysis. During the January 16, 2001 resampling event, arsenic was detected in the 4.5-5.5 and 5.5-6.5 ft. depth intervals at concentrations of 49.2 and 32.5 mg/kg, respectively. These concentrations are well below the 77.9 mg/kg concentration of arsenic detected in the previous RFI sample collected on 8/12/1997.

Inorganics Continued

Concentrations of barium exhibited a general decrease with depth. Barium was detected in all 38 soil samples collected at SWMU S109. Barium was detected in concentrations of between 60.2 mg/kg (S109-SS10) and 414 mg/kg (S109-SS05) in samples collected from the surface to 5 ft. depth interval of SWMU S109. Concentrations of barium at the 5-10 ft. depth interval ranged from 44.4 mg/kg (S109-SB04) to 132 mg/kg (S109-SB04 and S109-SB09). Concentrations below the 10 ft. depth interval ranged from 25.6 mg/kg (S109-SB08) to 161 mg/kg (S109-SB10).

Concentrations of cadmium exhibited a general increase with depth. Concentrations of cadmium were detected in 9 of 16 soil samples at the surface to 5 ft. depth interval at concentrations of between 0.58J mg/kg (S109-SS03) and 1.3 mg/kg (S109-SS04 and S109-SS05). Concentrations of cadmium were detected in 9 of 11 soil samples at the 5-10 ft. depth interval ranging from 0.73 mg/kg (S109-SB09) to 2.0 mg/kg (S109-SB04). Cadmium was detected in 8 of 11 soil samples below the 10 ft. depth interval at concentrations ranging from 0.82 mg/kg (S109-SB10) to 2.3 mg/kg (S109-SB08).

Concentrations of chromium exhibited a general decrease with depth. Chromium was detected in all 38 soil samples collected at SWMU S109. Chromium was detected in concentrations of between 12.1 mg/kg (S109-SS01) and 42.5J mg/kg (S109-SS05) in samples collected from the surface to 5 ft. depth interval of SWMU S109. Concentrations of chromium at the 5-10 ft. depth interval ranged from 8.2 mg/kg (S109-SB04) to 16.7 mg/kg (S109-SB09). Concentrations below the 10 ft. depth interval ranged from 8.4 mg/kg (S109-SB09) to 24.2J mg/kg (S109-SB10).

Cyanide was not detected in any soil samples collected at SWMU S109.

Concentrations of lead exhibited a general decrease with depth. Lead was detected in all 38 soil samples collected at SWMU S109. Lead was detected in concentrations of between 14.1J mg/kg (S109-SS03) and 120J mg/kg (S109-SS05) in samples collected from the surface of SWMU S109. Concentrations of lead at the 5-10 ft. depth interval ranged from 11.0 mg/kg (S109-SB08) to 18.6J mg/kg (S109-SB04). Concentrations below the 10 ft. depth interval ranged from 6.7 mg/kg (S109-SB08) to 33.4 mg/kg (S109-SB09).

Concentrations of mercury were detected in a limited number of results and exhibited a general decrease with depth. Mercury was detected in only 1 of 16 soil samples at the surface to 5 ft. depth interval at a concentration of 0.17 mg/kg (S109-SS05). Concentrations of mercury were detected in 3 of 11 soil samples at the 5-10 ft. depth interval ranging from 0.023 mg/kg (S109-SB08) to 0.037 mg/kg (S109-SB09). Mercury was detected in 6 of 11 soil samples below the 10 ft. depth interval at concentrations ranging from 0.015 mg/kg (S109-SB08) to 0.038 mg/kg (S109-SB09).

Concentrations of selenium exhibited a general increase with depth. Concentrations of selenium were detected in 2 of 16 soil samples at the surface to 5 ft. depth interval at concentrations of between 0.66J mg/kg (S109-SS01) and 0.94J mg/kg (S109-SS02). Concentrations of selenium were detected in 5 of 11 soil samples at the 5-10 ft. depth interval ranging from 0.75 mg/kg (S109-SB09) to 3.8 mg/kg (S109-SB04). Selenium was detected in 5 of 11 soil samples below the 10 ft. depth interval at concentrations ranging from 0.58 mg/kg (S109-SB09) to 5.6 mg/kg (S109-SB09).

Concentrations of silver were detected in a limited number of results and exhibited a general increase with depth. Silver was not detected in any of the samples from the surface to 5 ft. depth interval of SWMU S109. Concentrations of silver were detected in 1 of 11 soil samples at the 5-10 ft. depth interval at 0.30 mg/kg (S109-SB10). Silver was detected in 3 of 11 soil samples below the 10 ft. depth interval at concentrations ranging from 0.35 mg/kg (S109-SB08) to 1.2 mg/kg (S109-SB09).

SVOCs

SVOCs were collected in 11 of 38 samples from 24 locations in SWMU S109. The number and concentration of SVOC constituents decreased with depth, with a majority of constituents appearing in samples from the surface to 5 ft. depth interval. The primary SVOCs detected were PAHs and phthalates.

Concentrations of PAHs generally decreased with depth. PAHs were detected in 8 of 38 soil samples collected at SWMU S109. PAHs were detected in concentrations of between 42J $\mu\text{g}/\text{kg}$ (2-methylnaphthalene at S109-SS17) and 350J $\mu\text{g}/\text{kg}$ (2-methylnaphthalene at S109-SS08) in samples collected from the surface to 5 ft. depth interval. Only one PAH, 2-methylnaphthalene, was detected at depths at or below the 10 ft. interval. Concentrations of 2-methylnaphthalene at or below the 10 ft. depth interval ranged from 70J $\mu\text{g}/\text{kg}$ (S109-SB09) and 210 $\mu\text{g}/\text{kg}$ (S109-SB08).

Concentrations of phthalates exhibited a decrease with depth. Phthalates were detected in 5 of 38 soil samples collected at SWMU S109. Di-n-butylphthalate was detected in two samples, 62J $\mu\text{g}/\text{kg}$ (S109-SS01) and 46J $\mu\text{g}/\text{kg}$ (S109-SS02), collected from the surface of SWMU S109. Bis(2-ethylhexyl)phthalate was detected at a concentration of 330J $\mu\text{g}/\text{kg}$ in the surface sample collected at S109-SS01. Bis(2-ethylhexyl)phthalate was detected at 55J $\mu\text{g}/\text{kg}$ at the 5-10 ft. depth interval in S109-SB03. No phthalates were encountered at or below the 10 ft. depth interval.

Dibenzofuran was the only other SVOC found in soil samples at SWMU S109. Dibenzofuran was detected at 46J $\mu\text{g}/\text{kg}$ in the surface soil sample, S109-SS07.

VOCs

Acetone was the only VOC detected in soil samples at SWMU S109. Concentrations of acetone were detected in 3 of 25 soil samples at the 5-10 ft. depth interval at concentrations of 15J $\mu\text{g}/\text{kg}$ (S109-SB03), 7.5J $\mu\text{g}/\text{kg}$ (S109-SB04), and 22J $\mu\text{g}/\text{kg}$ (S109-SB05). VOCs were not detected in surface to 5 ft. depth interval soil samples or soil samples below the 10 ft. depth interval.

4.3.10.6 Discussion

The concentration of constituents generally decreases with depth. Exceptions to this were arsenic, selenium, and silver, which exhibited a general increase with depth. Several of the RCRA metals described above exhibit concentration profiles that suggest surface deposition of metals on the surface of the soil. The highest concentrations of aluminum, barium, lead, and mercury all occur in the 0-1 ft. depth interval.

Results of the two additional soil samples collected at the S109-SB07 did not duplicate the previous RFI detected concentration of arsenic at 77.9 mg/kg. It can be concluded based on the additional data collected on January 16, 2001 that slightly elevated concentrations of arsenic detected within the 4.5-5.5 and 5.5-6.5 ft.

depth intervals are isolated and most likely naturally occurring. The 77.9 mg/kg concentration of arsenic detected during the RFI 10/23/1993 sampling event appears to be an anomaly and therefore no further action is warranted at this location.

SVOCs were detected infrequently at SWMU S109 with the exception of several SVOCs identified in two samples in the surface to 5 ft. depth interval. Four different SVOCs were detected at S109-SS05 ranging in concentrations from 160J µg/kg (phenanthrene) to 300J µg/kg (2-methylnaphthalene). Five different SVOCs were detected at S109-SS07 ranging in concentrations from 46J µg/kg (dibenzofuran) to 160J µg/kg (2-methylnaphthalene). 2-Methylnaphthalene was the SVOC detected most frequently. Concentrations of 2-methylnaphthalene were detected in 8 of 38 samples ranging in concentration from 42 J µg/kg (S109-SS17 in the surface to 5 ft. depth interval) to 350 J µg/kg (S109-SS08 in the surface to 5 ft. depth interval).

VOCs were detected in only three samples at SWMU S109 with acetone being the only VOC detected. Two of these detections were in the 5-10 ft. depth interval (15J µg/kg at S109-SB03 and 7.5J µg/kg at S109-SB04) and one was at or below the 10 ft. depth interval (22J at S109-SB05).

4.3.11 SWMU S201 - DRUM STORAGE AREA # 4

4.3.11.1 Unit Description

Former Drum Storage Area #4 (SWMU S201) was used from approximately 1985 to 1988 for storage of open head and closed head drums awaiting processing. SWMU S201 is located northeast of and not contiguous with SWMU S109. The drums were stacked pyramid fashion and end to end on their sides in long rows. The drum storage area was not paved.

4.3.11.2 Potential Contaminants

There are no known or documented releases from this unit.

4.3.11.3 Potential Releases

The existence and extent of any contamination as a result of potential past releases from SWMU S201 has not been determined.

4.3.11.4 Summary of Investigation

The following table summarizes RFI investigation at SWMU S201.

| SWMU S201 SAMPLING SUMMARY | | | | |
|----------------------------|------------------------|--------------------------|------------------------|------------------------|
| SURFACE SOIL | SOIL BORING | WELL/PIEZOMETER | SEDIMENT | SURFACE WATER |
| S201-SS01 ¹ | S201-PZ01 ¹ | S201-PZ01 ^{1,5} | S201-SD01 | S201-SW01 |
| S201-SS02 ¹ | -- | S201-MW02 | S201-SD02 | S201-SW02 |
| S201-SS03 ¹ | S201-SB03 ⁴ | -- | S201-SD03 ⁶ | S201-SW03 ⁶ |
| S201-SS04 ¹ | S201-SB04 | -- | S201-SD04 ⁶ | S201-SW04 ⁶ |
| S201-SS05 ² | S201-SB05 | -- | BN-SD-3 ⁶ | BN-SW-3 ⁶ |
| S201-SS06 ² | S201-SB06 | -- | -- | -- |
| S201-SS07 ² | S201-SB07 | -- | -- | -- |
| S201-SS08 ² | S201-SB08 | -- | -- | -- |
| S201-SS09 ² | S201-SB09 | -- | -- | -- |
| S201-SS10 ² | S201-SB10 | -- | -- | -- |
| S201-SS11 ² | S201-SB11 | -- | -- | -- |

| SWMU S201 SAMPLING SUMMARY | | | | |
|----------------------------|-------------|-----------------|----------|---------------|
| SURFACE SOIL | SOIL BORING | WELL/PIEZOMETER | SEDIMENT | SURFACE WATER |
| S201-SS12 ² | S201-SB12 | -- | -- | -- |
| S201-SS13 ³ | -- | -- | -- | -- |
| S201-SS14 ³ | -- | -- | -- | -- |
| S201-SS15 ² | -- | -- | -- | -- |
| S201-SS16 ² | -- | -- | -- | -- |

¹ Sampling (or well/piezometer installation) associated with Phase I RFI Part 1.

² Sampling of surface soils associated with SWMU S109 and S201 field screening and surface soil sampling. Note that several surface soil samples are associated with soil boring locations.

³ No analytical data collected for this sample.

⁴ Soil boring for monitoring well abandoned as no water was encountered; no analytical data collected.

⁵ Groundwater collected from drilling augers during soil boring installation.

⁶ Sampled as background.

4.3.11.5 Analytical Results

A discussion of the analytical results for the soil, sediment, and surface water sampling is presented in the sections below. Thirty-seven soil samples were collected from 17 locations, four sediment samples were collected from four locations, and four surface water samples were collected from four locations. Soil samples were collected in accordance with the *Revised Amended Scope of Work for the Franklin Steel Company, Inc. Phase II RCRA Facility Investigation* (SAIC, 1995). A summary table of all detected analytical results is found in Table 4.3.11 and Table 4.3.2A. Groundwater sampling results are presented in Section 4.7.

4.3.11.5.1 Soil

Inorganics

Concentrations of aluminum exhibited a general decrease with depth. Aluminum was detected in all 37 soil samples collected at SWMU S201. Aluminum was detected in concentrations of between 7,290 mg/kg (S201-SS01) and 15,100 mg/kg (S201-SS11) in samples collected from the surface to 5 ft. depth interval of SWMU S201. Concentrations of aluminum at the 5-10 ft. depth interval ranged from 7,160 mg/kg (S201-SB07) to 13,700 mg/kg (S201-SB04). Concentrations below the 10 ft. depth interval ranged from 4,090 mg/kg (S201-SB12) to 8,490 mg/kg (S201-SB04).

Concentrations of arsenic exhibited a general increase with depth. Arsenic was detected in all 37 soil samples collected at SWMU S201. Arsenic was detected in concentrations of between 6.8 mg/kg (S201-SS12) and 73.7 mg/kg (S201-SS02) in samples collected from the surface to 5 ft. depth interval of SWMU S201. Concentrations of arsenic at the 5-10 ft. depth interval ranged from 13.2 mg/kg (S201-SB04) to 34.3 mg/kg (S201-SB06). Concentrations below the 10 ft. depth interval ranged from 10.7 mg/kg (S201-SB12) to 288 mg/kg (S201-SB10).

Additional Sampling of S201-SS02 for Arsenic

During RFI sampling activities on 10/23/1993, arsenic was detected at 73.7 mg/kg in surface sample S201-SS02 within the 0-1 ft. depth interval. In accordance with the Ohio EPA letter dated December 12, 2000, two additional surface soil samples and one duplicate soil sample were collected for arsenic analysis. The January 16, 2001 samples reported arsenic concentrations in the 0-1 ft. and 1-2 ft. depth intervals at concentrations of 16.4 mg/kg and 12.3 mg/kg, respectively. The duplicate was collected from the 0-1 ft. depth interval and reported an arsenic concentration of 19.3 mg/kg. These concentrations are well below the 73.7 mg/kg concentration of arsenic detected in the RFI sample collected on 10/23/1993.

Inorganics Continued

Concentrations of barium exhibited no definable decrease with depth. Barium was detected in all 37 soil samples collected at SWMU S201. Barium was detected in concentrations of between 62.1J mg/kg (S201-SS02) and 236 mg/kg (S201-SS06) in samples collected from the surface to 5 ft. depth interval of SWMU S201. Concentrations of barium at the 5-10 ft. depth interval ranged from 67.5 mg/kg (S201-SB06) to 207 mg/kg (S201-SB12). Concentrations below the 10 ft. depth interval ranged from 36.2 mg/kg (S201-SB04) to 227 mg/kg (S201-SB05).

Concentrations of cadmium exhibited no definable decrease with depth. Concentrations of cadmium were detected in 9 of 15 soil samples at the surface to 5 ft. depth interval ranging between 0.49J mg/kg (S201-SS03) and 1.1 mg/kg (S201-SS06). Concentrations of cadmium were detected in 9 of 11 soil samples at the 5-10 ft. depth interval ranging from 0.53 mg/kg (S201-SB10) to 1.1 mg/kg (S201-SB10). Cadmium was detected in 13 of 14 soil samples below the 10 ft. depth interval at concentrations ranging from 0.39 mg/kg (S201-SB05) to 3.0 mg/kg (S201-SB08).

Concentrations of chromium exhibited a general decrease with depth. Chromium was detected in all 37 soil samples collected at SWMU S201. Chromium was detected in concentrations of between 12.1 mg/kg (S201-SS04) and 18.8J (S201-SS06) mg/kg in samples collected from the surface to 5 ft. depth interval of SWMU S201. Concentrations of chromium at the 5-10 ft. depth interval ranged from 12.1 mg/kg (S201-SB10) to 18.2 mg/kg (S201-SB04). Concentrations below the 10 ft. depth interval ranged from 7.7 mg/kg (S201-SB12) to 13.4 mg/kg (S201-SB07).

Cyanide was not detected in any of the soil samples collected at SWMU S201.

Iron was detected in all 37 soil samples collected at SWMU S201. Iron was detected at concentrations ranging between 11,800 mg/kg (S201-SD02) and 29,900 (S201-SS02) mg/kg in samples collected from the surface to 5 ft. depth interval of SWMU S201. Concentrations of iron at the 5-10 ft. depth interval ranged from 23,500 mg/kg (S201-SB04) to 38,700 mg/kg (S201-SB06). Concentrations below the 10 ft. depth interval ranged from 14,800 mg/kg (S201-SB04) to 126,000 mg/kg (S201-SB10).

Concentrations of lead exhibited a general decrease with depth. Lead was detected in all 37 soil samples collected at SWMU S201. Lead was detected in concentrations of between 16.8J mg/kg (S201-SS10) and 45.3J mg/kg (S201-SS12) in samples collected from the surface to 5 ft. depth interval of SWMU S201. Concentrations of lead at the 5-10 ft. depth interval ranged from 11.6 mg/kg (S201-SB07) to 18.6 mg/kg (S201-SB09). Concentrations below the 10 ft. depth interval ranged from 8.3 mg/kg (S201-SB12) to 27.2J mg/kg (S201-SB10).

Concentrations of mercury exhibited a general decrease with depth. Concentrations of mercury were detected once at the surface to 5 ft. depth at 0.15 mg/kg (S201-SS06). Concentrations of mercury detected in 11 of 11 soil samples at the 5-10 ft. depth interval ranged from 0.023 mg/kg (S201-SB11) to 0.047 mg/kg (S201-SB04). Concentrations of mercury detected in 12 of 14 soil samples below the 10 ft. depth interval ranged from 0.015 mg/kg (S201-SB12 and S201-SB12 duplicate) to 0.037 mg/kg (S201-SB06).

Concentrations of selenium exhibited no definable decrease with depth. Concentrations of selenium were detected in 4 of 15 soil samples at the surface to 5 ft. depth interval at concentrations of between 0.23J mg/kg (S201-SS02) and 0.79J mg/kg (S201-SS03). Selenium was detected in only 1 of 11 soil samples in the 5-10 ft. depth interval at a concentration of 0.57 mg/kg (S201-SB06). Concentrations of selenium detected in 10 of 14 soil samples below the 10 ft. depth interval ranged from 0.52 mg/kg (S201-SB11) to 2.7 mg/kg (S201-SB08).

Silver was detected in only 1 of 14 soil samples below the 10 ft. depth interval at a concentration of 0.35 mg/kg (S201-SB08 at 12-13 ft.). Concentrations of silver were not detected in the surface to 5 ft. or 5-10 ft. depth intervals.

SVOCs

The number and concentrations of SVOC constituents detected was greater near the surface. PAHs and phthalates were the only SVOC constituents identified in SWMU S201.

Concentrations of PAHs exhibited an increase with depth. PAHs were not detected at depths above the 10 ft. depth interval. PAHs were detected in 6 of 14 soil samples collected below the 10 ft. depth interval. 2-Methylnaphthalene was detected at concentrations of 100J $\mu\text{g}/\text{kg}$ (S201-SB04), 140J $\mu\text{g}/\text{kg}$ (S201-SB07), and 340 J $\mu\text{g}/\text{kg}$ (S201-SB06) at the 10 ft. depth interval. 2-Methylnaphthalene was detected at concentrations of 84 J $\mu\text{g}/\text{kg}$ (S201-SB11 at 15-16 ft.), 90J $\mu\text{g}/\text{kg}$ (S201-SB07 at 15-16 ft.), and 110 J $\mu\text{g}/\text{kg}$ (S201-SB10 at 12-13 ft.). Naphthalene was detected in only one soil boring at a concentration of 300 J $\mu\text{g}/\text{kg}$ (S201-SB06 at 10-11 ft.).

Concentrations of phthalates exhibited a decrease with depth. Concentrations of phthalates were detected in 6 of 15 soil samples at the surface to 5 ft. depth interval ranging between 41 J $\mu\text{g}/\text{kg}$ (di-n-butylphthalate at S201-SS03) and 220 J $\mu\text{g}/\text{kg}$ (bis(2-ethylhexyl) phthalate at S201-SS11). Bis(2-ethylhexyl) phthalate was the only phthalate detected in soils at SWMU S201 (38 J $\mu\text{g}/\text{kg}$ at S201-SB07) at the 10-11 ft. depth interval.

No other SVOCs were detected in the soil samples collected at SWMU S201.

VOCs

VOCs were detected in 7 of 29 samples from 17 locations at SWMU S201. VOC constituents were all detected below the 10 ft. depth interval except for one sample in the 5-10 ft. depth interval. The VOCs detected included acetone, benzene, ethylbenzene, methylene chloride, tetrachloroethene, toluene, and xylenes.

Acetone was detected in 2 of 14 samples below the 10 ft. depth interval (14J $\mu\text{g}/\text{kg}$ in S201-SB06 and 49J $\mu\text{g}/\text{kg}$ in S201-SB07), but not in the surface to 5 ft. or the 5-10 ft. depth intervals. Benzene was detected in 1 of 14 samples at or below the 10 ft. depth (17J $\mu\text{g}/\text{kg}$ in S201-SB06), but not in the surface to 5 ft. or 5-10 ft. depth intervals. Ethylbenzene was detected in 1 of 14 soil samples below the 10 ft. depth interval (2.6J $\mu\text{g}/\text{kg}$ in S201-SB06), but not in the surface to 5 ft. or the 5-10 ft. depth intervals. Tetrachloroethene was detected in 1 of 14 samples below the 10 ft. depth interval (5.5J $\mu\text{g}/\text{kg}$ in S201-SB05), but not in the surface to 5 ft. or the 5-10 ft. depth intervals. Toluene was detected in 1 of 14 samples below the 10 ft. depth interval (13J $\mu\text{g}/\text{kg}$ in S201-SB06), but not in the surface to 5 ft. or the 5-10 ft. depth intervals. Xylenes were detected in 1 of 14 samples below the 10 ft. depth interval (13J $\mu\text{g}/\text{kg}$ in S201-SB06), but not in the surface to 5 ft. or the 5-10 ft. depth intervals.

4.3.11.5.2 Sediment

Inorganics

Aluminum was detected in both sediment samples at concentrations of 9,360J mg/kg (S201-SD01) and 14,700 mg/kg (S201-SD02).

Arsenic was detected in both sediment samples collected at SWMU S201. The highest concentrations of arsenic was 22.9 mg/kg (S201-SD01, downstream of the plant). Concentrations of arsenic at the other sediment sample location was 3.0 mg/kg (S201-SD02).

Barium was detected in both sediment samples collected at SWMU S201. The highest concentration of barium was detected in the sediment sample collected from the pond (200J mg/kg at S201-SD02). The lowest concentration of barium was detected at S201-SD01 at a concentration of 90.5J mg/kg.

Cadmium was detected in both sediment samples collected at SWMU S201. Cadmium concentrations were 1.9 mg/kg at S201-SD01 and 2.0 mg/kg at S201-SD02.

Chromium was detected in both sediment samples collected at SWMU S201. Chromium concentrations were 13.9 mg/kg at S201-SD01 and 16.5 mg/kg at S201-SD02.

Lead was detected in both sediment samples collected at SWMU S201. Lead was detected at the highest concentration in sediment sample S201-SD02 at 31.9 mg/kg. Sediment sample S201-SD01 contained lead at a concentration of 24.5 mg/kg.

Antimony and selenium were not detected in the sediment samples collected at SWMU S201.

SVOCs

SVOCs were detected in only one of five sediment samples (S201-SD01) collected at SWMU S201. The SVOCs detected were 4-methylphenol and phenol at concentrations of 500 µg/kg and 94J µg/kg, respectively. No other SVOCs were detected in the sediment samples collected from S201.

VOCs

Acetone was detected in both sediment samples collected at SWMU S201. Acetone was detected at its highest concentration in sediment sample S201-SD01 (54J µg/kg). Acetone was also detected in S201-SD02 at a concentration of 40J µg/kg.

Toluene and 2-butanone were also detected in sediment sample S201-SD01 at concentrations of 93 µg/kg and 14J µg/kg, respectively. No other VOCs were detected in sediment samples collected at SWMU S201.

4.3.11.5.3 Surface Water

Inorganics

Aluminum was detected in both surface water samples at SWMU S201. The maximum concentration was 29.5J mg/L, detected at location S201-SW02 with a concentration of 0.99J mg/L at S201-SW01

Arsenic, chromium, and lead were detected at only S201-SW02. Arsenic was detected at a concentration of 0.014 mg/L (S201-SW02), chromium at a concentration of 0.032 mg/L (S201-SW02), and lead at a concentration of 0.061 mg/L (S201-SW02).

Barium was detected in both surface water samples collected at SWMU S201. The maximum concentration was 0.45J mg/L (S201-SW02) with a concentration of 0.055J mg/L at S201-SW01.

Concentrations of antimony, cadmium, cyanide, mercury, selenium, and silver were not detected in the surface water at SWMU S201.

SVOCs

SVOCs were found in only the S201-SW02 sample location. 4-Methylphenol and phenol were detected in concentrations of 3.6J µg/L and 4.0J µg/L, respectively, at S201-SW02. No other SVOC concentrations were found in surface water samples collected at SWMU S201.

VOCs

VOCs were only detected in surface water samples at S201-SW01 and S201-SW02. Chloroform was detected at a concentration of 2.0 µg/L at S201-SW01. 2-Butanone, acetone, and 4-methyl-2-pentanone were detected at concentrations of 9.4J µg/L, 5.8J µg/L, and 2.1J µg/L, respectively, at S201-SW02. No other VOCs were detected in SWMU S201 surface water samples.

4.3.11.6 Discussion

The concentration of constituents in soil at SWMU S201 are relatively low with no general trend in the different depth intervals. None of the eight RCRA metals were found in very high concentrations, although very low levels were found at most of the sample locations and in all of the depth intervals.

Results of the two additional surface soil samples and one duplicate sample collected at the S201-SS02 location did not duplicate the level of arsenic detected during the RFI 10/23/1993 sampling event and are far below the arsenic background concentration. The 73.7 mg/kg concentration of arsenic detected during the RFI 10/23/1993 sampling event appears to be an anomaly and therefore no further action is warranted at this location.

Only 12 of 37 soil samples reported detections of SVOCs. The highest concentrations were found in S201-SB06 at or below the 10 ft. depth interval (340J µg/kg for 2-methylnaphthalene and 300J µg/kg for naphthalene).

Only 7 of 37 soil samples reported detections of VOCs. The highest concentration was detected in S201-SB07 at or below the 10 ft. depth interval (49J µg/kg for acetone). Several VOCs were identified in low concentration in S201-SB06 at or below the 10 ft. depth interval.

The highest concentrations of aluminum, cadmium, and chromium (16,400, 2.3, and 23.7J mg/kg, respectively) were detected in upstream sediment samples S201-SD03 and S201-SD04. With the exception of arsenic, the lowest concentrations were detected downstream of the plant (S201-SD01). The downstream sample had the highest concentration of arsenic (22.9 mg/kg).

In the surface water samples, the highest concentrations of aluminum, arsenic, barium, chromium, and lead (29.5J, 0.014, 0.45, 0.032, and 0.061 mg/L, respectively) were detected in the pond (S201-SW02). All of the SVOCs and VOCs detected were also in the pond (S201-SW02), except for chloroform, which was detected in S201-SW01 at a concentration of 2.0 µg/L.

4.4 RFI PART 2 AOC INVESTIGATION AND RESULTS

This section presents the sampling results for the 12 new AOCs identified by the Ohio EPA that were investigated. Included in the discussion is a description of each area, the potential COCs and mechanisms for release of the COCs, a summary of the investigation, presentation of the analytical results, and a discussion and interpretation of the results.

The RFI Part 2 investigation was not designed to determine the full nature and extent of contamination, but rather document the highest potential constituent associated with each AOCs. If COCs exceed the protection standards, then additional evaluation may be conducted as part of corrective measures for the site.

4.4.1 Area A – Hazardous Waste Storage Area

4.4.1.1 Unit Description

The hazardous waste (haz-waste) storage area, a concrete pad with a steel channel curb around its perimeter but no roof, is located at the southwest corner of the main parking lot on the manufacturing plant site's west side. This area was actively used from the early 1990s until October 2002 for the storage of 55-gallon drums containing hazardous wastes, non-regulated wastes, investigation-derived wastes and various other process chemicals. Following Ohio EPA's Division of Hazardous Waste Management's (DHWM) October 3, 2002 recommendations, CSD began storing their hazardous waste inside the adjacent metal building. However, CSD is using this area for the storage of other wastes and chemicals.

The objective of the investigation conducted for the RFI – Part 2 at Area A was to determine if existing RCRA generator closure activities were sufficient; and to conduct an additional investigation if the activities were not sufficient. Data gathered was used to evaluate whether additional corrective measures are necessary in this area.

4.4.1.2 Potential Contaminants

As the constituents handled in Area A could have consisted of any RCRA hazardous waste, samples were analyzed for VOCs, SVOCs and metals.

4.4.1.3 Potential Releases

During Ohio EPA's DERR site inspection on December 19, 2002, stormwater was observed pooling and running over the steel channel (off the pad) at the southeast corner of the haz-waste pad.

4.4.1.4 Summary of Investigation

The area immediately surrounding the Hazardous Waste Storage Area was examined in light of the closure activities that have been conducted in the area. The immediate area surrounding the haz-waste storage was examined for contamination resulting from any waste spillage or leakage at this pad. Four soil samples were collected from two discrete soil-sampling locations: two (2) surface soil samples (A-GP-5 (0-1.5 ft.) and A-GP-6 (0-1 ft.)) and two subsurface samples (A-GP-5A (3-4 ft.) and A-GP-6A (3-4 ft.)) were collected from areas around the pad that exhibit the most staining as determined by field observation. The surface and subsurface soil samples were collected by utilizing a Geoprobe®.

4.4.1.5 Analytical Results

Discussion of the analytical results for soil are presented in the sections below. Soil samples were analyzed for VOCs, SVOCs, and metals. A summary table of all detected analytical results is found in Table 4.4.1

Inorganics

Aluminum concentrations exhibited an increase with depth. Aluminum was detected in all four soil samples at 4,710 mg/kg (A-GP-5 (0-1.5 ft.)), 11,600 mg/kg (A-GP-5A (3-4 ft.)), 1,860 mg/kg (A-GP-6 (0-1 ft.)), and 11,700 mg/kg (A-GP-6A (3-4 ft.)).

Antimony was detected in both surface soil samples at 0.609 J mg/kg (A-GP-5 (0-1.5 ft.)) and 1.00 J mg/kg (A-GP-6 (0-1 ft.)). Antimony was not detected in either subsurface soil sample which were collected from the 3-4 ft. depth interval.

Arsenic concentrations exhibited an increase with depth. Arsenic was detected in all four soil samples at 12.3 mg/kg (A-GP-5 (0-1.5 ft.)), 18.3 mg/kg (A-GP-5A (3-4 ft.)), 2.64 mg/kg (A-GP-6 (0-1 ft.)), and 5.92 mg/kg (A-GP-6A (3-4 ft.)).

Barium concentrations exhibited a decrease with depth. Barium was detected in all four soil samples at 276 mg/kg (A-GP-5 (0-1.5 ft.)), 132 mg/kg (A-GP-5A (3-4 ft.)), 182 mg/kg (A-GP-6 (0-1 ft.)), and 165 mg/kg (A-GP-6A (3-4 ft.)).

Beryllium concentrations were detected in 3 of the 4 soil samples at 0.568 J mg/kg (A-GP-5 (0-1.5 ft.)), 0.450 J mg/kg (A-GP-5A (3-4 ft.)), and 0.666 J mg/kg (A-GP-6A (0-1 ft.)). Beryllium was not detected in surface soil sample A-GP-6 (0-1 ft.).

Cadmium concentrations exhibited a decrease with depth. Cadmium was detected in 3 of the 4 soil samples at 1.21 J mg/kg (A-GP-5 (0-1.5 ft.)), 2.37 J mg/kg (A-GP-6 (0-1 ft.)), and 0.177J mg/kg (A-GP-6A (3-4 ft.)). Cadmium was not detected in soil sample A-GP-5A (3-4 ft.).

Chromium concentrations exhibited a decrease with depth. Chromium was detected in all four soil samples at 87.9 mg/kg (A-GP-5 (0-1.5 ft.)), 13.6 mg/kg (A-GP-5A (3-4 ft.)), 45.2 mg/kg (A-GP-6 (0-1 ft.)), and 15.0 mg/kg (A-GP-6A (3-4 ft.)).

Cobalt concentrations exhibited a decrease with depth. Cobalt was detected in all four soil samples at 12.8 mg/kg (A-GP-5 (0-1.5 ft.)), 12.3 mg/kg (A-GP-5A (3-4 ft.)), 11.4 mg/kg (A-GP-6 (0-1 ft.)), and 6.81 mg/kg (A-GP-6A (3-4 ft.)).

Cyanide concentrations exhibited a decrease with depth. Cyanide was detected in the surface soil samples at 13.4 mg/kg (A-GP-5 (0-1.5 ft.)) and 1.79 mg/kg (A-GP-6 (0-1 ft.)). Cyanide was not detected for both samples from the 3-4 ft. depth interval.

Iron was detected at similar concentrations for all four soil samples: 17,900 mg/kg (A-GP-5 (0-1.5 ft.)), 20,600 mg/kg (A-GP-5A (3-4 ft.)), 26,400 mg/kg (A-GP-6 (0-1 ft.)), and 25,000 mg/kg (A-GP-6 (3-4 ft.)).

Lead concentrations exhibited a decrease with depth. Lead was detected in all four soil samples at 379 mg/kg (A-GP-5 (0-1.5 ft.)), 11.5 J mg/kg (A-GP-5A (3-4 ft.)), 207 mg/kg (A-GP-6 (0-1 ft.)), and 17.8 mg/kg (A-GP-6A (3-4 ft.)).

Mercury was detected at similar concentrations for all four soil samples: 0.0420 mg/kg (A-GP-5 (0-1.5 ft.)), 0.0690 mg/kg (A-GP-5A (3-4 ft.)), 0.0457 mg/kg (A-GP-6 (0-1 ft.)), and 0.043 mg/kg (A-GP-6 (3-4 ft.)).

Nickel concentrations exhibited a slight decrease with depth. Nickel was detected in all four soil samples at 18.0 mg/kg (A-GP-5 (0-1.5 ft.)), 16.6 mg/kg (A-GP-5A (3-4 ft.)), 21.7 mg/kg (A-GP-6 (0-1 ft.)), and 16.1 mg/kg (A-GP-6A (3-4 ft.)).

Selenium concentrations were detected in 3 of the 4 soil samples, and exhibited a decrease with depth. Selenium was detected at 15.3 J mg/kg (A-GP-5 (0-1.5 ft.)), 5.43 J mg/kg (A-GP-5A (3-4 ft.)), and 8.23 J mg/kg (A-GP-6 (0-1 ft.)). Selenium was not detected in A-GP-6A (3-4 ft.).

Thallium concentrations exhibited an increase with depth. Thallium was detected in all four soil samples at 0.318 J mg/kg (A-GP-5 (0-1.5 ft.)), 0.874 J mg/kg (A-GP-5A (3-4 ft.)), 0.135 J mg/kg (A-GP-6 (0-1 ft.)), and 0.467 J mg/kg (A-GP-6A (3-4 ft.)).

SVOCs

In general, the number and concentration of SVOC constituents decreased with depth. Only 5 of the 28 SVOC concentrations detected in Area A were detected in the 3-4 ft. depth interval. The primary SVOCs detected were PAHs and phthalates.

Bis(2-ethylhexyl)phthalate was detected in surface soils (<5 feet) at concentrations ranging from 20.05 µg/kg (A-GP-5A) to 1,530 µg/kg (A-GP-6). Concentrations of PAHs were found in concentrations up to 491 µg/kg (benzo(a)pyrene in A-GP-6 (0-1 ft.)).

VOCs

VOCs detected in Area A were acetone, benzene, 2-butanone, chloroethane, 1,1-dichloroethane, 2-hexanone, methylene chloride, 4-methyl-2-pentanone, and 1,1,1-trichloroethane. All of these constituents were detected in soil sample A-GP-6A (3-4 ft.), with the exception of benzene and 1,1,1-trichloroethane. Only one constituent, 1,1,1-trichloroethane, was detected in the surface soil sample A-GP-6 (0-1 ft.).

4.4.1.6 Discussion

The immediate area surrounding the haz-waste storage was examined for contamination resulting from any waste spillage or leakage at this pad. The constituents of concern were VOCs, SVOCs, and metals. Four soil samples, two surface and two subsurface, were collected from two discrete soil sample locations. Concentrations of metals and SVOCs generally decreased with depth. There is no strong evidence of impact to soil by inorganic constituents. Only one SVOC, benzo(a)pyrene was found at elevated levels in surface soil sample A-GP-6 (0-1 ft.), but it was not detected in the A-GP-6A (3-4 ft.) soil sample.

Concentrations of VOCs at the A-GP-6 sample location generally increase with depth; however, the concentrations of VOCs at the A-GP-5 sample location do not appear to demonstrate a distribution trend. The VOCs detected at both sample locations were low concentrations.

4.4.2 Area B – Shot Blast Dust Collector Area

4.4.2.1 Unit Description

The shot blast dust collector area is located outside the drum reconditioning plant's south side, approximately one-third of the way from the southwest corner of the drum reconditioning plant building.

4.4.2.2 Potential Contaminants

Probable constituents resulting from operations at the unit are metals. Contamination of soil from lead and non-RCRA metals such as zinc and iron may be of particular concern at this site.

4.4.2.3 Potential Releases

This shot blast dust collector unit was installed at the site in late 1992, and still remains in operation.

4.4.2.4 Summary of Investigation

Sampling was conducted to investigate the concentration of metals adjacent to the Shot Blast Dust Collector. Soil areas adjacent to the concrete pad were evaluated for staining. Three surface soil samples (B-GP-7 (0-1 ft.), B-GP-8 (0-1 ft.), and B-GP-9 (0-1 ft.)) were collected adjacent to the concrete pad that exhibited the most staining as determined from field observation. The surface soil samples were collected from the 0-1 ft depth interval utilizing a Geoprobe®. The three samples obtained were analyzed for metals.

4.4.2.5 Analytical Results

A discussion of the analytical results for the soil samples is presented below. Three soil samples were collected and analyzed for metals. A summary table of all detected analytical results is found in Table 4.4.2.

Inorganics

Each metal constituent was detected in all three surface soil samples collected, except for antimony was not detected in B-GP-9 (0-1 ft.). The detected levels of inorganics in the samples were low concentrations; however, arsenic was detected at 93.7 mg/kg at B-GP-8 (0-1 ft.).

4.4.2.6 Discussion

Three surface soil samples were collected for inorganic analysis from areas adjacent to the Shot Blast Dust Collector which exhibited the most staining. The inorganic analysis showed one surface soil sample B-GP-8 (0-1 ft.) had an arsenic concentration of 93.7 mg/kg. However, the two other surface soil samples contained concentrations of arsenic below the site specific background concentration.

4.4.3 Area C – Shot Blast Dust Bags Storage Area

4.4.3.1 Unit Description

The shot blast dust bags storage area (in white super sacks) is located to the east of the site's wastewater treatment plant building, south of the drum reconditioning plant building. On December 19, 2002, Ohio EPA observed this area being used for storage of white super sacks from the three on-site shot blast dust collector units. The area had one Roll-off box full of super sacks, and 30 to 40 of these super sacks placed directly on the gravel next to the Roll-off box (south side). During Ohio EPA's site visit on January 16, 2003, the same Roll-off box and super sacks (on the ground) were still being stored in this area.

4.4.3.2 Potential Contaminants

Probable constituents resulting from storage operations in the area are metals.

4.4.3.3 Potential Releases

There are no known or documented releases from this unit. The shot blast dust bag storage area and area surrounding this unit were examined for contamination resulting from any spillage or leakage from the storage of these shot blast dust bags.

4.4.3.4 Summary of Investigation

Soil areas in the vicinity of the storage area were evaluated for staining. A surface soil sample was collected from the two areas in the immediate vicinity of area C that exhibit the most staining as determined from field observation. Surface soil samples C-GP-10, C-GP-11, and C-GP-11A were collected from the 0-2 ft, 0-1 ft., and 1-2 ft. depth intervals, respectively, utilizing a Geoprobe®. The three samples obtained were analyzed for metals.

4.4.3.5 Analytical Results

Discussion of the analytical results for soil are presented in the sections below. Soil samples were analyzed for metals. A summary of all detected analytical results is in Table 4.4.3

Inorganics

Aluminum concentrations ranged from 2,410 mg/kg (C-GP-11 (0-1 ft.)) to 5,590 mg/kg (C-GP-11A (1-2 ft.)).

Arsenic concentrations ranged from 6.50 mg/kg (C-GP-11 (0-1 ft.)) to 8.38 mg/kg (C-GP-11A (1-2 ft.)).

Chromium concentrations ranged from 30.8 mg/kg (C-GP-11A (0-1 ft.)) to 134 mg/kg (C-GP-10 (0-2 ft.)).

Cyanide concentrations ranged from 0.622 mg/kg (C-GP-11 (0-1 ft.)) to 2.64 mg/kg (C-GP-11A (1-2 ft.)).

Concentrations of lead were reported at 542 mg/kg, 418 mg/kg, and 192 mg/kg for samples C-GP-10 (0-2 ft.), C-GP-11 (0-1 ft.), and C-GP-11A (1-2 ft.), respectively.

Nickel concentrations ranged from 15.7 mg/kg (C-GP-11 (0-1 ft.)) to 24.9 mg/kg (C-GP-10 (0-2 ft.)).

Selenium concentrations ranged from 3.34 mg/kg (C-GP-11A (1-2 ft.)) to 7.95 mg/kg (C-GP-11 (0-1 ft.)).

4.4.3.6 Discussion

Two surface soil and one near surface soil sample were collected for metals analysis from the areas in the immediate vicinity of area C that exhibit the most staining as determined from field observation. There is no strong evidence of impact to soil by inorganic constituents..

4.4.4 Area D – Filter Press Sludge Storage Pad

4.4.4.1 Unit Description

The filter press cake storage pad is a concrete pad with a metal roof (but no walls), and it houses two lugger boxes used to contain solids from the wastewater treatment process. This storage pad is located on the east side of the site's wastewater treatment plant building. During Ohio EPA's December 19, 2002 site visit, stormwater was observed pooling and running over the concrete curb (off the pad) at the southwest corner of the storage pad. To the east and south of this storage pad, the soil is stained. Visible trash was also scattered around the area.

4.4.4.2 Potential Contaminants

The Filter Press Sludge Storage Pad stores the sludges generated from treatment of plant washwater. Possible constituents associated with this operation include VOCs, SVOCs and metals.

4.4.4.3 Potential Releases

There are no known or documented releases from this unit. The area surrounding the filter press sludge storage pad was examined for contamination resulting from any spillage or leakage at this storage pad.

4.4.4.4 Summary of Investigation

Sampling was conducted to investigate the concentration of VOCs, SVOCs and metals adjacent to the Filter Press Sludge Storage Pad. Soil areas adjacent to the concrete pad were evaluated for staining. A surface soil sample (D-GP-12 (0-1 ft.)) was collected from the one area adjacent to the concrete pad that exhibited the most staining as determined by field observation. Surface soil sample D-GP-12 (0-1 ft.) was collected from the 0-1 ft depth interval utilizing a hand auger. The sample was analyzed for VOCs, SVOCs, and metals.

4.4.4.5 Analytical Results

Discussion of the analytical results for soil are presented in the sections below. Soil samples were analyzed for VOCs, SVOC, and metals. A summary of all detected analytical results is in Table 4.4.4

Inorganics

Each metal constituent was detected in the surface soil sample at low concentrations.

SVOCs

Eleven SVOCs were detected for sample D-GP-12 (0-1 ft.) and mainly consisted of phthalates and PAHs at low concentrations.

Bis(2-ethylhexyl)phthalate was detected in surface soil sample D-GP-12 (0-1 ft.) at a concentration of 2,350 µg/kg (S107-SB11).

VOCs

Five VOCs were detected at low levels for sample D-GP-12 (0-1 ft.): dibromochloromethane (46 J µg/kg); 2-hexanone (11.1 J µg/kg); methylene chloride (9.21 J mg/kg); 4-methyl-2-pentanone (6.17 J µg/kg); and PCE (1.36 J µg/kg).

4.4.4.6 Discussion

Surface soil sample D-GP-12 (0-1 ft.) was collected from the area which exhibited the most staining adjacent to the Filter Press Storage Pad and analyzed for VOCs, SVOCs, and metals. All of the constituents detected were at low concentrations.

4.4.5 Area E – Former Hazardous Waste Storage Pad

4.4.5.1 Unit Description

The former hazardous waste drum storage pad (concrete pad with no roof) is located south of the old oxidizer building. Franklin Steel used this pad for the storage of 55-gallon drums of various types of hazardous wastes from the early 1970s through 1990. Franklin Steel submitted a RCRA clean closure report for the former hazardous waste drum storage pad in September 1990 to Ohio EPA's DHWM. The closure report was accepted by Ohio EPA DHWM.

4.4.5.2 Potential Contaminants

Although the exact substances that may have leaked are not known, based on the description of materials found in Area E as summarized in the Ohio EPA January 31, 2003 letter, the materials could have contained VOCs, SVOCs and metals.

4.4.5.3 Potential Releases

On December 9, 2002, Ohio EPA observed numerous 55-gallon drums, some stacked on their sides, being stored in this area. Several drums were in poor condition, very rusted and dented. Many of these drums had a blue "non-regulated waste" label on them. Since the drain trench valve in the vault at the haz-waste pad southeast corner was closed, stormwater had runoff the concrete pad into the gravel road. When questioned about these drums, Gary Davis (CSD's environmental manager) was not sure of the contents in these 55-gallon drums, but he stated that the tote bins adjacent to the wall of the old oxidizer building contained

various chemicals used for the drum rinsing operation inside this building.

During Ohio EPA's site visit on December 19, 2002, the former hazardous waste drum storage pad was observed to have all of the 55-gallon drums removed for this area. However, the concrete was heavily discolored and stained, with the collected rainfall's water (about one hour of light rain before coming to the pad) also having a blue-gray coloration, and the tote bins were still being stored against the wall of the old building.

On January 16, 2003, Ohio EPA observed that this former haz-waste drum storage pad again had approximately 70 55-gallon drums. A blue "Non-Regulated Waste" label could be seen on the front row of drums, and one drum was leaking an unknown white substance onto the ground. Closer examination showed a yellow "Hazardous Waste" label on many of these drums, as well as the blue "non-regulated waste" label. Many drums also had the DOT stickers for dangerous contents: flammable liquids, flammable solids, toxic or corrosive, placed on them besides the hazardous waste labels. The easily accessible (outer row) 55-gallon drums appeared to be full of some type of material, as noted by tapping on the sides of the drums.

4.4.5.4 Summary of Investigation

Sampling was conducted to investigate the concentration of VOCs, SVOCs and metals adjacent to the Former Hazardous Waste Storage Pad. Soil areas adjacent to the Former Hazardous Waste Storage Pad were evaluated due to staining. Two soil samples (E-GP-13 (0-1 ft.) and E-GP-14 (0-1 ft.)) were collected from the areas adjacent to the concrete pad that exhibited the most staining as determined by field observation. The surface soil samples were collected from the 0-1 ft depth interval utilizing a Geoprobe®. The samples obtained were analyzed for VOCs, SVOCs, and metals.

4.4.5.5 Analytical Results

A discussion of the analytical results for the soil sampling is presented in the sections below. Two surface soil samples were collected from two discrete sampling locations which exhibited the most staining. Table 4.4.5 summarizes the detected constituents.

Inorganics

Concentrations of aluminum were detected at 683 mg/kg and 11,200 mg/kg in E-GP-13 (0-1 ft.) and E-GP-14 (0-1 ft.), respectively.

Concentrations of arsenic were detected at 2.46 mg/kg and 1.52 mg/kg in E-GP-13 (0-1 ft.) and E-GP-14 (0-1 ft.), respectively.

Concentrations of barium were detected at 88.0 mg/kg and 104 mg/kg in E-GP-13 (0-1 ft.) and E-GP-14 (0-1 ft.), respectively.

Concentrations of cadmium were detected at 1.04 J mg/kg and 0.699 J mg/kg in E-GP-13 (0-1 ft.) and E-GP-14 (0-1 ft.), respectively.

Concentrations of chromium were detected at 15.7 mg/kg and 17.4 mg/kg in E-GP-13 (0-1 ft.) and E-GP-14 (0-1 ft.), respectively.

Cyanide was not detected in either sample at Area E.

Concentrations of lead were detected at 39.6 mg/kg and 26.9 mg/kg in E-GP-13 (0-1 ft.) and E-GP-14 (0-1 ft.), respectively.

Concentrations of mercury were detected at 0.0100 mg/kg and 0.105 mg/kg in E-GP-13 (0-1 ft.) and E-GP-14 (0-1 ft.), respectively.

Concentrations of selenium were only detected at E-GP-13 (0-1 ft.) (8.13 J mg/kg).

Concentrations of silver were detected at 0.197 J mg/kg and 0.00958 J mg/kg in E-GP-13 (0-1 ft.) and E-GP-14 (0-1 ft.), respectively.

SVOCs

A total of 10 SVOC constituents were detected between the two surface soil samples collected in Area E. Nine of the constituents were detected at E-GP-13 (0-1 ft.) and only two of the constituents were detected at E-GP-14 (0-1 ft.). The ten SVOC constituents detected in Area E were: anthracene; benzo(b)fluoranthene; bis(2-ethylhexyl)phthalate; 4-bromophenyl phenyl ether; butyl benzyl phthalate; di-n-butyl phthalate, 4,6-dinitro-2-methylphenol, di-n-octyl phthalate, phenanthrene, and pyrene.

Bis(2-ethylhexyl)phthalate was detected in two surface soils (0-1 feet bgs) at concentrations of 387 µg/kg in E-GP-13 and 37.85 µg/kg in E-GP-14.

VOCs

A total of five VOC constituents were detected between the two surface soil samples collected in Area E. Concentrations of methylene chloride (8.21 J $\mu\text{g}/\text{kg}$) and 4-methyl-2-pentanone (6.02 J $\mu\text{g}/\text{kg}$) were detected in E-GP-13 (0-1 ft.). Both of these constituents were not detected in the E-GP-14 (0-1 ft.) sample. Instead, concentrations of ethylbenzene (1.24 J $\mu\text{g}/\text{kg}$), toluene (9.73 $\mu\text{g}/\text{kg}$), and total xylenes (5.16 J $\mu\text{g}/\text{kg}$) were detected at E-GP-14 (0-1 ft.).

4.4.5.6 Discussion

Surface soil samples E-GP-13 (0-1 ft.) and E-GP-14 (0-1 ft.) were collected from the two areas which exhibited the most staining adjacent to the Former Hazardous Waste Storage Pad and analyzed for VOCs, SVOCs, and metals. All of the constituents detected were at low concentrations.

4.4.6 Area F – Drum Conveyor Chain Ash Fall-Off Area

4.4.6.1 Unit Description

Many of the 55-gallon drums being sent through the New Thermal Oxidizer still have residue materials inside them which cause a significant amount of ash material to accumulate under and around the drum conveyor chain. This ash falloff area begins at the exit of the thermal oxidizer enclosure; where the drum conveyor chain goes west for a short distance, then turns south for approximately two hundred feet before heading back to the north (to allow the drums time to cool down after the oxidizer), then the chain goes west again to enter the drum reconditioning building. This entire distance of the drum conveyor chain has significant amounts of ash residues from the 55-gallon drums that have fallen onto the ground.

CSD has stated earlier to Ohio EPA's DHWM that this material is swept up at the end of each day and put into the containers with the oxidizer sludge waste. However, Ohio EPA noted twenty (20) 55-gallon drums (many without lids) full of this ash material being stored out in open areas at three different locations during the December 9, 2002 site visit. During Ohio EPA's January 16, 2003 site visit, twenty (20) 55-gallon drums (six without lids) were again observed full of ash residue being stored in the drum conveyor chain cooling loop area.

4.4.6.2 Potential Contaminants

Ash fall-off material that remains after the drums are ran through the New Thermal Oxidizer is likely to contain SVOCs and metals.

4.4.6.3 Potential Releases

CSD has stated earlier to Ohio EPA's DHWM that this material is swept up at the end of each day and put into the containers with the oxidizer sludge waste. However, Ohio EPA noted twenty (20) 55-gallon drums (many without lids) full of this ash material being stored out in open areas at three different locations during the December 9, 2002 site visit. During Ohio EPA's January 16, 2003 site visit, twenty (20) 55-gallon drums (six without lids) were again observed full of ash residue being stored in the drum conveyor chain cooling loop area. This area's soil has a different appearance than the adjacent access road.

4.4.6.4 Summary of Investigation

A total of seven surface soil samples were collected to investigate the concentration of SVOCs and metals in soils adjacent to concrete surfaces located to the east and west of the Drum Conveyor Chain. Soil areas adjacent to the Drum Conveyor Chain were evaluated for staining. A surface soil sample was collected from the three areas adjacent to the concrete pad's west side, and similarly, four areas to the pad's east side that

exhibit the most staining as determined by field observation. Surface soil samples were collected from the 0-1 ft depth interval utilizing a hand auger or Geoprobe®. The seven samples obtained were analyzed for metals and SVOCs. The seven surface soil samples collected were F-GP-15 (0-1 ft.), F-GP-16 (0-1 ft.), F-GP-17 (0-1 ft.), F-GP-18 (0-1 ft.), F-GP-19 (0-1 ft.), F-HA-1 (0-1 ft.), and F-HA-2 (0-1 ft.).

4.4.6.5 Analytical Results

A discussion of the analytical soil sampling results is presented in the sections below. Seven surface soil samples were collected from seven discrete soil sampling locations. Samples collected were analyzed for metals and SVOCs. A summary table of all detectable analytical results is found in Table 4.4.6.

Inorganics

Aluminum was detected in 7 of 7 surface soil samples at concentrations ranging from 369 mg/kg (F-GP-16 (0-1 ft.)) to 8,500 mg/kg (F-HA-2 (0-1 ft.)).

Antimony was detected in 7 of 7 surface soil samples at concentrations ranging from 0.605 J mg/kg (F-GP-16 (0-1 ft.)) to 117 mg/kg (F-GP-17 (0-1 ft.)).

Arsenic was detected in 6 of 7 surface soil samples at concentrations ranging from 1.36 J mg/kg (F-HA-2 (0-1 ft.)) to 3.61 mg/kg (F-HA-1 (0-1 ft.)).

Barium was detected in 7 of 7 surface soil samples at concentrations ranging from 161 mg/kg (F-GP-16 (0-1 ft.)) to 3,020 mg/kg (F-HA-2 (0-1 ft.)).

Cadmium was detected in 7 of 7 surface soil samples at concentrations ranging from 0.706 J mg/kg (F-GP-16 (0-1 ft.)) to 47.0 mg/kg (F-GP-18 (0-1 ft.)).

Chromium was detected in 7 of 7 surface soil samples at concentrations ranging from 19.9 mg/kg (F-GP-16 (0-1 ft.)) to 732 mg/kg (F-HA-2 (0-1 ft.)).

Copper was detected in 7 of 7 surface soil samples at concentrations ranging from 13 mg/kg (F-GP-16 (0-1 ft.)) to 8,210 mg/kg (F-HA-2 (0-1 ft.)).

Cyanide was detected in 3 of 7 surface soil samples at concentrations ranging from 0.220 mg/kg (F-HA-1 (0-1 ft.)) to 0.930 mg/kg (F-GP-18 (0-1 ft.)).

Iron was detected in 7 of 7 surface soil samples at concentrations ranging from 3,890 mg/kg (F-GP-16 (0-1 ft.)) to 154,000 mg/kg (F-GP-18 (0-1 ft.)).

Lead was detected in 7 of 7 surface soil samples at concentrations ranging from 71.7 mg/kg (F-GP-16 (0-1 ft.)) to 4,610 mg/kg (F-GP-17 (0-1 ft.)).

Mercury was detected in 7 of 7 surface soil samples at concentrations ranging from 0.00977 mg/kg (F-GP-16 (0-1 ft.)) to 0.602 mg/kg (F-GP-19 (0-1 ft.)).

Nickel was detected in 7 of 7 surface soil samples at concentrations ranging from 6.97 mg/kg (F-GP-16 (0-1 ft.)) to 468 mg/kg (F-HA-2 (0-1 ft.)).

Selenium was detected in 6 of 7 surface soil samples at concentrations ranging from 4.25 mg/kg (F-GP-16 (0-1 ft.)) to 42.9 mg/kg (F-HA-1 (0-1 ft.)).

Silver was detected in 7 of 7 surface soil samples at concentrations ranging from 0.429 mg/kg (F-GP-16 (0-1 ft.)) to 8.62 mg/kg (F-GP-19 (0-1 ft.)).

Zinc was detected in 7 of 7 surface soil samples at concentrations ranging from 108 mg/kg (F-GP-16 (0-1 ft.)) to 6,000 mg/kg (F-HA-2 (0-1 ft.)).

VOCs

Twenty-two different SVOC constituents were detected in Area F. The primary SVOCs detected were PAHs and phthalates.

Concentrations of PAHs were detected in 5 of 7 surface soil samples at concentrations between 161 J mg/kg (anthracene at F-HA-1 (0-1 ft.)) and 1830 µg/kg (pyrene at F-GP-18 (0-1 ft.)).

Concentrations of butyl benzyl phthalate were found in 7 of 7 surface soil samples between 637 J in F-GP-16 (0-1 ft.) to 6930 J µg/kg in F-GP-18 (0-1 ft.).

Concentrations of bis(2-ethylhexyl)phthalate were found in 7 of 7 surface soil samples between 261 J in F-GP-16 (0-1 ft.) to 1400 J µg/kg in F-GP-18 (0-1 ft.).

Concentrations of phenols were found in 5 of 7 surface soil samples between 438 J in F-GP-15 (0-1 ft.) to 3250 µg/kg in F-GP-18 (0-1 ft.).

Concentrations of benzo (b) fluoranthene were found in 7 of 7 surface soil samples between 218 in F-GP-15 (0-1 ft.) to 2110 µg/kg in F-GP-18 (0-1 ft.).

4.4.6.6 Discussion

Three of the seven surface soil samples indicated elevated concentrations of various metals. Concentrations of lead were detected at F-GP-17 (0-1 ft.) (4,610 mg/kg) and F-HA-2 (0-1 ft.) (2,860 mg/kg), respectively. Elevated concentrations of iron (154,000 mg/kg), chromium (732 mg/kg), barium (3,020 mg/kg), cadmium (47.0 mg/kg), and chromium (732 mg/kg) were present within surface soils at depth interval less than 1 foot.

Low concentrations of SVOCs were found in all of the seven soil samples except for the concentration of benzo (b) fluoranthene detected at F-GP-18.

4.4.7 Area G – Thermal Oxidizer Building Doorway Areas

4.4.7.1 Unit Description

On Ohio EPA's January 16, 2003 site visit, the doorways of the thermal oxidizer building were observed to have significant staining of the building and adjacent soil, with visible trash scattered around the area.

4.4.7.2 Potential Contaminants

The soil samples obtained were analyzed for metals, VOCs, and SVOCs.

4.4.7.3 Potential Releases

There are no known or documented releases from this area.

4.4.7.4 Summary of Investigation

Two doorways exist at the New Thermal Oxidizer Building. One composite surface soil sample was collected

from the most visibly stained areas associated with each of the doorways. The surface soil samples were collected from the 0–1 ft depth interval utilizing a Geoprobe®. The two composite surface soil samples obtained were analyzed for metals, SVOCs, and VOCs. The two composite surface soil samples collected were G-Comp-1 (0-1 ft.) and G-Comp-2 (0-1 ft.).

4.4.7.5 Analytical Results

A discussion of the analytical soil sampling results is presented in the sections below. Two composite surface soil samples were collected. Samples collected were analyzed for metals, SVOCs, and VOCs. A summary table of all detectable analytical results is found in Table 4.4.7.

Inorganics

Concentrations of aluminum were detected at 726 mg/kg (G-Comp-1 (0-1 ft.)) and 703 mg/kg (G-Comp-2 (0-1 ft.)).

Concentrations of arsenic were detected at 2.48 mg/kg (G-Comp-1 (0-1 ft.)) and 1.76 J mg/kg (G-Comp-2 (0-1 ft.)).

Concentrations of barium were detected at 66.6 mg/kg (G-Comp-1 (0-1 ft.)) and 64.6 mg/kg (G-Comp-2 (0-1 ft.)).

Concentrations of cadmium were detected at 0.497 J mg/kg (G-Comp-1 (0-1 ft.)) and 0.284 J mg/kg (G-Comp-2 (0-1 ft.)).

Concentrations of chromium were detected at 11.4 mg/kg (G-Comp-1 (0-1 ft.)) and 16.9 mg/kg (G-Comp-2 (0-1 ft.)).

Cyanide was only detected at G-Comp-1 (0-1 ft.) (0.355 mg/kg).

Concentrations of lead were detected at 8.20 J mg/kg (G-Comp-1 (0-1 ft.)) and 6.42 J mg/kg (G-Comp-2 (0-1 ft.)).

Concentrations of mercury were detected at 0.0713 mg/kg (G-Comp-1 (0-1 ft.)) and 0.0895 mg/kg (G-Comp-2 (0-1 ft.)).

Concentrations of selenium were detected at 10.4 J mg/kg (G-Comp-1 (0-1 ft.)) and 11.9 J mg/kg (G-Comp-2 (0-1 ft.)).

Concentrations of silver were detected at 0.353 J mg/kg (G-Comp-1 (0-1 ft.)) and 0.242 J mg/kg (G-Comp-2 (0-1 ft.)).

SVOCs

A total of 18 different SVOC constituents were detected between the two composite surface soil samples. All but 2 of the 18 SVOCs were detected in G-Comp-2 (0-1 ft.). Eight of the 18 SVOCs were detected in G-Comp-1 (0-1 ft.). The primary SVOCs detected were PAHs and phthalates.

Concentrations of PAHs ranged between 381 J µg/kg (pyrene at G-Comp-2 (0-1 ft.)) and 900 J µg/kg (pyrene at G-Comp-1 (0-1 ft.)).

Concentrations of phthalates ranged between 4160 µg/kg (bis(2-ethylhexyl)phthalate at G-Comp-1 (0-1 ft.)) to 62.0 µg/kg (dimethyl phthalate at G-Comp-2 (0-1 ft.)).

VOCs

Only 1 VOC constituent was detected in Area G. Methylene chloride was detected at 11.0 µg/kg (G-Comp-1 (0-1 ft.)) and 176 µg/kg (G-Comp-2 (0-1 ft.)).

4.4.7.6 Discussion

All of the constituents detected were at low concentrations.

4.4.8 Area H – Thermal Oxidizer Sludge Storage Area

4.4.8.1 Unit Description

The thermal oxidizer sludge storage area, a concrete pad with a metal roof, is located at the northeast corner of the manufacturing site. The concrete pad is found on the north side of the thermal oxidizer building enclosure; it is large enough to store three Roll-off boxes.

4.4.8.2 Potential Contaminants

Sludge generated as a result of the operation of the New Thermal Oxidizer could potentially contain metals, SVOCs, and VOCs.

4.4.8.3 Potential Releases

During Ohio EPA's site visit on December 9, 2002, three Roll-off boxes were being stored in the gravel truck yard, while two more full Roll-off boxes were being stored on the concrete pad without a Roll-off box. There were also ten (10) 55-gallon drums full of the conveyor chain's ash residue which had fallen onto the ground and was scraped up by the local worker.

On December 19, 2002, Ohio EPA observed that the three Roll-off boxes full of the oxidizer sludge had been removed from the gravel truck yard, adjacent to the sludge storage area since the December 9, 2002 visit. In addition, the sludge pile laying on the ground, also noted during the December 9, 2002 site visit, had been removed from the concrete pad of this storage area. Only two Roll-off boxes were present on the oxidizer sludge storage area's concrete pad.

During Ohio EPA's site visit on January 16, 2003, a significant amount of contaminated liquid was noted in the oxidizer sludge storage area's concrete pad. This liquid was observed moving off the pad. Sludge and liquid materials were observed dragged from this concrete pad out into the gravel truck yard. These contaminated materials were spread over a large part of the gravel truck yard.

4.4.8.4 Summary of Investigation

Sampling was conducted to investigate the concentration of metals, SVOCs, and VOCs adjacent to the concrete surfaces associated with the New Thermal Oxidizer Sludge Storage Area. Soil areas adjacent to the New Thermal Oxidizer Sludge Storage Area were evaluated for staining. Surface soil samples were collected from the four areas adjacent to the concrete pad that exhibit the most staining as determined by field observation. Four surface soil samples were collected from the 0-1 ft depth interval and one near surface soil sample was collected from the 1-2 ft. depth interval utilizing a Geoprobe®. The five samples obtained were analyzed for metals, SVOCs, and VOCs. Three soil samples were collected from two sampling locations adjacent to the sludge storage area's concrete pad's north side (H-GP-20 (0-1 ft.), H-GP-21 (0-1 ft.) and H-GP-21A (1-2 ft.)) and two soil samples were collected from the north side of the concrete walkway adjacent to the thermal oxidizer's exit enclosure (H-GP-22 (0-1.5 ft.) and H-GP-23 (0-1 ft.)).

4.4.8.5 Analytical Results

A discussion of the analytical soil sampling results is presented in the sections below. Four surface soil samples and one near surface soil sample were collected. Samples collected were analyzed for metals, SVOCs, and VOCs. A summary table of all detectable analytical results is found in Table 4.4.8.

Inorganics

Concentrations of aluminum were detected in 5 of 5 samples and ranged between 1,450 mg/kg (H-GP-20 (0-1 ft.)) and 4,420 mg/kg (H-GP-23 (0-1 ft.)).

Concentrations of arsenic were detected in 5 of 5 samples and ranged between 2.39 mg/kg (H-GP-22 (0-1.5 ft.)) and 5.68 mg/kg (H-GP-21A (1-2 ft.)).

Concentrations of barium were detected in 5 of 5 samples and ranged between 60.2 mg/kg (H-GP-20 (0-1 ft.)) and 1,330 mg/kg (H-GP-23 (0-1 ft.)).

Concentrations of cadmium were detected in 5 of 5 samples and ranged between 0.307 J mg/kg (H-GP-20 (0-1 ft.)) and 7.50 mg/kg (H-GP-23 (0-1 ft.)).

Concentrations of chromium were detected in 5 of 5 samples and ranged between 9.77 mg/kg (H-GP-20 (0-1 ft.)) and 215 mg/kg (H-GP-23 (0-1 ft.)).

Concentrations of copper were detected in 5 of 5 samples and ranged between 11.9 mg/kg (H-GP-20 (0-1 ft.)) and 54.5 mg/kg (H-GP-22 (0-1.5 ft.)).

Concentrations of cyanide were detected in 3 of 5 samples and ranged between 0.143 mg/kg (H-GP-22 (0-1.5 ft.)) and 0.179 mg/kg (H-GP-21 (0-1 ft.)).

Concentrations of iron were detected in 5 of 5 samples and ranged between 4,150 mg/kg (H-GP-20 (0-1 ft.)) and 29,800 mg/kg (H-GP-21A (1-2 ft.)).

Concentrations of lead were detected in 5 of 5 samples and ranged between 15.6 mg/kg (H-GP-20 (0-1 ft.)) and 1,540 mg/kg (H-GP-23 (0-1 ft.)).

Concentrations of mercury were detected in 4 of 5 samples and ranged between 0.00817 J mg/kg (H-GP-22 (0-1.5 ft.)) and 0.0537 mg/kg (H-GP-23 (0-1 ft.)).

Concentrations of nickel were detected in 5 of 5 samples and ranged between 9.3 mg/kg (H-GP-20 (0-1 ft.)) and 63.2 mg/kg (H-GP-23 (0-1 ft.)).

Concentrations of selenium were detected in 5 of 5 samples and ranged between 6.24 J mg/kg (H-GP-23 (0-1 ft.)) and 14.4 mg/kg (H-GP-21 (0-1 ft.)).

Concentrations of silver were detected in 5 of 5 samples and ranged between 0.0676 J mg/kg (H-GP-20 (0-1 ft.)) and 2.27 mg/kg (H-GP-23 (0-1 ft.)).

Concentrations of zinc were detected in 5 of 5 samples and ranged between 46.5 mg/kg (H-GP-20 (0-1 ft.)) and 2,270 mg/kg (H-GP-23 (0-1 ft.)).

SVOCs

Twenty (20) different SVOC constituents were detected in Area H. The primary SVOCs detected were PAHs and phthalates.

Concentrations of PAHs were detected in 4 of 5 soil samples at concentrations between 0.0361 J $\mu\text{g}/\text{kg}$ (fluoranthene at H-GP-21A (1-2 ft.)) and 0.27 J $\mu\text{g}/\text{kg}$ (phenanthrene at H-GP-20 (0-1 ft.)).

Concentrations of butyl benzyl phthalate were found in 3 of 5 soil samples between 0.141 J in H-GP-23 (0-1 ft.) to 0.501 $\mu\text{g}/\text{kg}$ in H-GP-22 (0-1.5 ft.).

Concentrations of bis(2-ethylhexyl)phthalate were found in 4 of 5 soil samples between 0.305 J in H-GP-21 (0-1 ft.) to 1.38 $\mu\text{g}/\text{kg}$ in both H-GP-21A (1-2 ft.) and H-GP-22 (0-1.5 ft.).

Concentrations of phenols were found in 3 of 5 soil samples between 0.0368 J in H-GP-21A (1-2 ft.) to 0.627 $\mu\text{g}/\text{kg}$ in H-GP-20 (0-1 ft.).

Concentrations of benzo (a) pyrene were found in 5 of 5 soil samples between 0.0166 mg/kg in H-GP-21 (0-1 ft.) to 0.326 $\mu\text{g}/\text{kg}$ in H-GP-20 (0-1 ft.).

VOCs

VOCs were detected in 4 of the 5 soil samples collected in Area H. VOCs were not detected for the H-GP-23 (0-1 ft.) sample. The VOCs detected were acetone, 2-butanone, carbon disulfide, methylene chloride, 4-methyl-2-pentanone, toluene, and total xylenes. 4-methyl-2-pentanone and total xylenes were only detected in one sample (H-GP-20 (0-1 ft.)) at 3.00 J $\mu\text{g}/\text{kg}$ and 4.60 $\mu\text{g}/\text{kg}$, respectively.

Concentrations of acetone were found in 3 of 5 samples between 6.89 J $\mu\text{g}/\text{kg}$ (H-GP-21 (0-1 ft.)) and 139 $\mu\text{g}/\text{kg}$ (H-GP-20 (0-1 ft.)).

Concentrations of 2-butanone were found in 2 of 5 samples at 60.8 $\mu\text{g}/\text{kg}$ (H-GP-20 (0-1 ft.)) and 10.6 J $\mu\text{g}/\text{kg}$ (H-GP-21A (1-2 ft.)).

Concentrations of carbon disulfide were found in 3 of 5 samples between 1.33 J $\mu\text{g}/\text{kg}$ (H-GP-21A (1-2 ft.)) and 2.67 J $\mu\text{g}/\text{kg}$ (H-GP-21 (0-1 ft.)).

Concentrations of methylene chloride were found in 4 of 5 samples between 1.87 J $\mu\text{g}/\text{kg}$ (H-GP-22 (0-1 ft.)) and 13.7 $\mu\text{g}/\text{kg}$ (H-GP-21A (1-2 ft.)).

Concentrations of toluene were found in 3 of 5 samples between 2.37 J $\mu\text{g}/\text{kg}$ (H-GP-21 (0-1 ft.)) and 4.69 J $\mu\text{g}/\text{kg}$ (H-GP-20 (0-1 ft.)).

4.4.8.6 Discussion

Concentrations of barium (1,330 mg/kg) at H-GP-23 (0-1 ft.), cadmium (7.50 mg/kg) at H-GP-23 (0-1 ft.), chromium (215 mg/kg) at H-GP-23 (0-1 ft.), iron (29,800 mg/kg) at H-GP-21A (1-2 ft.), and lead (1,540 mg/kg) at H-GP-23 (0-1 ft.) were detected within the H-GP sampling area at a depth interval less than 2 foot. Low concentrations of SVOCs and VOCs were found in all of the five soil samples except for the concentration of benzo (a) pyrene detected at H-GP-20.

4.4.9 Area I – Heavy Drums Storage Pad

4.4.9.1 Unit Description

The heavy drums (not a RCRA empty drum) pad, a concrete pad without a roof, is located to the south of the wastewater treatment plant, in between two drum conveyor lines in Solid Waste Management Unit (SWMU) S107. This concrete pad is used for the storage of 55-gallon drums with excess material in them so that CSD can return these non-empty drums to the originating customer.

4.4.9.2 Potential Contaminants

Containers stored on the Heavy Drums Storage Pad could have potentially leaked materials onto the surrounding soil surfaces. Although the exact substances that may have leaked are not known, the materials could have contained metals, SVOCs, and VOCs.

4.4.9.3 Potential Releases

There are no known or documented releases from this area.

4.4.9.4 Summary of Investigation

Sampling was conducted to investigate the concentration of VOCs, SVOCs and metals adjacent to the Heavy Drums Storage Pad. Soil areas adjacent to the Heavy Drums Storage Pad were to be evaluated for staining. However, a concrete pad was not observed by B&N field personnel or Mr. Brian Grannon of CSD in the area marked as Area I on Figure 1 of the RFI –Part 2 Work Plan (B&N, Revised October 2006) during sample collection activities. Therefore, one surface soil sample (I-HA-7 (0-1 ft.)) was collected from the area designated as Area I that exhibited the most staining as determined by field observation. The surface soil sample was collected from the 0-1 ft depth interval utilizing a hand auger. The sample obtained was analyzed for metals, SVOCs, and VOCs.

4.4.9.5 Analytical Results

A discussion of the analytical soil sampling results is presented in the sections below. One surface soil sample (I-HA-7 (0-1 ft.)) was collected and analyzed for metals, SVOCs, and VOCs. A summary table of all detectable analytical results is found in Table 4.4.9.

Inorganics

Aluminum was detected at 7,930 mg/kg.

Arsenic was detected at 9.66 mg/kg.

Barium was detected at 114 mg/kg.

Cadmium was detected at 0.795 mg/kg.

Chromium was detected at 16.6 mg/kg.

Cyanide was not detected.

Lead was detected at 37.6 mg/kg.

Mercury was detected at 0.0949 mg/kg.

Selenium was detected at 16.5 mg/kg.

Silver was detected at 1.48 mg/kg.

SVOCs

Fifteen SVOC constituents were detected and mainly consisted of PAHs and phthalates.

Concentrations of PAHs ranged between 25.5 J $\mu\text{g}/\text{kg}$ for benzo(a)anthracene and benzo(a)pyrene to 77.0 J $\mu\text{g}/\text{kg}$ for pyrene.

Concentrations of phthalates ranged between 90.8 J mg/kg (di-n-butyl phthalate) and 1960 mg/kg (bis (2-ethylhexyl)phthalate).

VOCs

The methylene chloride concentration of 5.07 J $\mu\text{g}/\text{kg}$ was the only VOC detected.

4.4.9.6 Discussion

All of the constituents detected were at low concentrations.

4.4.10 Area J – Old Oxidizer Quench Pit Area

4.4.10.1 Unit Description

The soil sample collected during Franklin Steel's installation of groundwater monitoring well S108-MW04 (off the northeast corner of the old oxidizer building) had an elevated lead level of 1,020 milligrams per kilogram (mg/kg). Ohio EPA had concerns that the full extent of contamination has yet to be identified. It is noted that the area west of the old oxidizer, known collectively as the Five Unit Corridor, contains lead concentrations that consistently exceed screening values established during the RFI.

4.4.10.2 Potential Contaminants

Possible metals contamination.

4.4.10.3 Potential Releases

There are no known or documented releases from this unit.

4.4.10.4 Summary of Investigation

Sampling was conducted to delineate the lead contamination in the vicinity of S108-SB10 which consisted only of surface soil sampling. Surface soil samples were collected from the 0–1 ft depth interval utilizing a hand auger. A sample was obtained from the surface soil at a distance of 50 ft. north (J-HA-3 (0-1 ft.)), 50 ft east (J-HA-6 (0-1 ft.)), and 50 ft south (J-HA-5 (0-1 ft.)) of the location of S108-SB10. The samples taken to the north and south of S108-SB10 were taken at the same distance in an eastern direction from the old oxidizer as S108-SB10. An additional sample (J-HA-4 (0.0-0.5 ft.)), at a distance of 100 feet north of boring S108-SB10, was also collected. The four samples obtained were analyzed for metals.

4.4.10.5 Analytical Results

A discussion of the analytical soil sampling results is presented in the sections below. Four surface soil samples, J-HA-3 (0-1 ft.), J-HA-4 (0.0-0.5 ft.), J-HA-5 (0-1 ft.), and J-HA-6 (0-1 ft.) were collected and analyzed for metals. A summary table of all detectable analytical results is found in Table 4.4.10.

Inorganics

Concentrations of aluminum were detected in 4 of 4 samples between 3,440 mg/kg (J-HA-6 (0-1 ft.)) and 7,170 mg/kg (J-HA-5 (0-1 ft.)).

Concentrations of arsenic were detected in 4 of 4 samples between 4.62 mg/kg (J-HA-4 (0.0-0.5 ft.)) and 15.3 mg/kg (J-HA-5 (0-1 ft.)).

Concentrations of barium were detected in 4 of 4 samples between 83.3 mg/kg (J-HA-5 (0-1 ft.)) and 3,120 mg/kg (J-HA-4 (0-0.5 ft.)).

Concentrations of cadmium were detected in 4 of 4 samples between 0.796 J mg/kg (J-HA-5 (0-1 ft.)) and 63.0 mg/kg (J-HA-4 (0-0.5 ft.)).

Concentrations of chromium were detected in 4 of 4 samples between 16.4 mg/kg (J-HA-5 (0-1 ft.)) and 546 mg/kg (J-HA-4 (0-0.5 ft.)).

Concentrations of copper were detected in 4 of 4 samples between 22.9 mg/kg (J-HA-4 (0-0.5 ft.)) and 641 mg/kg (J-HA-5 (0-1 ft.)).

Concentrations of cyanide were detected in 4 of 4 samples between 0.369 mg/kg (J-HA-3 (0-1 ft.)) and 1.47 mg/kg (J-HA-6 (0-1 ft.)).

Concentrations of iron were detected in 4 of 4 samples between 13,200 mg/kg (J-HA-6 (0-1 ft.)) and 165,000 mg/kg (J-HA-4 (0-0.5 ft.)).

Concentrations of lead were detected in 4 of 4 samples between 62.7 mg/kg (J-HA-5 (0-1 ft.)) and 5,060 mg/kg (J-HA-4 (0-0.5 ft.)).

Concentrations of mercury were detected in 4 of 4 samples between 0.0441 mg/kg (J-HA-3 (0-1 ft.)) and 0.0917 mg/kg (J-HA-5 (0-1 ft.)).

Concentrations of nickel were detected in 4 of 4 samples between 17.9 mg/kg (J-HA-6 (0-1 ft.)) and 129 mg/kg (J-HA-4 (0-0.5 ft.)).

Concentrations of selenium were detected in 4 of 4 samples between 9.40 J mg/kg (J-HA-4 (0.0-0.5 ft.)) and 17.4 J mg/kg (J-HA-6 (0-1 ft.)).

Concentrations of silver were detected in 4 of 4 samples between 0.139 J mg/kg (J-HA-6 (0-1 ft.)) and 1.60 mg/kg (J-HA-4 (0-0.5 ft.)).

Concentrations of zinc were detected in 4 of 4 samples between 114 mg/kg (J-HA-5 (0-1 ft.)) and 6,150 mg/kg (J-HA-4 (0-0.5 ft.)).

4.4.10.6 Discussion

The objective of the investigation conducted for the RFI – Part 2 at Area J is to further define lead impacts in the vicinity of S108-SB10. Each of the four surface soil samples were analyzed for metals. Concentrations of barium (3,120 mg/kg), cadmium (63.0 mg/kg), chromium (546 mg/kg), iron (165,000 mg/kg), and lead (5,060 mg/kg) in J-HA-4 (0.0-0.5 ft.) were detected within the Area J. Surface soil sample J-HA-4 (0.0-0.5 ft.) is located 100 feet north of S108-SB10, which is near the south end of the drum conveyor chain cooling loop area in Area F. Surface soil sample J-HA-3 (0-1 ft.) was collected 50 feet north of S108-SB10, and based on sampling results, lead concentrations found at S108-SB10 has been delineated to the north, east, and south.

4.4.11 Area K – Former Drum Storage Area – Trailer Parking Lot, Southwest Corner of Property

4.4.11.1 Unit Description

Based on an April 2001 aerial photograph, 55-gallon drums were stored in the semi-trailer parking lot.

4.4.11.2 Potential Contaminants

The contents of the drums were unknown. Materials could have contained VOCs, SVOCs and metals.

4.4.11.3 Potential Releases

There are no known or documented releases from this unit.

4.4.11.4 Summary of Investigation

The contents of the drums were unknown, and could have potentially leaked materials onto the surrounding soil surfaces. Four surface soil samples (K-GP-1 (0-1 ft.), K-GP-2 (0-1 ft.), K-GP-3 (0-1 ft.), and K-GP-4 (0-1 ft.)) and one near surface soil sample (K-GP-3A (2-4 ft.)) were collected from four areas where the parking lot's soil exhibits the most staining as determined by field observation. The surface soil samples were collected utilizing a Geoprobe®. The samples obtained were analyzed for metals, SVOCs, and VOCs.

4.4.11.5 Analytical Results

A discussion of the analytical soil sampling results is presented in the sections below. Four surface soil samples and one near surface soil sample were collected and analyzed for metals, SVOCs, and VOCs. A summary table of all detectable analytical results is found in Table 4.4.11.

Inorganics

Concentrations of aluminum were detected in 5 of 5 samples between 7,100 mg/kg (K-GP-1 (0-1 ft.)) and 15,000 mg/kg (K-GP-2 (0-1 ft.)).

Concentrations of arsenic were detected in 5 of 5 samples between 12.9 mg/kg (K-GP-3 (0-1 ft.)) and 19.7 mg/kg (K-GP-3A (2-4 ft.)).

Concentrations of barium were detected in 5 of 5 samples between 57.3 mg/kg (K-GP-2 (0-1 ft.)) and 231 mg/kg (K-GP-4 (0-1 ft.)).

Concentrations of cadmium were detected in 5 of 5 samples between 0.167 mg/kg (K-GP-2 (0-1 ft.)) and 1.14 mg/kg (K-GP-3A (2-4 ft.)).

Concentrations of chromium were detected in 5 of 5 samples between 11.3 mg/kg (K-GP-1 (0-1 ft.)) and 16.7

mg/kg (K-GP-2 (0-1 ft.)).

Cyanide was not detected in Area K.

Concentrations of lead were detected in 5 of 5 samples between 13.0 J mg/kg (K-GP-2 (0-1 ft.)) and 49.3 mg/kg (K-GP-4 (0-1 ft.)).

Concentrations of mercury were detected in 5 of 5 samples between 0.0180 mg/kg (K-GP-3 (0-1 ft.)) and 0.0328 mg/kg (K-GP-4 (0-1 ft.)).

Concentrations of selenium were detected in 2 of 5 samples at 4.80 J mg/kg (K-GP-1 (0-1 ft.)) and 2.94 J mg/kg (K-GP-2 (0-1 ft.)).

Concentrations of silver were detected in 5 of 5 samples between 0.0832 J mg/kg (K-GP-3 (0-1 ft.)) and 0.158 J mg/kg (K-GP-4 (0-1 ft.)).

SVOCs

SVOCs were detected in 3 of the 5 soil samples and mainly consisted of PAHs and phthalates. SVOCs were not detected in the K-GP-3A (2-4 ft.) and K-GP-4 (0-1 ft.) soil samples. A total of 13 SVOC constituents were detected in Area K. Eleven SVOCs were detected in the K-GP-1 (0-1 ft.) sample. Only three SVOCs were detected in soil samples K-GP-2 (0-1 ft.) and K-GP-3 (0-1 ft.).

Concentrations of SVOCs detected ranged between 22.3 µg/kg (pyrene in K-GP-2 (0-1 ft.)) and 310 µg/kg (4,6-dinitro-2-methylphenol in K-GP-3 (0-1 ft.)).

VOCs

Concentrations of methylene chloride were detected in 5 of 5 samples between 3.70 µg/kg (K-GP-3A (2-4 ft.)) and 10.0 µg/kg (K-GP-2 (0-1 ft.)).

No other SVOCs were detected in Area K.

4.4.11.6 Discussion

Five soil samples were collected in Area K for metals, SVOCs, and VOCs at four separate locations which exhibited the most staining. All of the constituents detected were at low concentrations.

4.4.12 Area L – Newly Discovered Storm Water Outfall, Southeastern Corner of Property.

4.4.12.1 Unit Description

A second stormwater outfall, outfall 002, was identified in 2006 during the investigation work used to prepare the current site operator's storm water management plan. The second outfall is located on the north side of the current factory building.

4.4.12.2 Potential Contaminants

Stormwater discharge, therefore, metals, SVOCs, and VOCs were analyzed.

4.4.12.3 Potential Releases

There are no known or documented releases from this unit.

4.4.12.4 Summary of Investigation

The objective of the investigation conducted for the RFI – Part 2 at Area L is to determine if the sediment in the drainage swale located in the southeastern corner of the property may have been contaminated from the recently discovered stormwater discharge.

Two sediment samples (L-HA-8 (0-1 ft.) and L-HA-9 (0-1 ft.)) were collected from the discharge location with a hand auger. The samples were analyzed for metals, SVOCs, and VOCs.

4.4.12.5 Analytical Results

A discussion of the analytical sediment sampling results is presented in the sections below. Two sediment samples, L-HA-8 (0-1 ft.) and L-HA-9 (0-1 ft.) were collected and analyzed for metals, SVOCs, and VOCs. A summary table of all detectable analytical results is found in Table 4.4.12.

Inorganics

Concentrations of aluminum were detected at 8,940 mg/kg (L-HA-8 (0-1 ft.)) and 5,810 mg/kg (L-HA-9 (0-1 ft.)).

Concentrations of arsenic were detected at 7.74 mg/kg (L-HA-8 (0-1 ft.)) and 16.1 mg/kg (L-HA-9 (0-1 ft.)).

Concentrations of barium were detected at 280 mg/kg (L-HA-8 (0-1 ft.)) and 124 mg/kg (L-HA-9 (0-1 ft.)).

Concentrations of cadmium were detected at 3.06 J mg/kg (L-HA-8 (0-1 ft.)) and 1.16 J mg/kg (L-HA-9 (0-1 ft.)).

Concentrations of chromium were detected at 28.4 mg/kg (L-HA-8 (0-1 ft.)) and 11.0 mg/kg (L-HA-9 (0-1 ft.)).

Concentrations of copper were detected at 46.4 mg/kg (L-HA-8 (0-1 ft.)) and 28.6 mg/kg (L-HA-9 (0-1 ft.)).

Concentrations of cyanide were detected at L-HA-8 (0-1 ft.) (0.818 mg/kg) only.

Concentrations of lead were detected at 102 mg/kg (L-HA-8 (0-1 ft.)) and 19.5 mg/kg (L-HA-9 (0-1 ft.)).

Concentrations of mercury were detected at 0.137 mg/kg (L-HA-8 (0-1 ft.)) and 0.0319 mg/kg (L-HA-9 (0-1 ft.)).

Concentrations of nickel were detected at 28.6 mg/kg (L-HA-8 (0-1 ft.)) and 34.8 mg/kg (L-HA-9 (0-1 ft.)).

Concentrations of selenium were detected at 15.7 J mg/kg (L-HA-8 (0-1 ft.)) and 14.5 J mg/kg (L-HA-9 (0-1 ft.)).

Concentrations of silver were detected at 0.293 J mg/kg (L-HA-8 (0-1 ft.)) and 0.177 J mg/kg (L-HA-9 (0-1 ft.)).

Concentrations of zinc were detected at 301 mg/kg (L-HA-8 (0-1 ft.)) and 101 mg/kg (L-HA-9 (0-1 ft.)).

SVOCs

Seventeen SVOC constituents were detected at L-HA-8 (0-1 ft.) which mainly consisted of phthalates and phenols. Concentrations ranged from 19.0 µg/kg (4-chloroaniline) to 180.5 µg/kg (2,4-dinitrophenol). Only one SVOC was detected at L-HA-9 (0-1 ft.) (di-n-butyl phthalate at 56.2 J µg/kg). PAHs detected in L-HA-9 (0-1 ft.) were reported at concentrations ranging from 35.6 J µg/kg (naphthalene) to 1,070 µg/kg (pyrene).

VOCs

VOCs were not detected in either Area L sample.

4.4.12.6 Discussion

VOCs were not detected in either of the Area L samples. Generally, metals and SVOC concentrations were higher in L-HA-8 (0-1 ft.) compared to L-HA-9 (0-1 ft.). L-HA-8 is located closer to the newly discovered outfall and upstream of L-HA-9. All of the COCs detected were at low concentrations in the L-HA-9 sample.

The four inorganic COCs which were reported at elevated concentrations for the L-HA-8 sediment sample were cadmium (3.06 J mg/kg), copper (46.4 mg/kg), lead (102 B mg/kg), and zinc (301 mg/kg).

Ten SVOCs were reported at elevated concentrations for the L-HA-8 sediment sample: benzo(a)anthracene (328 J µg/kg); benzo(g,h,i)perylene (201 J µg/kg); benzo(k)fluoranthene (338 J µg/kg); benzo(a)pyrene (493 µg/kg); chrysene (471 J µg/kg); dibenzo(a,h)anthracene (68.0 J µg/kg); fluoranthene (790 µg/kg); phenanthrene (307 J µg/kg); phenol (50.7 J µg/kg); and pyrene (1070 µg/kg).

4.5 GROUNDWATER MONITORING DESCRIPTION

Contiguous Area #1 encompasses the active operations area and truck trailer parking area. Contiguous Area #2 consists of the drum storage areas, the adjacent field formerly used for drum storage to the east, SWMU S201 and the area immediately surrounding SWMU S201. The area east of Contiguous Area #2 consists of the Jefferson Township Well Field which has monitoring wells and water supply wells. The Jefferson Township Well Field is located downgradient of Contiguous Area #2 which is located downgradient of Contiguous Area #1.

4.5.1 Background Wells S100-MW01 and S107-MW02

Approximately one-half mile to the north-northwest of the Franklin Steel Company's offices and just east of Taylor Station Road was the location of the background well, S100-MW01. This well was used for comparing the groundwater results with the other wells/piezometers on the Franklin Steel property and downgradient-offsite properties.

Background monitoring well S100-MW01 was permanently plugged and abandoned on December 26, 2000 due to the extensive construction activity/commercial development in the immediate are of S100-MW01. Furthermore, this well was abandoned because of the continued high turbidity in the collected groundwater samples, suspected to be the result of improper well construction and/or well damage. Because of these reasons, all existing data from well S100-MW01 was not used to determine background levels for the RFI Report. The Water Well Sealing Report is included in Appendix G.

Based on the Potentiometric Surface Maps, Figure 2.7 and Figure 2.8, monitoring well S107-MW02 appears to be upgradient to the zone of industrial activities on Franklin Steel Company property. Therefore, monitoring well S107-MW02 is designated as the replacement background well for the abandoned S100-MW01.

S107-MW02

In S107-MW02 the concentrations of aluminum ranged between 0.40 mg/l (March 1998) to 34.7 mg/l (September 1998). Concentrations of arsenic ranged between 0.0048 mg/l (July 1997) to 0.096 mg/l (September 1998). Concentrations of barium ranged between 0.04B mg/l (September 1999) to 0.47 mg/l (September 1998). Cadmium was only detected during the September 1998 sampling event at a concentration of 0.0038 mg/l. Chromium was detected at concentrations ranging between 0.0057 mg/l (July 1997) and 0.075 mg/l (September 1998). Concentrations of lead ranged between 0.0030 mg/l (June 1998 and March 2000) to 0.045 mg/l (September 1998). Concentrations of manganese ranged from 0.086 mg/l (March 1998) to 3.30 mg/l (September 1998). Mercury was detected in only two sampling events at concentrations of 0.000049 mg/l (July 1997) and 0.0001 mg/l (September 1998). Concentrations of selenium ranged between 0.0056 mg/l (September 1998) and 0.0058 mg/l (March 1999). Thallium concentrations ranged from 0.0011B mg/l (January 1998) to 0.0021 mg/l (September 1998). Concentrations of vanadium ranged between 0.0079 mg/l (June 1998) to 0.028B mg/l (October 1997). Antimony, cyanide, and silver were not detected in groundwater samples collected at S107-MW02.

The SVOC bis(2-ethylhexyl)phthalate was detected during the March 1999 sampling event at a concentration of 18 µg/L. There were no other SVOCs detected in groundwater at S107-MW02.

The VOC carbon disulfide was detected during the September 1999 sampling event at a concentration of 0.18J µg/L. Methylene chloride was detected during the March 2000 sampling event at a concentration of 0.14J µg/L.

The temporal change in concentrations among the inorganic constituents shows a near static to slightly increasing trend from the May 1997 to the March 2000 sampling events.

4.5.2 Contiguous Area #1

The groundwater results from Contiguous Area #1 were collected from wells/piezometers located in SWMUs S101 through S109. Piezometers S108-PZ01 and S107-PZ01 appear to be side-to-downgradient to the industrial activities. The remaining wells/piezometers within Contiguous Area #1 seem to be directly downgradient to the industrial activities and are listed in order from upgradient to downgradient: S108-PZ01 (sidegradient); S107-PZ01 (sidegradient); S105-MW01; S108-MW03; S108-MW04; S108-PZ02; S101-MW01; S101-MW01R; S108-MW05; S108-MW06D; S109-PZ01; S109-MW05D; and S109-MW06.

S108-PZ01

Piezometer S108-PZ01 had concentrations of aluminum ranging between 0.47 mg/l (March 1999) to 23.8 mg/l (July 1997). Concentrations of arsenic ranged between 0.0044 mg/l (October 1998) to 0.011 mg/l (March 1998). Concentrations of barium ranged between 0.13B mg/l (March 2000) to 0.44 mg/l (July 1997). Concentrations of chromium ranged between 0.0082B mg/l (September 1999) to 0.037 mg/l (July 1997). Concentrations of lead ranged between 0.0027B mg/l (January 1998) to 0.026J mg/l (July 1997). Concentrations of manganese ranged from 0.26 mg/l (May 1997 and October 1998) to 0.89 mg/l (July 1997). Mercury was detected only once during the July 1997 sampling event at a concentration of 0.000051 mg/l. Vanadium concentrations ranged from 0.01B mg/l (October 1997, January 1998) to 0.086 mg/l (July 1997). Antimony, cadmium, cyanide, selenium, silver, and thallium were not detected in groundwater samples collected from S108-PZ01.

The SVOC, bis(2-ethylhexyl)phthalate, was detected once (March 1998) at a concentration of 36 µg/L. No other SVOCs were detected in groundwater samples collected at S108-PZ01.

The VOC chloroethane was detected during the March 1998 sampling event at a concentration of 36 µg/L. No other VOCs were detected in groundwater samples collected as S108-PZ01.

The temporal change in concentrations among the inorganic constituents shows essentially static conditions with a slight decrease from the May 1997 to the March 2000 sampling events. Only one of the 11 sampling events in this piezometer indicated the presence of bis(2-ethylhexyl)phthalate.

S107-PZ01

Concentrations of aluminum ranged between 0.095 mg/l (September 1998) to 0.39 mg/l (March 1998). Concentrations of arsenic ranged between 0.011 mg/l (October 1997) to 0.016 mg/l (June 1999 and March 2000). Concentrations of barium ranged between 0.26 mg/l (May 1997) to 0.35 mg/l (September 1998, March 1999 and March 2000). Manganese concentrations ranged between 0.035 mg/l (March 1999) to 0.096 mg/l (June 1999). Antimony, chromium, cyanide, lead, selenium, silver, thallium, and vanadium were not detected in groundwater samples collected at S107-PZ01.

The SVOC, bis(2-ethylhexyl)phthalate, was detected at concentrations of 1.5J µg/L (July 1997) and 4.8J µg/L (May 1997). No other SVOCs were detected in groundwater samples collected at S107-PZ01.

The VOC carbon disulfide was detected during the March 1999 sampling event at a concentration of 0.26J µg/L. No other VOCs were detected in groundwater samples collected at S107-PZ01.

The temporal change in concentrations among the inorganic constituents shows essentially static conditions to a slight increase from the May 1997 to the March 2000 sampling events.

S105-MW01

Aluminum concentrations ranged between 2.2J mg/l (December 1998) and 79.8 mg/l (March 1998). Arsenic concentrations ranged between 0.024 mg/l (March 2000) and 0.19 mg/l (March 1998). Barium concentrations ranged between 0.25 mg/l (March 2000) and 1.0 mg/l (October 1998). Concentrations of cadmium ranged between 0.0046B mg/l (June and September 1999) and 0.015 mg/l (March 1998). Chromium concentrations ranged between 0.018 mg/l (March 2000) and 0.15 mg/l (March 1998). Cyanide was detected once with a concentration of 0.008B (March 1999). Lead concentrations ranged between 0.021 mg/l (March 2000) and 0.25 mg/l (March 1998). Concentrations of manganese ranged between 0.8 mg/l (March 2000) and 4.8L mg/l (October 1998). Mercury concentrations ranged between 0.00008J mg/l (December 1998) and 0.00044 mg/l (March 1998). Selenium concentrations ranged between 0.0054 mg/l (October 1998) and 0.0071 mg/l (June 1999). Thallium concentrations ranged between 0.0034 mg/l (June 1998) and 0.0092 mg/l (March 1998). Concentrations of vanadium ranged between 0.056 mg/l (March 2000) and 0.34 mg/l (March 1998 and October 1998). Antimony and silver were not detected in the groundwater samples collected at S105-MW01.

SVOCs were not detected in the groundwater samples collected at S105-MW01.

The VOC acetone was detected at a concentration of 7.8J µg/L (June 1999). Carbon disulfide was detected at a concentration of 0.33J µg/L (March 1999). Methylene chloride was detected in the June 1998 groundwater sample at a concentration of 6.7 µg/L (June 1998). Concentrations of toluene were detected with a range between 0.22J µg/L (March 1999) and 0.28J µg/L (October 1998). No other VOCs were detected in groundwater samples collected at S105-MW01.

The temporal changes in concentrations among the inorganic constituents show a decreasing trend from the March 1998 to the March 2000 sampling events. The VOC, methylene chloride was detected and shows a slight decreasing trend.

S108-MW03

Concentrations of aluminum ranged between 0.34 mg/l (March 1998) to 30.5 mg/l (June 1999). Concentrations of arsenic ranged between 0.0033 mg/l (March 1998) to 0.066 mg/l (October 1998). Barium concentrations ranged between 0.22 mg/l (March 1998) to 0.62 mg/l (June 1999). Concentrations of cadmium ranged between 0.005 mg/l (March 1999) and 0.0095 mg/l (October 1998). Concentrations of chromium ranged between 0.010 mg/l (July 1997) to 0.063 mg/l (June 1999). Lead concentrations ranged between 0.0043 mg/l (January 1998) to 0.058 mg/l (June 1999). Concentrations of manganese ranged between 0.23 mg/l (March 1998) to 1.10 mg/l (October 1998). Mercury was detected at concentrations ranging between 0.000042 mg/l (July 1997) and 0.00030 mg/l (June 1999). Concentrations of selenium ranged between 0.0090 mg/l (March 1999) and 0.0160 mg/l (June 1999). Thallium concentrations ranged between 0.0013J mg/l (July 1997) to 0.0085 mg/l (June 1999). Concentrations of vanadium ranged between 0.029B mg/l (January 1998) to 0.34 mg/l (June 1999). Antimony, cyanide, and silver were not detected in the groundwater samples collected at S108-MW03.

SVOCs were not detected in groundwater samples collected at S108-MW03.

The VOC carbon disulfide was detected during two sampling events with concentrations of 0.12J µg/L (June 1999) and 0.13J (September 1999).

The temporal change in concentrations among the inorganic constituents show a near static to slightly increasing trend from the May 1997 to the March 2000 sampling events.

S108-MW04

Aluminum concentrations ranged between 9.50 mg/l (March 2000) and 27.6 J mg/l (June 1998). Arsenic concentrations ranged between 0.017 mg/l (March 2000) and 0.073 mg/l (June 1998). Barium concentrations ranged between 0.31 mg/l (March 2000) and 0.69 mg/l (March 1998). Concentrations of cadmium ranged between 0.0038B (June 1999) and 0.0045 mg/l (March 1998). Chromium concentrations ranged between 0.017 mg/l (March 2000) and 0.064 mg/l (March 1998). Lead concentrations ranged between 0.02 mg/l (March 2000) and 0.15 mg/l (March 1998). Manganese concentrations ranged between 0.70 mg/l (March 2000) and 2.4 mg/l (June 1998). Mercury concentrations ranged between 0.00011B mg/l (March 1999) and 0.00017 mg/l (March 1998). Concentrations of selenium ranged between 0.0071 mg/l (March 1999) and 0.0077 mg/l (June 1999). Thallium concentrations ranged between 0.0026J mg/l (October 1998, March 1999 and June 1999) and 0.0032 mg/l (June 1998). Concentrations of vanadium ranged between 0.038B mg/l (March 2000) and 0.11 mg/l (June 1998, October 1998 and June 1999). Antimony, cyanide, and silver were not detected in the groundwater samples collected at S108-MW04.

SVOCs were not detected in the groundwater samples collected at S108-MW04.

The VOC methylene chloride was detected during the March 1998 sampling event at a concentration of 0.48J µg/L. Carbon disulfide was detected during the March 1999 sampling event at a concentration of 0.42J µg/L. No other VOCs were detected in the groundwater samples collected at S108-MW04.

The temporal change in concentrations among the inorganic constituents shows a near static to slight decreasing trend from the March 1998 to the March 2000 sampling events.

S108-PZ02

Piezometer S108-PZ02 had concentrations of aluminum ranging between 0.37 mg/l (October 1998) to 3.1 mg/l (July 1997). Concentrations of arsenic ranged between 0.0032B mg/l (January 1998) to 0.0062J mg/l (July 1997). Barium concentrations ranged between 0.072 mg/l (October 1997) to 0.11 mg/l (July 1997 and September 1999). Chromium was detected during the July 1997 sampling event at a concentration of 0.0064

mg/l. Lead concentrations were detected during two sampling events at 0.0022 mg/l (October 1997) and 0.0047J mg/l (July 1997). Manganese concentrations ranged between 0.36 mg/l (March 1999) to 0.66 mg/l (July 1997). Mercury was detected during the July sampling event at a concentration of 0.000028 mg/l. Selenium was detected during the June 1998 sampling event at a concentration of 0.0045 mg/l. Vanadium was detected during two sampling events at concentrations of 0.0061B mg/l (January 1998) and 0.014B mg/l (July 1997). Antimony, cadmium, cyanide, thallium and silver were not detected in the groundwater samples collected at S108-PZ02.

The SVOC bis(2-ethylhexyl)phthalate was detected during the June 1999 sampling event at a concentration of 4.0J µg/L. No other SVOCS were detected in the groundwater samples collected at S108-PZ02.

VOCs were not detected in the groundwater samples collected at S108-PZ02.

The temporal change in concentrations among the inorganic constituents shows a static to a slight decreasing trend from the May 1997 to the March 2000 sampling events.

S101-MW01

Monitoring well S101-MW01 had aluminum concentrations ranging between 9.0 mg/l (July 1997) to 101 mg/l (June 1998). Arsenic concentrations ranged from 0.032 mg/l (January 1998) to 0.22 mg/l (June 1998). Barium concentrations ranged from 0.29 mg/l (January 1998) to 2.4 mg/l (June 1998). Cadmium concentrations ranged from 0.0047B mg/l (September 1999) to 0.015 mg/l (June 1998). Chromium concentrations ranged between 0.021 mg/l (January 1998) to 0.23 mg/l (June 1998). Lead concentrations ranged between 0.022 mg/l (January 1998) to 0.32 mg/l (June 1998). Concentrations of manganese ranged between 0.58 mg/l (January 1998) to 6.2 mg/l (June 1998). Concentrations of mercury ranged between 0.000055 mg/l (July 1997) and 0.00027 mg/l (October 1998). Concentrations of selenium ranged between 0.0020J mg/l (July 1997) and 0.0091 mg/l (June 1998). Thallium concentrations ranged between 0.0012B mg/l (January 1998) to 0.013J mg/l (October 1998). Vanadium concentrations ranged between 0.032 mg/l (July 1997) to 0.31 mg/l (June 1998). Antimony, cyanide and silver were not detected in the groundwater samples collected at S101-MW01.

SVOCS were not detected in the groundwater samples collected at S101-MW01.

The VOC carbon disulfide was detected during three sampling events at concentrations of 0.13J µg/L (March 1998), 0.35J µg/L (June 1998) and 0.14J µg/L. Concentrations of chloroethane ranged between 0.34J µg/L (June 1998) to 0.52J µg/L (October 1997). Methylene chloride was detected during the March 1998 sampling event at a concentration of 0.46J µg/L. No other VOCs were detected in the groundwater samples collected at S101-MW01.

The temporal change in concentrations among the inorganic and VOC constituents show a near static trend from the May 1997 to the March 2000 sampling events.

S108-MW05

Aluminum concentrations ranged from 2.0 mg/l (December 1999) to 53.4 mg/l (March 1999). Arsenic concentrations ranged from 0.0041B mg/l (December 1999) to 0.067 mg/l (March 1999). Barium concentrations ranged from 0.15 mg/l (September 1998) to 0.91 mg/l (March 1999). Concentrations of cadmium ranged from 0.0037B mg/l (June 1999) to 0.075 mg/l (June 1998). Concentrations of chromium ranged from 0.0095B mg/l (March 2000) to 0.081 mg/l (March 1999). Concentration of cyanide ranged between 0.0025B mg/l (March 2000) and 0.006B mg/l (December 1999). Lead concentrations ranged from 0.01 mg/l (December 1999) to 0.075 mg/l (March 1999). Manganese was found in concentrations between 0.30 mg/l (September 1998) to 2.7 mg/l (March 1999). Concentrations of mercury ranged between 0.00014B mg/l (March 1999) and 0.00017B (June 1999). Concentrations of selenium ranged between 0.0053 mg/l

The SVOC bis(2-ethylhexyl)phthalate was detected in this piezometer only once at 1.2J µg/L (May 1997). There were no other SVOCs detected in groundwater for this SWMU.

There were no VOCs detected in this well.

The temporal change in concentrations among the inorganic constituents shows essentially static to slightly increasing conditions from the May 1997 to the June 1998 sampling events. Only the first of the six sampling events in this piezometer indicated the estimated presence of bis(2-ethylhexyl)phthalate and the rest were non-detections.

S109-MW05D

Aluminum concentrations ranged from 0.75 mg/l (August 1999) to 7.2 mg/l (September 1998). Arsenic concentrations ranged between 0.0037B mg/l (August 1999) and 0.0094 mg/l (June 1998). Barium concentrations ranged from 0.28 mg/l (March 1998 and June 1999) to 0.35 mg/l (June 1998). Concentrations of chromium ranged between 0.010 mg/l (June 1998) and 0.013 mg/l (September 1998). Concentrations of lead ranged between 0.0065 mg/l (March 1999) and 0.017 mg/l (September 1998). Total manganese was found in concentrations from 0.17 mg/l (August 1999) to 0.39 mg/l (September 1998). Concentrations of selenium ranged between 0.0044 mg/l (June 1998) and 0.0083 mg/l (March 1999). Concentrations of thallium ranged between 0.0016 mg/l (June 1998) and 0.0019B (March 1999). Concentrations of vanadium ranged between 0.021B mg/l (March 1999) and 0.46 mg/l (September 1999). There were no detections of antimony, cadmium, mercury, and silver in this monitoring well.

Bis(2-ethylhexyl)phthalate was detected in this well only once at 9.6 µg/L (March 1998). No other SVOCs were detected in groundwater for this SWMU.

The VOC chloroform was detected once at a concentration of 0.97J µg/L (March 1998). No other VOCS were detected in groundwater for this SWMU.

The temporal change in concentrations among the inorganic constituents shows a near static to slight decreasing trend from the March 1998 to the March 2000 sampling events. Only the March 1998 sampling event in this monitoring well indicated the presence of the SVOC bis(2-ethylhexyl)phthalate and the VOC chloroform.

S109-MW06

Aluminum concentrations ranged from 2.6 mg/l (September 1999) to 98.8 mg/l (March 1998). Arsenic concentrations were found at 0.0036B mg/l (March 2000) and 0.24 mg/l (March 1998). Barium concentrations ranged from 0.26 mg/l (March 2000) to 1.5 mg/l (March 1998). Concentrations of cadmium ranged from 0.0099 mg/l (June 1998) to 0.028 mg/l (March 1998). Concentrations of chromium ranged from 0.01 mg/l (June 1998) to 0.20 mg/l (March 1998). Lead concentrations ranged from 0.0043 mg/l (March 2000) to 0.25 mg/l (March 1998). Manganese concentrations ranged from 0.32 mg/l (June 1998) to 3.7 mg/l (March 1998). Mercury was found in concentrations from 0.00018 mg/l (June 1998 and March 1999) to 0.00034 mg/l (September 1998). Concentrations of selenium ranged from 0.014 mg/l (March 1999) to 0.043 mg/l (March 1998). Thallium was found in concentrations from 0.0015J mg/l (June 1999) to 0.015 mg/l (March 1998). Concentrations of vanadium ranged from 0.013 mg/l (March 2000) to 0.85 mg/l (March 1998). There were no detections of antimony, cyanide, and silver in this monitoring well.

No SVOCs including bis(2-ethylhexyl)phthalate have been detected in this monitoring well.

The VOC 1,1-dichloroethane ranged from 2.1J µg/L (September 1998) to 18.0J µg/L (June 1999). Carbon disulfide was detected once at a concentration of 0.92 µg/L (March 1998). Chloroethane ranged from 100 µg/L (November 2006) to 480 µg/L (June 1999). Vinyl chloride detections range from 3.0 µg/L (December 2003) TO 9.3 µg/L (October 2007).

The temporal change in concentrations among the inorganic constituents show a decrease from the March 1998 to the March 2000 sampling events. Among the VOC constituents the temporal change indicates an increase from the March 1998 to the March 2000 sampling events.

S109-PZ02

Aluminum concentrations in piezometer S109-PZ02 ranged from 0.29 mg/l (June 1998) to 120.0 mg/l (August 1999). Concentrations of arsenic ranged from 0.0036 mg/l (March 1998) to 0.0061B mg/l (October 1997). Barium concentrations ranged from 0.11B mg/l (March 1999) to 0.29 mg/l (January 1998). Cadmium was detected once at a concentration of 0.0073 mg/l (August 1999). Concentrations of chromium ranged between 0.0054 mg/l (October 1997) and 0.31mg/l (August 1999). Lead was found once at a concentration of 0.0039 mg/l (October 1997). The range of concentrations of manganese was from 0.19 mg/l (October 1997) to 6.4 mg/l (August 1999). Mercury was found once at a concentration of 0.000023 mg/l (July 1997). Selenium was detected once at a concentration of 0.011 mg/l (August 1999). Thallium was detected once at a concentration of 0.058 mg/l (August 1999). Concentrations of vanadium ranged between 0.018B mg/l (October 1997) and 0.40 mg/l (August 1999). There were no detections of antimony, cyanide, and silver in this piezometer.

Bis(2-ethylhexyl)phthalate was detected only once during the May 1997 sampling event at a concentration of 2.1J µg/L. No other SVOCS were detected in groundwater at this piezometer.

The VOCS 1,1-dichloroethane and chloroethane were detected during the September 1998 sampling event at concentrations of 0.29J and 24.0 µg/L, respectively.

The temporal change in concentrations among the inorganic constituents shows essentially static to slight increasing conditions from the May 1997 to the March 2000 sampling events. Only one sampling event has indicated the estimated presences of the bis(2-ethylhexyl)phthalate and the rest were non-detections.

4.5.3 Contiguous Area #2

The groundwater results from Contiguous Area #2 were collected from two monitoring wells and one piezometer used for groundwater monitoring in the area of SWMU S201. The wells/piezometers within Contiguous Area #2 seem to be downgradient to the Franklin Steel industrial area and are listed in order from upgradient to downgradient: S109-PZ02; S201-MW02; S201-PZ01; and S201-MW02R.

S201-MW02

Aluminum concentrations in monitoring well S201-MW02 ranged from 1.0 mg/l (March 1998) to 29.8 mg/l (June 1998). Arsenic concentrations ranged from 0.0054 mg/l (July 1997) to 0.064 mg/l (June 1998). Barium concentrations ranged from 0.064 mg/l (March 1998) to 0.63 mg/l (December 1998). Cadmium was detected once (June 1998) at a concentration of 0.0051 mg/l. Chromium concentrations ranged from 0.017 mg/l (June 1998) to 0.064 mg/l (June 1998). Lead concentrations ranged from 0.0066 mg/l (January 1998) to 0.041 mg/l (September and December 1998). Concentrations of manganese ranged from 0.14 mg/l (July 1997, March 1998) to 1.3 mg/l (June 1998). Mercury concentrations ranged from 0.000028B mg/l (July 1997) to 0.00012B mg/l (June 1998). Selenium was detected twice (June and September 1998) at concentrations of 0.0097 and 0.007 mg/l, respectively. Thallium concentrations ranged from 0.0015J mg/l (June 1999) to 0.0045 mg/l (June 1998). Vanadium concentrations ranged from 0.0073 mg/l (July 1997) mg/l to 0.12 mg/l (June 1998). Antimony, cyanide, and silver were not detected in this monitoring well.

The SVOC, bis(2-ethylhexyl)phthalate was detected at concentrations ranging between 1.2J µg/L (May 1997) and 8.8J µg/L (July 1997).

The VOC carbon disulfide was detected at concentrations ranging between 0.31J µg/L (June 1998) and 0.34J (June 1999).

The temporal change in concentrations among the inorganic constituents shows near static to slight increase from the May 1997 to the June 1998 March 2000 sampling events. Only the first two of the six sampling events in this monitoring well have indicated the presence of bis(2-ethylhexyl)phthalate.

S201-PZ01

Aluminum concentrations detected in piezometer S201-PZ01 ranged from 0.077 mg/l (March 1998) to 1.1 mg/l (December 1998). Concentrations of arsenic detected ranged from 0.0032 mg/l (March 1999) to 0.0091 mg/l (June 1998). Barium was detected in concentrations that ranged from 0.023 mg/l (March 2000) to 0.11 mg/l (January 1998). Cobalt was detected once at a concentration of 0.023B mg/l (March 2000). Concentrations of magnesium ranged from 32.6 mg/l (May 1997) to 95.3 mg/l (March 2000). Manganese was detected in concentrations that ranged from 0.091 mg/l (August 1999) to 3.1 mg/l (March 2000). Mercury was detected once (July 1997) at a concentration of 0.000028 mg/l. Nickel was detected three times at concentrations that range from 0.17B mg/l (March 1999) to 0.2 mg/l (March 2000). Selenium was detected once (June 1998) at a concentration of 0.0043B mg/l. Beryllium, cadmium, chromium, cyanide, lead, thallium, and vanadium were not detected in this piezometer.

The SVOC bis(2-ethylhexyl)phthalate was detected four times in this piezometer at concentrations ranging from 1.2J µg/L (May 1997) to 250 µg/L (December 1998). The last three sampling rounds showed bis(2-ethylhexyl)phthalate at concentrations below the detection limit of 3.11 µg/L.

The VOC carbon disulfide was detected once in this monitoring well at a concentration of 0.29J µg/L (June 1998). Toluene was detected once in this monitoring well at a concentration of 0.21J µg/L (October 1997). Methylene chloride was detected once at a concentration of 0.41J µg/L (December 1998).

The temporal change in concentrations among the inorganic constituents show a near static to slight increase from the May 1997 to December 1999 sampling events. The March 2000 sampling event indicates noticeable increases in the concentrations of several inorganic parameters.

4.5.4 Jefferson Township Monitoring Wells

The Jefferson Township monitoring wells are located east of SWMU S201. The Jefferson Township monitoring wells monitored for the Franklin Steel RFI in order from upgradient to downgradient are: JTMW-1D; JTMW-1S; JTMW-3D; and JTMW-3S.

MW-1D (Jefferson Township Monitoring Well)

Aluminum was found at concentrations ranging from 0.66 mg/l (March 2000) and 14.5 mg/l (June 1998). Arsenic concentrations ranged between 0.0033 mg/l (December 1998) and 0.019 mg/l (March 1998). Barium was found in concentrations from 0.16 mg/l (March 2000) to 0.38 mg/l (June 1998). Beryllium was detected twice at concentrations of 0.00084B mg/l and .00092B (March 1999). Chromium was found in concentrations from 0.0073 (March 1999) to 0.018 mg/l (July 1998). Lead was found at concentrations from 0.0022B (March 2000) to 0.014 mg/l (March 1998, July 1998). Manganese was found in concentrations from 0.13 mg/l (March 2000) to 0.37 mg/l (July 1998). Mercury was found twice at concentrations of 0.000094 mg/l (March 1998) and 0.00016 mg/l (June 1999). Thallium was found twice at concentrations of 0.001B

mg/l (March 1999) and 0.0013 mg/l (July 1998). Concentrations of vanadium ranged from 0.011B mg/l (June 1999) to 0.059 mg/l (July 1998). Cadmium, cyanide, and selenium were not detected in this monitoring well.

The SVOC bis(2-ethylhexyl)phthalate was detected in this well once at a concentration of 3.0 µg/L (June 1998). VOCs were not detected in the groundwater samples collected at MW-1D.

The temporal change in concentrations among the inorganic constituents shows a near static to slight increase from the March 1998 to the March 2000 sampling events. Only the June 1998 sampling event in this monitoring well indicated the presence of bis(2-ethylhexyl)phthalate. The March 1998 sampling event was a non-detection for bis(2-ethylhexyl) phthalate.

MW-1S (Jefferson Township Monitoring Well)

Aluminum concentrations in well MW-1S ranged from 0.97 mg/l (December 1998) to 47.0 mg/l (September 1998). Arsenic concentrations ranged from 0.0087B mg/l (December 1998) to 0.1 mg/l (September 1998). Barium was found in concentrations from 0.067B mg/l (March 2000) and 1.0 mg/l (December 1999). Beryllium was detected at concentrations ranging from 0.0008 mg/l (June 1999) and 0.003 mg/l (September 1998). Cadmium was detected once at a concentration of 0.0036 mg/l (September 1998). Chromium was found at concentrations ranging between 0.108 mg/l (September 1999) and 0.092 (September 1998). Lead was found in concentrations ranging from 0.0022 mg/l (March 1998) to 0.077 mg/l (September 1998). Magnesium was detected at concentrations ranging from 37.8 mg/l (March 1998) to 113.0 mg/l (September 1998). Manganese was found in concentrations ranging from 0.65 mg/l (September 1999) to 2.9 mg/l (September 1998). Mercury was detected at concentrations ranging from 0.0001B (June 1999) TO 0.00021 mg/l (September 1998). Nickel was detected at concentrations ranging from 0.31B (September 1999) to 0.22 mg/l (September 1998). Thallium was found at concentrations ranging from 0.0009J (September 1999) and 0.0045 (September 1998). Concentrations of vanadium ranged from 0.011 mg/l (March 1998) to 0.18 mg/l (September 1998). Cyanide, selenium, and silver were not detected in this monitoring well.

The only SVOC detected was bis(2-Ethylhexyl)phthalate at a concentration of 10 µg/L (March 1999). The last three sampling rounds showed bis(2-ethylhexyl)phthalate at concentrations below the detection limit of 3.11 µg/L.

The only VOCs detected were carbon disulfide at a concentration of 0.26 µg/L and chloromethane at a concentration of 0.22 µg/L (both detected only once in December 1999).

The temporal change in concentrations among the inorganic constituents indicate a slight increase from the March 1998 to the June 1998 sampling events, but do not indicate any other apparent trends.

MW-3D (Jefferson Township Monitoring Well)

Ranged from 0.87 mg/l (June 1999) to 13.7 mg/l (July 1998). Arsenic concentrations ranged from 0.0081B mg/l (March 2000) and 0.055 mg/l (July 1998). Barium was found in concentrations from 0.25 mg/l (December 1999) to 0.43 mg/l (June 1998). Chromium was found in concentrations from 0.008 mg/l (September 1999) to 0.022 mg/l (June 1998). Cyanide was detected twice at concentrations of 0.0055B mg/l (December 1999) and 0.007B mg/l (September 1999). Lead was found in concentrations from 0.0049 mg/l (March 1999) to 0.032 mg/l (June 1998). Manganese was found in concentrations from 0.1 mg/l (March 2000) to 0.59 mg/l (July 1998). Mercury was found in concentrations from 0.00076J mg/l (December 1998) to 0.00011 mg/l (March 1998). Selenium was found once (June 1998) at a concentration of 0.0049 mg/l. Thallium was found only once at a concentration of 0.0018 mg/l (June 1998). Concentrations of vanadium ranged from 0.0063B mg/l (December 1999) to 0.076 mg/l (July 1998). Cadmium was not detected in this monitoring well.

The SVOC bis(2-ethylhexyl)phthalate was detected in this well only once during the March 1998 sampling event a concentration of 8.5J µg/L. The VOC chloromethane was detected in one sampling event (December 1999) at a concentration of 0.10J µg/L.

The temporal change in concentrations among the inorganic constituents shows a near static to slight increase from the March 1998 to the March 2000 sampling events. Only the March 1998 sampling event in this monitoring well indicated the presence of bis(2-ethylhexyl)phthalate. The June 1998 sampling event was a non-detection for bis(2-ethylhexyl)phthalate.

MW-3S (Jefferson Township Monitoring Well)

Aluminum concentrations ranged from 0.45 mg/l (September 1998) to 25.7J mg/l (December 1998). Arsenic was found at concentrations from 0.0059 mg/l (March 1998) to 0.043 mg/l (December 1998). Barium was found in concentrations from 0.027B mg/l (September 1999) to 0.28 mg/l (December 1998). Beryllium was detected twice at concentrations of 0.0012B mg/l (March 1999) and 0.0014B mg/l (December 1998). Lead was found in concentrations of 0.0033 mg/l (March 2000) to 0.068 mg/l (December 1998). Manganese was found in concentrations from 0.21 mg/l (March 1998) to 1.70 mg/l (December 1998). Mercury was found in concentrations that ranged from 0.000098 mg/l (March 1998) to 0.00013 mg/l (December 1998). Selenium was detected twice at concentrations of 0.004 mg/l (July 1998) and 0.0078 mg/l (March 1999). Thallium was found at concentrations ranging from 0.001B mg/l (July 1998) to 0.004J mg/l (December 1998). Concentrations of vanadium ranged from 0.0093 mg/l (June 1998) to 0.092 mg/l (December 1998). Cyanide was not detected in this monitoring well.

SVOCs and VOCs have not been detected in this monitoring well.

The temporal change in concentrations among the inorganic constituents shows a near static to slight increase from the March 1998 to the March 2000 sampling events.

4.6 GROUNDWATER RESULTS SUMMARY

The following section presents the groundwater sampling results for inorganics, SVOCs and VOCs from the piezometers and monitoring wells located on-site and offsite. The sampling results discussed include the detections that were above the lesser value of either the federal drinking water MCLs or 100% of the U.S. EPA's Region 9 PRG's tap water exposure value for carcinogens and 10% of the listed value for non-carcinogens.

Groundwater sampling has progressed for the Franklin Steel facility in the following chronological sequence; three sampling events in 1997; four sampling events in 1998; four sampling events in 1999; three sampling events (March, June and October) in 2000; two sampling events (April and October) in 2001; no sampling events in 2002; two sampling events (January and December) in 2003; one sampling event (December) in 2004; no sampling events in 2005; two sampling events (March and November) in 2006; and, one sampling event (October) in 2007.

Inorganics

The historical groundwater data presented in Table 4.5 shows concentrations of many unfiltered metals reported above their respective MCL, including concentrations in background well S107-MW02. The SAIC RFI groundwater sampling methodology utilized bailers to purge groundwater which greatly increased the turbidity of the groundwater samples. High turbidity water may cause artificially elevated concentrations of metals in groundwater samples (Gibbons and Sara, 1993) (Ohio EPA, 2006). Filtered groundwater samples for metals analysis have been collected and analyzed for all groundwater sampling events. Most of the unfiltered metals concentrations reported above their respective MCL were reported below the MCL for the

filtered metals sample. The difference in historical RFI metals concentrations between the unfiltered and filtered samples supports the presumption that unfiltered sample concentrations collected with bailers are most likely artificially elevated. According to Chapter 10 of the Ohio EPA Technical Guidance Manual for Hydrogeologic Investigations and Groundwater Monitoring (Ohio EPA 2006), filtered data may be used if there is an obvious discrepancy between filtered and unfiltered data or if secondary MCLs are exceeded (U.S. EPA, 1991).

Filtered metals concentrations reported above their respective MCL in background well S107-MW02 was reported during the March 1999 and March 2000 sampling events. During the March 1999 sampling event filtered concentrations of antimony in background well S100-MW01 were reported above the MCL of 0.006 mg/L at 0.028 B mg/L. During the March 2000 sampling event filtered concentrations of beryllium were reported above the MCL of 0.004 mg/L at 0.046 B mg/L and 0.087 B mg/L in background wells S107-MW02 and S100-MW01, respectively. A verification resample of background monitoring well S100-MW01 was collected on March 20, 2000 (10 days after the original March 2000 sampling date for S100-MW01) and reported a filtered beryllium concentration of 0.074 B mg/L and a filtered duplicate concentration of 0.088 B mg/L. The verification resample results confirmed the original result collected on March 10, 2000.

B&N and RMT collected groundwater samples during the last three semiannual monitoring events (March 2006, 2006, and October 2007). The wells were purged using low-flow purging techniques to minimize agitation of the water within the wells, resulting in less-turbid samples and lower unfiltered metal analytical results.

Laboratory results of the October 2007 sampling event indicated arsenic in monitoring wells S101-MW01R and S105-MW01 to be the only metals concentrations reported above their respective Primary MCL for unfiltered and filtered samples. Monitoring well S101-MW01R is located immediately north of the storm water drainage holding ponds in SWMU S101. Monitoring well S105-MW01 is located immediately east of the reconditioning plant near the former caustic rinse system and caustic sludge holding tank. Monitoring well S101-MW01R reported unfiltered and filtered arsenic concentrations of 0.0318 mg/L and 0.0254 mg/L, respectively. Monitoring well S105-MW01 reported unfiltered and filtered arsenic concentrations of 0.0127 mg/L and 0.0147 mg/L, respectively. The MCL for arsenic is 0.01 mg/L. As for further groundwater characterization, only those results from unfiltered samples (i.e., low-flow sampling techniques) will be used for to evaluate groundwater quality. Inorganic results are summarized below:

Aluminum has been detected above the Region 9 tap water exposure value of 0.20 mg/L during 6 sampling events since March 1998. Concentrations of aluminum peaked in S109-MW06 during the October 2000 sampling event at a concentration of 2.4 mg/L.

Arsenic has been detected above the Region 9 tap water exposure value of 0.010 mg/L during 8 sampling events since May 1997. Concentrations of arsenic peaked in S108-MW03 during the March 1999 sampling event at a concentration of 0.028 mg/L.

Beryllium has been detected above the Region 9 tap water exposure value of 0.0040 mg/L in various wells during sampling events since May 1997. Concentrations of beryllium peaked in S107-PZ01 during the June 2000 sampling event at a concentration of 0.78 mg/L.

Cobalt has been detected above the Region 9 tap water exposure value of 0.0073 mg/L during three sampling events. Concentrations of cobalt peaked in S108-PZ22 during the October 2000 sampling event at a concentration of 0.028 mg/L.

Iron has been detected above the Region 9 tap water exposure value of 0.30 mg/L in various wells during sampling events since May 1997. Concentrations of iron peaked in S109-MW06 during the December 2003 sampling event at a concentration of 12.6 mg/L.

Manganese has been detected above the Region 9 tap water exposure value of 0.050 mg/L in various wells during sampling events since May 1997. Concentrations of manganese peaked in S201-PZ01 during the March 1998 sampling event at a concentration of 3.9 mg/L.

Nickel has been detected above the Region 9 tap water exposure value of 0.0073 mg/L in various wells during sampling events since May 1997. Concentrations of nickel peaked in S109-MW05 during the June 2000 sampling event at a concentration of 0.25 mg/L.

SVOCs

Although only one SVOC (bis(2-ethylhexyl)phthalate) is denoted as above its respective MCL for the RFI monitoring wells, it shall be noted that historical (1997 -2003) laboratory data did not note "reportable detection limits" (RDLs). The 2004 laboratory RDL results indicated a RDL of 10 µg/l for bis(2-ethylhexyl) phthalate, which is above the MCL of 6 µg/l. Therefore, it is plausible various historical PAH results were above their respective drinking water MCLs.

Sporadic detections of bis(2-ethylhexyl)phthalate were observed in some of the RFI monitoring wells during the late 1990s, including in upgradient wells S100-MW01 and S107-MW02. Most of these detections were reported below the respective MCL of 6 µg/L for bis(2-ethylhexyl)phthalate. Prior to the November 2006 sampling event, bis(2-ethylhexyl)phthalate was not detected in any of the RFI monitoring wells since March 1999 when it was detected in the upgradient well S107-MW02 at 18.0 µg/L and the downgradient Jefferson Township monitoring well JTMW-1S at 10.00 µg/L. Bis(2-ethylhexyl)phthalate has been detected above the Region 9 tap water exposure value of 4.8 µg/L during 7 sampling events since October 2000.

During the November 2006 sampling event, the bis(2-ethylhexyl)phthalate concentration of 10.8 µg/l in monitoring well S105-MW01 was the only SVOC reported above its respective MCL. This is the first time concentrations of bis(2-ethylhexyl)phthalate have been detected in S105-MW01 which has been sampled 16 times since March 1998. No other concentrations of bis(2-ethylhexyl)phthalate were detected in any other well sampled during the November 2006 groundwater sampling event. The concentration of bis(2-ethylhexyl) phthalate was below the detection limit of 3.11 µg/l during the last sampling event in October 2007. Monitoring well S105-MW01 is located in the process area of Contiguous Area #1. Concentrations of bis(2-ethylhexyl)phthalate were detected in S108-PZ02 at a concentration of 4.0 µg/L during the June 1999 sampling event. There does not appear to be any sort of trend for concentrations of bis(2-ethylhexyl)phthalate in groundwater for any of the RFI monitoring wells.

VOCs

Laboratory results indicate VOCs reported above their respective MCL have been limited to three RFI groundwater monitoring locations located in Contiguous Area #1: S105-MW01, S109-MW06, and S101-MW01R. However, historical (1997 -2003) laboratory data did not list RDLs. Therefore, it is plausible various historical VOC results were above their respective drinking water MCLs. For example, the 2004 laboratory RDL results indicated a RDL of 6.7 µg/l for methylene chloride, which is above the MCL of 5 µg/l.

Chloroethane has been detected above the Region 9 tap water exposure value of 4.6 µg/L in well S109-MW06 for 18 consecutive sampling events since March 1998 including the November 2007 concentration of 100 µg/L. Concentrations of chloroethane peaked in S109-MW06 during the December 1999 sampling event at a concentration of 540 µg/L.

Methylene chloride has been detected above the Region 9 tap water exposure value of 4.3 µg/L during one sampling event (October 2000) in well S105-MW01 at a concentration of 6.7 µg/L. Methylene chloride was detected at a concentrations of 6.0 µg/L in monitoring well S105-MW-01 (July 1998, December 1998 and November 2004) at a concentration of 7.3 µg/L and 7.0 µg/L, respectively. However, methylene chloride in S105-MW01 has only been detected during one other sampling event (April 2001) at a concentration of 0.51 µg/L which is below the MCL. As stated earlier, monitoring well S105-MW01 is located immediately east of the reconditioning plant near the former caustic rinse system and caustic sludge holding tank.

Beginning in January 2003, concentrations of vinyl chloride in S109-MW06 have been reported above the MCL for six consecutive sampling events including the October 2007 concentration of 9.2 µg/L. Historically, concentrations of vinyl chloride in S109-MW06 peaked during the November 2004 sampling event at a concentration of 8.3 µg/L. The MCL for vinyl chloride is 2 µg/L. Prior to January 2003, vinyl chloride was not detected. Monitoring well S109-MW06 is located immediately east of the drainage ditch situated between SWMU 108 (Drum Storage Area #2) and SWMU 109 (Former Drum Storage Area #3). Well S109-MW06 is located within the drinking water source protection area (five-year time-of-travel zone) for the Jefferson Township Water & Sewer District public water system. A map depicting the drinking water source protection area is provided as Figure 4.0.

As stated earlier, monitoring well S101-MW01R is located immediately north of the storm water drainage holding ponds and was sampled for the first time during the November 2006 monitoring event. Analytical results reported one VOC (vinyl chloride at 2.06 µg/L) slightly above the MCL. During the latest sampling event, October 2007, the concentration of vinyl chloride was below the detection limit of 0.540 µg/L. Historical laboratory results for nearby abandoned monitoring well S101-MW01 never detected vinyl chloride and no other VOC constituents were reported above their respective MCL.

4.6.1 Discussion

Results of the last three semiannual monitoring events (May and November 2006, and October 2007) indicate groundwater results reported above their respective Primary MCL were limited to RFI monitoring wells S101-MW01R, S105-MW01, and S109-MW06 which are located in Contiguous Area #1. Therefore, impacted groundwater is confined to Contiguous Area #1 onsite. There were no results above the MCLs in hydraulically downgradient Contiguous Area #2 or Jefferson Township Well Field.

4.7 REFERENCES

- Burgess & Niple, Inc. 2007. *November 2006 Groundwater Sampling Results Report for the RCRA Facility Investigation at the Franklin Steel Company, Inc.* February 1, 2007.
- Columbus Steel Drum Company 1998. Correspondence from Columbus Steel Drum to Ohio EPA Pretreatment Coordinator, J. Kwolek. Unpublished. October 13, 1988.
- Columbus Steel Drum Company 1998. Letter from Columbus Steel Drum to Ohio EPA Pretreatment Coordinator, J. Kwolek. Unpublished. November 30, 1988.
- ERM-Midwest. 1993. *RCRA Facility Investigation Work Plan, Franklin Steel Company.* February 1993.
- Franklin Steel Company. 2001. Letter from Franklin Steel Company to Ohio EPA Project Coordinator, D. O'Toole, Jr. RE: Additional RFI/CMS Arsenic and SVOCs Sampling Results Report. Unpublished March 16, 2001.
- Ohio EPA. 1990. Letter from A. DeHavilland to Columbus Steel Drum RE: Solid Waste. Unpublished. 2pp. April 11, 1990.

- Ohio EPA. 1992. Administrative Order on Consent. Unpublished. June 23, 1992.
- Ohio EPA. 2001. Letter from D. O'Toole, Jr. to Franklin Steel Company RE: Additional Sampling. Unpublished. June 8, 2001.
- Ohio EPA. 2003. Letter from D. O'Toole, Jr. to Franklin Steel Company RE: Franklin Steel Company Franklin County Ohio I.D. No. 125-1368 RFI Revisions. Unpublished. April 28, 2003.
- Ohio EPA. 2003. Letter from D. O'Toole, Jr. to Franklin Steel Company RE: Franklin Steel Company Franklin County Ohio I.D. 125-1368 RFI Part 1 and Part 2. Unpublished. October 23, 2003.
- Ohio EPA. 2006. *Technical Guidance Manual for Hydrogeologic Investigations and Ground Water Monitoring*. February 2006. Revision 1 of Chapter 10.
- SAIC. 1995. *Revised Amended Scope of Work for the Franklin Steel Company, Inc. Phase II RCRA Facility Investigation*. November 30, 1995.
- SAIC. 1994. *Final Work Plan for the Franklin Steel Company, Inc. Phase II RCRA Facility Investigation*. October 3, 1994.
- TestAmerica. 2004. *TestAmerica Analytical Testing Corporation Quality Assurance / Quality Control Manual*. December 15, 2004.
- U.S. EPA. 1993. *Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses. Revised*. January 1993.
- U.S. EPA. 1991. *The National Functional Guidelines for Organic Data Review. Revised*. June 1991.

5.0 GROUNDWATER MODELING

Fate and transport modeling was completed for 20 organic compounds, listed on Table 5.1, present in soil at the Franklin Steel site. The COPCs represent those constituents that exceeded their respective Region 9 PRGs as determined from screening of the soils data in support of the human health risk assessment. The groundwater modeling was performed for Contiguous Area #1, known as Exposure Unit 1 (see Section 6 for more details). Modeling was performed to evaluate the leaching potential, as well as fate and transport of COPCs in soil to groundwater and the fate and transport of compounds present in groundwater.

Data from soil samples collected from September of 1993, through March 1998 were used in the development of the model. The modeling was completed in three steps. First, a three-dimensional (3-D) model of the soil contamination was developed using Earthvision™ software (produced by Dynamic Graphics, Inc.). The 3-D model of soil helped define the potential source areas within Exposure Unit 1. Second, the seasonal soil compartment model, or SESOIL (General Sciences Corporation, 1998), was used to help predict the amount of contaminant (if any) that may leach into the groundwater from these areas. Third, the groundwater transport model, Analytical Transient 1-, 2-, 3-Dimensional Model (AT123D) (General Sciences Corporation, 1998), was then used to predict how the leachate moved once they reach the groundwater.

5.1 SOIL CONTAMINANT MODELING

Prior to the evaluation of predicting the amount of compound that may potentially leach into the groundwater, the extent of soil impacts must be evaluated. A desktop study was performed to determine the aerial extent and depth of soil impacts present on site for 19 of the 20 COPCs. For a COPC in soil to leach to groundwater, it must exhibit physical properties to allow it to do so. Evaluating chemical mobility in soil involves reviewing the physical properties of the chemical to assess its potential for movement. The potential for a constituent to sorb to soil particles affects migration through soil and aquifer materials. When a constituent enters the soil environment, some of it binds with particles through the process of sorption and some dissolve in the water contained in the spaces between the soil particles (pore water). The term "sorption" includes adsorption (constituent bound to the outside of soil particles) and absorption (constituent distributed throughout the particle matrix). Sorption to soil reduces volatilization, leaching, and biodegradation. Conversely, a constituent that is adsorbed is released more easily and therefore may be mobile.

Adsorption potential typically is expressed in terms of a partition coefficient. The compounds organic carbon-water partitioning coefficient (K_{oc}) is the measure of its mobility. The soil organic carbon-water partitioning coefficient is the ratio mass for the chemical that is adsorbed in the soil per unit mass of organic carbon in the soil per the equilibrium chemical concentration in solution. In other words, it is the "distribution coefficient" (K_d) normalized to total organic carbon content. The organic carbon-water partitioning values are useful in predicting the mobility of organic soil contaminants; higher K_{oc} values correlate to less mobile organic chemicals while lower K_{oc} values correlate to more mobile organic chemicals. High values of K_{oc} (greater than 10,000) indicate a high potential for the constituent to adsorb to organic carbon in soil and aquifer materials; constituents with low K_{oc} values (less than 1,000) do not adsorb strongly (Ney 1990). This parameter is used to calculate a soil concentration that is protective of ground water using the 3-phase and 4-phase equilibrium partitioning models. Other chemical and physical properties include: decay rate, fraction of solids, fraction organic carbon, log octanol-water partition coefficient, log organic carbon partition coefficient, organic carbon partition coefficient, and soil-water partition coefficient. Chemical and physical parameters of the modeled compounds are presented on Table 5.1.

Figures 5.1 through 5.19 display the aerial extent of the evaluated COPCs. Based on the chemical and physical properties of dibenz(a,h)anthracene, it is not included within the desk top evaluation. The compound dibenz(a,h)anthracene is nearly immobile in soil with a K_{oc} value (see Table 5.1) of $5.7E+05$ ($\mu\text{g/g-oc}$)/($\mu\text{g/ml}$).

The depths and approximate areas listed in Table 5.2 correspond to an interpretation of representative site data, and are cumulative based on the depth of the impacted zones. For instance, the three impacted zones displayed in Figure 5.5 for Aroclor 1254 all extend to an approximate depth of 4 feet bgs. In order to simplify the modeling and also make the model slightly more conservative, these three areas were added together and modeled as one large impact zone, rather than three smaller, separate zones. For compounds that are found in both shallow and deep samples, such as acetone (shown in Figure 5.15), two separate simulations were run to account for transport of the chemical from the different depth intervals. Four compounds, 4-methyl-2-pentanone, chlorobenzene, tetrachloroethene, and 2-butanone, do not exceed EPA Region 9 PRGs. However, based on the relatively high concentrations at depths which put them close to the saturated zone warranted their inclusion in the modeling.

One notable feature in these soil impact images is the sediment samples collected near the east edge of the impact extent maps. These sediment samples are generating the large areas of impact shown in some of the figures, such as Figures 5.2, 5.9, 5.11, 5.12, 5.14, 5.16, and 5.18. Since there are few sampling points immediately to the east of the sediment samples, relatively high readings from these tend to create large areas of modeled impacts, although impacts in this area are known to be confined to the drainage separating Exposure Unit 1 and Exposure Unit 2. This encroachment of impacts from the drainage ditch sediments greatly increases the aerial extent beyond its representative limit. However, this builds in a conservative layer to the modeling effort.

5.2 VADOSE ZONE MODELING

SESOIL (Version 3.0) is a one-dimensional vertical transport model and helps predict contaminant transport in the unsaturated zone by using equations of mass balance and equilibrium partitioning of the chemical between four different phases (dissolved, sorbed, vapor, and pure). It is capable of accounting for volatilization of the contaminant to the atmosphere, biodegradation and hydrolysis, adsorption and cation exchange, and metal complexation.

Many parameters must be set including chemical properties of the soil, climatological data, and chemical properties of the modeled compound. Once the parameters are set, SESOIL predicts the time and leachate concentration for a contaminant moving through the soil column to groundwater. Assumptions used in the development of the model are presented in Table 5.1

5.2.1 Sesoil Assumptions/Limitations

Two main assumptions must be made to simplify the conceptual model of the site so it can be processed by SESOIL. First, SESOIL models impact transport in one dimension. This means horizontal movement of the contaminants cannot be modeled. Second, the soil is assumed to be homogeneous. All soil borings advanced in the active operations, indicate a less than 5% detection of fill like material (i.e., brick) within the total soil sample column. Although it has been reported the site has been filled, the extent is unknown and evidence indicates native material is dominate. The unsaturated zone in the active operations area is dominated by fat and lean clays. This characteristic is supported by the fact water primarily moves vertically through clay, and the thick upper clay provides a relatively homogeneous zone for the unsaturated zone of the modeled area. Transport simulations were performed for up to 100 years to permit sufficient time for mobile constituents to reach the groundwater. Constituents that did not reach the groundwater within 100 years were not further evaluated.

5.3 SATURATED ZONE MODELING

The AT123D Model (Version 3.0) was used to model the potential transport of impacts to the groundwater surface as predicted by the SESOIL simulations. AT123D is an analytical code that helps predict the distribution of impacts in an aquifer using advection of the chemical, dispersion of the chemical (including hydrodynamic dispersion and molecular diffusion), adsorption of the chemical, and decay of the chemical.

AT123D can model compounds that are either applied to the aquifer instantaneously (e.g., spill) or continuously (e.g., point source). It can simulate the transport of radioactive substances, chemicals, or heat. Impact sources can be a line source, a point source, an area source, or a volume source. The aquifer dimensions can be infinite in width and depth, finite in both width and depth, or finite in one and infinite in the other.

Output from SESOIL simulations can be imported directly into AT123D, or the aquifer parameters can be input by the user independently of any other programs. For the simulations presented here, output from SESOIL was imported directly into AT123D.

5.3.1 AT123D Assumptions/Limitations

AT123D assumes the aquifer is homogeneous and isotropic. Groundwater flow is assumed to be virtually horizontal. Water can only flow in one direction through the aquifer, and it must have a constant velocity.

Unlike the unsaturated zone for the SESOIL model, the saturated zone in the active operations area has a great deal of heterogeneity based upon cross sections and boring logs generated from the site. Dispersivity values were used to help account for some of the heterogeneity in the aquifer. On average, the potentiometric surface indicates an easterly gradient drop ranging from 6 feet to 9 feet over a distance of 2,070 (2.8×10^{-3} ft/ft to 4.3×10^{-3} ft/ft). Immediately to the east of the SWMU S201 the gradient becomes much flatter, 5×10^{-4} ft/ft, closer to the central portion of the buried valley. Flow east of SWMU S201 is a more south-southeasterly. Based on all data collected, groundwater contours for the site indicate flow to be fairly uniform, almost due east with only slight perturbations in the flow direction and velocity.

5.4 MODEL APPLICATIONS AT FRANKLIN STEEL

Tables 5.1 presents the data, both chemical and physical, used as inputs to the SESOIL model for each compound. SESOIL's climate database was used to provide 10 years of climate data for the simulations. The "Fredericktown 4 S" location was used to provide a representative data set for Franklin Steel's climate. The Bennington Unit, in SESOIL's soil database, was selected for all three soil layers to represent the unconsolidated material located within the active operations area of the site. The upper layer was set to 3 feet thick, the second layer was 5 feet thick, and the third layer was 7 feet thick, for a total of 15 feet of unsaturated thickness through the model. These depths were depicted based on an evaluation of average deposition zones noted within representative boring logs.

Initial concentrations were set for the layers in the model, and no additional impact loading was applied. Table 5.3 shows the concentrations used and the layers in which the impacts were set. Compounds indicating a N/A in the layer and concentration columns were not modeled due to their chemical specific K_{oc} values are high. High K_{oc} values associate to less mobility. This assumption is based on the simulation of 2-methylnaphthalene which has a K_{oc} of 8,500 ($\mu\text{g/g-oc}$)/($\mu\text{g/ml}$). This is relatively low compared to a K_{oc} of 96,000 ($\mu\text{g/g-oc}$)/($\mu\text{g/ml}$) for benzo(ghi)perylene, additionally 2-methylnaphthalene was strongly adsorbed and showed very little movement in the soil for the entire 100-year simulation. Compounds with higher K_{oc} values are expected to be more readily adsorbed to the soil and therefore migrate even more slowly to groundwater.

Outputs for each compound modeled with SESOIL are presented on Figures 5.20 through 5.37. These figures show the concentration of COPCs near the groundwater surface in the SESOIL model. The figures display the concentrations of each contaminant in three different phases including dissolved, adsorbed, and soil gas within the soil voids. Aroclor 1254 (Figure 5.24), bis(2-ethylhexyl)phthalate (Figure 5.25), benzo(g,h,i) perylene (Figure 5.29), and 2-methylnaphthalene (Figure 5.37) are strongly adsorbed to soil and have very low concentrations in the dissolved and gaseous phases. As a result, their migration is slow through the soil. As the figures indicate, after 100 years of movement these three compounds have not migrated down to layer 3. Compound 2-methylnaphthalene originated in layers 2 and 3 of the model, which has resulted in the high concentration of the adsorbed phase seen in Figure 5.37. Since so little 2-methylnaphthalene is in a mobile phase, it is not expected to pose a threat to the groundwater.

The output files from SESOIL for those constituents predicted to migrate to and interface with groundwater were imported into AT123D to utilize calculated constituent loading rates. Aquifer parameters were set in AT123D and included the following: the hydraulic gradient (0.004 m/m), hydraulic conductivity (0.134 cm/sec) (Eagon & Associates, 1977), longitudinal, transverse, and vertical dispersivities 21m (70 feet), 4 m (14 feet) and 1m (3 feet), respectively (Anderson, 1979), bulk density (1,560 kg/m³), and effective porosity (0.3).

Each of the AT123D models developed for the active operations area was centered on the impacted modeled soil. Five observation points were set relative to this central location (the origin) to observe the movement of the compounds through the groundwater. The origin itself makes up the first observation point. The second observation point was set 480 feet due east from the center of the soil impacts. This distance was chosen as a marker based on the travel needed to reach the eastern boundary of SWMU S108. Compounds shown in Figures 5.1 through 5.19 exhibit high K_{oc} values and have been predicted by SESOIL not to have the ability to migrate into the groundwater at concentrations greater than Region 9 PRGs. The third observation point was set 1,000 feet east and 240 feet north of the origin at the intersection of the new drum driveway and Blatt Boulevard. The fourth observation point was set at 1,500 feet east and 1,350 feet north of the origin at the northeast corner of SWMU S201. The fifth observation point was set at 2,350 feet east and 1,950 feet north of the origin. This is the approximate location of the Blacklick Well Field.

For each COPC modeled, the maximum predicted concentration in groundwater directly beneath the soil was compared to the respective Region 9 PRGs. Each constituent, with the exception of benzo(a)pyrene, was well below their respective groundwater Region 9 PRGs while considering only dispersion and retardation of the COPCs. Benzo(a)pyrene occurred above its groundwater Region 9 PRG (9.2×10^{-3} µg/L) directly beneath the impacted soil using a conservative K_{oc} and no degradation. A decay constant of 0.0022 per day was developed based upon a half-life of 309 days for benzo(a)pyrene in a dissolved phase in sandy loam soils (Specialized Information Services, 2000). Modeling results utilizing the conservative K_{oc} and decay rate indicate concentrations less than the Region 9 PRG directly beneath the source zone. Concentrations in the groundwater decrease downgradient from the source zone as a result of dispersion. Table 5.5 lists the maximum concentration predicted to occur in groundwater at the source zone and at a distance of 480 feet downgradient of the source zone.

Figures 5.38 through 5.64 display graphs of the AT123D output for each compound simulated within the model. Each compound is shown within its source zone (at the origin) and within the second observation point 480 feet downgradient. Chlorobenzene and acetone are shown at additional distances downgradient due to their low K_{oc} (highly mobile in groundwater). It is apparent from the modeled graphs, that even very mobile compounds are below their respective Region 9 PRG.

An additional set of AT123D simulations were performed to evaluate the potential impacts to the Blacklick well field in the event the well field is operating at full capacity. The transport of four constituents (acetone, chlorobenzene, 1,2-dichloroethylene, and xylenes) was completed for this evaluation. Acetone and chlorobenzene were selected due to their high mobility (low K_{oc} values), very soluble, and have the ability to

move quickly through the groundwater system. Both 1,2-dichloroethylene and xylenes were selected because they reached the groundwater directly beneath their source zones at the highest concentrations.

Two parameters within the AT123D model were modified. First, the hydraulic gradient was doubled to account for the increased pumping at the well field. And, secondly the well field was simulated as being directly down gradient from the origin or source zones for the constituents entering the groundwater system (assumes the well field lies directly in the flow path and will intercept the highest concentrations occurring at that location over time). This is highly conservative, current potentiometric surface maps show a distinct flow pattern change east of the SWMU S201. Groundwater has a natural trend to flow in a south-southeasterly direction. The observation point selected to represent the well field was located 3,050 feet from the origin or source zone in each of the model simulations. All other observation points remained unchanged. No other parameters were changed within the AT123D model.

The results of these model simulations indicate that both the mobile constituents and those leaching to the groundwater at the highest concentrations are below their respective Region 9 PRGs while migrating through the aquifer. Maximum modeled concentrations at the observation point for the well field are well below their respective Region 9 PRGs or MCLs. The maximum concentration for both acetone ($<0.01 \mu\text{g/L}$) and chlorobenzene ($<0.0015 \mu\text{g/L}$) reach the observation point in approximately 2 years. The maximum concentration for 1,2-dichloroethylene ($<0.25 \mu\text{g/L}$) reaches the observation point in approximately 8 years. The maximum concentration for xylenes ($<7.0 \times 10^{-5} \mu\text{g/L}$) reaches the observation point in approximately 40 years.

5.5 TAYLOR ROAD WELL FIELD

A “*Delineation of the Wellhead Protection Area Taylor Road Well Field*” (Eagon & Assoc., Inc. 1997) was prepared for the Jefferson Water and Sewer District. This document describes the surface topography and drainage, subsurface conditions, aquifer hydraulic properties, and the wellhead protection area for the wellfield. All information contained within this document appears consistent with the findings of this modeled exercise and the finding within this RFI report..

5.6 ADDITIONAL MODELING

The SESOIL/AT123D model was developed for those COPCs that exceeded their respective Region 9 PRGs in soil as determined from data included in the human health risk assessment. The modeling was performed for soils in the area of Exposure Unit 1 (active operations area). Historical and recent sampling activities (i.e., January 2003 – October 2007, vinyl chloride has shown an increase in concentration from $3.0 \mu\text{g/L}$ to $9.3 \mu\text{g/L}$ in monitoring well S109-MW06. This recent detection suggest two things; 1. residual parent products in soil (i.e., tetrachloroethene, trichloroethene and cis-1,2-dichloroethylene) from the active operations area have begun their degradation/attenuation processes, and/or; 2. there is an additional source zone lending to the detection of vinyl chloride. The latter shows a greater possibility, as parent compounds to vinyl chloride have not been detected in excess concentrations within soils (or groundwater) beneath the active operations area.

Based on the increasing trend, and in addition to the above modeling activities, a BIOCHLOR (U.S. EPA 2000) model was utilized to evaluate (screen) historic and recent detected vinyl chloride concentrations. It was also used to evaluate if vinyl chloride is attenuating at sufficient rates prior to off-site migration. The BIOCHLOR model is a screening model that simulates remediation by natural attenuation (RNA) of dissolved chlorinated solvents. The model is developed using a spreadsheet environment based on the Domenico analytical solute transport model with the ability to simulate 1-dimensional advection, 3-dimensional dispersion, linear adsorption, and biotransformation via reductive dechlorination (the dominant biotransformation process at most chlorinated solvent sites). Reductive dechlorination is assumed to occur under anaerobic conditions and dissolved solvent degradation is assumed to follow a sequential first-order

decay process. Under the BIOCHLOR model, three different model types can be used; 1. solute transport without decay, 2. solute transport with biotransformation modeled as a sequential first-order decay process, and, 3. solute transport with biotransformation modeled as a sequential first-order decay process with two different reaction zones (i.e., each zone has a different set of rate coefficient values). Parameters used for the development of the BIOCHLOR model are presented in Table 5.2.

General set-up for the BIOCHLOR model consist of determining hydrogeologic data (groundwater and soil characteristics), dispersivity, absorption, potential biotransformation, your source zone, representative field source data points, estimated plume characteristics (width, length, depth), and various site characteristics. These parameters are the same as those used in the SESOIL/AT123D model. Model parameters, including chemical and physical characteristics of vinyl chloride are presented in Table 5.1.

Monitoring S105-MW01 was defined as a historic source area, with monitoring wells S108-MW03, S108-MW04 and S109-MW06 defined as downgradient catch wells in a flow line consistant with current groundwater flow (i.e., east-southeasterly). Monitoring wells S108-MW05, S109-MW05D and S109-PZ02 were defined as the perimeter catch wells, exhibiting the extent of vinyl chloride detections. The Blacklick Well Field was defined as the modeled end point.

The upgradient source (S105-MW01) shows a gentle progression as you would expect from a chlorinated impact with a defined source area. Field data points verify this trend with a progression from 7.1 µg/L to <0.25 µg/L (S108-MW05) along the southeasterly flow. At this rate, concentrations within S105-MW01 will not migrate off-site above the MCL (2.0 µg/L). At S109-MW06, groundwater data show an increasing trend in vinyl chloride concentrations. Data indicate impact in the localized area of S109-MW06, currently at a concentration of 9.2 µg/L. Data also indicate an abrupt decrease in the vinyl chloride concentrations outside the influence of S109-MW06 (all concentrations recorded in downgradient wells are below the laboratory detection limit). This is confirmed by monitoring well S109-PZ02 and S109-PZ04 located downgradient of S109-MW06 exhibiting no detections for vinyl chloride, and perimeter cross gradient wells S108-MW06 and S108-MW05. Thus, vinyl chloride is currently a localized impact within the confines of S109-MW06. Results of these model evaluations are presented on Figures 5.65 and 5.66.

5.7 FINDINGS AND CONCLUSIONS

Several assumptions were made that result in conservative results for the soil migration model. First, adsorption, dispersion, and volatilization were the only mechanisms modeled that could reduce the concentrations of the COPCs. Decay (such as biodegradation) was not used in either the SESOIL or the AT123D models with the exception of benzo(a)pyrene. Second, for compounds which had a range of K_{oc} values listed in literature, the lowest value found was used, therefore increasing the potential for the compound to travel in soil. Third, modeled impacts were grouped together as one source verses several smaller areas of impact. In addition, all impacts (for those boring indicating detections in the 1 to 2 foot interval) were set to occupy the entire thickness of the layer they were placed. For example, constituents placed in layer 3, which is 7 feet thick, would occupy the entire 7-foot thickness.

To date, chloroethane, bis(2-ethylhexyl)phthalate and vinyl chloride are the only COCs that have appeared in monitoring wells on site in excess of Region 9 PRGs. The results of the current SESOIL and AT123D models suggest that other compounds may occur in the groundwater but at levels well below their respective Region 9 PRGs. The model predicts these compounds entering the groundwater at the site would attenuate in concentrations below their respective Region 9 PRGs directly beneath and/or within a small radius of the source zone and before migrating off-site. The exception being, vinyl chloride, which exhibits a range of 3.0 µg/L to 9.3 µg/L during the last six sampling events, which is above the MCL of 2 µg/L.

The BIOCHLOR modeling indicates vinyl chloride concentrations within S105-MW01 following the natural groundwater flow would attenuate in concentrations below the MCL before migrating off-site. Data indicates that vinyl chloride detections in S109-MW06 are localized based on no detectable concentrations of vinyl chloride in the downgradient monitorings wells.

The soil model presented has been modified from its original development by RMT. RMT recognizes the limitations (e.g., one-dimensional flow) of the original model developed by SAIC, however, the model does define the extent and concentration of soil impacts and how those impacts affect groundwater. The model indicates that none of the 20 compounds will migrate off-site at concentrations greater than Region 9 PRGs.

5.8 REFERENCES

- Anderson, May P. (1979). *Using Models to Simulate the Movement of Contaminants Through Groundwater Flow Systems, Critical Reviews in Environmental Controls* 9, No. 2; pg. 97-156.
- Eagon and Associates (October 1997). *Delineation of the Wellhead Protection Area Taylor Road Well Field* (prepared for Jefferson Water and Sewer District).
- General Sciences Corporation. (1998, May). SESOL Reference Guide and User's Guide. Beltsville, MD. Unpublished manual.
- General sciences corporation. (1998, May). AT123D Reference Guide and User's Guide. Beltsville, md. Unpublished manual.
- Specialized Information Services. (2000). Toxnet Hazardous Substances Data Bank. [on-line]. Available: <http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?hsdb>.
- Syracuse Research Corporation. (2000). SRC Physical Properties Database. [on-line]. Available: <http://esc.syrres.com/interkow/physdemo.htm>
- US EPA. (January 2000). BIOCHLOR. Natural Attenuation Decision Support System. Office of Research and Development, Washington, DC. EPA/600/R-00/008

6.0 BASELINE HUMAN HEALTH RISK ASSESSMENT

The objective of the human health risk assessment (HHRA) for the Franklin Steel SWMUs and AOCs was to determine if the units present an unacceptable risk to human health and to provide additional information to determine the need for remedial action at these units. The risk assessment examines the presence of chemical contaminants from the source areas under investigation, the observed levels of the substances in the environment, the potential routes of exposure to human receptors, and the likelihood of adverse effects following contact with the contaminants. The methods used to characterize risk at the Franklin Steel SWMUs and AOCs were consistent with all Ohio Environmental Protection Agency (Ohio EPA) and U.S. Environmental Protection Agency (EPA) guidance.

6.1 DATA COMPILATION AND EVALUATION

Environmental data used in this risk assessment are from samples collected at the site from 1993 through 2006 under the Phase I and Phase II Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI). Although, as further discussed in following sections, only filtered groundwater data prior to 2006 and unfiltered (low-flow) data after 2006 was used for evaluation purposes. All data used in the risk assessment have undergone quality assurance/quality control (QA/QC) evaluation as specified in the February 1993, Task III - RFI Work Plan (ERM 1993) and October, 1994 Final Work Plan for the Franklin Steel Company, Inc. Phase II RCRA Facility Investigation (SAIC 1994). All available data for soils, groundwater, surface water, and sediment were evaluated in the risk assessment.

6.1.1 Background Data Set

Media-specific background data were used in the RFI to evaluate the nature and extent of contamination and in the risk assessments to select human health chemicals of potential concern (COPCs) and ecological COPCs. Background data were collected in the vicinity of the Franklin Steel site in areas that were either upgradient from source areas within the sites or locations that were not believed to be impacted by any release from the facility. Background data were collected for soils, groundwater, surface water and sediment. Background data for soils included seven samples analyzed for target analyte list/target compound list (TAL/TCL) compounds and 16 samples analyzed for RCRA metals. The background soil locations and data were approved for use in the RFI by Ohio EPA in both December 1994 (Ohio EPA 1994) and via the Risk Assessment Assumptions Document communications (May 2008). Consistent with this approval, one elevated detection of selenium (870 mg/kg) was not included in the background data set for soil. Background data for groundwater were generated from samples collected under the quarterly monitoring of upgradient monitoring well S100-MW01 (limited data based on well de-construction), S107-MW02 and two Jefferson Township wells. Background groundwater samples were analyzed for TAL/TCL compounds. Background data for surface water and sediment were generated from samples collected at upstream locations. These samples were analyzed for TAL compounds.

Background criteria for all affected media were calculated as the 95% upper tolerance limit (UTL) (EPA, 1989a) or the maximum detected concentration depending on the number of results above the detection limit and the shape of the distribution. The Shapiro-Wilk statistic was used to determine whether the distribution of concentrations was most like a normal or lognormal distribution.

This method is recommended in *Statistical Analysis of Ground-water Monitoring Data at RCRA Facilities* (EPA 1989d) and in other EPA guidance (EPA 1989a and EPA 1992a). A UTL is the value that the specified portion (i.e., 95%) of the data population will fall below, with a specified level of confidence. The background concentration was calculated as the upper 95% tolerance limit, with 95% coverage.

The 95% UTL is determined by first selecting all appropriate samples from the database (i.e. samples that are not duplicates). Next the sample results are reviewed to ensure that blank results and “R” qualified (rejected) data are removed. Non-detects are identified and result values are appropriately modified (1/2 the detection limit is used for non-detects). For inorganic constituents with no detections in background, the background value is set to the minimum detection limit.

An outlier test is performed using a multiplier of 3 times the inter-quartile range. Results exceeding this data boundary are designated and not included in the background calculations.

The Shapiro-Wilk test for normality is performed on the data for both un-transformed and log transformed data. Analytes are assigned an appropriate designator. Those analytes which are neither normal nor log normal or have greater than 50% non-detects are designated for non-parametric estimators.

The normal UTL95 is calculated with the following equation:

$$UTL95 = \text{Mean} + K * S$$

Where K is a value from a table equivalent to Table A-3 of Gilbert (1987) and S is the standard deviation of the data. For lognormal data the same equation is used on the log transformed data and then the result is back transformed into a normal value.

$$UTL95 = e^{(\text{mean} + K * S)}$$

Data which is neither normal nor lognormal by the Shapiro-Wilk test or which has more than 50% non-detects uses a non-parametric UTL. This value is based on order statistics and is the value of the observations representing the 95% for those distributions having 50% or more detects and the 99% for those having less than 50% detects. If there are no detects the UTL is selected as the minimum detection limit. All background concentrations (all media) were calculated in accordance with Ohio EPA DERR TDC Methodology for Evaluating Site-specific Background Concentrations of Chemicals (March 2004).

6.1.2 Identification of Chemicals of Potential Concern (COPCs)

All chemicals detected in environmental media of interest are considered to be COPCs unless there is a specific, justifiable rationale for their exclusion. For each medium of interest, surface soil (0 – 2 bgs), subsurface soil (2 feet bgs to 10 feet bgs), sediment, surface water and groundwater data were compiled in standard Risk Assessment Guidance for Superfund (RAGS) Part D format. This format provides information on the number of samples, the frequency of detection, and the minimum and maximum values. Chemicals that meet one or more of the following criteria are excluded from the list of COPCs and will not be further evaluated in the HHRA:

- Chemicals detected are excluded from the list of COPCs if the maximum concentration is below toxicity-based thresholds associated with 100 percent (%) of the United States (US) EPA Region 9 Preliminary Remediation Goals (PRGs) residential exposures for carcinogens and 10% of the U.S. EPA Region 9 PRGs for non-carcinogens, as recommended by the Ohio EPA Division of Emergency and Remedial Response. (DERR) (Ohio EPA 2004). Although the Franklin Steel study area is not within a residential land use, residential screening values are used to ensure the conservatism of the assessment. Region 9 PRG toxicity-based screening values are generally viewed as the most complete with respect to exposure pathways, toxicity criteria and chemicals considered.
- Inorganic chemicals are excluded from the list of COPCs if the maximum measured concentration is below local background concentrations and there is no evidence that its presence is related to Franklin Steel activities.

- Chemicals are excluded from the list of COPCs if they are essential nutrients (e.g., calcium).
- Chemicals are excluded from the list of COPCs if they are detected in less than 5% of samples analyzed for a given environmental medium.

Even if chemicals are present at a low frequency of detection within a given medium, they are retained as COPCs if: a) there is reasonable evidence that they are associated with facility operation activities; b) they are present at concentrations greater than the toxicity-based screening concentrations; c) they are degradation products of other COPCs; or d) they are persistent, bioaccumulative and toxic compounds (PBTs).

Selection of COPCs also takes into account the interconnectedness of environmental media and the potential for migration between media. If a chemical is identified as a COPC, it is also selected as a COPC in those connected media in which it was also detected. For example, chemicals identified as COPCs in sediment are also identified as COPCs in surface water, if they are detected in surface water.

Screening values for trivalent chromium rather than hexavalent chromium are used in the COPC selection process. Chromium is found in nature as the trivalent form (Barnhart 1997). The hexavalent state is the second most stable state, but rarely occurs in nature (NPS 1997). Hexavalent chromium is manufactured by reacting chromium-containing ore with a caustic material such as sodium hydroxide at temperatures above 1000°C in an excess of oxygen. These energy intensive reaction conditions are necessary due to the inert nature of trivalent chromium and the extraordinary slow oxidation kinetics associated with the conversion of trivalent chromium to hexavalent chromium. The Franklin Steel facility did not manufacture hexavalent chromium nor has there been evidence to the use of hexavalent chromium at the facility.

However, the valance of chromium in soil could have been affected by the “ash” produced from reconditioning the used drums by burning the barrels’ residues in a thermal oxidizer. Since the respirable inhaled chromium is recognized as a pulmonary and sinonasal carcinogen, the U.S. EPA Region 9 provided “carcinogenic” PRG values for “Total Chromium” in soil under the assumption of 6 to 1 ratio of hexavalent chromium to trivalent chromium [U.S. EPA Region 9 (2004) User’s Guide]. Therefore, the screening toxicity value selected for total chromium in soil was Region 9 PRG’s residential value of 210 milligrams per kilogram (mg/kg).

Based on the prescreening evaluation, all data retained from the frequency of detection review were then compared to background concentrations (all media), U.S. EPA Region 9 (U.S. EPA 2000) PRGs (residential soil and tap water), and U.S. EPA Drinking Water Standards Maximum Contaminant Levels (MCLs). The background concentration was either the 95% upper confidence level (UCL), or the maximum detected concentration in background if this value was lower than the 95% UCL. The screening value for each constituent would be the 100% of the residential value listed on the PRG table for carcinogenic compounds and 10% the listed PRG value for non-carcinogenic compounds. Region 9 PRGs for residential soil were used for both soil and sediment comparisons, as were tap water PRGs used for comparison of surface water. This screening comparison is in accordance with the Ohio EPA Technical Decision Compendium (TDC) (April 2004), which states the use of Region 9 PRGs residential soil and tap water values for the purpose of screening sediment, soil and surface water in the HHRA. For groundwater, in cases where an MCL was available, the lesser of the MCL, 100% of the Region 9 PRG tap water exposure values for carcinogens and 10% of the listed tap water value for non-carcinogens, were used for the comparison.

For all media, the maximum detected value in site media was used as the comparison value. For inorganics, this value was first compared to the background value, then the PRG or MCL. For organics, the maximum detected value was compared only to the PRG or MCL (i.e., organic background was not used to screen data).

Using this methodology, it was determined whether a particular constituent met the criteria as a COPC.

Constituents that are essential human nutrients were further evaluated for exclusion as COPCs. Calcium, iron, magnesium, potassium, and sodium were detected in environmental samples collected from the Franklin Steel SWMUs and AOCs. These chemicals are essential components of the human diet and were not detected at concentrations that are considered hazardous to humans. Therefore, these compounds were eliminated from further evaluation in the HHRA. However, in the case the compound (e.g., iron) was detected at very high levels, the compound was further evaluated.

Note that retaining constituents as a result of one or several detections greater than the background criteria or for the toxicity-based reasons described above can result in COPCs with exposure concentrations less than the background criteria. For example, when less than 20 samples are available, any constituent detected above the background criteria one or more times will be retained in the risk assessment. However, in many cases, the exposure concentration (e.g., 95% UCL) for that constituent will be less than the background criteria because most of the detections were below background. The list of COPCs used in the development of the HHRA, are included in Tables 6 - 1 through 6 - 9.

Physical data collected for the Franklin Steel facility indicates the presence of a glacial deposit layer at a 5-10 foot depth. This defined geological layer is persistent for naturally occurring elevated concentrations of arsenic (SAIC 2003). Thus, arsenic has been detected at elevated concentrations both within the area of the Franklin Steel facility and surrounding.

Furthermore, it is well documented that arsenic is a commonly detected background constituent in soils, particularly within glacial deposits. Elevated concentrations of arsenic, as high as 73 milligrams per kilogram (mg/kg), have been found to naturally occur in soils throughout the eastern U.S. (Shacklette, Boemgen 1984). In Ohio, arsenic has been found to occur in background soil as high as 56 mg/kg (Cox, Colvin 1996). These concentrations are well above the arsenic concentrations found within the Franklin Steel study area and that of the documented background concentration of 28.5 mg/kg. However, even though arsenic has a relatively high background concentration in the area of the Franklin Steel facility, arsenic will be evaluated through the HHRA exposure evaluation.

6.1.3 "Hot Spot" Evaluation

During the RFI and risk assessment evaluation, it became apparent that various localized areas (hot spots) of the Franklin Steel facility exhibited elevated values of target SVOCs and VOCs. These hot spots and the compounds identified are as follows:

Active Operation Area – Surface Soil (0 to 2 feet bgs)

- Sample location H-GP-20 exhibited elevated concentrations of dibenzo(a,h)anthracene (190 µg/kg), N-nitrosodipethylamine (354 µg/kg), 2,4-dinitrophenol (2,480 µg/kg), and 4-Nitrophenol (2,290 µg/kg).
- Sample location F-HA-2 exhibited an elevated concentration of N-nitrosodipethylamine (370 µg/kg).
- Sample location F-GP-18 exhibited elevated concentrations of dibenzo(a,h)anthracene (960 µg/kg), N-nitrosodipethylamine (1,835 µg/kg), and 2,4-dinitrophenol (12,850 µg/kg).
- Sample location G-Comp exhibited elevated concentrations of dibenzo(a,h)anthracene (186 µg/kg), N-nitrosodipethylamine (352 µg/kg), 2,4-dinitrophenol (2,535 µg/kg), and 4-Nitrophenol (2,290 µg/kg).
- Sample location S106-SB06 exhibited an elevated concentration of naphthalene (4,400 µg/kg).
- Sample location S107-SB12 exhibited elevated concentrations of bis(2-ethylhexyl)phthalate

(110,000 µg/kg), naphthalene (4400 µg/kg), ethylbenzene (210,000 µg/kg), toluene (310,000 µg/kg), and total xylenes (720,000 µg/kg).

- Sample location S107-SB11 exhibited an elevated concentration of bis(2-ethylhexyl)phthalate (130,000 µg/kg).
- Sample location S107-SS05 exhibited an elevated concentration of bis(2-ethylhexyl)phthalate (100,000 µg/kg).
- Sample location S107-SB07 exhibited elevated concentrations of bis(2-ethylhexyl)phthalate (230,000 µg/kg), ethylbenzene (210,000 µg/kg), toluene (7,400 µg/kg), and trichloroethene (690 µg/kg)

Active Operations Area – Subsurface Soil (2 feet bgs to 10 feet bgs)

- Sample location S108-SB21 exhibited an elevated concentration of copper (8,210 mg/kg).
- Sample location OX-SS01 exhibited an elevated concentration of mercury (41.4 mg/kg).
- Sample location S108-SB13 exhibited elevated concentrations of benzo(a)anthracene (6,200 µg/kg), benzo(a)pyrene (5,100 µg/kg), and benzo(b)fluorathene (5,900 µg/kg)
- Sample location S105-SB01 exhibited elevated concentrations of ethylbenzene (40,000 µg/kg), and total xylenes (140,000 µg/kg).
- Sample location S105-SB02 exhibited elevated concentrations of ethylbenzene (22,000 µg/kg), and total xylenes (93,000 µg/kg).
- Sample location S108-SB23 exhibited an elevated concentration of total xylenes (320,000 µg/kg)
- Sample location S108-SS03 exhibited an elevated concentration of total xylenes (12,000 µg/kg).

Unzinger's Ditch - Sediment

- Sample location S101-SD17 exhibited an elevated concentration of bis(2-ethylhexyl)phthalate (620,000 µg/kg).
- Sample location S101-SD18 exhibited an elevated concentration of bis(2-ethylhexyl)phthalate (400,000 µg/kg).
- Sample location S101-SD07 exhibited an elevated concentration of bis(2-ethylhexyl)phthalate (100,000 µg/kg).

These hot spots were excluded from the holistic risk assessment evaluation as these concentrations interfered with the population distribution. Therefore, these values were removed from the population to balance the statistical ratio between min, max, mean and the 95% UCL. Doing this, these impacts, or waste samples, were removed from the native soil samples allowing for proper evaluation. It is obvious these areas of concern exceed both human health and ecological risk standards and will need to be address during the Corrective Measure Study.

6.2 EXPOSURE SETTING

This section presents exposure pathways for each media, identification of potentially exposed human populations, and calculations of intakes for both hypothetical current and future exposures. Future land use of the Property is assumed to be that or the same as the current operations, i.e., industrial. To further this claim, information has come available that the facility has been sold and will continue to operate as a drum reconditioning facility.

As described above, the Franklin Steel facility is a large industrial facility surrounded by commercial/industrial land use. The property has long been used for industrial purposes and is located within

a portion of Blacklick, Ohio that is zoned for industrial use. The Franklin Steel facility is an active industrial facility and, as such, the company has control over any activities that occur within the facility's boundaries. Current employee manuals (Columbus Steel Drum, 2006) require workers to wear personal protective equipment (e.g., steel toe boots, long pants, and safety glasses) while on-site.

Unzinger's Ditch is a shallow drainage conveyance flowing from north to south with depths generally ranging from one to two feet. Although Unzinger's Ditch is not a desirable water body for human activity, a desk-top hypothetical preliminary human use of Unzinger's Ditch was conducted. That is, based on the setting of the drainage conveyance, surrounding development, potential future land use, and intermittent capacity and flow, Unzinger's Ditch is considered an unlikely area for trespasser activities, however, a trespasser evaluation has been completed.

Furthermore, the demographics of the area surrounding Franklin Steel are expected to influence the overall exposure setting and likelihood of various exposure scenarios. Commercial and industrial areas are located on both Research Road and Blatt Blvd, and additionally along upstream portions of Unzinger's Ditch. Commercial areas flank the downstream portion of Unzinger's Ditch. The 2000 Census data for Blacklick, Ohio, indicates a total residential population of approximately 9,500. Approximately 2,800 of these residents are under the age of 18. Census data suggest a limited portion "trespasser potential" population is accessible to the Franklin Steel facility and surrounding areas.

6.3 EXPOSURE ASSESSMENT

Exposure assessment is the process of measuring or estimating the intensity, frequency and duration of human exposure to substances present in the environment. Exposure assessment includes the identification of potentially exposed populations, analysis of exposure pathways, definition of exposure units, estimation of exposure point concentrations (EPCs), and characterization of exposure scenarios. This information is used to estimate potential doses under current and reasonably foreseeable conditions. For purposes of visual interpretation, a Conceptual Site Model (CSM) has been developed for the Franklin Steel facility. The CSM is illustrated on Figure 6-1.

Consistent with U.S. EPA (1992c) guidance, exposure assessment evaluates both central tendency exposure (CTE) and high end exposure (HEE) scenarios. High end scenarios describe individuals at the upper end of the population distribution (i.e., greater than the 90th percentile, but not above the distribution), while the central tendency scenarios characterize individuals in the middle of the population distribution (approximately the 50th percentile). The HEE scenario is analogous to the reasonable maximum exposure (RME) scenario described in earlier U.S. EPA guidance.

Consistent with U.S. EPA (1989a) guidance, the exposure assessment begins with the characterization of the physical setting and the human populations that may be exposed to COPCs. The characterization of potentially exposed populations includes the identification of both current and foreseeable exposures, as well as the identification of any subpopulations of concern.

6.3.1 Identification of Potentially Exposed Populations

Based on the site setting, three general exposure scenarios are plausible: Franklin Steel site workers (adults); construction/utility workers (adults), and hypothetical trespassers (children and adolescents).

Site Workers

As described previously, the site is currently operating as a steel drum reconditioning facility. Based on the current and projected future uses of the site, 80% of the site workers are considered to be indoor workers who may have limited exposure to environmental media. Under these conditions, it is possible that workers could contact surface soil as they walk between buildings, eat lunch outside, or engage in other work-related

activities. Potentially complete pathways, therefore, include ingestion, dermal contact, and inhalation of particulates. Inhalation of volatile organic compounds (VOCs) is considered an insignificant pathway given that any volatiles will quickly disperse in ambient air.

In addition to contact with surface soil, site workers may have limited exposure to sediment and surface water while conducting routine maintenance activities within on-site settling ponds. All site workers are adults (18 years of age and older).

Construction/Utility Workers

In the event of future development of the site, construction/utility workers may be exposed to on-site surface soil, subsurface soil, sediment, surface water and groundwater. Complete pathways include ingestion and dermal contact with surface and subsurface soil, surface water, groundwater and inhalation of soil particulates. Inhalation of VOCs from subsurface soil and groundwater is considered an insignificant pathway given that any volatiles will quickly disperse in ambient air. All construction/utilities workers are assumed to be adults (i.e., 18 years of age and older).

Hypothetical Trespassers

Hypothetically, trespassers may access the Franklin Steel property, although this is extremely unlikely due to the vicinity and distance of the facility from residential development and the fairly undesirable nature of the surrounding land. However, in the event trespassing does occur, a trespasser may contact surface soil through incidental ingestion, dermal contact, or inhalation of particulates. Inhalation of VOCs is considered an insignificant pathway given that any volatiles will quickly disperse in ambient air. Furthermore, trespassers may come in contact with sediment and surface water in Unzinger's Ditch. Complete exposure pathways include ingestion and dermal contact with sediment and surface water. Hypothetical trespassers are assumed to be either children (6 to 12 years of age) or adolescents (12 to 18 years of age). Adults are also capable of trespassing at the facility; however, because the child and adolescent have lower body weights than adults, the child and adolescent hypothetical trespasser scenarios are more conservative than (and, therefore, protective of) an adult hypothetical trespasser scenario and therefore the hypothetical adult trespasser is not evaluated in the HHRA.

6.3.2 Identification of Exposure Pathways

Current and future worker receptors at Exposure Unit 1 (site worker and construction/utility worker) and Exposure Unit 2 (construction/utility worker) may be exposed to chemicals in surface soil (0 - 2 feet bgs) and subsurface soil (2 - 10 feet bgs) (construction/utility worker only), sediments and surface water, and air (fugitive dust and volatile compounds). Workers may contact soils directly while working outside in these areas, therefore, pathways evaluated include direct (incidental ingestion, dermal contact) and indirect contact (inhalation of fugitive dust and volatile emissions). Workers may be exposed to surface water and sediment in the S101 Holding Pond while conducting National Pollution Discharge Elimination System (NPDES) sampling in the Holding Pond.

Sampling is conducted once a month in compliance with the Ohio EPA NPDES permit requirements. Workers wear protective clothing during sampling and are unlikely to contact surface water and sediment. However, in order to evaluate the most conservative scenario possible, exposure to surface water and sediment via the dermal pathway was evaluated.

Future hypothetical trespasser receptors at Exposure Units 3 may be exposed to surface soils, surface water and sediment located in nearby drainages. Exposure pathways evaluated for soils include direct (ingestion, dermal contact) and indirect (inhalation of fugitive dust and volatile emissions) contact pathways. Hypothetical trespassers have the potential to be exposed to surface water and sediment if exposed to the ponds and surface drainage ditches near the site. Routes of exposure include dermal contact with these media.

The frequency and duration of exposures would be limited to the warmer months and would only include those instances when the ponds and drainage ditches contain water from frequent rainfall.

6.3.3 Definition of Exposure Units

The typical concept of human exposure is that individuals contact impacted media on a periodic and random basis throughout the duration of the exposure period. Because of the nature of such contact, human exposure does not really occur at any one fixed point; rather, it occurs with equal likelihood at a variety of points. The collection of points where contact is equally likely may be described as the exposure unit. Areas of the Franklin Steel study area with elevated chemical concentrations relative to surrounding areas, as well as parts of the study area with unique features that might lead to different frequencies of contact are defined as separate exposure units. For Unzinger's Ditch, the downstream and upstream segments are represented chemically by samples taken either downstream or upstream of a 15-inch diameter outfall (Outfall) just upstream of Mile 0.6. For purposes of this evaluation, exposure units and/or media that do not have any COPCs (e.g., floodplain soils) are excluded from the evaluation and are not listed below. The exposure units defined for the Franklin Steel study area include:

Exposure Unit 1 - Active Operations Area

- Facility operations (S101 – S108) surface soils (0-2 feet bgs)
- Truck Trailer Parking Lot surface (0-2 feet bgs)

Exposure Unit 2 - Inactive Operations Area

- Historical drum storage (S109 and S201) surface (0-2 feet bgs)/subsurface soils (2 feet bgs to 10 feet bgs)

Exposure Unit 3 - Unzinger's Ditch

- Downstream of Outfall sediment and surface water
- Upstream of the Outfall (*i.e.*, holding ponds to outfall) sediment.

The separation of Exposure Unit 1 and Exposure Unit 2 is based on the distinct separation of land use. The current operations area (*i.e.*, Exposure Unit 1) consists of an area that has been involved in facility operations since conception. The S109, S201 areas (*i.e.*, Exposure Unit 2) were used strictly for storage and staging of drums and/or equipment, *i.e.*, this area has never been used for facility operation activity. Exposure Unit 1 and Unit 2 are illustrated on Figure 6-2.

The physical separation of Exposure Unit 2 (Unzinger's Ditch) sediment and surface water (*i.e.*, downstream of East Broad Street) is based on observations regarding potential human use patterns and down gradient potential of impacts from the Franklin Steel operations. The Exposure Unit 2 is illustrated in Figure 6-3.

6.3.4 Estimation of Exposure Point Concentrations

U.S. EPA defines an EPC as the representative chemical concentration a receptor may contact at an exposure unit over the exposure period (U.S. EPA 1989a). EPCs for HEEs are set equal to either the maximum detected concentration or the 95% upper confidence limit on the mean (95% UCL), whichever is lower. The EPCs for CTEs are set equal to the average (mean) concentration. The following discussions justify why it is appropriate to apply mean concentrations as central tendency EPCs and 95% UCL concentrations as high end EPCs.

First, U.S. EPA's Guidance for Risk Characterization (1995a) states that, "central tendency descriptors generally reflect central estimates of exposure or dose. The descriptor addressing central tendency may be based on either the arithmetic mean exposure or the median exposure (median estimate), either of which should be clearly labeled. The average estimate used to approximate the arithmetic mean can often be derived using average values for all the exposure factors."

Second, as noted in U.S. EPA (1989b) guidance on the assessment of health risks from fish and shellfish, "arithmetic means are needed to compare exposure estimates with reference doses (RfDs) and to calculate health risk for chronic effects because long-term consumption is an averaging process" (p. 51). U.S. EPA (1989b) continues that:

"Use of the upper 90 or 95% confidence limit in place of the mean would provide a conservatively high estimate of exposure. Calculation of conservative estimates for exposure is an appropriate step in uncertainty analysis. Use of upper confidence limits for chemical concentrations in combination with a plausible-upper-limit estimate for the Carcinogenic Potency Factor may lead to an unrealistic (i.e., highly unlikely) estimate of upper-bound risk, especially if a conservatively high estimate of fish consumption is also adopted. In most cases, the best estimate of exposure based on mean contaminant concentrations should be used to develop risk estimates (p. 52)."

Third, use of the 95% UCL as the EPC for both scenarios would yield virtually identical results because the EPC is the most sensitive exposure parameter required for the calculation of risks. Using the specified EPCs for the central tendency and HEEs provides an indication of the uncertainty associated with the analytical database and exposure assumptions, as well as a measure of the influence of those exposure assumptions on the overall outcome of the risk assessment.

Fourth, calculation of population risks (in addition to individual risks) requires an estimate of average risks, which would be lacking if the 95% UCL were used as the EPC for both central tendency and HEEs, therefore, resulting in a risk assessment that is inconsistent with U.S. EPA (1992c) exposure assessment guidance.

Finally, the high end scenario, which is defined as the highest exposure that could reasonably be expected to occur for a given exposure pathway, is typically used to estimate risk for decision-making purposes (U.S. EPA 1992c). Therefore, using the 95% UCL to represent the high end EPC is a conservative and appropriate approach.

For all of these reasons, the mean concentration is a more meaningful, useful and appropriate EPC than the 95% UCL for CTEs. Derivation of mean values follows the data handling practices previously described. Occasionally, a lognormal distribution may be highly skewed, which can result in a mean value that is higher than the 95% UCL. In these cases, the minimum variance unbiased estimator of the mean (MVU) is used as the central tendency EPC, consistent with the recommendations of Gilbert (1987).

Exposure point concentrations for all media within the exposure units identified for Franklin Steel are presented in Tables 6-10 through 6-18.

6.3.5 Characterization of Exposure Scenarios

Based on the exposure scenarios identified above, exposure parameter values and dose equations have been selected to estimate contact between people and affected environmental media. The specific parameters and equations selected for site workers, construction/utility workers and hypothetical child and adolescent trespassers are identified in Tables 6-19 through 6-32. The proposed exposure parameter values are consistent with U.S. EPA's (1997b) Exposure Factors Handbook, factoring in local considerations and updates to relevant studies that have been released since the publication of the Exposure Factors Handbook, as well as considerations from both the Ohio EPA (2006) Closure Plan Review Guidance, and Technical Background for generic cleanup numbers (GCNs). Professional judgment is also used to estimate values for a small number of factors for which these guidance documents provide no information (e.g., exposure frequency for trespassers).

For HEE scenarios, values equal to or greater than the 90th percentile are used for the most sensitive exposure parameters (U.S. EPA 1992c). All other parameters are set equal to their mean or median values. In many cases, the most sensitive exposure parameter values are expected to relate to EPCs and contact rate. However, there may be exceptions to this guideline, per U.S. EPA (1997b).

To the extent that data provided by U.S. EPA (1997b) support doing so, similar percentile values are selected for factors that are likely to be correlated. However, in the case of body weight and skin surface area, for high end scenarios, 90th percentile skin surface areas are paired with average body weights. This approach increases the conservatism of the exposure calculations, because higher (e.g., 90th percentile) body weights would effectively dilute the calculated doses, thereby lowering predicted risks. For the CTE scenarios, all parameters are set equal to their mean or median values. Additional considerations that warrant further explanation are presented in the following subsections.

6.3.5.1 Exposure Duration

Exposure duration describes the amount of time (in years) that an individual may spend in the area of concern (i.e., trespassing on the site or working at the site). For HEE exposures, the site workers are conservatively assumed to work on the Franklin Steel facility for 25 years, which is U.S. EPA's (2002) recommendation for a working lifetime. Conversely for the HHE exposure, the construction/utility workers are conservatively assumed to work on the Franklin Steel facility for 21.9 years (U.S. EPA 1997b). A site and construction/utility worker CTE duration of 6.6 years is employed, based on U.S. EPA's (1997b) recommended value for the median occupational tenure for working men and women 16 years and older. Due to the short duration of potential construction activities, construction/utility workers are estimated to work at the site for one year under both HEE and CTE scenarios.

The child and adolescent trespassers are assumed to be exposed to relevant media by the number of years in the age group (i.e., 6 years for the 6 through 12 year child and 6 years for the 12 through 18 year adolescent). Therefore, both the HEE and the CTE duration are defined as 6 years for both the child and adolescent trespasser.

6.3.5.2 Exposure Frequency

Default values on exposure frequency of site receptors are available for site workers. Consistent with EPA (1997a), site workers were estimated to be exposed to surface soil for 250 days/year under HEE conditions and 195 days/year under CTE conditions, assuming no exposure during the 4 winter months (i.e., the ground is frozen and/or covered in snow). For the inhalation of indoor air pathway, CTE was assumed to be equal to HEE.

In contrast, data for construction/utility workers and trespassers are limited or not available. Although EPA (2002a) provides an estimated exposure frequency for the construction/utility worker, the value listed does not reflect the anticipated future uses of the site. As a result, site-specific information is used to evaluate construction/utility workers and trespassers.

The construction/utility worker is estimated to work at the site for five days per week for 26 weeks or 130 days per year under the HEE scenario. For the CTE scenario, the construction/utility worker is estimated to work at the site for 65 days or five days per week for 13 weeks. While at the site, it is assumed that construction and utility workers may occasionally be exposed to groundwater that seeps into excavation trenches. For the construction/utility worker, exposure to groundwater is assumed to occur for 52 days/year under HEE conditions and 26 days/year under CTE conditions. For the utility worker, given the short duration of exposure, it was conservatively assumed that groundwater could enter excavation trenches during the entire exposure period.

For the settling ponds and discharge channels, exposure is expected to be less frequent. These exposures correspond to 52 days per year for HEE conditions and 26 days per year for CTE conditions as based on the National Pollutant Discharge Elimination System (NPDES) sampling requirements.

The hypothetical trespassers are assumed to access soils throughout the Franklin Steel facility either four or two days per month (corresponding to 36 and 24 days per year) for high end and central tendency exposures, respectively. Although, the site is monitored by a front kiosk and checked regularly to prevent unauthorized access, it is conservatively assumed that children and adolescents gain access to the site. Therefore, trespassers are conservatively assumed to spend approximately 10% of their time in Exposure Unit 1 (i.e., 4 and 1 day per year) and approximately 90% of their time elsewhere in Exposure Unit 2 (i.e., 32 and 11 days per year). Similarly for Unzinger's Ditch, exposure to sediment and surface water is assumed to be limited to 36 and 24 days per year for high end and CTEs, respectively.

6.3.5.3 Body Weight

Consistent with U.S. EPA (1997b) guidance, mean body weights of 30.8 kg, 56 kg and 71.8 kg are used for children, adolescents and adults, respectively.

6.3.5.4 Sediment and Soil Ingestion Rates

A soil ingestion rate of 200 mg/day is used to very conservatively estimate soil and sediment ingestion by children (ages 6 to 12) for HEE with a 100 mg/day for the CTE. For adolescents, soil and sediment ingestion is assumed to be 50 mg/day for CTEs and 200 mg/day for HEEs as recommended by U.S. EPA (2002) guidance.

The soil ingestion rate of 100 mg/day is identified based on a conservative interpretation of the findings of Stanek, Calabrese et al. (2001). Stanek, Calabrese et al. (2001) estimated the long-term (annual) average soil ingestion exposure distribution for children under 6 years old, using daily soil ingestion estimates from several mass balance studies. Using bootstrapping methods, they estimated the median soil ingestion for children as 24 mg/day and the 95th percentile soil ingestion as 91 mg/day. For adults, soil and sediment ingestion is assumed to be 50 mg/day for both the high end and CTEs, consistent with U.S. EPA (1997b) guidance.

6.3.5.5 Fraction Sediment or Soil Ingested from Source

The soil and sediment ingestion rates described above reflect the total amount of soil or sediment incidentally ingested throughout the day from all sources. EPA's (1997a) recommended soil ingestion rates for children are based on trace element mass balance studies that measured the total trace element input (from food and water) and output (from urine and feces) over comparable time periods on subjects, and converted the

difference to the amount of soil ingested using element concentrations in soil. Thus, these studies looked at soil ingestion over the exposure period from all sources and converted it to a daily intake rate. These rates should not be interpreted to represent the soil or sediment intake during only a portion of a day at a specific location.

It is reasonable to conclude that children and adolescents ingest soil from other play areas, and in and around the home, in addition to the hypothetical ingestion of soil and sediment from the site. Therefore, a factor for the fraction of soil or sediment ingested from the source is incorporated into the equation used to calculate exposures to trespassers. Although it is highly unlikely that anyone would spend half of their waking hours trespassing on the site or in Unzinger's Ditch, a value of 0.5 is conservatively assumed for purposes of evaluation in the fraction of soil and the fraction of sediment ingested from the site and other off-site areas for the hypothetical trespasser. In other words, it is assumed that half of the total soil or sediment ingested per day is derived from the site and half of the total soil or sediment ingested per day is derived from off-site areas. One hundred percent of the site worker and construction/utility worker soil ingestion is conservatively assumed to be derived from the site.

6.3.6 Surface and Ground Water Ingestion Rates

A water ingestion rate of 0.05 L/day is used to estimate incidental surface water or ground water ingestion by construction/utility workers and trespassers for both HEE and CTE scenarios, consistent with EPA (1989) guidance.

6.3.7 Skin Surface Area

The skin surface area is that area of exposed skin which may have the potential to come in contact with impacted media. For the site worker and construction/utility worker a surface area of 3,300 cm² and 1,506 cm² were used for HEE and CTE conditions, respectively. Site workers are assumed to have exposed skin surface areas corresponding to hands and one-half the head. As previously discussed, this assumption is consistent with the requirements of the employee manual (Franklin Steel 2006).

As for the hypothetical trespassers, the 90th percentile and 50th percentile of skin surface areas for the relevant body parts will be used for the HEE (3,249 cm² and 4,786 cm²) and CTE (2,756 cm² and 4,159 cm²) for the child and adolescent scenarios, respectively (U.S. EPA 1997b). The assumed exposed skin surface areas that are applied for the hypothetical trespasser in the HHRA are assumed to wear sleeveless shirts, shorts and sandals in the summer. In the spring and fall, hypothetical trespassers are assumed to wear short-sleeved shirts, pants and shoes or sneakers. In the winter, hypothetical trespassers are assumed to wear coats, pants and shoes or boots.

6.3.8 Skin Adherence Factor

Adherence of soil and sediment to exposed skin is an integral part of the assessment of dermal exposures. Kissel, Richter et al. (1996) and Kissel, Shirai et al. (1998) evaluated skin adherence to various body parts for different indoor and outdoor activities. Although Kissel, Richter et al. (1996) and Kissel, Shirai et al. (1998) did not specifically consider scenarios identical to those that shall be included in this HHRA, several scenarios that they did consider approximate dermal adherence associated with scenarios relevant to all risk assessments.

A dermal adherence factor of 0.20 mg/cm² is applied for site worker contacting soil and sediment under both HEE and CTE scenarios. A dermal adherence factor of 0.30 mg/cm² (HEE) and 0.20 mg/cm² (CTE) is applied for construction/utility workers contacting soil and sediment. These values are based on the weighted 50th percentile for equipment operators and utility workers (U.S. EPA 2002).

For children and adolescents who trespass at the Inactive Operations Area and/or the Unzinger's Ditch, Kissel, Richter et al.'s (1996) and Kissel, Shirai et al.'s (1998) indicates the children playing in wet soil scenario yields an adherence factor for contact with sediment of 0.2 mg/cm²-day. For adolescents' exposures to soil, the adolescent soccer player scenario yields a skin adherence factor of 0.07 mg/cm²-day for HEE conditions, and a factor of 0.04 mg/cm² for the CTE condition (U.S. EPA 2002). For children's exposures to soil, the child playing with dry soil scenario also yields a skin adherence factor of 0.04 mg/cm²-day for HEE conditions and 0.20 mg/cm² for the CTE conditions. These values are applied to the relevant exposure scenarios and are consistent with recommendations of U.S. EPA (2001b).

6.3.9 Dermal Absorption Factor

Dermal absorption factors, consistent with U.S. EPA (2001b) guidance, will be used in the HHRA to derive intake via dermal contact. A dermal absorption factor of 0.13 for PAHs is based on Wester, Maibach et al. (1990). U.S. EPA (2001b) does not provide dermal absorption factors for lead. Instead, U.S. EPA Region 3 (1995c) for assessing dermal exposure to soils will be used to determine a dermal absorption factor for inorganic COPCs. U.S. EPA Region 3 recommends using a value of 0.01 based on Ryan, Hawkins et al. (1987).

Dermal absorption factors for COPCs employed within the HHRA are listed in Table 6-33.

6.3.10 Dermal Permeability Coefficients

Dermal permeability constants expressed in centimeters per hour (cm/hr) are used to estimate uptake of chemicals in surface water through the skin. U.S. EPA (2001b) presents permeability constants for most COPCs in surface water. For those surface water COPCs that lack published permeability coefficients (e.g., benzo(k)fluoranthene), the following equation is used to calculate permeability coefficients, as presented in U.S. EPA (2001b):

$$\text{Log Kp} = -2.8 + 0.67\text{LogKow} - 0.0056\text{MW}$$

where:

Log Kp = Logarithm of the permeability coefficient;

LogKow = Logarithm of the octanol-water partition coefficient; and

MW = Molecular weight.

6.3.11 Volatilization Factor

For the site worker and hypothetical trespasser scenarios, estimation of doses via inhalation of vapors requires the derivation of a volatilization factor for each COPC. Table 6-34 presents the methodology and assumptions that are employed in the derivation of volatilization factors for COPCs.

The Jury Model was used to estimate the concentration of chemicals in air volatilized from soil. The model is applicable where saturation has not occurred. The affected soil is above the elevation of groundwater and there was no free product detected in the monitoring wells at the site, so this model is appropriate. A volatilization factor (VF) is calculated for on-site workers and trespassers based on different exposure times.

$$D_a = \frac{[(\theta_a^{10/3} \times D_i \times H) + (\theta_w^{10/3} \times D_2)]}{(P_b \times K_d) + \theta_w + (\theta_a \times H)} \times n^2$$

$$\text{VF} = \frac{Q}{C} \times \frac{(3.14 \times D_a \times T)}{2 \times P_b \times D_a} \times 0.001$$

where:

| | |
|---------------------------------------|---|
| Da = Apparent Diffusivity | Calculated |
| θa = Air-filled Soil Porosity | 0.31 |
| Di = Diffusivity in Air | Chemical-specific |
| H = Henry's Constant | Chemical-specific |
| θw = Water-filled Soil Porosity | 0.15 |
| Dw = Diffusivity in Water | Chemical-specific |
| n = Total Soil Porosity | 0.46 |
| Pb = Dry Soil Bulk Density | 1.43 (g/cm ³) |
| Kd = Soil/Water Partition Coefficient | Chemical-specific |
| VF = Volatilization Factor | Calculated |
| Q/C = Constant | 85.63 g/m ² -S/kg/m ³ |
| T = Exposure Interval | 9.5x10 ⁸ sec. |

A Jury Model will be used to estimate the inhaled concentration of chemicals in respirable particles from soil at the Franklin Steel facility. The model is applicable where saturation has not occurred. Evaluations of the Franklin Steel facility indicate affected surface soils are above the elevation of the groundwater so this model is appropriate. A particulate emission factor (PEF) is calculated for a site worker and trespasser exposure, which is used in the intake equation for dusts.

Equation:

$$PEF = \frac{Q}{C} \times \frac{3600}{0.036 \times (1 - V) \times \left(\frac{U_m}{U_t}\right)^3 \times F_x}$$

where:

| | |
|---|------------|
| PEF = Particulate Emission Factor | Calculated |
| Q/C = Inverse of the Mean Concentration at Center of Square Source | 85.63 |
| V = Fraction of Vegetative Cover | 0.5 |
| Um = Mean Annual Wind Speed | 4.2 m/s |
| Ut = Equivalent Threshold Value of Wind Speed at 7 m | 11.32 m/s |
| Fx = Function Dependent on Ut/Um | 0.371 |

6.3.12 Calculation of "Doses"

"Doses" for the site worker, construction/utility worker and hypothetical trespasser scenarios are conservatively estimated using the equations shown in Tables 6-19 through 6-32. For computational efficiency, "doses" are calculated using all exposure factors except those that are chemical-specific. Therefore, because the values presented are not true intake rates or doses, they are presented as "doses" in the HHRA.

6.4 TOXICITY ASSESSMENT

Part of the HHRA is the toxicity assessment. In this step, the relationship between the administered and/or the absorbed dose of a chemical and the magnitude or likelihood of the adverse health effects are characterized (U.S. EPA 1989a). For systemic toxicants, or chemicals that give rise to toxic endpoints other than cancer and gene mutations (called noncarcinogenic effects), the toxicity assessment process determines a threshold value below which adverse noncarcinogenic effects are not expected in the general population, including sensitive subgroups. For chemicals that are known or suspected to cause cancer, the toxicity assessment defines the relationship between the dose of the risk agent and the probability of induction of carcinogenic effects in humans or animal species of interest.

Quantitative toxicity values are used in risk assessment to evaluate health risks based on the relationship between the dose of chemical received and the incidence or magnitude of the toxic response observed (i.e., the dose-response relationship). Laboratory animal studies are generally used to characterize the dose-response relationship for a chemical, unless adequate human epidemiological data are available.

A toxicity assessment is presented below for all COPCs. The Ohio EPA – DERR (TDC 2004) recommends use of toxicity values identified using a hierarchy of approved sources. The three primary sources are (in descending order of preference): EPA's Integrated Risk Information System (IRIS); EPA's Office of Research and Development (ORD) provisional peer-reviewed toxicity values (PPRTVs); and U.S. EPA's Health Effects Assessment Summary Tables (HEAST) (U.S. EPA 1997c). However, where alternative, more scientifically defensible toxicity values are available; the effect of those alternative values on the risk conclusions may be considered as part of the uncertainty analysis.

6.4.1 Noncarcinogenic Effects

In the risk assessment process, a distinction is made between cancer and noncancer health effects. For noncancer effects, the toxicity assessment yields a reference dose (RfD) or reference concentration (RfC), which corresponds to an estimate of the daily dose or concentration likely to be without appreciable risk of adverse noncarcinogenic effects during a lifetime, with uncertainty spanning perhaps an order of magnitude (Dourson and Stara 1983).

RfD values are generally calculated by determining the highest dose at which there are no observable adverse health effects (NOAEL) and by adjusting this dose using a series of uncertainty factors (UFs) and modifying factors (MFs). These practices are intended to conservatively account for the variation in sensitivity within the human population, uncertainty in extrapolating from animals to humans, uncertainty in extrapolating from short-term animal studies to chronic exposures in humans, and/or the inability of the toxicological database to address all possible adverse outcomes in humans. Modifying factors may be applied to address specific scientific uncertainties or overall database quality. For studies in which a NOAEL cannot be identified, the lowest dose associated with an observable adverse effect (LOAEL) is used and an additional UF is applied to account for the uncertainty of using LOAEL data rather than NOAEL data.

Table 6-35 summarizes the noncancer toxicity data for COPCs for the oral and dermal pathways. For each COPC, the target organ for the critical effect is noted and the magnitude of the total UF is indicated.

It is not necessary to adjust noncancer toxicity values to account for body weights other than 70 kg or lifetimes other than 70 years. U.S. EPA's (1997b) Exposure Factors Handbook states that standard exposure assumptions (e.g., 70 kg body weight, 70 year lifetime, 20 m³ per day inhalation rate) are inaccurate for the national population. Appendix 1A of the Exposure Factors Handbook presents procedures for ensuring that population parameters used in exposure assessments are consistent with the population parameters used to derive the dose-response values in IRIS. Noncancer toxicity values (i.e., RfDs and RfCs) are based on animal or human dose-response data and application of uncertainty factors. As such, these values do not contain any human exposure factors. Therefore, no adjustment for body weight or lifetime duration is necessary (U.S. EPA 1997b).

Unadjusted oral RfDs are used to evaluate dermal exposure scenarios. The simplistic oral-to-dermal route extrapolation outlined by U.S. EPA (1989a) is subject to a number of uncertainties related to differences in pre-systemic metabolism and absorption rate. In addition, there is a large degree of variability in the analysis of oral absorption studies for many chemicals. U.S. EPA (2001b) states that adjustment of an oral toxicity factor is only recommended when a scientifically defensible database demonstrates that gastrointestinal absorption is less than 50%. U.S. EPA (2001b) does not recommend adjusting the oral toxicity values of any of the COPC evaluated in a human health risk assessment.

Table 6-36 summarizes the noncancer toxicity data for COPCs for the inhalation pathway. For those COPCs lacking published toxicity values (e.g., RfDs or RfCs), Ohio EPA DERR was contacted for recommendations. Based on U.S. EPA, the preferred method for route-to-route extrapolation involves the physiologically based pharmacokinetic (PBPK) models, capable of describing disposition of the chemical for the oral, inhalation and other routes of exposure (U.S. EPA 1994).

6.4.2 Carcinogenic Effects

The assessment of cancer health effects generally follows a two-step process consisting of assignment of a qualitative weight of evidence classification and derivation of a quantitative toxicity value when appropriate. The weight of evidence classification scheme contains five classes, as follows:

| | |
|---------|---|
| Group A | Known human carcinogens; |
| Group B | Probable human carcinogens; B1: Probable human carcinogen; limited evidence in humans; B2: Probable human carcinogen; sufficient evidence in animals and inadequate data in humans; |
| Group C | Possible human carcinogens; |
| Group D | Inadequate evidence to classify; and |
| Group E | No evidence of carcinogenicity. |

The weight of evidence classification is based on the strength of the data demonstrating carcinogenesis in both laboratory animal studies and human epidemiology studies. Quantitative toxicity values, including cancer slope factors (CSFs) and/or inhalation unit risk (UR) values are generally derived for Group A and B1/B2 carcinogens. Because U.S. EPA generally favors use of a linear dose-response model, many available CSFs and UR values were derived using the linearized multistage model (LMS). These CSFs and UR values usually represent the 95% UCL on the probability of a response per unit dose of a chemical, and are expressed as either (mg/kg-day)⁻¹ or (ug/m³)⁻¹, respectively.

A more recent approach to cancer risk assessment is presented in U.S. EPA's (1996c) Proposed Guidelines for Carcinogen Risk Assessment. Under this approach, standard cancer risk descriptors are used instead of the traditional classification scheme and several alternative methods are available for dose-response modeling and low dose extrapolation. U.S. EPA is in the process of re-evaluating dose-response assessments that pre-date the 1996 guidance, with the goal of making them consistent with the new guidance and more reflective of actual toxicological potential. HHRA's based on the older methodology may overestimate the potential for toxic effects. Table 6-37 summarizes the oral and dermal toxicity data for carcinogens identified as COPCs. For each COPC, the weight of evidence classification and the target organ for cancer are presented.

Unadjusted oral CSFs are used to evaluate dermal exposure scenarios. As discussed above, current guidance from U.S. EPA (2001b) states that adjustment of an oral toxicity factor is only recommended when a scientifically defensible database demonstrates that gastrointestinal absorption is less than 50%. U.S. EPA (2001b) does not recommend adjusting the oral toxicity values of any of the COPCs.

CSFs based on animal studies (e.g., CSFs for PAHs) contain an animal-to-human scaling factor that is based on a human body weight of 70 kg. Therefore, CSFs will be adjusted to reflect the 71.8 kg body weight used in the exposure assessment. A body weight correction factor of 1.01 $[(71.8/70)^{1/3}]$ was calculated using the equation presented in Table 1A-1 of the Exposure Factors Handbook (U.S. EPA 1997b). Therefore, CSFs for PAHs are multiplied by 1.01 to yield adjusted CSFs. A lifetime duration adjustment is not necessary for CSFs derived from animal data, because the assumption is made that events occurring in the lifetime animal bioassay will occur with equal probability in a human lifetime, regardless of duration (U.S. EPA 1997b).

Table 6-38 summarizes the cancer toxicity data for COPCs for the inhalation pathway.

6.4.3 Chemical-Specific Toxicity Values

While the majority of toxicity values applied in the HHRA and presented in Tables 6-35 through 6-38 are default values recommended by U.S. EPA, those proposed for PAH and inorganic compounds warrant further discussion, as follows.

PAH Compounds

Oral RfDs are available from IRIS for several individual PAH compounds. There are many additional PAHs for which no RfD value has been assigned by U.S. EPA, due to a lack of specific toxicological studies. Many PAH compounds produce similar types of noncancer health effects (i.e., liver and kidney toxicity). Therefore, the oral RfD for naphthalene is used for structurally similar PAHs lacking verified RfDs. For all other PAHs that lack verified RfDs, the RfD for pyrene is used as a surrogate. The RfD for pyrene is the lowest for the PAH derivatives; therefore, this is a very conservative approach that is expected to significantly overestimate noncancer hazards from PAHs.

Cancer risks are evaluated for the seven PAH derivatives considered by U.S. EPA to be probable human carcinogens: benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene. The evaluation of PAH cancer risks is performed using U.S. EPA's provisional guidance for risk assessment of PAHs (U.S. EPA 1993). U.S. EPA (1993) describes this approach as estimation of the order of potential potency for various PAH compounds. This approach utilizes data from skin painting, interperitoneal or subcutaneous injection, and lung implantation studies and dose-response modeling techniques to estimate the potency of each PAH relative to benzo(a)pyrene. The estimated relative potency is then applied to the CSF for benzo(a)pyrene that is presented in IRIS.

Inorganic Compounds

Various inorganic compounds have been identified as COPCs for the Franklin Steel facility. Oral RfD values for all, excluding lead, are available from IRIS and or NCEA. U.S. EPA has not issued either cancer or noncancer toxicity criteria for lead. Rather, exposure to lead is typically evaluated using biokinetic uptake models that provide estimates of blood lead levels in either children or adults. U.S. EPA has used their Integrated Exposure Uptake Biokinetic (IEUBK) Model to derive a screening level for lead in residential soil of 400 mg/kg (U.S. EPA 1994b). The IEUBK model was developed specifically for evaluating lead exposures in children and therefore cannot be used to evaluate adult exposures to lead. Therefore, in the assessment of adult exposure to lead, recommendations of the Technical Review Workgroup (TRW) will be utilized in the development of the HHRA.

U.S. EPA uses a default calculated non-residential lead exposure concentration of 710 mg/kg (U.S. EPA 2003), based on an approach recommended by a TRW for Lead (TRW 1996). This approach uses a method that relates soil lead intake to blood lead concentrations in women of childbearing age. Hence, risks posed by lead to children are evaluated by comparing the EPCs for lead to the 400 mg/kg screening level (U.S. EPA 1994b), while risks posed by lead to adults are evaluated by comparing EPCs for lead to the 710 mg/kg screening concentration (TRW 1996). Surface water EPCs for lead are compared to U.S. EPA's action level for lead in drinking water (15 µg/L) (cited in U.S. EPA Region 5's Multimedia Strategy for the Management and Reduction of Lead Hazards www.epa.gov/reg5foia/pb/strategy).

6.5 RISK CHARACTERIZATION

Risks were characterized by integrating the toxicity and exposure assessments into quantitative expressions of risk based on the guidance provided in U.S. EPA, 1989b. To characterize carcinogenic risks, probabilities that an individual will develop cancer over a lifetime of exposure were estimated from projected intakes and chemical-specific dose-response information. This probability is expressed as an excess lifetime cancer risk (ELCR). To characterize potential noncarcinogenic effects, comparisons were made between the projected

intakes of substances and approved toxicity values. This comparison is expressed as a hazard quotient (HQ). Risks are quantified for each exposure pathway for those COPCs for which Ohio EPA approves toxicological criteria.

For carcinogens, risks are estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen (i.e., incremental or excess individual lifetime cancer risk). Carcinogenic risks are calculated using the chronic daily intake determined through the exposure assessment and chemical specific toxicity criteria. The cancer risk equation is defined below:

$$\text{Cancer Risk} = \text{CDI} \times \text{SF}$$

Where:

CDI = Chronic Daily Intake averaged over 70 years (mg/kg-day); and,
SF = Chemical specific slope factor (mg/kg-day)⁻¹

U.S. EPA guidance requires that risks associated with simultaneous exposures to several substances be estimated. In order to assess the risks posed by multiple chemicals, individual cancer risks are summed for each exposure pathway using the following equation:

$$\text{Risk}_t = \text{Risk}_1 + \text{Risk}_2 + \dots + \text{Risk}_i$$

Where:

Risk_t = the total cancer risk, expressed as a unitless probability; and
Risk_i = the risk estimate for the ith substance,

The risk summation methodology assumes that there are no synergistic or antagonistic chemical interactions and that all substances result in the same carcinogenic effect.

For noncarcinogens the potential for toxic effects is measured by comparing an exposure level over a specific time period with a chemical-specific reference dose derived for a similar exposure period. The noncancer HQ ratio assumes that there is a level of exposure below which it is unlikely that adverse health effects will occur, even to sensitive sub-populations. The threshold level is determined through animal and human epidemiological studies and is called the reference dose or RFD. The equation for determining the noncancer HQ is described below:

$$\text{Noncancer Hazard Quotient} = \text{E/RFD}$$

Where:

E = exposure level (or intake);
RFD = chemical-specific reference dose

If the hazard quotient exceeds unity (1), there may be a potential noncancer effect. To assess the overall potential for noncarcinogenic effects posed by more than one chemical, a hazard index (HI) approach is used. This approach assumes that simultaneous sub-threshold exposures to several chemicals could result in an adverse health effect.

The HI is equal to the sum of the HQs, as shown below:

$$\text{Noncancer Hazard Index} = E1/RfD1 + E2/RfD2 + \dots E_i/RfD_i$$

Where:

E_i = exposure level (or intake) for the i th toxicant;

RfD_i = chemical-specific reference dose for the i th toxicant

The HI assumes that the magnitude of the effect will be proportional to the sum of the hazard quotients.

6.5.1 Summary of Pathway-Specific Risks

The risk-based goal for carcinogenic compounds has been established at 1×10^{-5} (1E-05) excess lifetime cancer risk (ELCR). For noncarcinogens, acceptable exposure levels are concentrations that do not exceed a Hazard Index (HI) of 1. Compounds present in media at the Franklin Steel site SWMUs and AOCs above these risk-based goals were further evaluated to determine if remedial action is warranted. Calculations for all pathway-specific noncancer hazards and cancer risks are included in Appendix B. A summary of noncancer hazards and cancer risks for all exposure pathways are provided on Table 6-39.

Exposure Unit 1 - Active Operations Area - Soil

The risks to site workers and construction/utility workers were evaluated for Exposure Unit 1. For site workers, exposures were limited to surface soils (0 - 2 feet bgs). Construction/utility workers could be exposed to both surface (i.e., 0 to 2 feet bgs) and subsurface soils (i.e., 2 feet bgs to 10 feet bgs) when conducting excavations associated with construction activities. Exposure pathways evaluated for both receptors included the dermal contact, incidental ingestion and inhalation (fugitive dust and volatile emissions) routes.

Site Workers

Table 6-39 summarizes the total risk to site workers from all pathways. The HI for all pathways for site workers is 1.6 for the HEE condition and 0.35 for the CTE conditions. The total ELCR for site workers is 4E-03 for the HEE condition and 3E-04 for the CTE condition.

Construction/Utility Workers

Table 6-39 summarizes the total risk to construction/utility workers for all pathways. The HI for all pathways for the construction worker is 2.4 for the HEE condition and 0.12 for the CTE condition. The total ELCR for construction/utility workers is 3E-03 for the HEE condition and 9E-05 for the CTE condition.

Exposure Unit 1 - Active Operations Area - Surface Water and Sediment

Surface water and sediment collected from Exposure Unit 1 were evaluated. Both the site workers and construction/utility workers were evaluated based on route maintenance for the site worker and potential future development for the construction/utility workers.

Site Workers

Exposures were limited to dermal contact associated with the collection of surface water during NPDES sampling. Currently, NPDES sampling is performed once a month at the regulated outfall in the holding pond. Although surface water is the only media contacted (note that currently gloves are worn), the risk assessment included the dermal contact with sediment pathway in order to evaluate a reasonable worst-case scenario. Risks associated with surface water and sediments are summarized in Table 6-39. The total HI from contact of surface water is 1.0 for the HEE condition and 0.23 for the CTE condition. The total HI from

contact with sediment is 0.40 for the HEE condition and 0.09 for the CTE condition. The total ELCR for contact of surface water is 1E-02 for the HEE condition and 6E-04 for the CTE condition. The total ELCR for contact with sediment is 6E-03 for the HEE condition and 4E-04 for the CTE condition.

Construction/Utility Workers

Construction/utility workers exposures were limited to dermal contact and incidental ingestion associated with subsurface construction activities. The risk assessment included the contact with both surface water and sediment pathways in order to evaluate a reasonable worst-case scenario. Risks associated with these media are summarized in Table 6-39. The total HI from contact of surface water is 1.3 for the HEE condition and 0.17 for the CTE condition. The total HI from contact with sediment is 4.0 for the HEE condition and 0.19 for the CTE condition. The total ELCR for contact of surface water is 4E-02 for the HEE condition and 1E-03 for the CTE condition. The total ELCR for contact with sediment is 6E-02 for the HEE condition and 9E-04 for the CTE condition.

Exposure Unit 1 and 2 - Groundwater

Groundwater collected for the site was evaluated. The construction/utility workers were evaluated based on the potential for future development and excavation activities that may encounter groundwater.

Construction/Utility Workers

Construction/utility workers exposures were limited to dermal contact and incidental ingestion associated with subsurface construction activities. Risks associated with groundwater are summarized in Table 6-39. The total HI from contact of groundwater is 0.18 for the HEE condition and 0.2 for the CTE condition. The total ELCR for contact of groundwater is 5E-03 for the HEE condition and 5E-05 for the CTE condition.

Exposure Unit 2 - Inactive Operations Area - Soil

Exposure evaluations included the hypothetical child and adolescent trespassers, and the construction/utility workers. These evaluated receptors and results are summarized in Table 6-39. Soils from 0 - 2 ft. were included in the evaluation of the hypothetical trespasser and construction/utility worker. In addition, for purposes of evaluating potential future development, subsurface soils (2 feet bgs – 10 feet bgs) were evaluated for the construction/utility worker. Exposure pathways evaluated included dermal contact, incidental ingestion, and inhalation (fugitive dust and volatile emissions).

Hypothetical Trespasser

The HI for the child trespasser to soil via all pathways was 0.08 for the HEE condition and 0.017 for the CTE condition. The child trespasser total ELCR for the HEE condition is 1E-06 and for the CTE condition is 2E-07. The HI for the adolescent trespasser to soil via all pathways was 0.04 for the HEE condition and 0.005 for the CTE condition. The adolescent trespasser total ELCR for the HEE condition is 5E-07 and for the CTE condition is 6E-08.

Construction/Utility Worker

A construction utility worker scenario was evaluated for the Inactive Operations Area soils. Construction/utility workers could be exposed to surface and subsurface soils via the dermal, incidental ingestion and inhalation pathways. Total risks to construction workers are summarized in Table 6-39. The total HI for all pathways (i.e., surface and subsurface) is 1.0 for the HEE condition and 0.048 for the CTE condition. The total ELCR for all surface and subsurface pathways is 6E-05 for the HEE condition and 8E-07 for the CTE condition.

Exposure Units 3 - Unzinger's Ditch, Surface Water and Sediment

Risks to hypothetical child and adolescent trespassers were evaluated for exposures to Unzinger's Ditch surface water and sediment. Hypothetical trespassers may be exposed to surface water and sediment if they frequent the surface drainage ditches near the site. Table 6-39 summarize the total risks to the hypothetical child and adolescent trespasser based on dermal contact and incidental ingestions with surface water and sediment.

The total HI risk to the hypothetical child trespasser based on exposure to surface water and sediment is 2.1 and 0.50 for the HEE condition, respectively, and 0.53 and 0.11, respectively, for the CTE condition. The total ELCR for surface water and sediment is 2E-02 and 2E-03 for the HEE condition, respectively, and 4E-03 and 4E-04 for the CTE condition, respectively. Benzo(a)pyrene contributes 82% of the total ELCR for surface water and benzo(b)fluoranthene contributes 17%. Benzo(a)pyrene contributes 54% of the total ELCR for sediment.

The total HI risk to the hypothetical adolescent trespasser based on exposure to surface water and sediment is 1.6 and 0.51 for the HEE condition, respectively, and 0.40 and 0.07, respectively, for the CTE condition. The total ELCR for surface water and sediment is 1E-02 and 2E-03 for the HEE condition, respectively, and 4E-03 and 3E-04 for the CTE condition, respectively. Dermal contact with surface water contributes the greatest risk with benzo(a) pyrene responsible for 82% of the surface water risk and benzo(b)fluoranthene contributing 17% of the total ELCR. Benzo(a)pyrene contributes 54% of the total ELCR for sediment. Bis(2-ethylhexyl)phthalate contributes 10% of the ELCR for sediment exposure for both child and adolescent.

6.6 UNCERTAINTY ASSESSMENT

The primary goal of the uncertainty analysis is to provide a discussion of the key assumptions made in the risk assessment that may significantly influence the estimate of potential risk. Uncertainty is inherent in all of the principle components of the risk assessment. A discussion of the sources of uncertainty contributing to the potential risk and the associated effects (overestimation or underestimation of risk) of these factors is presented in this section.

In the absence of empirical- or site-specific data, assumptions are developed based on best estimates of exposure or dose-response relationships. To assist in the development of these estimates, U.S. EPA (1989, 1991) recommends the use of guidelines and standard factors in risk assessments conducted under CERCLA. The use of these standard factors is intended to promote consistency among risk assessments where assumptions must be made. Although the use of standard factors undoubtedly promotes comparability, their usefulness in accurately predicting potential risk is directly related to their applicability to the actual site-specific conditions.

The potential noncarcinogenic hazard and carcinogenic risk estimates for the site are based on a number of assumptions that incorporate varying degrees of uncertainty resulting from many sources, including the following:

- Environmental monitoring and data evaluation
- Assumptions in the selection of exposure pathways and scenarios
- Estimation of the magnitude of exposure under selected exposure scenarios
- Assumptions in the expression of potential noncarcinogenic hazard and carcinogenic risk

The estimated incremental risk and potential HIs for the exposure pathways quantified are summarized in Table 6-39. Several factors introduced in the risk assessment may contribute to the uncertainty of the potential risk estimates, including the following:

- Sampling concentrated in areas at the site believed to be affected by constituents (biased sampling) is likely to overestimate exposure.
- Use of environmental data qualified as estimated potentially biases the actual value low or high.
- Using U.S. EPA-approved toxicity values with low confidence ratings and high uncertainty factors could potentially overestimate or underestimate the risk calculated in this RFI.
- Using toxicity values that are largely based on animal studies and extrapolated to humans could potentially overestimate or underestimate the risk calculated in this RFI.
- Not quantitatively evaluating constituents that do not have toxicity data may underestimate actual risk.
- Not quantitatively evaluating synergistic or cumulative toxicity effects associated with the co-occurrence of COPCs in environmental media may underestimate actual risk.
- Compounding conservative assumptions in the risk assessment yield extremely conservative (overestimated) potential risk estimates.
- Assuming constituents present in soils and sediment have a significant tendency to desorb from the soil and pass through the skin is likely to overestimate exposure.
- Using 95% UCL and maximum concentrations is likely to overestimate intakes since actual exposure is probably at lower concentrations.

The assumption that ingestion exposures correspond to populations spending their entire workdays within the localized affected areas of the site overestimates exposure.

The following discussions detail the key assumptions and uncertainties in each phase of the risk assessment that resulted in a significant contribution to total potential risk.

Characterization of Affected Media

The intent of the RFI conducted for the site was to characterize the nature and extent of the COPCs in various media and potential risk(s) to human health and the environment. To achieve this goal in a timely, cost-effective manner, the investigation focused on those areas of the site that were known or suspected to be affected by chemical releases. In the absence of a representative sample population (i.e., an equally distributed number of data points from all portions of the site), the available data used in the baseline risk assessment were assumed to be representative of the entire site. For the site worker and construction/utility worker, this assumption is more likely to overestimate risk than to underestimate it, since potential receptors may spend less time in the sampled areas than the site as a whole.

The characterization of data from waste sites presents considerable uncertainty due to variation in wastes, environmental media and time. Characterization of the soils at the Franklin Steel RCRA Units presented uncertainties due to the nature of the site. The units are located in an active industrial facility within an industrial park. The facility was constructed on shallow fill material (i.e., for grading purposes) that is believed to have been brought in from the City of Columbus coal-fired power plant on Spring Street;

therefore, characterization of background for the area was very difficult. Fill material located inside the industrial area was considered site soil. No fill samples were included in the background data set. Characterization of surface water and sediment is especially difficult due to impacts from other discharges in the area and the variability of the flow in the drainage ditches.

The sampling program at the Franklin Steel facility was designed to minimize the potential to underestimate exposure point concentration. Background levels were established using data from locations on or near the site in order to distinguish between chemicals associated with activities near the site from past waste activities at the areas under investigation. Upgradient and down gradient surface water and sediment samples were collected in order to characterize chemicals associated with the units.

High concentrations of organic contaminants resulted in high detection limits during the analysis of some organic compounds in some sediment samples. The high concentrations of organic compounds such as bis(2-ethylhexyl)phthalate can cause interference with the analysis of other organic compounds. This adds uncertainty to the risk assessment in that some additional chemicals may be present in sediment that were not reported by laboratory analysis. If present, these additional chemicals could pose risks to ecological receptors beyond those presented in this summary.

Exposure Assessment

There are numerous assumptions made in the exposure assessment, including the selection of exposure routes, scenarios, and factors (e.g., contact rates, exposure frequency, body weight) used to estimate exposure doses. The HEE was used to develop exposure doses and is defined as the high-end exposure that is reasonably expected to occur at the site. Several variables that determine the exposure dose for the HEE are based on high-end (typically 90th percentile or greater) estimates. These variables are as follows:

- Exposure concentration is the 95% UCL or the maximum concentration observed.
- Intake rate is an upper bound or maximum value.
- Exposure frequency is an average or upper-bound value.
- Exposure duration is an upper-bound value.
- Fraction ingested is an upper-bound (conservative) value.

Therefore, the calculated HEE dose for any given constituent, which results from a multiplication of these selected variables, represents a high-end value and a conservative estimate of the actual exposure dose. The use of this exposure dose, coupled with conservative estimates of toxicity, will yield a potential risk result that represents a high-end estimate of the likelihood of noncarcinogenic effects.

Uncertainty in all elements of the exposure assessment are brought together and compounded in the estimate of intake or dose. The professional judgment of the risk assessor becomes particularly important, and the risk assessor must examine and interpret a diversity of information, including: the nature, extent, and magnitude of contamination; transport of chemicals in the environment; identification of exposure routes; identification of receptor groups currently at risk and potentially at risk in the future; and activity patterns of receptors and receptor groups.

Receptors for the exposure units at Franklin Steel were defined based on information provided by the facility and on-site observations. Site-specific information for the exposure units were used to develop exposure assumptions and intake parameters, if available. However, most assumptions were based on EPA standard default parameters. These values represent reasonable worst-case scenarios for an industrial land use scenario. Many of the exposure parameters represent 90th to 95th percentile values. When several upper bound values are combined in estimating exposure for any one pathway, resulting risk estimates may well be in excess of the 99th percentile exposure and thereby be outside the range of exposures that might reasonably be expected to occur at a site. Therefore, resulting risks calculations are conservative and most likely overestimate the actual exposures that may be associated with the site. Therefore, the CTE condition (most

likely to occur), mean exposure is a more meaningful, useful and appropriate when evaluating receptor exposure.

The risk assessment treats each exposure parameter as a single point estimate. None of these parameters, however, is truly a single value. Instead, a range of values or distribution would more accurately represent these parameters. Defining a range of values for any given parameter is actually a measure of variability in the risk assessment. Quantitative uncertainty analysis allows one to measure this variability, but is difficult because of the quantity and quality of data available.

Toxicity Assessment

Although U.S. EPA provides toxicity values that are point estimates, a significant amount of uncertainty may surround these point estimates. Identification of the sources of this uncertainty enables the risk assessor to establish the degree of confidence associated with the toxicity measures.

Uncertainty is inherent within the toxicity assessment and is primarily due to differences in study design, species, sex, routes of exposure, or dose-response relationships. A major source of uncertainty involves using toxicity values based on experimental studies that substantially differ from typical human exposure scenarios. The derivation of the toxicity values must take into account such differences as (1) using dose-response information from animal studies to predict effects in humans, (2) using dose-response information from high-dose studies to predict adverse health effects from low doses, (3) using data from short-term studies to predict chronic effects, and (4) extrapolating from specific homogeneous populations to general heterogeneous populations.

The cancer slope factors in particular are based on studies that may differ greatly from realistic situations. Experimental cancer bioassays typically expose animals to very high levels of chemicals (i.e., the maximum tolerated dose) for their entire lifetime. After the appropriate studies have been identified, the slope factor is calculated as the upper 95th percent confidence limit of the slope of the dose-response curve. This introduces conservatism into the risk assessment.

The derivation of reference doses generally involves the use of animal studies. Uncertainty factors ranging from 1 to 10,000 are incorporated into the reference dose to provide an extra level of public health protection. The factors used depend on the type of study from which the value has been derived (e.g., animal or human, chronic or acute). The scientific basis for this practice is somewhat uncertain. In general, high uncertainty factors are meant to bias the results conservatively so that exposures at the reference dose level will not result in adverse health effects.

Oral administered dose toxicity values are typically used to determine absorbed dose toxicity values for use in evaluating the dermal contact pathway. A chemical-specific gastrointestinal absorption factor is used to convert an oral administered dose to a dermal adsorbed dose. This is considered a more accurate approach than using unadjusted oral toxicity values for the dermal pathway. Uncertainty is introduced in the use of the gastrointestinal absorption factors. Limited information is available on the gastrointestinal absorption of some chemicals and many have no information at all. In addition, no adjustments have been made for the medium of exposure (e.g., when the medium of exposure in the site differs from the medium of exposure assumed by the toxicity value). In addition, default absorption factors (ABS) were used for chemicals with no specific values. The uncertainty associated with using the absorbed dose toxicity values for the dermal pathway is moderate and the bias unknown.

There are many chemicals for which no toxicity values exist and for which little information is available. Therefore, a quantitative risk estimate cannot be calculated for these chemicals. For example, many chemicals are not evaluated for the inhalation pathway because of limited inhalation-based toxicological information. The lack of toxicity information for some chemicals contributes to the underestimation of risks.

Cancer and noncancer risks are summed in the risk characterization process (separately for carcinogens and noncarcinogens) to estimate potential risks associated with the simultaneous exposure to multiple chemicals. In the case of carcinogens, this gives carcinogens with a class B or class C weight-of-evidence the same weight as carcinogens with a class A weight-of-evidence. It also equally weights slope factors derived from animal data with those derived from human data. Uncertainties in the combined risks are also compounded because RFDs and cancer slope factors do not have equal accuracy or levels of confidence and are not based on the same severity of effect.

The assumptions of the exposure assessment are conservative, and in general, result in overestimates of exposure. In the face of uncertainties, the assumptions of the exposure assessment are purposely conservative (high-end). This conservative risk and hazard estimate approach, dealing with uncertainties for exposure, conforms to U.S. EPA guidance provided in RAGS (U.S. EPA, 1989).

6.6.1 Uncertainties in Risk Characterization

Uncertainties in any phase of the risk analysis are reflected in the risk estimates. Some uncertainty is associated with the summation of risks and hazards (HQs) for multiple chemical contaminants. As stated in RAGS (U.S. EPA 1989b), "The assumption of dose additivity ignores possible synergisms or antagonisms among chemicals, and assumes similarity in mechanisms of action and metabolism." However, summing cancer risks and HQs for multiple substances in the risk assessment provides a conservative estimate.

In some cases, total risks presented in this assessment are not significantly different from background risks. Also, in some cases elevated risk are the result of one or two elevated detections. In these cases, constituents posing unacceptable risk may not require corrective action because the site concentrations may not be the result of contamination. This may be the case for arsenic in soil and for metals in groundwater. These two cases are discussed in detail below.

Arsenic in Soil

Arsenic is a naturally occurring compound that was detected in all background soil samples. The background criterion (28.5 mg/kg) is higher than the 95% UCL exposure concentration (source term) for Exposure Unit 2 (26.0 mg/kg) because nearly all of the on-site detections were below background. Furthermore, in the 26 soil samples collected from 0 - 10 ft. below ground surface at Exposure Unit 2, the arsenic concentration ranged from 7.6 to 77.9 mg/kg; however, only three detections exceeded the established background concentration of 28.5 mg/kg. All three detections occurred 5 feet or deeper from the ground surface. Two of these detections, 32.1 and 35.3 mg/kg, only slightly exceeded background and they occurred in the same soil boring (S109-SB04). The third detection above background had a concentration of 77.9 mg/kg (S109-SB07).

On January 16, 2001, two additional soil samples were collected at S109-SB07 for arsenic analysis to confirm or deny whether the RFI detected concentration of arsenic exists at a level above established background in soil at this location within the 5-6 foot depth interval. During RFI sampling activities conducted on August 12, 1997, arsenic was detected above the RFI calculated background level (28.5 mg/kg) at this location within the 5-6 foot depth interval at a concentration of 77.9 mg/kg; and below background in the 8-9 foot depth interval at a concentration of 24.7 mg/kg.

During the January 16, 2001 sampling event, arsenic was detected in the 4.5-5.5 and 5.5-6.5 foot depth intervals at concentrations of 49.2 and 32.5 mg/kg, respectively. These concentrations are well below the 77.9 mg/kg concentration of arsenic detected in the RFI sample collected on 8/12/97.

Results of the two additional soil samples collected at this location did not duplicate the RFI detected concentration of arsenic at 77.9 mg/kg. It is suggested by the RFI and additional sampling data that the slightly elevated concentrations of arsenic detected within the 4.5-5.5 and 5.5-6.5 foot depth intervals are isolated and most likely naturally occurring. The concentration of arsenic at the 0-1 foot depth interval in soil

at this location was found to be 10.4 J mg/kg and 24.7 mg/kg in the 8-9 foot depth interval. The next highest concentration of arsenic detected within SWMU S109 during RFI activities was located approximately 270 feet southeast from S109-SB07 at S109-SB04 at a concentration of 35.3 mg/kg, also within the 5-6 foot depth interval. The detected arsenic concentration at the 0-1 foot depth interval (S109-SS06) at this location was 10.9 J mg/kg. All other detected concentrations of arsenic within SWMU S109 are below these concentrations.

It is important to note that arsenic has never been a component of any known Franklin Steel waste stream. It is therefore unlikely that waste management practices, including the temporary storage of drums, could be responsible for the observed concentrations of arsenic, particularly in the subsurface samples. Furthermore, the geology that overlays the area is a tight, highly cohesive clay that averages three feet in thickness, essentially acting as a cap or barrier from any potential release that may have occurred during waste management practices. As stated above, concentrations of arsenic were detected at only 10.4 J and 10.9 J mg/kg in surface soil at the locations discussed above and would not be expected to migrate beyond near surface depths. In fact, the highest concentration of arsenic detected in surface soil within all of SWMU S109 is 20.5 J mg/kg at S109-SS04, well below the 28.5 mg/kg background concentration.

Further, there is a general trend of arsenic concentrations found throughout SWMU S109. Generally speaking, most of the arsenic concentrations detected at this SWMU are found to be below 20 mg/kg from the 0-5 feet and below 10 feet depth intervals. Concentrations of arsenic tend to be greater than 20 mg/kg from within the 5-10 feet depth interval. This suggests that there may be a layer of glacial deposits at the 5-10 feet depth interval with naturally occurring elevated concentrations of arsenic.

It is also well documented that arsenic is commonly detected in background soils at elevated concentrations, particularly within a glacial deposit setting such as the Franklin Steel site. Concentrations of arsenic have been found to naturally occur in soil at concentrations as high as 73 mg/kg within the eastern United States (Shacklette and Boerngen, 1984). In Ohio, arsenic has been found to occur in background soil as high as 56 mg/kg (Cox and Colvin, 1996). These concentrations are well above the arsenic concentrations detected within the SWMU S109 and the background concentration of 28.5 mg/kg.

Any releases at S109 would have occurred at the surface. The surface samples (0 - 1 ft.) collected at S109-SB04 and S109-SB07 contained arsenic concentrations of 24.7 and 13.4 mg/kg, respectively. These detections are below background and do not indicate a surface release occurred. Migration of arsenic through clay soils is very slow making it unlikely that a past surface release could have resulted in the elevated detections below 5 ft. Based on the arsenic evaluation the concentrations of arsenic detected at S109-SB07 are naturally occurring at this location.

In addition, there is a general pattern of higher arsenic concentrations in the 5 - 10 ft. Soil interval across all areas sampled during the Franklin Steel RFI, although most do not exceed the background concentration of 28.5 mg/kg. Glacially-deposited soils in Ohio often contain concentrations of arsenic that are elevated well above the national average. It is likely that this soil interval represents such a soil deposit. This general geologic knowledge coupled with lack of elevated arsenic concentrations from the area's other soil samples indicate that the three detections do not represent contamination.

Metals in Groundwater

Aluminum, arsenic, cadmium, manganese, thallium, and vanadium are naturally occurring compounds that were detected in background groundwater samples. The background criteria (the maximum concentrations detected in the 76 background metal samples) for all five compounds are higher than or equivalent to the 95% UCL exposure concentrations for site-wide groundwater because most of the on-site detections were below background. Therefore, these six compounds are not COPCs.

6.7 REFERENCES

- Barnhart, J. 1997. Chromium chemistry and implications for environmental fate and toxicity. *J. Soil Contam.*, 6(6):561-568.
- Calabrese, E.J., E.J. Stanek, C.E. Gilbert, and R.M. Barnes. 1990. Preliminary adult soil ingestion estimates; results of a pilot study. *Regul. Toxicol. Pharmacol.* 12:88-95.
- Cox, Craig A., and Colvin, George H., 1996, Evaluation Of Background Metal Concentrations in Ohio Soils, June 21, 1996.
- Dourson, M.L., and J.F. Stara. 1983. Regulatory history and experimental support of uncertainty (safety) factors. *Reg. Toxicol. Pharmacol.*, 3:224-238.
- Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*. Van Nostrand Reinhold. New York.
- Hawley, J.K. 1985. Assessment of health risk from exposure to contaminated soil. *Risk Analysis*. 5:289-302.
- Kissel, J., K.Y. Richter, and R.A. Fenske. 1996. Field measurement of dermal soil loading attributed to various activities: Implications for exposure assessment. *Risk Analysis*. 16:115-125.
- Kissel, J., J.H. Shirai, K.Y. Richeter, and R.A. Fenske. 1998. Investigation of dermal contact with soil using a fluorescent marker. *J. Soil Contamination*. 7:737-759.
- Krablin, R. 1989. Letter to Jonathan Z. Cannon concerning soil ingestion rates. Denver, Colorado: Arco Coal Co. October 13.
- ERM-Midwest, Inc. 1993. Task III Report - RCRA Facility Investigation Work Plan. February 5, 1993.
- IRIS. Integrated Risk Information System, National Center for Environmental Assessment, U.S. Environmental Protection Agency, 26 West Martin Luther King Drive, MS-190, Cincinnati, Ohio 45268. (513) 569-7254.
- NPS. 1997. Environmental contaminants encyclopedia: Chromium VI (hexavalent chromium). National Park Service, Water Resources Division, Fort Collins, Colorado.
- Ohio EPA. Letter from Ronald E. Nabors (Site Coordinator) to Robert M. Hinson Approving Background Data Set. December 22, 1994.
- Ohio EPA. 1999. Closure Plan Review Guidance for RCRA Facilities. Ohio EPA, Division of Hazardous Waste Management. March, 1999.
- Ohio EPA. 1999. Ohio Voluntary Action Program, 3745-300. Ohio Environmental Protection Agency, Division of Emergency and Remedial Response, Columbus, Ohio.
- Ohio EPA. 2006. Closure Plan Review Guidance, Technical Background for Resource Conservation and Recovery Act Facilities. Ohio Environmental Protection Agency, Division of Hazardous Waste Management. May 2006 (Revised June 2006).
- Ohio EPA, 2001. Letter written to Franklin Steel Company in reference to Columbus Steel Drum, Franklin County, Ohio MSL I.D. No. 125-1368, Additional Sampling. June 2001.

- Ryan, E.A., E.T. Hawkins, et al. 1987. Assessing Risk from Dermal Exposure at Hazardous Waste Sites. In Bennett, G. and J. Bennett, eds. Superfund '87: Proceedings of the Eighth National Conference; November 16-18; Washington, D.C. The Hazardous Materials Control Research Institute. pp. 166-168.
- SAIC. 2003. RCRA Facility Investigation Report. Franklin Steel Company, Inc., Columbus, Ohio. 19 December.
- Shacklette, Hansford T., and Boerngen, Josephine G., 1984. Element Concentrations in Soil and Other Surficial Materials of the Conterminous United States. U.S. Geological Survey Professional Paper 1270.
- Stanek, E.J., E.J. Calabrese, and M. Zorn. 2001. Soil Ingestion Distributions for Monte Carlo Risk Assessment in Children. *Human and Ecological Risk Assessment* 7(2):357-368.
- TRW. 1996. Recommendations of the Technical Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil. U.S. Environmental Protection Agency, Technical Review Workgroup for Lead. December.
- U.S. EPA. 1989a. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A). Interim Final. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. EPA/540/1-89/002. December.
- U.S. EPA. 1989b. Assessing Human Health Risks from Chemically Contaminated Fish and Shellfish: A Guidance Manual. U.S. Environmental Protection Agency, Office of Marine and Estuarine Protection and Office of Water Regulations and Standards, Washington, DC. EPA-503/8-89-002. September.
- U.S. EPA, 1989c. Statistical Analysis of Ground-water Monitoring Data at RCRA Facilities. Interim Final Guidance, Office of Solid Waste, Waste management Division, U.S. Environmental Protection Agency, Washington, D.C., February, 1989.
- U.S. EPA. 1992a. Supplemental Guidance to RAGS: Calculating the Concentration Term. PB92-963373, May, 1992.
- U.S. EPA. 1992b. Dermal Exposure Assessment; Principles and Applications. EPA/600/8-91/011B, January, 1992.
- U.S. EPA. 1992c. Guidelines for Exposure Assessment. 57 Federal Register 57:22888-22938.
- U.S. EPA. 1993. Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure, Preliminary Review Draft.
- U.S. EPA. 1993. Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons. U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC. EPA/600/R-93/089. July.
- U.S. EPA. 1994a. Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities. OSWER Directive #9355.4-12. July, 1994.
- U.S. EPA. 1994b. Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) Version 0.99D and Guidance Manual for Integrated Exposure Uptake Biokinetic Model for Lead in Children. EPA/540/R-93/081. February 1994.

- U.S. EPA. 1994a. Methods for Derivation of Inhalation Reference Concentrations and Application of Inhalation Dosimetry. U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC. EPA/600/8-90/066F. October.
- U.S. EPA. 1994b. Revised Interim Soil Guidance for CERCLA Sites and RCRA Corrective Action Facilities. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC. OSWER Directive #9355.4-12. July.
- EPA. 1995. AP-42, Fifth Edition, January 1995. A Compilation of Air Pollutant Emission Factors.
- U.S. EPA. 1995a. Guidance for Risk Characterization. U.S. Environmental Protection Agency, Science Policy Council, Washington, DC. February.
- U.S. EPA. 1995c. Assessing Dermal Exposure from Soil. U.S. Environmental Protection Agency, Region 3. Philadelphia, Pennsylvania. EPA/903-K-95-003. December.
- EPA. 1996a. Soil Screening Guidance, Technical Manual.
- EPA. 1996b. Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposure to Lead in Soil. December.
- EPA. 1996c. "Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised," SCREEN3 Model. EPA-450/R-92-019.
- U.S. EPA. 1996c. EPA's Proposed Guidelines for Carcinogen Risk Assessment. U.S. Environmental Protection Agency, Office of Research and Development. EPA/600/P-92/003C. April.
- U.S. EPA. 1996c. "Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised," SCREEN3 Model. EPA-450/R-92-019.
- U.S. EPA. 1997b. Exposure Factors Handbook. Volumes I, II, and III. U.S. Environmental Protection Agency, Office of Health and Environmental Assessment, Washington, D.C. EPA/600/P-95/002Fa,b,c. August.
- U.S. EPA. 1997c. Health Effects Assessment Summary Tables (HEAST). FY 1997 Update. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA-540-R-97-036. July.
- U.S. EPA. 2001b. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. EPA/540/R/99/005. September.
- U.S. EPA. 2002b. Region 9 Preliminary Remediation Goals Table. www.epa.gov/region09/waste/sfund/prg/r9prgtable.xls
- U.S. EPA. 2003. Recommendations of the Technical Review Workgroup for lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil. U.S. EPA Guidance EPA-540-R-03-001. January 2003.
- Wester, R.C., H.I. Maibach, D.A.W. Bucks, L. Sedik, J. Melendres, C.L. Laio, and S. DeZio. 1990. Percutaneous absorption of [14C]DDT and [14C]benzo(a)pyrene from soil. Fund. Appl. Toxicol. 15:510-516.

7.0 SCREENING ECOLOGICAL RISK ASSESSMENT

Ecological risk assessment (ERA) defines the likelihood of harmful effects on plants and animals and their habitats as a result of exposure to chemical constituents. A screening ERA for the aquatic exposure units at the Franklin Steel facility was conducted by SAIC to evaluate the risk to plants, animals, and the environment from current and future exposure to possible contamination at the Franklin Steel exposure units. More precisely, a preliminary comparison or screening step was conducted on surface water and sediment at each exposure unit (EU) before the screening ERA.

The initial regulatory guidance for the ERA is contained in the U.S. Environmental Protection Agency's (EPA's) *Risk Assessment Guidance for Superfund (RAGS), Volume II, Environmental Evaluation Manual* (EPA 1989a) and subsequent documents (EPA 1991, 1992b). Further discussion on the scientific basis for assessing ecological effects and risk is presented in *Ecological Assessments of Hazardous Waste Sites: A Field and Laboratory Reference Document* (EPA 1989b). Other early 1990s guidance is provided in the *Framework for Ecological Risk Assessment* (EPA 1992a). A second generation of guidance consists of the *Ecological Risk Assessment Guidance* (EPA 1997, EPA 1998), which supersedes RAGS, Volume II (EPA 1989a). This latter guidance makes the distinction between the inter-related roles of screening and baseline ERAs. Briefly, a screening ERA utilizes conservative assumptions for exposures and effects, while a baseline ERA means increasingly exposure unit-specific, more realistic (and generally less conservative) exposures and effects and, if possible, includes site-specific biological effects. As stated above, this ERA is of the screening type.

These documents do not provide a detailed step-by-step approach to ERAs. Instead, they discuss an overall approach to considering ecological effects and identifying sources of information necessary to perform ERAs. Thus, professional knowledge and experience are important in ERAs to compensate for this lack of specific guidance and established methods. This professional experience comes from a team of risk scientists at SAIC, Ohio EPA and RMT.

7.1 SCOPE AND OBJECTIVES

The scope of the ERA is to characterize potential risk to plant and animal populations at the aquatic exposure units at the Franklin Steel facility. The ERA assesses the risk to ecological receptors, including both aquatic and sediment-dwelling species and terrestrial species exposed directly by consumption of water or through aquatic food chains. Unlike the human health risk assessment, which focuses on individuals, the ERA focuses primarily on populations or groups of interbreeding individuals. In the ERA process, individuals are always addressed if they are protected under the Endangered Species Act (ESA).

The objective of the ERA is to assess the potential for harmful effects on ecological receptors due to exposure to chemical contamination. These chemical constituents are called chemicals of potential ecological concern (ecoCOPCs). When it has been demonstrated that the ecoCOPCs may cause risk, they are called chemicals of ecological concern (ecoCOCs). At each exposure unit, the ERA examines both the direct and indirect effects of ecoCOPCs and ecoCOCs on the ecological receptors.

Analytical results from various surface water and sediment were compiled (Tables 4.3.2 through Tables 4.3.11), which identifies analytes that were retained for comparison and screening. Concentrations of these analytes were used along with chemical water quality criteria, ecological screening values (ESVs), and persistence parameters for a preliminary comparison that identified preliminary ecoCOPCs (Tables C.1 through C.11). Concentrations of preliminary ecoCOPCs that were retained after the preliminary comparison were used along with toxicity values to yield quantitative estimates of exposure and risk to ecological receptors (Tables C.12 through C.31 in Appendix C).

Another study was conducted in conjunction with the present screening ERA. The State of Ohio conducted field measurements and interpretations of aquatic use in Unzinger's Ditch (Ohio EPA 2001). This study included evaluations of fish and benthic invertebrate communities, determination of the Index of Biotic Integrity (IBI), and analysis of chemicals in sediment. The results were used with State of Ohio biological and chemical water quality criteria to determine the use designation(s) for Unzinger's Ditch and the attainment status at the site. These two studies (Ohio EPA 2001 and the Remedial Investigation results) were compared in this document.

7.2 PROCEDURAL FRAMEWORK FOR ERAS

According to the *Framework for Ecological Risk Assessment* (EPA 1992a), the ERA process consists of three inter-related phases: problem formulation, analysis (composed of exposure assessment and ecological effects assessment), and risk characterization. In conducting the ERA for the exposure units at the Franklin Steel facility, these three phases were completed by performing the following four inter-related steps:

Problem Formulation (Step 1). Problem formulation establishes the goals, breadth, and focus of the ERA and provides a preliminary characterization of chemical stressors (chemicals that restrict growth and media and reproduction or otherwise disturb the balance of ecological population and systems) present in the various aquatic habitats at the Franklin Steel exposure units. The problem formulation step also includes a preliminary characterization of the components, especially the receptor species, in the ecosystem likely to be at risk. In addition, problem formulation also includes the selection of assessment and measurement endpoints as a basis for developing a conceptual model of stressors, components, and effects. The preliminary ecoCOPCs are selected in this step (Section 7.3).

Exposure Assessment (Step 2). Exposure assessment evaluates the exposures of ecological receptors to chemical and physical stressors. It also describes the ecological receptors and defines the route, magnitude, frequency, duration, trend, and spatial pattern of the exposure of each receptor population or habitat to a chemical or physical stressor (Section 7.4).

Effects Assessment (Step 3). Effects assessment evaluates the ecological response to ecoCOPCs and physical stressors in terms of the selected assessment and measurement endpoints. The effects assessment results in a profile of the ecological response of animals to the chemical concentrations or doses of ecoCOPCs and to other types of stress to which receptors are exposed. Data from both field observations and controlled laboratory studies are used to assess ecological effects (Section 7.5).

Risk Characterization (Step 4). Risk characterization integrates exposure of ecoCOPCs on receptor populations using hazard quotients (ratios of exposure to effect). The resulting data are used to define the risk from contamination at each exposure unit, in contrast to background (naturally occurring) risk, and to assess the potential for population and ecosystem recovery (Section 7.6).

The discussion of the ERA presented in this report is organized by the four steps of the EPA framework. Sections 7.3 through 7.6 detail the technical issues and data evaluation procedures associated with each step in the screening ERA. Section 7.7 provides a summary of the Ohio EPA study and relates it to the risk assessment. Section 7.8 evaluates the degree of reliability or uncertainty of these methodological steps and the data used. The major findings are summarized in Section 7.9.

There are two types of ERAs: screening and baseline. The former is performed in the Franklin Steel work. Screening means the use of conservative exposure and effects while baseline means use of less conservative exposure and effects. There is one set of exposure/effect assumptions for the screening ERA while the baseline ERA integrates results of the screening ERA with site-specific observations of biological effects. To some extent the Biological and Sediment Quality Study by Ohio EPA constitutes a type of baseline ERA although it is not presented as such.

7.3 PROBLEM FORMULATION

The first step of EPA's approach to the screening ERA process, problem formulation, includes:

- Determination of the scope of the assessment (discussed earlier in Section 7.1)
- Formulation of a conceptual exposure unit model of the Franklin Steel exposure units based on existing information and reasonable assumptions, including habitats and populations, and any threatened and endangered species (Section 7.3.1)
- Description of habitats and sensitive species and selection of exposure units and ecological receptors (Sections 7.3.2 and 7.3.3)
- Identification of the hazards (i.e., ecoCOPCs) (Section 7.3.4)
- Selection of assessment and measurement endpoints for the ERA (Section 7.3.5)

7.3.1 Conceptual Exposure Unit Model

The conceptual exposure unit model of the Franklin Steel facility was developed for the ERA using the available exposure unit-specific information and professional judgment. The contaminant source, release mechanisms, exposure media, exposure routes, and ecological receptors to chemicals are described in this subsection. The conceptual exposure unit model in Figure 7.1 shows this process diagrammatically.

The conceptual exposure unit model for the Franklin Steel exposure units describes how receptors present or likely to be present at the exposure units are potentially exposed to analytes present in one or more source medium. The transport and exposure pathways linking contaminated source media and potential ecological receptors are shown in Figure 7.1. Potential routes of exposure to analytes in potential exposure media (i.e., surface water, sediment, and food) are indicated for aquatic receptors and classes. Not all receptors in each are exposed by all routes to analytes in the exposure media (e.g., top predators are not exposed to sediment analytes by direct ingestion of sediment, although indirect ingestion of sediment may occur). For receptors each class, potential exposure routes or pathways are classified as complete or incomplete depending on the likeliness of exposure by that route. Complete pathways are classified further as being evaluated quantitatively or qualitatively. Each part of the conceptual exposure unit model is explained in more detail below.

Contaminant Source. Various exposure units at the facility may have had a variety of releases, including releases associated with receiving activities, waste storage, handling, waste water and chemical treatments, and storage of drums. These releases may have migrated directly by surface runoff, storm water outfalls (i.e., Outfall 002) or sediment transport to the water bodies at or near Franklin Steel, especially Unzinger's Ditch, the S101 Siphon Dam, and the S201 Wetland. Some chemicals have been detected at concentrations above background or naturally occurring concentrations. The concentration of these site-related analytes are compared to site-specific background levels (see Sections 6.1.1, 7.3.4.1, and 7.3.4.2) to determine whether they need to be carried through the ERA.

Exposure Media. Sufficient time (generally 10 years or more) has elapsed for the analytes in original sources to have migrated to potential exposure media, resulting in possible exposure of aquatic and sediment biota that come into contact with these media.

Surface water and sediment are found in a number of ditches at or near the site (e.g., Unzinger's Ditch). Groundwater is not considered an exposure medium because ecological receptors are unlikely to contact groundwater at its depth of greater than 5 feet bgs. Soil exposure units are or soon will be developed into industrial properties; therefore, soil is not a viable exposure medium for the ERA. Air is not considered an exposure medium because potential volatile organic compounds (VOCs) are believed to have dissipated. Thus, surface water, sediment, and biota (e.g., food chains) were retained as the exposure media for the ERA.

Exposure Routes. A principal exposure route is contact of biota with surface water and sediment at the Franklin Steel EUs. Animals also are exposed through ingestion of contaminated prey species. Animals may potentially come into direct contact with surface water at Franklin Steel EUs by direct ingestion.

The exposure pathways that are the primary source of risk for terrestrial ecological receptors are aquatic plant and animal matter by animals in Unzinger's Ditch, the S101 Siphon Dam, and the S201 Wetland. For aquatic organisms, the primary sources of analytes are the sediment/water itself and contaminated food. The exposure pathways are evaluated quantitatively using exposure unit measurements and published exposure parameters and toxicity data.

Receptors. Both aquatic receptors and terrestrial receptors that feed on aquatic organisms are recognized in the conceptual exposure unit model presented in Figure 7.1 and are discussed in Section 7.4.1.

7.3.2 Habitats and Sensitive Species

The following discussion is based on site walkovers conducted in August and September 1998 and information obtained from the U.S. Fish and Wildlife Service (USFWS) and Ohio Department of Natural Resources (ODNR).

7.3.2.1 Habitats

The land use surrounding the Franklin Steel facility is a mixture of industrial, light industrial, agricultural, and undeveloped land. Habitats present in the area include very limited to no habitat in developed areas (e.g., paved areas, gravel lots, and lawns), monoculture croplands (soybeans), early successional old fields (approximately 6-8 yrs. in age), small wetlands, a narrow riparian corridor, and tree-lines separating larger habitats. Because there is limited habitat for terrestrial animals, the lack of important terrestrial ecological resources, and future development of the terrestrial habitat is anticipated, potential risks from exposure of terrestrial biota to soil were not evaluated in the ecological risk assessment. Aquatic habitats are summarized in Table 7.1. Each aquatic habitat is explained below.

Unzinger's Ditch and the S101 Siphon Dam

Unzinger's Ditch is small and has few tributaries; it is a southerly-flowing stream which drains the area. Near Franklin Steel and south to Blacklick Creek, Unzinger's Ditch is lined with a narrow band of trees (one to two trees wide on both sides) forming a riparian corridor (see Photo 1). Tree species include mainly pin oak (*Quercus palustris*), honey locust (*Gleditsia triacanthos*), swamp white oak (*Quercus bicolor*), and green ash (*Fraxinus pennsylvanica*). The area drained near the facility consists of old fields, soybean fields, paved areas, and a railroad track. A culvert from the S101 Siphon Dam discharges 55 m south of River Mile (RM) 0.73 to Unzinger's Ditch southeast of the facility. The drainage area south of the facility includes soybean fields and further south, industrial and light industrial facilities prior to discharging to Blacklick Creek.

Tree-lines separate many of the agricultural fields, old fields, and industrial areas from one another. These tree-lines are limited to a few dominant species such as pin oak, cottonwood, black cherry (*Prunus serotina*), sassafras (*Sassafras albidum*), American elm (*Ulmus americana*), and white ash (*Fraxinus americana*).

An additional observation pertains to the presence of sediment and chemical contamination in Unzinger's Ditch. Sediment constitutes a physical stressor that moves from place to place during normal water flow and especially during storm events. The movements of sediment expose one area and cover another. The same is true of quantities of chemicals as they move with the sediment in the stream. The organisms, such as benthic macroinvertebrates, that live in the creek are affected by the physical movements of sediment per se as well as any additional chemicals mixed with the sediment. When sediments contain contaminants, especially high

levels of petroleum compounds, the exposing and physical smothering of benthic organisms takes on an added dimension to the consequences of sediment alone.

Recently, Ohio EPA published a biological and water quality study of Blacklick Creek and selected tributaries (Ohio EPA, 1998). A reference to Unzinger's Ditch on page 7 reads that pollutant loads "... were minimal and appeared to have little effect on the water quality of Blacklick Creek." However, the total suspended solids (TSS) loading to Blacklick Creek, as detailed in the Ohio EPA (1998) report's chart on page 26, indicates that the Franklin Steel site (Columbus Steel Drum) contributes 8.00% of the relative TSS loading to Blacklick Creek, which is greater than the Jefferson Township Wastewater Treatment Plant contribution of 5.4%. Aquatic habitats in Unzinger's Ditch have been classified into two stretches, warmwater habitat in the lower reach (0 to 0.6 miles) of the stream, and limited resource water in the upper reach (0.6 to 1.1) miles. This classification was confirmed in 2000 (Ohio EPA 2001). The chemical-specific water criteria are promulgated standards as explained in the Ohio Administrative Code and, thus, the State of Ohio Water Quality Standards were used as described in Section 7.3.5. Where State of Ohio Water Quality Standards were absent, ecological screening values were used.

Wetlands

A small, palustrine emergent wetland is located just northwest of S201. This wetland is roughly circular and approximately 3.5 acres in size, with a perimeter of approximately 0.19 miles. It is an isolated, depressional spot characterized by a shallow pool of open water, surrounded by a ring of vegetation. The central portion of the wetland was disturbed during the installation of a sewer line by the City of Gahanna in the fall of 2000. This vegetation is herbaceous and consists primarily of rice cut grass (*Leersia orzyoides*), beggar-ticks (*Bidens* spp.), rushes (*Juncus* spp.), and sedges (*Carex* spp. and *Cyperus strigosus*). Several dead trees are present. The shallow pool was completely dry in mid-September, 1998 as a result of drought conditions (see Photo 2). In January 2001, Ohio EPA evaluated the wetland using the Ohio Rapid Assessment Method (ORAM). The wetland received a score of 46.5 and was classified as Category 2.

The southern border of S201 consists of a drainage ditch flowing east and discharging to Unzinger's Ditch. This drainage contains primarily cattails (*Typha latifolia*), sedges, beggar-ticks, and water plantain (*Alisma plantago-aquatica*) (see Photo 3).

Several small patches of wetland vegetation are present at S109 and S201 in small, depressional areas and tire ruts. These areas contain cattails, sedges, cottonwood, and willows.

Sensitive Habitats

ODNR did not identify any sensitive habitats on the Franklin Steel property during their natural heritage data search (see Appendix D). ODNR did note that Gahanna Woods Nature Preserve is located within one mile of the facility.

7.3.2.2 Animal Populations

Resident amphibians and reptiles that use the aquatic EUs likely would include some of the following common species: American toad (*Bufo americanus*), bullfrog (*Rana catesbeiana*), wood frog (*Rana sylvatica*), snapping turtle (*Chelydra serpentina*), painted turtle (*Chrysemys picta*), and northern water snake (*Nerodia sipedon*).

A few bird species could use the available aquatic habitats as foraging areas. Species sighted during walkover included great blue heron (*Ardea herodias*), which is assumed to forage in the water bodies.

Numerous arthropod species (e.g., insects, spiders) are present. For example, butterflies and moths (lepidoptera), beetles (coleoptera), bees, wasps, and ants (hymenoptera), and flies (diptera) all were seen during the site walkover.

The wetland areas, drainage ditches, and Unzinger's Ditch provide habitat for aquatic insects and other arthropods (e.g., crayfish), amphibians and reptiles, as well as small fish such as minnows and darters. None of these upstream aquatic environments is believed to be sufficiently large to provide adequate habitat for large game fish. The Ohio EPA (2000) study confirms the presence of many tolerant species and some intolerant species of aquatic organisms.

7.3.2.3 Threatened and Endangered Species

The USFWS and ODNR were contacted regarding the presence of federally- and state-listed threatened and endangered (T&E) species (see Appendix D). The Franklin Steel facility is located within the ranges of five federally-listed endangered species that might use the aquatic habitats. These species include: Indiana bat (*Myotis sodalis*), Scioto madtom (*Noturus trautmani*), clubshell mussel (*Pleurobema clava*), and the northern riffleshell (*Epioblasma tortulosa rangiana*). USFWS noted that except for the Indiana bat, no impact to these species is expected from activities at the facility. Summer habitat for the Indiana bat (dead trees, trees with exfoliating bark, stream corridors, riparian areas, and woodlots) should be conserved wherever possible. In general, the industrial activity and disturbed environments are believed to make the presence of Indiana bats near the facility highly unlikely. In addition, available summer habitat is very limited.

ODNR noted that two animal species and two plant species with special status in Ohio have been sighted within one mile of the facility at the Gahanna Woods Nature Preserve. Species that might be associated with the aquatic habitats include: four-toed salamander (*Hemidactylium scutatum*) - special interest, cypress-knee sedge (*Carex decomposita*) - endangered, and false hop sedge (*Carex lupuliformis*) - threatened. None of these species was sighted during the site walkover.

7.3.3 Selection of Exposure Units and Receptor Species

From the ecological assessment viewpoint, an EU is the investigation area composed of combined habitats containing site-specific analytes and distinct from other habitats by some feature, for example a pond or wetland, as distinct from a ditch or stream. Ecological receptors are likely to gather food, seek shelter, reproduce, and move around in the EU, and as a result of these activities, be potentially exposed to EU analytes. Thus, each EU was defined on the basis of existing habitat, observed and assumed patterns of behavior of the receptors, and the spatial area of exposure unit habitats relative to the home range and foraging areas of the receptors. On the basis of the biological and sediment quality study (Ohio EPA 2001), Ohio EPA divided Unzinger's Ditch into two segments: the lower 0.6 mile has physical habitat conditions that could support a warmwater biological community and was classified as Warmwater Habitat; and the habitat upstream of mile 0.6 cannot support a typical warmwater fish community and was classified as Limited Resource Water (Ohio EPA 2001). The downstream and upstream segments are represented chemically by samples taken either downstream or upstream of a 15-inch tile outfall just upstream of Mile 0.6.

The spatial boundaries of the ecological EU are the same as the units defined for the human health risk assessment. These EUs are the specific Franklin Steel exposure units included in this investigation:

- Unzinger's Ditch, downstream
- Unzinger's Ditch, upstream
- Outfall 002
- S101 Holding Pond (Siphon Dam)
- S201 Wetland

Receptors for the ERA at the Franklin Steel exposure units were selected from animal species found in aquatic habitats, using three criteria specified in *Guidelines for Ecological Risk Assessment and Superfund Guidance* (EPA 1997). Receptors were selected according to their ecological relevance, susceptibility to known or potential stressors, and representativeness of management goals, as shown in Table 7.2.

The selected receptors are ecologically relevant because they represent important resources of the ecosystems at the Franklin Steel facility, contributing to the structure, function, and biodiversity. These receptors interact as food sources and consumers, forming a food web through which both nutrients and analytes move through the ecosystem. Figure 7.2 shows food webs for the receptors. Due to their range of body sizes, diets, life spans, reproductive rates, home ranges, and taxonomic relationships, these receptors represent a range of potential susceptibilities to analytes at the Franklin Steel facility. All of these receptors are potentially exposed to analytes at Franklin Steel exposure units because they are present or likely to be present there, and they ingest or live in direct contact with contaminated prey or media. The selected receptors are judged to be consistent with general management goals of protecting the environment, including T&E or other species with special status.

7.3.4 Preliminary Ecological Chemicals of Potential Concern

Preliminary ecoCOPCs are those substances detected at each exposure unit at concentrations above background that have the potential to pose a hazard to animals. The potential exposure media are surface water and sediment.

A preliminary comparison was done to eliminate analytes that meet Ohio EPA chemical water quality criteria, are not toxic at the measured concentrations, and are not likely to accumulate to toxic levels. The selection of preliminary ecoCOPCs was done by comparing maximum analyte concentrations to chemical water quality criteria promulgated in Ohio Administrative Code (OAC) 3745-1 or to ecological screening values (ESVs), chemical concentrations that are expected not to harm aquatic or sediment-dwelling biota, as described in the following subsections. Analytes whose concentrations were below the chemical water quality criteria or ESVs were not retained as preliminary ecoCOPCs (Table 7.3). The selection of preliminary COPCs was done as described in the following subsections.

7.3.4.1 Surface water

The results of analysis of media samples were gathered and evaluated. Analytical results for surface water were expressed as $\mu\text{g/L}$ of water. Analytes that were not detected (i.e., were less than analytical blank concentrations and/or method detection limits), and analytes that were never detected at concentrations greater than background concentration (see Section 6.1.1), were not retained for further assessment. Background concentrations for surface water are shown in Tables 4.3.2, 4.3.2A, 4.3.9, and 4.3.11.

Criteria for the evaluation of surface water and sediment depend on the type and use designation of surface water. Surface water is classified as lentic (not flowing) or lotic (flowing) [Ohio Administrative Code (OAC) Chapter 3745-1]. Lotic streams are further classified according to the habitat appropriate to the stream segment. Outfall 002, S101 Siphon Dam and the S201 Wetland are classified as lentic, whereas Unzinger's Ditch is classified as lotic; the upstream segment is further classified as Limited Resource Water, and the downstream segment is classified as Warmwater Habitat (Ohio EPA 2001). Chemical water quality criteria for surface water are promulgated by the State of Ohio in OAC 3745-1. The maximum measured concentrations of analytes in lentic surface water were compared to the Ohio chemical water quality criteria specified for the use designation of each EU. Analytes with concentrations above chemical water quality criteria were retained as ecoCOPCs. Analytes for which there were no chemical water quality criteria were compared to ESVs (see Section 7.3.4.3 below), and analytes that met screening criteria (see Section 7.3.4.3) were not retained as ecoCOPCs. Analyte concentrations in lotic surface water were compared in the same

way, and the stream segment also had to meet biological criteria appropriate to the aquatic life habitat designation (OAC Chapter 3745-1).

7.3.4.2 Sediment

The results of analysis of sediment samples were gathered and evaluated. Analytical results for sediment were expressed as mg/kg of dry sediment. Analytes that were not detected (i.e., were less than analytical blank concentrations and/or method detection limits), and analytes that were never detected at concentrations greater than background concentration (see Section 6.1.1), were not retained for further assessment. Background concentrations for sediment are shown in Tables 4.3.2, 4.3.2A, 4.3.9, 4.3.11, and 4.3.12.

Analyte concentrations in sediment were compared to ESVs for sediment (see Section 7.3.4.3 below). Analytes that met screening criteria (see Section 7.3.4.3) were not retained as preliminary ecoCOPCs. In addition, a lotic stream segment must meet the biological criteria for aquatic life appropriate to the stream segment's classification.

7.3.4.3 Hierarchy of Screening Values

The comparison of concentrations at each EU was done for surface water and sediment. The chemical water quality criteria and toxicity screening values for surface water and sediment are shown in Appendix Tables C.1 and C.2 respectively. The Ohio EPA recommended hierarchy for comparisons to water quality criteria and toxicity screening values for the Franklin Steel ERA is as follows:

For surface water:

1. OMZM (outside mixing zone maximum) values from Ohio Chronic Water Quality Criteria for the Ohio River Basin (OAC Chapter 3745-1-33 as Amended on October 31, 1997). These are promulgated chemical criteria that must be met by any stream that has been given a use designation by Ohio EPA (OAC 3745-1). OMZM values were used because the surface water values were from grab samples rather than time-averaged values.
2. National Ambient Water Quality Criteria and Tier II Chronic Screening Values (compiled and published by Suter and Tsao 1996).
3. Ecological Data Quality Levels (EDQLs) for surface water published by U.S. EPA Region 5 (1998).

For sediment:

1. Consensus threshold effect concentrations (TECs) published by MacDonald et al. (2000). Concentrations below TECs are not expected to cause adverse effects.
2. EDQLs for sediment published by U.S. EPA Region 5 (1998).

7.3.4.4 Other Criteria

Persistent, bioaccumulative, and toxic (PBT) pollutants - PBT pollutants are chemicals that are not readily metabolized by ecological receptors, are expected to bioaccumulate, and are toxic. Any inorganic analyte with a measured or predicted bioconcentration factor (BCF) of 2 or greater was retained for further evaluation. Any organic analyte for which the logarithm of the octanol-water partitioning coefficient (log Kow) is 4 or greater was retained for further evaluation. BCFs and log Kows are shown in Appendix Table C.3.

Essential nutrients - four analytes (calcium, magnesium, potassium, and sodium) are considered to be biologically necessary components of ecological systems and biological organisms. These were considered to be ecoCOPCs regardless of their low potentials for producing adverse effects.

The first criterion or screening value from the hierarchy list for each medium is used, even if a lower number exists from another source. When the first listed source has no number, reliance is given the second source and so forth. As stated, the screening values for surface water and sediment are shown in Appendix Tables C.1 and C.2 respectively. The EU-specific maximum concentrations were compared to the screening values for each medium and reported in Appendix Tables C.4 through C.11.

7.3.4.5 Results

The results of the comparisons (water quality standards or ESVs and maximum concentrations) are presented in Appendix Tables C.4 through C.7 for surface water and Appendix Tables C.8 through C.11 for sediment, at the downstream and upstream reaches of Unzinger's Ditch, Outfall 002, the S101 Siphon Dam, and the S201 Wetland, respectively. The values shown are the maximum observed concentrations of each analyte within the corresponding medium for each EU. Analytical results for surface water are presented as µg/L of water; those for sediment are presented as mg/kg of dry sediment.

The surface water comparison yielded a total of 12 inorganic preliminary ecoCOPCs out of 19 analytes detected, 10 semivolatile preliminary ecoCOPCs out of 14 analytes detected, and no volatile preliminary ecoCOPC out of 4 analytes detected (Table 7.3). For sediment, there were 22 inorganic preliminary ecoCOPCs out of 25 analytes detected, 27 semivolatile organic preliminary ecoCOPCs out of 27 analytes detected, and 4 volatile organic preliminary ecoCOPCs out of 11 analytes detected (Table 7.3). Table 7.3 also indicates which analytes were retained because they exceeded Ohio chemical water quality criteria.

Analytes that were retained as preliminary ecoCOPCs by the preliminary screen were evaluated by a second screening assessment that identified ecoCOPCs. Methods and results of the screening risk assessment are presented in Sections 7.4 through 7.6.

7.3.5 Ecological Assessment and Measurement Endpoints

The protection of ecological resources, such as the plants and animals and habitats described in Section 7.4.1, is mandated by a variety of legislation and government agency policies (e.g., the Resource Conservation and Recovery Act [RCRA] and the National Environmental Policy Act [NEPA]), which establish protection goals. To determine whether this protection goal has been met, assessment and measurement endpoints were formulated to define the specific ecological values to be protected and the degree to which each may be protected.

An *assessment endpoint* is defined by EPA (1992a) as “an explicit expression of the environmental value that is to be protected.” A *measurement endpoint* is defined by EPA (1992a) as “a measurable ecological characteristic that is related to the valued characteristic chosen as the assessment endpoint.” Assessment endpoints are societal values expressed as ratios that, if they exceed 1.0 or unity, suggest the need for further examination. The ratios compare an exposure concentration (estimated from a measured concentration in a medium) and an effects concentration (e.g., the toxicity threshold below which there are no adverse effects). Measurement endpoints are the measurement or concentrations (of a chemical and a toxicity threshold) that are used to define and develop the ratio in the assessment endpoint.

Two such policy goals were defined for the Franklin Steel exposure units. Assessment and measurement endpoints, along with decision criteria, are provided with each policy goal in Table 7.4:

- **Policy Goal 1** - The conservation of threatened, endangered, and rare species and their critical or environmentally sensitive habitats
- **Policy Goal 2** - The protection of aquatic populations and ecosystems.

Table 7.4 must be used to understand these matters fully.

The assessment endpoints or ecological resources and their evaluation for the ERA are stated quantitatively in terms of toxicity or hazard quotients (Barnhouse et al. 1986). A hazard quotient is the ratio of the measured or predicted concentration of an analyte to which receptors are exposed in an environmental medium, and the measured concentration of an analyte that adversely affects an organism (benchmark or toxicity threshold). If the measured concentration equals or is less than the concentration producing an adverse effect (i.e., the ratio of the two, or the hazard quotient, is less than or equal to 1), the risk is considered acceptable (protective of the ecological receptor). Any hazard quotient greater than 1 indicates that the ecoCOPC qualifies for further investigation. Risk or hazard or toxicity quotients are presented in Appendix C and summarized in Section 7.6 for the screening ERA. Identification of the ecoCOCs is possible only after additional evaluation of observed biological effects and of the applicability of exposure assumptions, toxicity thresholds, and uncertainties (e.g., background risk).

Ratios for assessment endpoints 1, 2, and 3 were calculated for ecoCOPCs in surface water and sediments, as shown in Table 7.4. Assessment endpoint 1 deals with the protection of T&E species. The ratios for assessment endpoint 2 were calculated for ecoCOPCs in surface water, and deal with the protection of aquatic biota, and fish-eating terrestrial predators. The ratios for assessment endpoint 3 were calculated for ecoCOPCs in sediment, and deal with the protection of sediment-dwelling biota. Calculation and evaluation of the Hazard Quotients (HQs) for the ecological receptors are discussed in Section 7.6 for the screening ERA.

7.4 EXPOSURE ASSESSMENT

Step 2 of EPA's four-step ERA process, as it applies to the Franklin Steel exposure units, is discussed in this section. The exposure assessment describes the receptors and quantification of exposure; it examines the route, magnitude, frequency, duration, trend, and spatial pattern of exposure of each receptor population and habitat to a chemical or physical stressor. For this assessment, exposure of aquatic biota to analytes whose concentrations exceeded Ohio chemical water quality criteria in surface water were not further evaluated for risk. However, exposure of raccoons and herons to those analytes and exposure of all receptors to the other preliminary ecoCOPCs in surface water was evaluated, as was exposure to preliminary ecoCOPCs in sediment.

7.4.1 Ecological Receptors and Their Exposure

The risk assessment evaluates the potential for adverse effects measured from the assessment endpoints. The ecological receptors were chosen to reflect the assessment endpoints. The primary receptor categories (e.g., aquatic biota; sediment-dwelling biota; consumers of surface water, i.e., raccoon; and predators of aquatic biota, i.e., great blue heron) group together species with similar feeding habits and physiologies. Each exposure class for the Franklin Steel facility represents an assessment endpoint.

7.4.1.1 Aquatic Exposure Classes and Receptors

The aquatic exposure classes and their ecological receptors at the Franklin Steel facility are:

- Fish and aquatic invertebrates, which include omnivores (e.g., minnows), predators (crayfish), and fish;
- Sediment-dwelling organisms, including caddisflies, mayflies, and worms; and

- Water-drinking terrestrial animals and fish-eating carnivores
 - Raccoon.
 - Great blue heron

Fish and Aquatic Animals. Fish and aquatic animals are exposed primarily to chemicals in surface water and in the food they ingest. The exposure concentration for these animals is assumed to be equal to the measured surface water concentration because the aquatic toxicity thresholds used are expected to protect aquatic life exposed through multiple pathways. It is assumed that all aquatic animals (omnivores, predators, and fish) are exposed to the full concentration in surface water by direct contact and all other pathways. Although sediment-ingesting fish are exposed to analytes in both sediment and surface water, there are no known dietary toxicity data for such fish.

Sediment-Dwelling Organisms. Sediment-dwelling organisms include the benthic macroinvertebrates such as mayflies (ephemeroptera), stone flies (plecoptera), and caddisflies (trichoptera) - three taxa of benthic insects that are unusually sensitive to pollutants. In addition, other invertebrates such as clams, snails, and worms are sediment-dwelling organisms.

Water-Drinking Terrestrial Animals and Fish-eating Carnivores. The raccoon (*Procyon lotor*) is a commonly encountered mammal in the riparian areas, fields, and forests near the Franklin Steel facility (Table 7.5). The raccoon drinks water in the exposure model. Dermal contact with water is expected to be minor. Great blue herons (*Ardea herodias*) (Table 7.6) prey upon fish and other aquatic organisms in creeks and ditches. Bioaccumulated ecoCOPCs in fish bodies could be passed along to this predator. The exposures of these receptor classes to analytes are estimated from the measured concentrations in the surface water or sediment and adjusted by exposure factors, as described below.

7.4.2 Quantification of Exposure

The exposure of an endpoint receptor to a chemical in surface water or sediment at the Franklin Steel facility was quantified using measured concentrations in the environment and exposure factors to estimate a receptor's exposure per unit concentration of ecoCOPC in the sampled source or exposure medium. Exposure factors numerically represent the dilution and magnification of contaminant concentrations that potentially occur along the pathways from source media to the exposed organism. For example, if a receptor obtains one-half (50 percent) of its food from an area where the water contains one unit of a substance, the receptor's food bioaccumulates the substance four times over the water concentration, and the receptor absorbs 100 percent of the substance in the food, the receptor would have an exposure factor of 2 for that contaminant ($0.5 \times 4 \times 1.0 = 2$). The exposure concentration for an endpoint receptor is obtained by multiplying the measured chemical concentration in a given medium by exposure factors for the endpoint receptor and the ecoCOPC. For the screening ERA, the concentration used was the RME concentration, which is defined as the lower of the 95th percentile upper confidence limit (UCL) on the mean of sample concentrations and the maximum observed value. The UCL was calculated by methods described by U.S. EPA (EPA 1992).

Exposure factors are based on published information on diets, the bioaccumulation potential of chemicals, and foraging areas of the receptors (EPA 1993a). The exposure parameters for the endpoint receptors at the Franklin Steel facility are provided in the food web (Figure 7.2), life history parameter tables (Tables 7.5 and 7.6), and bioaccumulation tables (Appendix C, Table C.3). Raccoons are assumed to be exposed to surface water analytes only by ingestion of surface water; surface water is assumed not to be a source of contamination to terrestrial food consumed by the raccoon (Table 7.5). Great blue herons are considered to ingest fish from the surface water EUs but only negligible amounts of plant matter and surface water (Table 7.6).

Exposure equations are presented below. The general equation is:

$$\text{Exposure} = \text{RME concentration} \times (\text{Quantity of ingested food adjusted for contaminant uptake} + \text{quantity of medium ingested}) \times \text{AUF} \times \text{TUF}$$

where:

- RME = Reasonable maximum exposure (mg/L water)
- AUF = Area use factor, which equals 1 for most receptors (unitless)
- TUF = Temporal use factor, which equals 1 (unitless), and therefore, TUF does not appear in the equations below

The equation for sediment-dwelling organisms exposed to analytes in sediment is:

$$\text{Exposure} = \text{RME concentration}$$

where:

- RME = Reasonable maximum exposure (mg/kg sediment)

The exposure of raccoons and great blue herons to analytes in water was calculated for both ingestion of aquatic food and drinking water. Dermal exposure is expected to be minor. The equations were:

- For water - Exposure = RME concentration $\times I_w \times \text{AUF}$
- For food - Exposure = RME concentration $\times \text{BCF} \times I_A \times \text{AUF}$

where:

- RME = Reasonable maximum exposure (mg/L)
- I_w = Daily ingestion of water (L/kg body wt/d).
- AUF = Area use factor, which is assumed to be 1 (unitless)
- BCF = Water-to-animal uptake factor (L/kg tissue)
- I_A = Daily ingestion of animal tissue (kg/kg body wt/d)

Likewise, the equation for aquatic organisms exposed to analytes in water is:

$$\text{Exposure} = \text{RME concentration}$$

where:

- RME = Reasonable maximum exposure (mg/L water).

The RME concentration is the lower of the maximum detected concentration and the upper 95th percentile confidence limit (UCL) on the mean. The RME is a conservative estimate of the central tendency of the distribution of contaminant concentrations in samples. The RME concentrations used to estimate exposure are provided in Appendix C, Table C.12.

Body weights for each receptor, ingestion rates, and conversion factors used to calculate dietary exposure are provided in the receptor tables (Tables 7.5 and 7.6). The fraction of the ecoCOPC detected in ingested water and tissue that is absorbed was assumed to be the same as that determined through laboratory experiments.

Ecological receptors use space for food gathering, hiding from predators, resting and reproducing. This space or area is called the home range. The ratio of the size of the EU to the home range is designated the area use factor. For raccoons and herons, the size of the EU is given as the length of stream or pond edge where the water is accessible. The home ranges are given in Tables 7.5 and 7.6, and AUFs were calculated from these values.

Continuous year-round exposure was assumed for all receptors. Therefore, the TUF is 1 and was not expressed in the exposure equations.

These assumptions are compatible with the conservative nature of the screening ERA, and these assumptions were endorsed by Ohio EPA during the conceptual planning stage.

Toxicity reference values for raccoons and herons described in Section 7.5 are expressed in mg/kg BW/d. Thus, the comparison of exposure as average daily dose and effects as toxicity reference values are in the same units to permit one-to-one comparisons.

The contaminant-specific values for water-to-animal (BCF) bioaccumulation are detailed in Appendix C, Table C.3. When the BCF was not available for an inorganic analyte, a default value of 500 was used. When a BCF was not available for an organic analyte, a BCF was calculated by using the relationship $\log(\text{BCF}) = 0.76 \times \log(\text{Kow}) - 0.23$ (Lyman, Rheel, and Rosenblatt 1990). The BAFs for prey ingested by herons are the reported BCFs for fish.

As stated earlier, it is assumed that toxicity values for aquatic receptors exposed directly to sediment and surface water take into account any uptake of ecoCOPCs by the receptors. Therefore, exposure for aquatic receptors is equal to the media concentration. When exposures of predators to aquatic prey are modeled, bioconcentration factors are used as provided in Appendix Table C.3.

7.4.3 Summary of Exposure Assessment

The RME concentrations of ecoCOPCs in surface water and sediment at the Franklin Steel facility are multiplied by bioconcentration factors, ingestion rates, and AUFs to estimate exposure concentrations for each endpoint receptor. Exposure concentrations are the concentrations of ecoCOPCs in these abiotic media and their prey to which the endpoint receptors are exposed. These exposure concentrations will be compared to published toxicity threshold concentrations (Section 7.5) to characterize the risks to endpoint receptors from direct and indirect exposure to ecoCOPCs in environmental media at the Franklin Steel facility (Section 7.6).

7.5 EFFECTS ASSESSMENT

The third step in EPA's ERA framework is discussed below. The purpose of the effects assessment is to present and evaluate the potential response of various receptors to ecoCOPCs and physical stressors at the Franklin Steel exposure units. Depending on the parameters of exposure, the effects assessment results in a profile of the potential response of receptors to stressors at concentrations or doses (or other units of stress) to which they are exposed.

7.5.1 Chemical Toxicity

Chemicals in the ecosystem may be directly toxic to organisms or indirectly harmful by reducing an organism's ability to survive and reproduce. These disparate effects are characterized by different dose response relationships and may result from different exposure pathways. The toxicity thresholds used for organisms at the Franklin Steel facility ERA are based on toxic effects observed in laboratory studies.

Chronic toxicity resulting from long-term exposure to ecoCOPCs is the primary concern at the Franklin Steel ERA. VOCs are unlikely to be present at high concentrations because they have degraded, volatilized, and/or have been transported off the site. Most organisms do not ingest large amounts of sediment. However, VOCs were quantitatively evaluated for the direct exposure pathway for sediment.

Some metals (e.g., selenium) accumulate in animal tissues and can have subtle deleterious effects on animals over long exposure times. Many lipid or fat attracting organic analytes can biomagnify in animals. No investigations into chronic effects on local plants and animals as a result of exposure to ecoCOPCs have been conducted at the Franklin Steel facility, and, therefore, reliance was placed on published laboratory studies that were extrapolated to the field situation at Unzinger's Ditch.

The toxicity of surface water and sediment analytes varies depending on the receptor species and the attending physical and chemical factors, the presence of complexing agents, or interaction with other chemicals at the Franklin Steel exposure units. Animals can be adversely affected in terms of behavioral and physiological changes, including reproductive impairment.

7.5.2 Toxicity Reference Values

The effects assessment for the exposure-unit specific screening uses toxicity benchmarks obtained from published databases. The toxicity benchmarks for aquatic biota and sediment-dwelling biota were the preferred screening values, renamed as toxicity reference values (TRVs) in the computation tables that are presented in Appendix Tables C.1 and C.2, respectively. The sources and descriptions of the toxicological benchmarks for the surface water and sediment screening values were presented in Section 7.3.5. These tables present three criteria or thresholds for chemicals in water and two for chemical in sediment. For surface water, the first value is not used as the preferred threshold in the screening ERA because it is the Ohio water quality criterion against which all analyte concentrations were previously compared (Section 7.3). Instead, the second source is used; for sediment, only the first value is used. EDQLs were not used as TRVs in this evaluation. The dietary toxicity benchmarks for the wildlife receptors mostly were obtained from Sample et al. (1996), and they are summarized in Appendix Tables C.13 (raccoon), C.14 (raccoon after body-weight adjustment) and C.15 (heron).

Two types of toxicological data that were used to assess effects of exposure unit contaminants on terrestrial ecological receptors exposed in aquatic habitats include:

No Observable Adverse Effect Levels (NOAELs). NOAELs are the highest tested concentration that caused no statistically significant increase in adverse effect to the test species in a toxicity test.

Lowest Observable Adverse Effect Level (LOAELs). LOAELs are the lowest tested concentration that caused statistically significant increase in adverse effect to the test species in a toxicity test.

For the exposure unit-specific screens, chronic NOAELs are the preferred toxicity benchmark because the screen is meant to be conservative. Thus, chronic NOAELs were used whenever possible, especially for the dietary toxicity benchmarks for the wildlife receptors. Dietary TRVs for the wildlife receptors were obtained by adjusting test species TRVs for uncertainties due to toxicity test durations and endpoint differences. Specifically, if the laboratory toxicity test duration for the effects study of a chemical was acute instead of chronic, the reported NOAEL was multiplied by an uncertainty factor of 0.1. Likewise, if the observed effect was a LOAEL instead of a NOAEL, the reported value was multiplied by an uncertainty factor of 0.1. These adjustments to the test species dietary TRVs were assumed to compensate for the uncertainty associated with the extrapolations from the test species to the wildlife species. Any adjustments to the NOAELs and LOAELs for the mammals or birds are explained in the columns and footnotes to Appendix Tables C.13 and C.15, respectively.

Ecological effects data are available for many ecoCOPCs at the Franklin Steel facility. These data encompass effects arising from exposure to ingested matter, especially water and food for animals. Data are available for ecological receptors in the exposure classes for the EUs at the Franklin Steel facility. These data are used in the screening of analytes to identify inorganic and organic ecoCOCs in the surface water and sediment. Risks are calculated using the toxicity thresholds for ecoCOPCs.

TRVs are not available for some analytes, especially for sediment-dwelling biota. High concentrations of bis(2-ethylhexyl) phthalate in Unzinger's Ditch are of particular concern, and no published TRV was available for sediment. Because of the special concern for bis(2-ethylhexyl) phthalate, an alternative method was used to derive a TRV for sediment. This method is described in the following paragraphs.

A sediment quality benchmark (SQB) for bis(2-ethylhexyl) phthalate in sediment was derived by calculating potentially toxic concentrations by equilibrium partitioning (EPA 1993b). The equilibrium partitioning approach (EPA 1993b) can be used for non-polar contaminants in sediment. It assumes that the fraction of the contaminant that is dissolved in pore water is the actual toxic agent. The SQB is estimated by using the water quality benchmark (WQB) as the pore-water concentration, along with the organic carbon-water partitioning coefficient (Koc), and the fraction of organic carbon (Fc) in the sediment. The equation is:

$$\text{SQB} = \text{WQB} \times \text{Koc} \times \text{Fc}$$

Because the preliminary remediation goal (see Section 8) is intended to protect against toxicity for chronic exposure, a chronic water quality benchmark is appropriate. The Ohio EPA water quality benchmark for chronic exposure to bis(2-ethylhexyl) phthalate is the Outside the Mixing Zone Average (OMZA) value for the Ohio River Basin of 8.4 µg/L (OAC 3745-1).

A measured value of 1.11×10^5 for the Koc of bis(2-ethylhexyl)phthalate (EPA 1996b) was used to calculate the SQB. The organic carbon fraction in Unzinger's Ditch sediment is not known, but it is likely to be above 1%. Because lower Fc values translate to lower SQBs, it is conservative to assume that Fc is 0.01. Therefore, the SQB is calculated as:

$$\text{SQB} = 0.0084 \text{ mg/L} \times 1.11 \times 10^5 \text{ L/kg} \times 0.01 = 9.3 \text{ mg/kg.}$$

This value was lower than conclusions of sediment toxicity studies. A summary of sediment toxicity studies reported by the European Council for Plasticisers and Intermediates (www.ecpi.org/health-and-environment/environmental-effects/sediment.htm) cites no-effect levels for *Chironomus tentans* and *Hyalella azteca* of 3000 mg/kg (Call et al., 1997), for *Chironomus riparius* of 10,000 mg/kg (Brown et al. 1996), and for *Rana arvalis* eggs of 600 mg/kg (Wennberg et al. 1997). Therefore, the SQB of 9.3 mg/kg appears to be a conservative TRV.

7.5.3 Body Weight Conversions

Body weight is an integral part of the units of the exposure equations expressed as average daily dose – mg/kg BW/d. Because toxicity is related to metabolic rate, which depends on body weight, toxicity benchmarks can be adjusted to the body weight of the receptor by applying a scaling factor. EPA Region V, as well as other EPA Regions, especially Region IV, provides guidance to exclude body weight conversions for birds. For raccoons, the body-weight corrected TRV used in the screening ERA is calculated as the product of the test species toxicity benchmark and the body-weight conversion factor, which is the ratio of the test species body weight and the receptor body weight all raised to the 1/4th power (Sample et al. 1996). The adjusted TRVs are shown in Table C.14. Body-weight conversions add more conservatism to the toxicity reference value (TRV) when the field receptor is larger than the laboratory test organism (e.g., raccoon in field versus mouse in laboratory). The converse, less conservative, prevails when the field receptor is smaller than the laboratory test organism. Published body weights for receptors are used to estimate exposure by ingestion of

contaminated matter. Published body weights used in the screening ERA are those presented in EPA (1993a) and other sources as shown on the receptor profiles (Tables 7.5 and 7.6 and applied beginning with Appendix Table C.24).

7.6 RISK CHARACTERIZATION FOR ECOLOGICAL RECEPTORS

Risk characterization correlates exposure and stressor response on endpoint receptors used in the assessment, summarizes risk or the likelihood of adverse effects to animals, and interprets the ecological significance of these findings.

Risk characterization compares exposures to effects to determine the risk or likelihood of harm to various animals. The ecological assessment endpoints or receptors depend on this comparison by using HQs to identify ecoCOPCs at the qualifying Franklin Steel exposure units. The HQs form the quantitative basis of this risk characterization (EPA 1989a).

HQs are the ratios of the estimated exposure concentrations and toxicity threshold concentrations. Exposure concentrations are derived from measured environmental concentrations (RMEs) by multiplying the measured concentration by exposure factors. The effects information is expressed as the toxicity reference value or that concentration that evokes no response or a small response. This relationship is shown as:

$$\text{Hazard Quotient (HQ)} = \frac{\text{Exposure Concentration or Average Daily Dose}}{\text{Toxicity Reference Value}}$$

An HQ greater than unity (1.0) indicates that there is a potential for harmful ecological effects and that the ecoCOPC qualifies for further investigation into its potential to pose a hazard. Although a threshold of 1.0 was used for retention of ecoCOPCs, in reality, HQs may range several orders of magnitude.

In addition to computation of HQs to show ecological risk, the hazard index (HI) was computed. The definition of an HI is the sum of all individual HQs for ecoCOPCs that have similar toxicological effects (e.g., neural, immunological, excretory, or organ). In the screening ERA, a more conservative approach was taken. All HQs, regardless of toxicological effect, were summed to compute the HI. Therefore, if the HI does not exceed a threshold, the HI for a single toxicological effect also cannot exceed the same threshold. In screening ERAs, any HI greater than 1 means that ecological risk may be unacceptable and that further investigation could be warranted. By contrast, an HI less than 1 means risks are acceptable. While there is no known EPA policy on HI magnitudes and corresponding nominal levels of risk, the decision threshold of an HI of 1 remains sufficient to define unacceptable ecological risk for a screening ERA.

7.6.1 Current Screening Risk to Ecological Receptors

Analytes whose surface water concentrations exceeded Ohio chemical water quality criteria are ecoCOCs. Other analytes whose concentrations were above ESV were retained as preliminary ecoCOPCs. Risks to ecological receptors from ecoCOPCs under current conditions are estimated by calculating HQs for the ecological receptors. Appendix C presents the screening HQs for all preliminary ecoCOPCs. Table 7.7 summarizes all of the screening level HQs greater than 1. This summary is presented on a location by location basis and an exposure medium by medium basis.

7.6.2 Aquatic Exposure Units

The EU-specific screens are presented in Appendix Tables C.16 through C.31. Table 7.7 shows the summarized results of the screening ERA for these preliminary ecoCOPCs.

7.6.2.1 Surface Water – Unzinger’s Ditch, Downstream Segment

Eight preliminary ecoCOPCs were retained as ecoCOCs because they exceeded Ohio chemical water quality criteria. They are copper, lead, manganese, mercury, zinc, butyl benzyl phthalate, fluoranthene, and bis(2-ethylhexyl) phthalate.

Three inorganic and three organic ecoCOPCs for which no Ohio chemical water quality criteria have been promulgated were identified as posing potential risk with HQs greater than 1. Each is identified below on a receptor by receptor basis:

- **Aquatic Biota.** Benzo(a)pyrene is the ecoCOPC that poses the highest risk, with an HQ of 79. Barium and aluminum have the next highest HQs at 35 and 29, respectively. Pyrene has an HQ of 18. No other preliminary ecoCOPC had an HQ greater than 1. The hazard index for aquatic biota at this EU is 165.
- **Raccoon.** No ecoCOPCs had HQs greater than 1 for raccoons at this EU.
- **Heron.** Mercury is the only inorganic ecoCOPC with an HQ that exceeds 1 (1.6) for herons at this EU. Bis(2-ethylhexyl)phthalate had an HQ of 143.

7.6.2.2 Surface Water – Unzinger’s Ditch, Upstream Segment

Six preliminary ecoCOPCs were retained as ecoCOCs because they exceeded Ohio chemical water quality criteria. They are copper, lead, mercury, zinc, fluoranthene, and bis(2-ethylhexyl) phthalate.

Three inorganic ecoCOPCs and one organic ecoCOPC for which no Ohio chemical water quality criteria have been promulgated were identified as posing potential risk with HQs greater than 1:

- **Aquatic Biota.** Barium and aluminum have HQs of 35 and 25, respectively. No other preliminary ecoCOPC had an HQ greater than 1. The hazard index for aquatic biota at this EU is 62.
- **Raccoon.** No ecoCOPCs had HQs greater than 1 for raccoons at this EU.
- **Heron.** Mercury is the only inorganic ecoCOPC with an HQ that exceeds 1 (1.3) for herons at this EU. Bis(2-ethylhexyl) phthalate had an HQ of 30.

7.6.2.3 Surface Water – Outfall 002

Five preliminary ecoCOPCs were retained as ecoCOCs because they exceeded Ohio chemical water quality criteria. They are aluminum, barium, copper, lead, and zinc.

Six inorganic and one organic ecoCOPCs for which no Ohio chemical water quality criteria have been promulgated were identified as posing potential risk with HQs greater than 1:

Aquatic Biota. Barium is the ecoCOPC that poses the highest risk at this EU, with an HQ of 49. Aluminum has the next highest HQs at 26. The remaining inorganic ecoCOPCs with an HQ greater than 1 include: zinc (4), copper (3), and cyanide and mercury (1). The only organic ecoCOPC whose HQ exceeds 1 is phenanthrene (1). The hazard index for aquatic biota at this EU is 95.

Raccoon. No ecoCOPCs had HQs greater than 1 for raccoons at this EU.

Heron. No ecoCOPCs had HQs greater than 1 for herons at this EU.

This evaluation is based on the assumptions that the surface water in the area of Outfall 002 are within the same water quality parameters as the S101 Siphon Dam. This assumption takes into consideration the detected sediments (L-HA-8 and L-HA-9) and is quite conservative. Based on the location of Outfall 002 and the variation in habitat qualifiers, it is bold to assume the areas are comparable for habitat. This assumption and conservative measure is utilized base on the fact that no surface water samples have been collected within the immediate area of Outfall 002 due to intermittent water flow.

7.6.2.4 Surface Water – S101 Siphon Dam

Four preliminary ecoCOPCs were retained as ecoCOCs because they exceeded Ohio chemical water quality criteria. They are copper, cyanide, lead, and zinc.

Five inorganic and one organic ecoCOPCs for which no Ohio chemical water quality criteria have been promulgated were identified as posing potential risk with HQs greater than 1:

Aquatic Biota. Barium is the ecoCOPC that poses the highest risk at this EU, with an HQ of 55. Aluminum has the next highest HQs at 30. The remaining inorganic ecoCOPCs with an HQ greater than 1 include: zinc (4), copper (3), and cyanide (1). The only organic ecoCOPC whose HQ exceeds 1 is phenanthrene (1). The hazard index for aquatic biota at this EU is 95.

Raccoon. No ecoCOPCs had HQs greater than 1 for raccoons at this EU.

Heron. No ecoCOPCs had HQs greater than 1 for herons at this EU.

7.6.2.5 Surface Water – S201 Wetland

Four preliminary ecoCOPCs were retained as ecoCOCs because they exceeded Ohio chemical water quality criteria. They are copper, lead, manganese, and zinc.

Five inorganic ecoCOPCs for which no Ohio chemical water quality criteria have been promulgated were identified as posing potential risk with HQs greater than 1:

Aquatic Biota. Aluminum is the ecoCOPC that poses the highest risk at this EU, with a HQ of 339. Barium has the next highest HQ at 113. The remaining inorganic ecoCOPCs with an HQ greater than 1 include: copper (4), manganese (3), and zinc (2). No organic ecoCOPC HQ exceeds 1. The hazard index for aquatic biota at this EU is 461.

Raccoon. Only aluminum had an HQ greater than 1 (1) for raccoons at this EU.

Heron. No ecoCOPCs had HQs greater than 1 for herons at this EU.

7.6.2.6 Sediment – Unzinger's Ditch, Downstream Segment

For sediment-dwelling biota, 18 ecoCOPCs were screened as posing potential risk with HQs greater than 1. Inorganic ecoCOPCs with an HQ greater than 1 include: arsenic (2), cadmium (10), chromium (4), copper (2), lead (22), mercury (3), nickel (2), and zinc (7). Organic ecoCOPCs that had an HQ exceeding 1 include: anthracene (18), benzo(a)anthracene (44), benzo(a)pyrene (32), bis(2-ethylhexyl)phthalate (67), chrysene (36), dibenzo(a,h)anthracene (24), fluoranthene (31), fluorene (7), phenanthrene (35), and pyrene (34). The hazard index for sediment-dwelling biota is 378.

7.6.2.7 Sediment – Unzinger’s Ditch, Upstream Segment

For sediment-dwelling biota, 14 ecoCOPCs were screened as posing potential risk with HQs greater than 1. Inorganic ecoCOPCs with an HQ greater than 1 include: arsenic (2), cadmium (4), copper (2), lead (4), mercury (1), and zinc (4). Organic ecoCOPCs that had an HQ exceeding 1 include: anthracene (4), benzo(a)anthracene (12), benzo(a)pyrene (6), chrysene (7), dibenzo(a,h)anthracene (6), fluoranthene (8), fluorene (2), phenanthrene (5), and pyrene (8). The hazard index for sediment-dwelling biota is 77.

7.6.2.8 Sediment – Outfall 002

For sediment-dwelling biota, 15 ecoCOPCs pose potential risk with HQs greater than 1. Inorganic ecoCOPCs with an HQ greater than 1 include: cadmium (8), chromium (2), copper (5), lead (9), nickel (7), and zinc (5). Organic ecoCOPCs that had an HQ exceeding 1 include: anthracene (12), benzo(a)anthracene (15), benzo(a)pyrene (11), bis(2-ethylhexyl)phthalate (2), fluoranthene (11), naphthalene (9), phenanthrene (11), and pyrene (22). The hazard index for sediment-dwelling biota is 129.

7.6.2.9 Sediment – S101 Siphon Dam

For sediment-dwelling biota, 16 ecoCOPCs pose potential risk with HQs greater than 1. Inorganic ecoCOPCs with an HQ greater than 1 include: cadmium (10), chromium (2), copper (5), lead (11), mercury (2), nickel (7), and zinc (7). Organic ecoCOPCs that had an HQ exceeding 1 include: anthracene (12), benzo(a)anthracene (15), benzo(a)pyrene (11), bis(2-ethylhexyl)phthalate (2), chrysene (12), fluoranthene (14), naphthalene (9), phenanthrene (18), and pyrene (22). The hazard index for sediment-dwelling biota is 158.

7.6.2.10 Sediment – S201 Wetland

No ecoCOPCs had HQs greater than 1 for sediment-dwelling biota at this EU. The hazard index is less than 1.

7.6.3 Summary of Current Screening-level Risk to Ecological Receptors

Three preliminary ecoCOPCs exceeded Ohio chemical water quality criteria in all EUs. They are copper, lead, and zinc. Cyanide, manganese, mercury, butyl benzyl phthalate, fluoranthene, and bis(2-ethylhexyl) phthalate exceeded water quality criteria in at least one EU.

High HQs from exposure to ecoCOPCs in surface water came primarily from aluminum, barium, benzo(a)pyrene, phenanthrene, pyrene, and bis(2-ethylhexyl) phthalate and were indicated primarily for aquatic biota. Barium and aluminum had HQs above 10 for aquatic biota at all EUs. HQs for these ecoCOPCs were fairly similar in segments of Unzinger’s Ditch, Outfall 002 and in the S101 Siphon Dam, but they were several-fold higher in the S201 Wetland surface water. HQs were between 1 and 10 for copper, cyanide, manganese, and zinc in Outfall 002, the S101 Siphon Dam and the S201 Wetland, but mercury, with HQs between 1 and 2, was the only other inorganic with an HQ above 1 in Unzinger’s Ditch. Therefore, few inorganics have concentrations high enough to cause ecological concern in the surface water of Unzinger’s Ditch, and releases of inorganics from the 15-inch tile outfall to the downstream segment of Unzinger’s Ditch does not cause markedly higher concentrations in the downstream segment than in the upstream segment. The concentration of aluminum in the S201 Wetland is much higher than at other locations, indicating a likely source near the wetland. Alternatively, surface water analytes in the wetland may be elevated because of concentration through evaporation during low precipitation periods.

Benzo(a)pyrene and pyrene had HQs above 10 for aquatic biota only in the downstream segment of Unzinger's Ditch. Bis(2-ethylhexyl) phthalate had HQs for exposure of herons to surface water that were above 10 in both downstream and upstream segments, although the HQ in the downstream segment was much higher than in the upstream segment.

The highest risks from inorganic ecoCOPCs in sediment came from cadmium and lead. Cadmium and lead had an HQ above 10 for the downstream segment of Unzinger's Ditch, Outfall 002 and the S101 Siphon Dam. Multiple organics had HQs above 10 in the sediment of the downstream segment of Unzinger's Ditch, Outfall 002 and the S101 Siphon Dam, while 4-methylphenol, benzo(a)anthracene, and bis(2-ethylhexyl)phthalate had an HQ above 10 in the upstream segment. The maximum bis(2-ethylhexyl)phthalate concentrations were 620 mg/kg in the downstream segment, 1.8 mg/kg in the upstream segment, and 17 mg/kg in the S101 Siphon Dam. Therefore, it is likely that Unzinger's Ditch contains most of the organics with concentrations high enough to be of ecological concern, and concentrations are generally higher downstream of the 15-inch tile outfall. No volatile organics occurred at a level that would cause risk to biota in any water body.

In summary, ecoCOPCs have accumulated in sediments of Outfall 002, the S101 Siphon Dam and both segments of Unzinger's Ditch. The greatest accumulation of ecoCOPCs is that of PAHs and bis(2-ethylhexyl)phthalate downstream of the 15-inch tile outfall. Sediment sampling in 2001 also showed significant accumulations of these compounds in the S101 Siphon Dam sediment. Except for benzo(a)pyrene and pyrene, which had high HQs in downstream surface water, the ecoCOPCs with the highest HQs in sediment did not have high HQs in surface water.

Bis(2-ethylhexyl) phthalate is of special concern because it is an indicator of transport from Franklin Steel soils with high levels of bis(2-ethylhexyl) phthalate contamination. Concentrations of bis(2-ethylhexyl)phthalate are much lower in the upstream segment compared to the downstream segment. Sediment is likely the source of bis(2-ethylhexyl) phthalate contamination of surface water that caused HQs of 143 and 30 to herons in downstream and upstream segments, respectively. This pattern differs from the other major organic contaminant, PAHs. Although lower in the upstream sediment, the concentrations are not dramatically different as is the case for bis(2-ethylhexyl)phthalate. This likely is the result of other sources of PAHs unrelated to Franklin Steel.

As indicated in the section on habitats (7.3.2.1), sediment per se and any contaminants mixed into the sediment move from place to place in Unzinger's Ditch. Scouring and deposition constitute normal physical activities in the stream and especially during storm events. In turn, organisms, and especially benthic macroinvertebrates, experience the consequence of having their habitat and themselves removed and covered-up. When sediments are highly contaminated, as some are in certain stretches of Unzinger's Ditch, additional adverse consequences may occur. For example, these sediments may coat and smother benthic macroinvertebrates, or inhibit movement and access to food sources. This is especially true for organic contaminants such as petroleum compounds, which appear to be present in the sediment in some areas of Unzinger's Ditch.

The high concentrations of organic contaminants also resulted in the laboratory's high detection limits during the analysis of some organic compounds in some sediment samples. The high concentrations of organic compounds such as bis(2-ethylhexyl)phthalate can cause interference with the analysis of other organic compounds. This adds uncertainty to the risk assessment in that some additional chemicals may be present in sediment that were not reported by laboratory analysis. If present, these additional chemicals could pose risks to ecological receptors beyond those presented in this screening ERA.

7.6.4 Future Screening Risk to Ecological Receptors

Future screening risks are assumed to be the same as current screening risks in the absence of actions to remove contaminated sediments and other contaminant sources. Because most sediment ecoCOPCs with high HQs are also PBT contaminants (Appendix Tables C.4 through C.11), it is unlikely that they will leach and be carried out of the Franklin Steel site in any near- to moderate-term future.

7.7 INTEGRATION OF BIOLOGICAL SURVEYS AND CHEMICAL SCREENING RESULTS

In this section a summary of Ohio EPA's study (Ohio EPA 2001) is presented. The relationship of this study to the screening ecological risk assessment is also provided. Note that the Ohio EPA places emphasis on the results of biological sampling for risk assessment and risk management decision making when lotic surface waters, other than those with aquatic life habitat use designations of limited resource water, have been impacted.

7.7.1 Summary of Ohio EPA Biological and Sediment Quality Survey of Unzinger's Ditch

7.7.1.1 Study Purpose

In September and November 2000 the Ohio Environmental Protection Agency (Ohio EPA 2001) described habitat quality, sampled fish and macroinvertebrate communities, and analyzed sediment chemistry along sections of a 1.1 mile reach of Unzinger's Ditch, a first order tributary Blacklick Creek that enters the Scioto River in Columbus (Ohio EPA 2001). The objectives of the Ohio EPA study were to confirm appropriate aquatic life and recreational use designations, establish biological conditions, and evaluate the relative levels of organic and inorganic contaminants in Unzinger's Ditch.

7.7.1.2 Sampling Localities

Biological and habitat sampling were completed at river mile (RM) 0.9, 0.5, and 0.1. Sediment samples, which were taken at RM 1.05, 0.73, 0.54, 0.53, and 0.40 were split and analyzed in separate labs supervised by SAIC and Ohio EPA project managers. There were no notable differences among the two lab analyses. A duplicate sediment sample was acquired from the site at RM 0.40. The SAIC controlled sample data were used in the downstream and upstream sample groupings for the screening ERA. The Ohio EPA controlled sample data were used in the sediment quality survey (Ohio EPA 2001).

7.7.1.3 Use Designations and Habitat Quality

The aquatic life use designation was based on physical habitat conditions as measured by the Ohio EPA's Qualitative Habitat Evaluation Index (QHEI). Habitat index scores (Table 7.8) from two sites (RM 0.5 and 0.1) in the lower 0.6 miles of Unzinger's Ditch indicated the presence of pool and riffle areas, pools greater than one meter deep, and a variety of instream cover types. Together these conditions are amenable to supporting a warmwater biological community; hence the Ohio EPA determined that the Warmwater Habitat (WWH) life use designation is appropriate for the lower 0.6 miles of Unzinger's Ditch. The low QHEI score from RM 0.9 (Table 7.8) indicated the channel at this location was modified from its natural state. Additionally, in the upper section of Unzinger's Ditch, flow is intermittent and the channel lacks adequate pool and riffle areas. Therefore, habitat quality in the upper 0.5 mile segment resulted in the Ohio EPA recommendation that aquatic life use be designated as Limited Resource Water (LRW).

As defined by the Ohio Water Quality Standards (WQS), Warmwater Habitat is expected to contain the "typical" warmwater assemblage of aquatic organisms for Ohio rivers and streams and Limited Resource Water refers to streams that have been "irretrievably altered" such that no appreciable assemblage of aquatic life can be supported. Usually streams are designated as LRW in watersheds with extensive drainage

modifications and also may include channels with ephemeral flows. It is pertinent to Unzinger's Ditch that the Ohio EPA emphasizes WWH "represents the principal restoration target for a majority of water resource management efforts in Ohio."

7.7.1.4 Study Results

Sediments

Concentrations of contaminants detected in sediment samples were compared with lowest effect level (LEL) and severe effect level (SEL) guidelines developed in Ontario and chronic effects criteria developed in New York. High concentrations of contaminants were present in samples from all sites. Arsenic, copper, and nickel, three inorganic chemicals, were the only contaminants slightly exceeding LELs at the uppermost site, RM 1.05. Upstream 55 m from the Franklin Steel NPDES discharge point at RM 0.73, several metals and seven PAHs exceeded LELs. The most substantially contaminated sediments were obtained at RM 0.54 and 0.53, approximately 0.15 RM downstream of the NPDES outfall. Sediment from these two locations contained concentrations of chromium, lead, zinc, and bis(2-ethylhexyl)phthalate that exceeded SELs. Levels of bis(2-ethylhexyl)phthalate at RM 0.54 and 0.53 were extremely high and exceeded New York's criteria for the protection of chronic toxicity. Although no SELs were exceeded at RM 0.4 and the concentration of bis(2-ethylhexyl)phthalate at was approximately 3% of concentrations upstream at RM 0.54 and 0.53, nine of the eleven PAHs and several inorganic compounds exceeded LELs.

Biological Communities

Fish and macroinvertebrate communities were sampled at RM 0.9, 0.5, and 0.1. Based on the quality of both communities, the Ohio EPA determined that WWH life use was not attained in Unzinger's Ditch. At each site, fish communities were analyzed by an index of biotic integrity (IBI) and macroinvertebrate communities were assessed by qualitative searches that reported species richness (Table 7.8). IBI scores range from 12 to 60, worst to best, respectively. No fish were present at RM 0.9, which was in a shallow low-flow segment of Unzinger's Ditch. Fish sampling at the lower two sites revealed a community composed predominately of pollution tolerant species and yielded IBI scores of 30 and 32 respectively. Both scores are in the fair range for headwater streams in the Eastern Cornbelt Plains ecoregion. However, these scores are significantly lower than 40, the IBI score indicative of a healthy fish community inhabiting a headwater WWH stream.

Macroinvertebrate communities were rated as poor at RM 0.9 and very poor at RM 0.5 and 0.1. Moving from the uppermost site downstream, samples yielded taxa richness values (number of taxa) of 24, 14, and 27, respectively. The uppermost site garnered a slightly higher rating than the lower two because individuals of one caddisfly species were present. No additional pollution sensitive taxa including mayfly, stonefly, or other caddisfly species were present in any of the samples. Notably, taxa richness was much lower at RM 0.5, which is in close proximity to the location where sediments contained the highest levels of contaminants, which is also closely located to the 15-inch discharge point from Franklin Steel.

7.7.1.5 Summary and Conclusions

The Ohio EPA determined that the lower 0.6 miles of Unzinger's Ditch, based on habitat evaluations, should be designated as Warmwater Habitat. Their evaluation of habitat upstream revealed channel alterations and intermittent flows, indicating habitat above RM 0.6 should be designated as Limited Resource Water. Upon classifying habitat, the Ohio EPA analyzed fish and invertebrate communities in the lower 1.1 miles of the ditch. The condition of both communities was depressed in comparison to that expected in an unimpacted stream and indicated that the entire 1.1 mile reach did not attain its designated aquatic life use status. Physical habitat quality in the lower 0.6 mile channel segment was suitable for supporting a warmwater assemblage of aquatic organisms typical of Ohio streams. Sediments analyzed by the Ohio EPA collected from points in the middle section, and near the upper and lower ends of the 1.1 mile reach had varying levels of contaminant concentrations. Except for relatively low amounts of contaminants found near RM 1.05, remaining sediment

samples had concentrations of inorganic and PAH contaminants that exceeded tolerance levels of benthic organisms per the report. In some cases concentrations were high enough such that pronounced disturbance to the sediment dwelling community can be expected (Persaud et al. 1993, as cited by Ohio EPA 2001). Sediments from approximately 0.15 miles downstream of the Franklin Steel outfall contained dramatically higher amounts of contaminants than other sample points in the ditch.

Aquatic communities inhabiting Unzinger's Ditch lack the structure and composition predicted by quality of physical habitat found there. Coupling habitat quality with findings of harmful levels of contaminants in sediments indicates chemical pollution likely is prohibiting aquatic communities from meeting the aquatic life use designations in Unzinger's Ditch.

7.7.2 Relationship of the Ohio EPA study to Franklin Steel Screening Risk Assessment

Table 7.8 provides a brief summary of the indices used by Ohio EPA to characterize and evaluate Unzinger's Ditch. Franklin Steel followed Ohio EPA guidance on a companion study, the Screening ERA. The findings of the screening ERA are provided in Section 7.6 and Appendix C. The sum of hazard quotients or the hazard index is shown for specific ecological receptors in Table 7.8.

Findings of the screening ERA corroborate Ohio EPA study results. The hazard index values for organisms that inhabit surface waters and sediments were much greater in the lower 0.6 miles of Unzinger's Ditch than in its upper segment. In particular, risks to herons from bis(2-ethylhexyl) phthalate in surface water were higher in the downstream segment than the upstream segment, probably as a result of sediment contamination. Thus, communities inhabiting areas below RM 0.6 are at greater risk of toxicity from contaminants.

7.8 UNCERTAINTIES

Uncertainties in the ERA are discussed in this section by the four steps of the EPA approach to an ERA: problem formulation, exposure assessment, effects assessment, and risk characterization.

7.8.1 Uncertainties with Problem Formulation

Environmental concentrations of analytes in the soil, sediment, and surface water at and near the exposure units are based on a limited number of samples. A degree of uncertainty exists about the actual spatial distribution of analytes. Exposure concentrations could be overestimated or underestimated, depending on how the actual data distribution differs from the measured data distribution. Because the estimated 95 percent UCL of the mean concentrations or maximum detected concentration was used as the RME concentration to calculate HQs, the estimates of risk from ecoCOPCs are conservative (i.e., protective). Using 95 percent UCL or maximum concentrations decreases the likelihood of underestimating the risk posed by each ecoCOPC and increases the likelihood of overestimating the risk.

The full distribution and abundance of organisms comprising the ecological receptors at the exposure units has not been quantified by field studies, although biological measurements have been taken at three locations (RM 0.1, RM 0.5, and RM 0.9). The lack of quantitative data introduces uncertainties concerning to what extent the risk characterization based on the selected receptor species underestimates or overestimates the risk to organisms that were not used in the risk computations but that are found at the exposure units. Reconnaissance established the nature and quality of habitat and confirmed the presence of active, visible animal species. Observations made during this reconnaissance confirmed the presence of organisms essential to normal ecosystem functioning, such as sediment-dwelling organisms.

It is possible that one, or more, of these species at the exposure units is more sensitive than those ecological receptors for which toxicity data were available. It does not necessarily follow that these unevaluated species are at significantly greater risk of harmful effects than that estimated in this ERA. This uncertainty is bounded, however, by the fact that most species present were pollution-tolerant ones.

7.8.2 Uncertainties with Exposure Assessment

The movement of analytes from source media to ecological receptors was not measured for this screening ERA, which introduces uncertainties about the actual modes and pathways of exposure to ecological receptors. Exposure concentrations can differ from measured environmental concentrations due to physical and chemical processes during transport from source to receptor or as the result of biomagnification through the food web. These processes were not evaluated quantitatively in this ERA. Although bioaccumulation was estimated for those receptors ingesting food for which toxicity thresholds were available, it is possible that exposure to top predators is underestimated due to biomagnification of certain analytes in their prey.

Conservative exposure estimates were used for absorption of ecoCOPCs by absorption after ingestion of water (1.0) and tissue (1.0). Overestimating exposure by using conservative exposure concentrations is thought to counter-balance the underestimation of exposure that results from neglecting certain exposure modes and pathways of lesser importance, such as inhalation. Additional uncertainties are inherent in ingestion rates and dietary fractions of plants and animals.

Exposure concentrations are likely overestimated because of conservative exposure factors. Exposure factors included published bioaccumulation factors, irrespective of species and environmental conditions. It should be noted that, while the largest bioaccumulation factors may overestimate bioaccumulation by at least one order of magnitude for some ecoCOPCs, very high bioaccumulation as well as biomagnification are well-documented for other analytes, although not necessarily those detected.

Chemical concentrations change through time. Degradation products can be more toxic than some parent compounds. In situ natural degradation rates are unknown. Without monitoring and documentation, the change in concentrations of contaminants and their breakdown products cannot be predicted. Therefore, the risk from degradation products cannot be evaluated.

Finally, the exposure of plants and animals to analytes below detection limits is not considered in the ERA. In addition, the exposure of ecological receptors to tentatively identified compounds is not considered. The high concentrations of organic contaminants resulted in high detection limits during the analysis of some organic compounds in some sediment samples. The high concentrations of organic compounds such as bis(2-ethylhexyl)phthalate can cause interference with the analysis of other organic compounds. This adds uncertainty to the risk assessment in that some additional chemicals may be present in sediment that were not reported by laboratory analysis. If present, these additional chemicals could pose risks to ecological receptors beyond those presented in the ERA.

7.8.3 Uncertainties with Effects Assessment

Toxicity thresholds were based on concentrations reported to have no or little effect on the test organism or were estimated conservatively from published toxicity data. Dietary limits used as threshold levels for soils were derived from NOAELs or LOAELs using an uncertainty factor of 0.1 to adjust for both duration and endpoint of the toxicity study (Opresko et al. 1994). These thresholds would underestimate the risks only to organisms at the exposure units that are considerably more sensitive than the study organisms. They are more likely to overestimate the risk to organisms that are equally or less sensitive than the study organisms. The possibility remains that some thresholds were set at levels at or above which some harm would occur to organisms at the exposure units.

The calculated risks to the ecological receptors at the exposure units are the risks of individual analytes. The risks from exposure to multiple analytes depend on contaminant interactions; effects could be greater or lesser than those from a single chemical. This ERA provides findings for specific ecoCOPCs. An evaluation of risk from chemical mixtures cannot be conducted without additional data and evaluation of alternative models of contaminant interaction.

There are no available threshold values for some of the ecoCOPCs, especially organic ones, for the ecological receptors considered. This, of course, contributes to uncertainty. Although these analytes were carried forward, qualitative as well as quantitative assessment of these analytes was not possible. Unless surrogate TRVs are provided by Ohio EPA, risk from these chemicals will remain uncertain.

Additional uncertainty exists as to the pertinence of individual organism toxicity for characterizing the risk to populations and ecosystems. It is possible that populations may compensate for the loss of large numbers of juveniles or adults with increased survival or birth-rates, and habitats or ecosystems may possess functionally redundant species that are less sensitive to analytes. Although the exposure unit's habitats surely possess these buffering mechanisms, a conservative approach is still justified to risk assessment based on organismal toxicity thresholds (i.e., NOAELs). Again, the EPA field study documented depressed macroinvertebrate and fish communities; thus, the risk predictions are certainly vindicated as being correct predictions.

7.8.4 Uncertainties with Risk Characterization

The uncertainties described above impact the quantification of current and future risks to terrestrial and aquatic animals at the exposure units. Four additional areas of uncertainty in the risk characterization exist: off-exposure unit risk, cumulative risk, future risk, and background risk.

Off-Exposure Unit Risk. The risks to off-exposure unit receptors cannot be characterized without clearly identified pathways (especially any surface water pathways) as well as contaminant tracer studies and off-exposure unit plant and animal and habitat surveys. Off-exposure unit receptors may be exposed to analytes via physical and organismal transport processes, but evaluating the exact magnitude of this exposure would require additional studies. It is unlikely that off-exposure unit receptors would have lower toxicity thresholds for analytes than the thresholds used for on-exposure unit receptors. In addition, there is little reason to expect that analytes migrating off exposure unit would be concentrated above measured concentrations at exposure units at the Franklin Steel facility unless a contaminant bioconcentrates in organisms that move extensively on and off the exposure unit. In general, the risk to most off exposure unit receptors is likely to be overestimated rather than underestimated by the risk estimate for on exposure unit receptors.

Cumulative Risk. The ERA estimates the risk to populations of ecological receptors from individual analytes. Yet, in nature, receptors are exposed simultaneously to mixtures of chemicals. Generally, the methods used are sufficiently conservative resulting in individual risks that are overestimated. Nevertheless, cumulative risk is possible when several living plants and animals are affected simultaneously. Harmful effects in ecosystems (including effects on individual organisms) may cascade throughout the system and have indirect effects on the ability of a population to persist in the area even though individual organisms are not sensitive to the given analytes in isolation. Therefore, the ecological risk characterization for exposure units at the exposure may underestimate actual risks to plants and animals from cumulative risks. The EPA field study showed a great deal of cumulative effects.

Future Risk. A third area of uncertainty in the ecological risk characterization is the future risk to the plants and animals from contamination at the exposure units. The ERA characterizes current risk based on chronic exposure to measured concentrations of analytes with the potential to persist in the environment for extended periods of time. Hazard quotients for animals estimate the risk to animal species that would be natural parts of future successional stages at these areas. Nevertheless, possible mechanisms exist that could significantly

increase (e.g., erosion, a leaching to surface water or groundwater) or decrease (e.g., enhanced microbial degradation) the risk to future plants and animals at the exposure units.

Background Risk. Another source of uncertainty is ecological risk relative to background conditions. Although only inorganic compounds with concentrations above background were examined in the ecoCOPC screening, some ecoCOPCs were detected above background by a statistically insignificant amount. The conservative approach to comparing exposure unit concentrations to background likely overestimates the risk from ecoCOPCs. This means that some ecoCOPCs may not be real ones.

7.8.5 Summary

The most important uncertainties in the ERA are those surrounding the estimates of the contaminant concentrations to which ecological receptors are actually exposed (exposure concentrations) and the concentrations that present an acceptable level of risk of harmful effects (toxicity reference values or thresholds). Mathematically, these uncertainties arise from multiple sources, especially from the lack of exposure unit-specific data on contaminant transport and transformation processes, organismal toxicity, animal behavior and diet, population dynamics, and the response of plant and animal populations to stressors in their environments. Despite these uncertainties, the available exposure unit-concentration data and published exposure and effects information allow ecoCOPCs (HQs >1) to be identified as risks characterized for each exposure unit. The findings of Ohio EPA's Biological and Sediment Quality Study of Unzinger Ditch 2000 (published on February 12, 2001) assures that ecological risk is real and is being manifested as real effects.

7.9 SUMMARY OF SCREENING ECOLOGICAL RISK ASSESSMENT

A screening ERA was performed in accordance with guidance from Ohio EPA, EPA Headquarters and EPA Region V. This guidance specifies a step-by-step procedure. The screening ERA conducted for the Franklin Steel facility adheres to this guidance and includes the following four steps: (1) problem formulation; (2) exposure assessment; (3) effects assessment; and (4) risk characterization with attention to uncertainties and summarization.

Current risks to ecological receptors at the Franklin Steel facility exposure units were characterized by evaluating ecological assessment endpoints using hazard quotients. Hazard quotients are calculated for different receptors for every ecoCOPC for which a toxicity threshold concentration was available from published information. Each hazard quotient compares two concentrations: the estimated preliminary ecoCOPC concentration (RME) to which a given receptor is exposed, and the TRV for the preliminary ecoCOPC and receptor. The TRV is a dietary limit or other threshold concentration expected to cause no harm to the receptor, minimal harm with no ecological significance, or minimal harm to a community of organisms (i.e., assemblage of species) exposed to the ecoCOPC in an appropriate medium. Thus, the TRV is a safe, or protective, concentration.

Of the many observed plant and animal taxa, three aquatic classes were selected (sediment-dwellers, fish and aquatic life, and fish-eating and water-drinking predators).

7.9.1 Summary of Ohio Chemical Water Quality Criteria Comparison

Concentrations of analytes in surface water were compared to Ohio chemical water quality criteria. Six inorganic analytes and three organic analytes exceeded the criteria in at least one EU. They are:

- Copper
- Cyanide
- Lead
- Manganese

- Mercury
- Zinc
- Butyl benzyl phthalate
- Fluoranthene
- Bis(2-ethylhexyl) phthalate

7.9.2 Summary of EcoCOPCs from Screening ERA

Hazard quotients were calculated for each qualifying exposure unit or exposure unit in the screening ERA. A number of ecoCOPCs with HQs greater than 1 were found and are summarized below (Tables 7.7, C.28, and C.29):

Surface water

- Aluminum
- Barium
- Mercury
- Benzo(a)pyrene
- Phenanthrene
- Pyrene
- Bis(2-ethylhexyl) phthalate

Sediment

- Arsenic
- Cadmium
- Chromium
- Copper
- Lead
- Mercury
- Nickel
- Zinc
- Bis(2-ethylhexyl)phthalate
- PAHs

Bis(2-ethylhexyl)phthalate was retained as an ecoCOPC because concentrations in Unzinger's Ditch downstream of Mile 0.6 exceed the sediment quality benchmark developed for this contaminant. When this sediment quality benchmark is used as a TRV, the HQ is 67 for sediment-dwelling biota in the downstream segment of Unzinger's Ditch.

7.10 REFERENCES

- Barnhouse, L. W., G. W. Suter II, S. M. Bartell, J. J. Beauchamp, R. H. Gardner, E. Linder, R. V. O'Neill, and A. E. Rosen, 1986. *User's Manual for Ecological Risk Assessment*. ORNL-6251, ESD/2679. Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory, Oak Ridge, TN.
- Beyer, W.N., E. Conner, and S. Gerould. 1994. "Estimates of soil ingestion by wildlife". *J. Wildlife Management*. 58: 375-382.
- Brown D., Thompson, R. S., Stewart, K. M., Croudace, C. P. and Gillings, E. (1996) The effect of phthalate ester plasticisers on the emergence of the midge (*Chironomus riparius*) from treated sediments. *Chemosphere*, 32, (17) 2177-2187.

Call, D.J. et al., 1997, "A Laboratory Evaluation of the Toxicity of Sediment-associated Phthalate Esters" Presented at the SETAC 18th Annual Meeting, San Francisco, 16-20 November 1997.

Chappell, W. R. 1992. *Scaling Toxicity Data Across Species*. Environ. Geochem. Health 14:71-80.

Efroymson, R.A., G.W. Suter, II, B.E. Sample and D.S. Jones. 1997a. *Preliminary Remediation Goals for Ecological Endpoints*. Oak Ridge National Laboratory, Oak Ridge, TN. 50 PP, ES/ER/TM-162/R2.

Efroymson, R.A., M.E Will, and G.W. Suter II. 1997b. *Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Processes: 1997 Revision*. Oak Ridge National Laboratory, Oak Ridge TN. ES/ER/TM-126/R2.

Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten. 1997c. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision*. Oak Ridge National Laboratory, Oak Ridge, TN. 128 PP, ES/ER/TM-85/R3.

EPA. 1989a. *Risk Assessment Guidance for Superfund (RAGS), Volume II: Environmental Evaluation Manual*. EPA/540/1-89-001. U.S. Environmental Protection Agency.

EPA. 1989b. *Ecological Assessments of hazardous Waste Sites: A Field and Laboratory Reference Document*. EPA/600/3-89/013.

EPA. 1991. *Ecological Assessment of Superfund Sites: An Overview* ECOUpdate 1(2), Office of Solid Waste and Emergency Response, Publ. 9345.0-051.

EPA. 1992a. *Framework for Ecological Risk Assessment*. Risk Assessment Forum. EPA/630/R-92/001.

EPA. 1992b. Risk Assessment Guidance for Superfund, Volume 1. Human Health Evaluation Manual, Supplemental Guidance, Dermal Risk Assessment, Interim Guidance Draft, U.S. Environmental Protection Agency, August 18, 1992.

EPA. 1993a. *Wildlife Exposure Factors Handbook*. EPA/600/R-93/187A,B. Office of Research and Development, Washington, D.C.

EPA. 1993b. *Technical Basis for Deriving Sediment Quality Criteria for Nonionic Organic Contaminants for the Protection of Benthic Organisms by Using Equilibrium Partitioning*. EPA-822-R-93-011. U.S. Environmental Protection Agency, Washington, DC.

EPA. 1996a. *Ecotox Thresholds*. Eco Update. EPA 40/F-95/038.

EPA. 1996b. Soil Screening Guidance: Technical Background Document . EPA/540/R-95/128.

EPA. 1997. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*. Interim Final. U.S. EPA Env. Response Team. Edison, NJ, June 1997.

EPA. 1998. Final Technical Approach for Developing Edqls for RCRA Appendix Ix Constituents and Other Significant Contaminants of Ecological Concern.

HAZWRAP (Hazardous Waste Remedial Action program). 1994. *Loring Air Force Base, Ecological Risk Assessment Methodology*.

- Ingersoll, C.G., P.S. Haverland, E.L. Brunson, T.J. Canfield, F.J. Dwyer, C.E. Henke, N.E. Kemble, D.R. Mount, and R.G. Fox. 1996. Calculation and Evaluation of Sediment Effects Concentrations for the Amphipod *Hyalella Azteca* and the Midge *Chironomus Riparus*. *J. Great Lakes RES.* 22:602-623.
- Lyman, W.J., W.F. Reehl, and D.H. Rosenblatt. 1990. *Handbook of Chemical Property Estimation Methods*. Amer. Chem. Soc., Washington, D.C.
- MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems, *Arch. Environ. Contam. Toxicol.* 39: 20-31.
- OAC (Ohio Administrative Code). 1997. Ohio Chronic Water Quality Criteria. Ohio Administrative Code Chapter 3745-1 AS Amended on October 31, 1997.
- Ohio EPA. 2001. *Biological and Sediment Quality Study of Unzinger Ditch, 2000*.
- Persaud, D., R. Jaagumagi, and A. Hayton. 1994. *Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario*. Ontario Ministry of the Environment and Energy.
- Sample, B.E., D.M. Opresko, and G.W. Suter, II. 1996. *Toxicological Benchmarks for Wildlife: 1996 Revision*. ES/ER/TM-86/R3, Oak Ridge National Laboratory, Oak Ridge, TN.
- Suter, G.W. II, and C.L. Tsao. 1996. *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision*. ES/ER/TM-96/R2. Lockheed Martin Energy Systems, Oak Ridge National Laboratory, Oak Ridge, Tenn.
- Talmage, S. S., and B. T. Walton. 1993. *Food Chain Transfer and Potential Renal Toxicity of Mercury to Small Mammals at a Contaminated Terrestrial Field Site*. *Exotoxicology* 2: 243-256.
- Travis, C.C., and R.K. White. 1988. "Interspecific scaling of toxicity data." *Risk Analysis* 8:119-124.
- Wennberg, L., Parkman, H., Remberger, M., Viktor, T. and Williams, C., Swedish Environmental Institute. Presented at SETAC Europe, Amsterdam, April 1997
- Wentzel, R. S., R. T. Checkai, T. W. LaPoint, M. Simini, D. Ludwig, and L. Brewer. 1994. *Procedural Guidelines for Ecological Risk Assessments at U.S. Army Sites, Vol. 1*. ERDEC-TR-221, Aberdeen Proving Ground, MD.
- Wentzel, R.S., La Point, T.W., Simini, M., Checkai, R.T., Ludwig, D., and Brewer, L. 1996. *Tri-service Procedural Guidelines for Ecological Risk Assessment, Vol. 1*. ERDEC-TR-221, Edgewood Development & Engineering Center, Aberdeen Proving Ground, MD.

8.0 PROTECTION STANDARDS

Protection standards were developed for the chemicals of concern (COCs) identified in the human health risk assessment (HHRA) and ecological chemicals of concern (ecoCOCs) identified in the ecological risk assessment (ERA). These protection standards are preliminary in nature and are not intended to serve as final cleanup goals. Rather they are intended to guide further evaluation of chemical contamination at the Franklin Steel facility regarding the need for remedial actions. Thus, these protection standards may be considered as site-specific preliminary remediation goals (PRGs).

8.1 HUMAN HEALTH PRELIMINARY REMEDIATION GOALS

COCs were identified in the HHRA in soil, sediment, surface water and groundwater. Nine metals and various SVOCs were identified in “hot spots” within surface and subsurface soils. Benzo(a)pyrene and benzo(b)fluoranthene were identified as COCs in Unzinger’s Ditch surface water. Seven metals, bis(2-ethylhexyl)phthalate were identified as COCs in groundwater; however, the presence of elevated metals in background produces uncertainty concerning the identification of metals as COCs. Protection standards were developed for these potential “hot spot” contaminants to assist in the evaluation of the need for any corrective action for these contaminants. Arsenic is the only COC depicted in S109 and S201. Section 6.6.1 discusses the detections of arsenic in these areas and the documented occurrence of arsenic in Ohio soils. Data indicates a thin (5 feet) glacially-deposited layer of naturally-occurring arsenic rich soils. This general geologic knowledge coupled with lack of elevated arsenic concentrations from the area’s other soil samples indicate that the detections do not represent contamination and arsenic is attributed to naturally occurring deposition.

Chemical-specific protection standards for these COCs were developed for specific medium and land use (commercial/industrial). Possible sources for site-specific PRGs included risk-based values, applicable or relevant and appropriate requirements (ARARs), or background concentrations for naturally-occurring constituents.

Site-specific PRGs were developed by using the same exposure parameters, intake equations, and toxicity data used in the HHRA. In other words, the risk equations were solved for a chemical concentration using an established risk value (noncancer hazard quotient of 1 and excess lifetime cancer risk value of $1E-06$). An ELCR of $1E-06$ was used to develop each cancer-based site-specific PRG to ensure that the cumulative risk would be below the target ELCR of $1E-05$. In addition, cancer-based site-specific PRGs were calculated with an ELCR equal to the target $1E-05$ value. National Primary Drinking Water Maximum Contaminant Levels (MCLs) are the only ARARs available for groundwater. No ARARs were used for soil, sediment, and surface water. Background concentrations are represented as the lower of the 95% UTL or maximum detected concentration of these chemicals in background samples.

The human health site-specific PRGs are presented in Table 8.1, based on a ELCR of both $1E-06$ and $1E-05$. In cases where background or ARARs exceed risk-based calculations, the site-specific PRG should be based on the ARAR or background. In addition, issues such as naturally-occurring levels of metals and non-site-related sources (e.g., PAH sources) need to be considered before determining the level of corrective action required.

Note that while not listed in Table 8.1, lead is a possible COC in Unzinger’s Ditch downstream of RM 0.6. Lead was detected at a maximum concentration of 775 mg/kg. The EPA screening level for soil exposure is 400 mg/kg, therefore, lead is considered a possible COC in sediment for the downstream stretch of Unzinger’s Ditch.

8.2 ECOLOGICAL PRELIMINARY REMEDIATION GOALS

Ecological site-specific PRGs are developed for contaminants of ecological concern in surface water and sediment and are intended to protect individuals and populations of ecological receptors at and near the Franklin Steel facility. For aquatic biota, the site-specific PRGs are based on Ohio chemical water quality criteria or, in the absence of criteria, the preferred screening values (Appendix Table C.1), or site background if this value is lower than background. For sediment-dwelling biota, the site-specific PRGs are based on published toxicity benchmarks (the preferred screening values in Appendix Table C.2) or site background concentrations if the preferred screening value is lower than the background concentration.

To become an ecoCOC that requires a site-specific PRG, an analyte must occur consistently in the surface water or sediment of a lotic stream segment that fails to meet the chemical and biological criteria specified by OAC 4735-1 or in the surface water or sediment of a lentic water body. In other cases, concentrations must be high enough to produce a reasonable likelihood that they will cause harm to the biological community. For this analysis, it is assumed that in a stream that failed to meet biological criteria, any contaminant that exceeded the Ohio chemical water quality criteria and/or produced a minimum calculated HQ of 1 for any given receptor in the screening ERA (Section 7.6) is an indicator of sufficient contamination to cause harm to biota. Indeed, the Ohio EPA study (Ohio EPA 2001) measured the presence of such harm and reported it as poor to very poor biological conditions. Other contaminants that might cause less harm are assumed to be distributed in the EU similarly to the distribution of ecoCOCs for which site-specific PRGs are derived. Therefore, any remedial action taken for the ecoCOCs with high HQs can be expected to remediate also any harm from collocated ecoCOCs with lower HQs.

The Ohio EPA (Ohio EPA 2001) divided Unzinger's Ditch into two similarly sized segments, one downstream and one upstream of Mile 0.6. In addition, to these two segments, the Outfall 002 drainage system was added for evaluation and comparison. These segments are represented chemically by samples taken either upstream or downstream of a 15-inch tile outfall just upstream of Mile 0.6. Both segments of Unzinger's Ditch failed to meet chemical water quality criteria (Section 7.3) and biological criteria (Section 7.7) and have ecoCOPCs with HQs above 1 (Section 7.6). They were thus designated ecoCOCs. Other analytes were designated ecoCOCs because they exceeded Ohio chemical water quality criteria.

The ecoCOCs in surface water and sediment in Unzinger's Ditch are:

- downstream surface water – aluminum, barium, copper, lead, manganese, mercury, zinc, benzo(a)pyrene, butyl benzyl phthalate, fluoranthene, bis(2-ethylhexyl) phthalate, and pyrene;
- upstream surface water – aluminum, barium, copper, lead, mercury, zinc, fluoranthene, and bis(2-ethylhexyl) phthalate;
- downstream sediment – arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, anthracene, benzo(a)anthracene, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, phenanthrene, and pyrene; and
- upstream sediment – arsenic, cadmium, copper, lead, mercury, zinc, anthracene, benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, phenanthrene, and pyrene.

A biological investigation was not done by Ohio EPA on the S101 Siphon Dam nor the S201 Wetland. However, these locations did not meet chemical criteria for lentic water. The ecoCOCs in surface water and sediment with HQs above 1 in Outfall 002, the S101 Siphon Dam and the S201 Wetland are:

Outfall 002 surface water – aluminum, barium, copper, lead, mercury and zinc;

S101 Siphon Dam surface water – aluminum, barium, copper, cyanide, lead, zinc and phenanthrene;

S201 Wetland surface water – aluminum, barium, copper, lead, manganese, and zinc;

Outfall 002 sediment - cadmium, chromium, copper, lead, nickel, zinc, anthracene, benzo(a)anthracene,

- benzo(a)pyrene, bis(2-ethylhexyl)phthalate, fluoranthene, naphthalene, phenanthrene, and pyrene; and
- S101 Siphon Dam sediment – cadmium, chromium, copper, lead, mercury, nickel, zinc, anthracene, benzo(a)anthracene, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, chrysene, fluoranthene, naphthalene, phenanthrene, and pyrene; and
- S201 Wetland sediment – none.

The development of site-specific PRGs for each of the above ecoCOCs is detailed in the following subsections.

8.2.1 Surface Water

Site-specific PRGs for surface water are based on background concentrations, chemical water quality criteria, and the screening values presented in Appendix Table C.1. Ohio EPA Outside Mixing Zone Average (OMZA) water quality criteria were the first choice, followed by chronic NAWQC. EPA Tier II chronic benchmark values were used in the absence of NAWQC benchmark data. Aquatic effects benchmarks are expressed for chronic exposure, where chronic exposure is defined for the minimum 7-day low flow that would occur in a 10-year period. Therefore, chronic benchmarks, including OMZA criteria, were chosen for PRGs because they protect aquatic life over long periods of time.

Table 8.2 presents background data from the site, Ohio chemical water quality criteria (OAC 3745-1), and other toxicity benchmark values along with site-specific PRGs for surface water. When the background value was above the toxicity benchmark, the background concentration was chosen as the site-specific PRG, because it is not reasonable to clean up concentrations below naturally occurring background concentrations.

The site-specific PRGs recommended for the surface water ecoCOCs are:

- aluminum – 250 µg/L (all locations),
- barium – 80 µg/L (all locations),
- copper – 10 µg/L (all locations),
- cyanide – 12 µg/L (S101 Siphon Dam only),
- lead – 6.4 µg/L (all locations),
- manganese – 100 µg/L (Unzinger’s Ditch downstream and S201 Wetland),
- mercury – 0.77 µg/L (Unzinger’s Ditch downstream and upstream),
- zinc – 120 µg/L (all locations),
- benzo(a)pyrene – 0.014 µg/L (Unzinger’s Ditch downstream only),
- butyl benzyl phthalate – 23 µg/L (Unzinger’s Ditch downstream only),
- fluoranthene – 0.8 µg/L (Unzinger’s Ditch downstream and upstream),
- phenanthrene – 2.3 µg/L (S101 Siphon Dam only),
- pyrene – 0.3 µg/L (Unzinger’s Ditch downstream only), and
- bis(2-ethylhexyl) phthalate – 8.4 µg/L (Unzinger’s Ditch downstream and upstream).

8.2.2 Sediment

Site-specific PRGs for sediment are based on background concentrations and preferred screening values presented in Appendix Table C.2. Ohio EPA’s preferred hierarchy of Environmental Screening Values is: 1) Consensus-based TECs (MacDonald, Ingersoll, and Berger 2000) and 2) EPA Region 5 Environmental Data Quality Levels (EDQLs). Only TECs were used to develop PRGs for sediment. EDQLs were not used as TRVs, and therefore, were not used to develop site-specific PRGs.

Table 8.3 presents background data from the site and the toxicity benchmark values along with site-specific PRGs. When the background for an ecoCOC was above its toxicity benchmark, background was chosen as the site-specific PRG, because it is not reasonable to clean up concentrations below naturally occurring background concentrations.

The site-specific PRGs recommended for the sediment ecoCOCs are:

arsenic – 21.2 mg/kg (Unzinger's Ditch downstream and upstream),
cadmium – 2.3 mg/kg (Unzinger's Ditch and S101 Siphon Dam),
chromium – 43.4 mg/kg (Unzinger's Ditch downstream and S101 Siphon Dam),
copper – 33.8 mg/kg (Unzinger's Ditch and S101 Siphon Dam),
lead – 35.8 mg/kg (Unzinger's Ditch and S101 Siphon Dam),
mercury – 0.18 mg/kg (Unzinger's Ditch and S101 Siphon Dam),
nickel – 42.2 mg/kg (Unzinger's Ditch downstream and S101 Siphon Dam),
zinc – 138 mg/kg (Unzinger's Ditch and S101 Siphon Dam),
total PAHs – 1600 µg/kg (Unzinger's Ditch downstream only),
anthracene – 57.2 µg/kg (Unzinger's Ditch and S101 Siphon Dam),
benzo(a)anthracene – 108 µg/kg (Unzinger's Ditch downstream and upstream),
benzo(a)pyrene – 150 µg/kg (Unzinger's Ditch and S101 Siphon Dam),
chrysene – 166 µg/kg (Unzinger's Ditch and S101 Siphon Dam),
dibenzo(a,h)anthracene – 33 µg/kg (Unzinger's Ditch downstream and upstream),
fluoranthene – 423 µg/kg (Unzinger's Ditch downstream and S101 Siphon Dam),
fluorene – 77.4 µg/kg (Unzinger's Ditch downstream and upstream),
phenanthrene – 204 µg/kg (Unzinger's Ditch and S101 Siphon Dam),
pyrene – 195 µg/kg (Unzinger's Ditch downstream only), and
bis(2-ethylhexyl)phthalate – 9300 µg/kg (Unzinger's Ditch downstream and S101 Siphon Dam).

The units of site-specific PRGs for organic ecoCOCs were converted from mg/kg, as shown in Table 8.3 and in the screening ERA, to µg/kg, which is the standard unit for reports by analytical laboratories.

The site-specific PRG of 1600 µg/kg for total PAHs (MacDonald, Ingersoll, and Berger 2000) should be used in addition to evaluating each PAH individually, to be sure that the sum of PAHs with site-specific PRGs and PAHs without site-specific PRGs does not cause the site-specific PRG for total PAHs to be exceeded when no individual PAH exceeds its site-specific PRG. For example, the sum of site-specific PRGs for individual PAHs is 1,410 µg/kg; concentrations of other PAHs, such as acenaphthene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene, when added to the sum of individual PRG concentrations, could exceed 1,600 µg/kg. Therefore, without the site-specific PRG for total PAHs, locations for which remediation is appropriate could be missed.

A site-specific PRG of 9,300 µg/kg for bis(2-ethylhexyl)phthalate in sediment was derived by using equilibrium partitioning to calculate a TRV for pore water. Measured bis(2-ethylhexyl) phthalate concentrations are above this the toxicity benchmark derived for sediment. Toxicity was also indicated by high HQs for herons exposed to bis(2-ethylhexyl) phthalate in surface water. Sediment is a likely source of bis(2-ethylhexyl) phthalate in surface water but, as detailed in the following paragraph, the quantitative contribution of sediment to bis(2-ethylhexyl) phthalate in surface water is predictable.

It is assumed that most bis(2-ethylhexyl) phthalate in sediment comes from contaminated soil washed into the Unzinger's Ditch by overland water flow, either directly or through drains. The bis(2-ethylhexyl) phthalate in surface water is assumed to come primarily by leaching from soil- and sediment-bound bis(2-ethylhexyl) phthalate. However, the reported surface water concentrations probably do not reflect bis(2-ethylhexyl) phthalate dissolved from sediment. Instead, because the reported concentrations in surface water are for

unfiltered water, they probably include some particle-bound bis(2-ethylhexyl) phthalate. Since only dissolved chemicals are bioconcentrated this would lead to an overestimate of exposure to herons via ingestion of fish. Direct releases of dissolved bis(2-ethylhexyl) phthalate via the drain at the beginning of the downstream segment may also contribute to surface water concentrations.

8.2.3 Summary

PRGs were developed for the ecoCOCs in surface water and sediment in Unzinger's Ditch, the S101 Siphon Dam, Outfall 002 drainage system and the S201 Wetland at or near the Franklin Steel facility. Ohio chemical water quality criteria, published data and data from the Franklin Steel Site were used to develop these site-specific PRGs. Fourteen site-specific PRGs for surface water and nineteen PRGs for sediment are advanced. These are believed to be conservative values and can be used with confidence that they protect ecological receptors in the sediment and surface water.

REFERENCES

MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems, Arch. Environ. Contam. Toxicol. 39: 20-31.

Ohio EPA. 2001. *Biological and Sediment Quality Study of Unzinger Ditch, 2000*.

9.0 SUMMARY

9.1 SITE INVESTIGATION

Ten SWMUs and 12 new AOCs were investigated during the Franklin Steel RFI. In order to characterize and define the site's potential impact on environmental media surface water, sediment, soil, and groundwater samples were collected from all SWMUs and AOCs and analyzed for TAL constituents in accordance with the Franklin Steel RFI Workplan (ERM 1993), Part 2 Work Plan (B & N 2006), and associated modifications.

As outlined in Section 2.0 (Characterization of the Environmental Setting) of this report, the environmental setting of the Franklin Steel site is now well understood as a result of this investigation and research. Site geologic data from the RFI indicate that the Franklin Steel site is situated near the western flank of a preglacial carved bedrock buried valley that was filled with glacial deposits which exists in the area. The valley-fill consists of glacial outwash and till deposits that may have been laid down in a braided stream environment.

The results of the RFI investigation indicate that the hydrogeologic setting underlying the facility consists primarily of glacial outwash and till ranging from well sorted fine silt, clay, and sand to poorly sorted fine to coarse gravel. The most consistent lithologic type found at the surface of the facility was silty-clay with varying amounts of sand and gravel. Averaging approximately 11.5 feet thick across the entire site, this upper-most layer appears to be very impermeable as compared to the underlying sand or sand and gravel water bearing zone. Groundwater was encountered at various depths throughout the site ranging from 8 feet bgs to 16 feet bgs. Composition of the saturated zone varied considerably. The lithology ranges from fine-grained sand with some silt to gravel (up to 40 mm) with some sand.

Groundwater flow under the Franklin Steel site and the adjacent area appears to be in an easterly direction towards the central portion of the buried valley. This is also in the general direction of the Taylor Road Well Field, which serves as the principle groundwater discharge point. There seems to be a groundwater depression, or discharge area, along the ditch next to the south-boundary's railroad tracks between S109-PZ02 and S109-PZ04.

Potential sources of contamination were identified in the RFI Description of Current Conditions (ERM-Midwest, 1993). Waste Characterization Data Sheets, that include detailed information concerning the physical and chemical properties of potential contaminants associated with these sources, were developed during the RFI and are included in this report (Appendix A).

Chemical constituents were noted above established background criteria (see Section 6.1.1) in various units investigated. The number and concentration of chemicals found in the two former drum storage areas, SWMUs S109 and S201, was relatively low. In SWMU S109, a number of inorganic constituents including aluminum, arsenic, barium, cadmium, chromium, lead, and mercury all exceeded background concentrations. SVOCs detected in S109 were primarily PAHs (naphthalene, phenanthrene, and 2-methylnaphthalene) and phthalates, with dibenzofuran as the only other SVOC found. Concentrations of PAHs and phthalates exhibited in general a decrease with depth. The most common PAH was 2-methylnaphthalene and the most common phthalate was bis(2-ethylhexyl)phthalate. The only VOC detected in S109 was acetone.

In SWMU S201, a number of inorganic constituents including aluminum, arsenic, cobalt, copper, lead, mercury, nickel, vanadium, and zinc all exceeded background concentrations. SVOCs detected in S201 were di-n-butylphthalate and bis(2-ethylhexyl)phthalate.

The industrial area (S101 through S108) exhibited a number of constituents above background concentrations. The inorganic RCRA metal constituents barium, cadmium, chromium, lead, mercury and silver all exceeded background concentrations. Numerous SVOCs were detected in the industrial area that consisted primarily of PAHs and phthalates. Concentrations of PAHs generally exhibited a decrease with depth and included benzo(a)pyrene, fluorene, pyrene and dibenzo(a,h)anthracene.

Concentrations of phthalates generally exhibited a decrease with depth and included butyl benzyl phthalate and bis(2-ethylhexyl)phthalate. Numerous VOCs were found in the industrial area, including acetone, 2-butanone, ethylbenzene, methylene chloride, toluene, trichloroethene, and xylenes.

Soil Results of RFI Part 1

Chemical constituents were detected above protection standards in 9 of the 10 SWMUs. None of the COCs (inorganic, SVOC, and VOC) detected in soil were reported above PRG values in:

- SWMU S101 – Stormwater Drainage System;

Inorganics

For SWMUs S109 and S201 arsenic was detected above the protection standards at isolated sample locations and depths. The documentation presented in SAIC's March 16, 2001 submittal concerning additional SVOC and arsenic sampling results concluded that arsenic concentrations in S109 are naturally occurring and in S201 were an anomaly. Ohio EPA found the sampling results of the SAIC March 16, 2001 submittal to be acceptable, and concluded the RFI sampling activities in S109 and S201 (Ohio EPA, 2001).

In SWMU S201, iron was detected at 126,000 mg/kg in soil sample S201-SB10 at the 12-13 ft. depth interval. However, the shallower soil sample collected at S201-SB10 (5-6 ft.) detected iron below the protection standard at 26,100 mg/kg. The protection standard for iron is 100,000 mg/kg.

The industrial area (SWMUs S101 through S108) exhibited concentrations of chromium, lead, or iron above Region 9 PRGs in:

- SWMU S103 – Shot Blast Dust Collector, iron was detected at a concentration of 166,000 mg/kg (S103-SB02) and lead was detected at concentrations of 1,110 mg/kg and 1,010 mg/kg at S103-SB02 and S103-SB03, respectively (August 1997).
- SWMU S104 – Former Shot Blast Dust Storage Area, lead was detected in 1 of 9 samples at a concentration of 810 mg/kg at S104-SS01 (October 1997).
- SWMU S105 – Former Caustic Rinse System and Caustic Sludge Holding Tank, chromium (461 mg/kg) and lead (4,070 mg/kg) were detected in 1 of 12 samples at S105-SB04 (August 1997);
- SWMU S106 – Oxidizer System, chromium was detected in 1 of 23 samples at a concentration of 1,120 mg/kg at S106-SS02 (October 1993). Lead was detected in 4 of the 23 soil samples, at concentrations ranging from 830 mg/kg (S106-SB02) to 4,310 mg/kg (S106-SS03) during October 1993 – August 1997;
- SWMU S107 – Drum Storage Area #1, lead was detected in 1 of 41 soil samples at a concentration of 472 mg/kg at S107-SS04 (October 1993); and

- SWMU S108 – Drum Storage Area #2, chromium was detected in 1 of 118 samples in S108-SB15 at a concentration of 313 mg/kg (September 1997). Lead was detected in 8 of 118 soil samples at concentrations ranging from 402 mg/kg (S108-SB13) to 1,840 mg/kg (S108-SB15) during October 1993 – August 1997 .

All of these protection standard exceedances were limited to the 0-1 ft. depth interval. Therefore, elevated concentrations of inorganic COCs appear to be limited to the 0-1 ft. depth interval at these sample locations.

Pesticides/PCBs

PCB Aroclor-1254, was found at a concentration of 100 µg/kg at S107-SB10 (March 1998) and 840 µg/kg (S108-SS09) in samples collected from the surface to 5 ft. depth interval. PCBs were not detected in any of the samples below the surface to a 5 ft. depth interval. In addition, the pesticide, methoxychlor, was found in one sample at a concentration of 44 µg/kg (S108-SS19) at a surface depth of 0-1 ft.

SVOCs

None of the SVOCs detected in SWMUs S101 through S106, S109, and S201 were reported above their respective protection standard.

Only 5 (i.e., S107-SS01, SS03, SS04, SS05 and S107-SB03) of the 41 soil samples collected in SWMU S107 – Drum Storage Area #1 reported a SVOC (i.e., benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene and bis(2-ethylhexyl)phthalate) concentration above its respective protection standard. All five samples were collected from the 0-1 ft. depth interval. A deeper sample (2-3 ft. or 5-6 ft. depth interval) was also analyzed at all five locations and reported concentrations below their respective protection standard. Therefore, SVOC concentrations reported above protection standards appear to be limited to the 0-1 ft. depth interval at these five soil sample locations.

In SWMU S108, only 3 of the 118 soil samples reported an SVOC concentration above its respective protection standard. Surface soil sample S108-SS03, reported benzo(a)pyrene above its respective protection standard in the 0-1 ft. depth interval. However, the S108-SS03 soil sample collected from the 2-3 ft. depth interval reported a benzo(a)pyrene concentration below the protection standard. Therefore, elevated concentrations of benzo(a)pyrene are limited to the 0-1 ft. depth interval at the S108-SS03 sample location.

Soil boring S108-SB13 reported concentrations of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene above their respective protection standard at the 7-8 ft. depth interval. However, none of these SVOCs were detected or reported above their respective protection standard in the 5-6 ft. depth interval.

VOCs

For all 10 SWMUs, only SWMU S107 – Drum Storage Area #1 exhibited VOCs above their respective protection standard. Surface soil samples collected at S107-SB07 and S107-SB12 reported concentrations of trichloroethene (TCE) and total xylenes, respectively, above their respective protection standards for the 0-1 ft. depth interval only. Two additional soil samples were collected at deeper sample intervals for both sample locations. The depth intervals of the deeper samples collected at S107-SB07 were 5-6 ft. and 10-11 ft. The depth intervals of the deeper samples collected at S107-SB12 were 5-6 ft. and 8-9 ft. All of the deeper samples at both locations reported VOC concentrations below their respective protection standard.

Soil Results of RFI Part 2

The purpose of the RFI Part 2 investigation was to determine whether there is contamination from any releases of hazardous wastes and hazardous constituents as a result of operations that occurred at the 12 new AOCs. The RFI Part 2 was not designed to determine the full nature and extent of contamination, but rather document the highest potential contamination associated with each of the AOCs as determined through field observation and subsequent sampling of the most heavily stained areas.

Chemical constituents were detected above protection standards in six of the 12 AOCs. None of the COCs (inorganic, SVOC, and VOC) detected in soil were reported above Region 9 PRGs:

- AOCs C – Shot Blast Dust Bags Storage Area;
- AOCs D – Filter Press Storage Pad Area;
- AOCs E – Former Hazardous Waste Storage Pad;
- AOCs G – Thermal Oxidizer Building Doorway Areas;
- AOCs I – Heavy Drum Storage Pad; and
- AOCs K – Former Drum Storage Area – Trailer Parking Lot, Southwest Corner of Property.

In AOCs A, one detected concentrations of benzo(a)pyrene was reported above the Region 9 PRGs. Benzo(a)pyrene was detected at a concentration of 491 µg/kg at A-GP-6 (0-1) during October 2006. All other detected COCs were reported below respective PRGs.

In AOCs B, one concentration of arsenic was reported above the Region 9 PRGs. Arsenic was detected at a concentration of 93.7 mg/kg at B-GP-8 (0-1) during October 2006. All other COCs were reported below the Region 9 PRGs.

In AOCs F, the inorganic RCRA metal constituents chromium, iron, and lead were reported above their respective PRGs. Chromium concentrations were 732 mg/kg in F-HA-2 (0-1) and iron concentrations were 154,000 in F-GP-18 (0-1) during October 2006 sampling. Lead concentrations ranged from 2,860 mg/kg (F-HA-2 (0-1)) to 4,610 mg/kg (F-GP-17 (0-1)) in October 2006. No other detected COCs were reported above the Region 9 PRGs. Various SVOCs were detected in AOCs F. The compound 2-methylnaphthalene (3,035 µg/kg), benzo(a)pyrene (845 µg/kg), benzo(b)fluoranthene (1,055 µg/kg), dibenzo(a,h)anthracene (960 µg/kg), inden(1,2,3-cd)pyrene (895 µg/kg), 4,6-dinitro-2-methylphenol (1,710 µg/kg), 2,4-dinitrophenol (12,850 µg/kg) were all detected in F-GP-18 (0-1). No other detected SVOCs were reported above PRGs.

In AOCs H, one detected concentration of lead was reported above the PRGs. Lead was detected at a concentration of 1,540 mg/kg at H-GP-23 (0-1) during the October 2006 sampling event. No other detected COCs were reported above their respective protection standard. Three SVOCs were detected in AOCs H above the Region 9 PRGs. The compounds benzo(a)pyrene (163 µg/kg), dibenzo(a,h)anthracene (186 µg/kg) and 4-nitrophenol (2,260 µg/kg) were all detected in H-GP-20 (0-1). No other detected SVOCs were reported above PRGs.

In AOCs J, the inorganic RCRA metal constituents chromium, iron, and lead were above Region 9 PRG values for one surface soil sample only. Chromium (546 mg/kg), iron (165,000 mg/kg) and lead 5,060 concentrations were detected at J-HA-4 (0-0.5) during the October 2006 sampling. No other detected COCs were reported above their respective PRG screening value.

In AOCs L, both aluminum and iron and numerous SVOC constituents were reported above Region 9 PRGs

at one sample location. Aluminum concentrations were detected at L-HA-8 and L-HA-9 at 8,940 mg/kg and 5,810 mg/kg, respectively. Iron concentrations were detected in L-HA-8 at 21,100 mg/kg and L-HA-9 at 24,100 mg/kg. Various SVOCs were detected ranging from 8.6 mg/kg (naphthalene in L-HA-9) to 181 mg/kg (2,4-Dinitrophenol in L-HA-8). No other detected COCs were reported above their PRG screening value.

Groundwater Results

Contiguous Area #1 encompasses active process, drum storage areas, and the adjacent field formerly used for drum storage to the east. Contiguous Area #2 consists of SWMU S201 and the area immediately surrounding SWMU S201. The area east of Contiguous Area #2 consists of the Jefferson Township Well Field which has monitoring wells and water supply wells. The Jefferson Township Well Field is located downgradient of Contiguous Area #2 which is located downgradient of Contiguous Area #1.

As indicated previously in Section 4.6, various metals, SVOCs and VOCs were detected in groundwater above Region 9 PRGs.

Metals

- Aluminum peaked at 2.4 mg/L in sample location S109-MW06;
- Arsenic peaked in S108-MW03 at a concentration of 0.028 mg/L;
- Beryllium peaked in S107-PZ01 at a concentration of 0.78 mg/L.
- Cobalt peaked in S108-PZ22 at a concentration of 0.028 mg/L;
- Iron peaked in S109-MW06 at a concentration of 12.6 mg/L;
- Manganese peaked in S201-PZ01 at a concentration of 3.9 mg/L;
- Nickel peaked in S109-MW05 at a concentration of 0.25 mg/L.

SVOCs

- Bis(2-ethylhexyl)phthalate has been detected above the Region 9 tap water exposure value of 4.8 µg/L during 7 sampling events since October 2000.

VOCs

- Chloroethane peaked in S109-MW06 at a concentration of 540 µg/L.
- Methylene chloride in S105-MW01 has only been detected during one other sampling event (April 2001) at a concentration of 0.51 JB µg/L which is below the MCL.
- Concentrations of vinyl chloride in S109-MW06 peaked during the October 2007 sampling event at a concentration of 9.2 J µg/L. Prior to January 2003, vinyl chloride was not detected.

Results of the last three semiannual monitoring events (May and November 2006, and October 2007) indicate groundwater results reported above their respective Primary MCL were limited to RFI monitoring wells S101-MW01R, and S105-MW01 in Contiguous Area #1 and S109-MW06 in Contiguous Area #2. The area's ground water aquifer system extends beyond Contiguous Area #1 downgradient into Contiguous Area #2; therefore, the impacted ground water is not confined to only Contiguous Area #1.

9.2 RISK ASSESSMENT

In order to evaluate the threat to human and ecological receptors from the identified chemicals in the SWMU and AOCs areas, an HHRA and screening ERA was conducted. The HHRA and ERA for the Franklin Steel facility examined the presence of chemical constituents in environmental media at and near the site, the potential routes of exposure to human and ecological receptors, and the likelihood of adverse effects following contact with these constituents. Results of the risk assessments are summarized below for each exposure unit. Constituents identified as COCs present unacceptable risks (HI greater than 1 and or ELCR greater than 1E-05) and require further consideration to determine the need for remedial action.

For the purpose of quantifying exposure and risk, the site was divided into the following three exposure units:

- Exposure Unit 1 - Active Operations Area;
- Exposure Unit 2 – Inactive Operations Area; and
- Exposure Unit 3 – Unzinger’s Ditch

HHRA

A baseline HHRA was conducted for all three exposure units. Receptors for Exposure Unit 1 included current site workers and future construction/utility workers. For Exposure Units 2 receptors included future construction/utility workers and hypothetical trespassers. Exposure Unit 3 included the evaluation of hypothetical trespassers. Chemicals were identified as COCs if risk from exposure to any receptor evaluated exceeded 1E-05 excess lifetime cancer risk or noncancer hazard index of 1. The following COCs based on human health risks were identified.

Soil: Several SVOCs (e.g., (i.e., benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene and bis(2-ethylhexyl)phthalate) constituents are present at elevated concentrations in localized areas (“hot spots”) of Exposure Unit 1 (see Section 6.1.3). Arsenic was identified as a COC in Exposure Units 1 and 2; however, the presence of arsenic is relative to background concentrations and data strongly suggests arsenic is a naturally occurring compound (see Section 6.6.1).

Groundwater: Bis(2-ethylhexyl)phthalate and vinyl chloride were identified as COCs. In addition, arsenic was identified as a COC; however, as discussed in Section 6.6.1, the presence of metals in groundwater is relative to the naturally-occurring concentrations (see Section 6.6.1).

Surface Water: Benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene and bis(2-ethylhexyl)phthalate were identified as COCs in Unzinger’s Ditch surface water.

Sediment: Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene and bis(2-ethylhexyl)phthalate were identified as COCs in Unzinger’s Ditch. In addition, seven metals (aluminum, antimony, arsenic, barium, cadmium, iron, lead, and thallium) were identified as COCs in Unzinger’s Ditch sediment via the quantitative risk characterization. There is no equivalent value for sediment.

ERA

A screening ERA was performed in accordance with guidance from Ohio EPA, EPA Headquarters and EPA Region V. This guidance specifies a step-by-step procedure. The screening ERA conducted for the Franklin Steel facility adheres to this guidance and includes the following four steps: (1) problem formulation; (2) exposure assessment; (3) effects assessment; and (4) risk characterization with attention to uncertainties and summarization.

Current risks to ecological receptors at the Franklin Steel facility exposure units were characterized by evaluating ecological assessment endpoints using hazard quotients. Hazard quotients are calculated for different receptors for every ecoCOPC for which a toxicity threshold concentration was available from published information. Each hazard quotient compares two concentrations: the estimated preliminary ecoCOPC concentration (RME) to which a given receptor is exposed, and the TRV for the preliminary ecoCOPC and receptor. The TRV is a dietary limit or other threshold concentration expected to cause no harm to the receptor, minimal harm with no ecological significance, or minimal harm to a community of organisms (i.e., assemblage of species) exposed to the ecoCOPC in an appropriate medium. Thus, the TRV is a safe, or protective, concentration.

Of the many observed plant and animal taxa, three aquatic classes were selected (sediment-dwellers, fish and aquatic life, and fish-eating and water-drinking predators).

Concentrations of analytes in surface water were compared to Ohio chemical water quality criteria. Six inorganic analytes and three organic analytes exceeded the criteria in at least one EU. They are:

- copper
- cyanide
- lead
- manganese
- mercury
- zinc
- butyl benzyl phthalate
- fluoranthene
- bis(2-ethylhexyl) phthalate

Hazard quotients were calculated for each qualifying exposure unit or exposure unit in the screening ERA. A number of ecoCOPCs with HQs greater than 1 were found and are summarized below:

Surface water

- aluminum
- barium
- benzo(a)pyrene
- phenanthrene
- pyrene
- bis(2-ethylhexyl) phthalate

Sediment

- arsenic
- cadmium
- chromium
- copper
- lead
- mercury
- nickel
- zinc
- PAHs
- bis(2-ethylhexyl)phthalate

Bis(2-ethylhexyl)phthalate was retained as an ecoCOC in sediment because concentrations in Unzinger's Ditch downstream of Mile 0.6 (south of the 15-inch tile outfall) exceed the sediment quality benchmark developed for this contaminant.

For purposes of the screening ERA, constituents exceeding Ohio water quality criteria and/or HQs greater than 1 can be considered ecoCOCs.

9.3 PROTECTION STANDARDS

Protection standards were developed for all COCs identified in the HHRA and ecoCOCs identified in the ERA. These protection standards are not intended to serve as final cleanup goals but are intended to guide further evaluation of chemical contamination at the Franklin Steel facility regarding the need for remedial actions. Thus, these protection standards may be considered as site-specific preliminary remediation goals (PRGs).

Site-specific PRGs for human health COCs were developed for specific medium and land use (i.e., industrial). Possible sources for PRGs included risk-based values, applicable or relevant and appropriate requirements (ARARs), or background concentrations for naturally-occurring constituents.

Site-specific PRGs were developed by using the same exposure parameters, intake equations, and toxicity data used in the HHRA. In other words, the risk equations were solved for a chemical concentration using an established risk value (noncancer hazard quotient of 1 and excess lifetime cancer risk value of $1E-06$). An ELCR of $1E-06$ was used to develop each cancer-based site-specific PRG to ensure that the cumulative risk would be below the target ELCR of $1E-05$. In addition, cancer-based site-specific PRGs were calculated with an ELCR equal to the target $1E-05$ value. National Primary Drinking Water MCLs are the only ARARs available for groundwater. No ARARs were used for soil, sediment, and surface water. Background concentrations are represented as the lower of the 95% UTL or maximum detected concentration of these chemicals in background samples.

A range of human health site-specific PRGs, based on the ELCR of $1E-06$ and $1E-05$, are presented in Table 8.1. In cases where background or ARARs exceed risk-based calculations, the site-specific PRG should be based on the ARAR or background. In addition, issues such as naturally-occurring levels of metals and non-site-related sources (e.g., PAH sources) need to be considered before determining the level of corrective action required.

Ecological site-specific PRGs are developed for contaminants of ecological concern in surface water and sediment and are intended to protect individuals and populations of ecological receptors at and near the Franklin Steel facility. For aquatic biota, the site-specific PRGs are based on Ohio chemical water quality criteria or, in the absence of criteria, the preferred screening values (Appendix Table C.1), or background (Tables 4.3.2, 4.3.2A, 4.3.9, and 4.3.11) if this value is lower than background. For sediment-dwelling biota, the PRGs are based on published toxicity benchmarks (the preferred screening values in Appendix Table C.2) or background concentrations (Tables 4.3.2, 4.3.2A, 4.3.9, 4.3.11, and 4.3.12) if the preferred screening value is lower than the background concentration.

Table 8.2 presents background data from the site, Ohio chemical water quality criteria (OAC 3745-1), and other toxicity benchmark values along with site-specific PRGs for surface water. When the background value was above the toxicity benchmark, the background concentration was chosen as the site-specific PRG, because it is not reasonable to clean up concentrations below naturally occurring background concentrations.

The site-specific PRGs recommended for the surface water ecoCOCs are:

aluminum – 250 µg/L (all locations),
barium – 80 µg/L (all locations),
copper – 10 µg/L (all locations),
cyanide – 12 µg/L (S101 Siphon Dam only),
lead – 6.4 µg/L (all locations),
manganese – 100 µg/L (Unzinger’s Ditch downstream and S201 Wetland),
mercury – 0.77 µg/L (Unzinger’s Ditch downstream and upstream),
zinc – 120 µg/L (all locations),
benzo(a)pyrene – 0.014 µg/L (Unzinger’s Ditch downstream only),
butyl benzyl phthalate – 23 µg/L (Unzinger’s Ditch downstream only),
fluoranthene – 0.8 µg/L (Unzinger’s Ditch downstream and upstream),
phenanthrene – 2.3 µg/L (S101 Siphon Dam only),
pyrene – 0.3 µg/L (Unzinger’s Ditch downstream only), and
bis(2-ethylhexyl)phthalate – 8.4 µg/L (Unzinger’s Ditch downstream and upstream).

Table 8.3 presents sediment background data from the site and the toxicity benchmark values along with sediment site-specific PRGs. When the background for an ecoCOC was above its toxicity benchmark, background was chosen as the site-specific PRG, because it is not reasonable to clean up concentrations below naturally occurring background concentrations.

The site-specific PRGs recommended for the sediment ecoCOCs are:

arsenic – 21.2 mg/kg (Unzinger’s Ditch downstream and upstream),
cadmium – 2.3 mg/kg (Unzinger’s Ditch, Outfall 002 and S101 Siphon Dam),
chromium – 43.4 mg/kg (Unzinger’s Ditch downstream, Outfall 002 and S101 Siphon Dam),
copper – 33.8 mg/kg (Unzinger’s Ditch, Outfall 002 and S101 Siphon Dam),
lead – 35.8 mg/kg (Unzinger’s Ditch and S101 Siphon Dam),
mercury – 0.18 mg/kg (Unzinger’s Ditch, Outfall 002 and S101 Siphon Dam),
nickel – 42.2 mg/kg (Unzinger’s Ditch downstream, Outfall 002 and S101 Siphon Dam),
zinc – 138 mg/kg (Unzinger’s Ditch, Outfall 002 and S101 Siphon Dam),
total PAHs – 1600 µg/kg (Unzinger’s Ditch downstream only),
anthracene – 57.2 µg/kg (Unzinger’s Ditch, Outfall 002 and S101 Siphon Dam),
benzo(a)anthracene – 108 µg/kg (Unzinger’s Ditch downstream, Outfall 002 and upstream),
benzo(a)pyrene – 150 µg/kg (Unzinger’s Ditch, Outfall 002 and S101 Siphon Dam),
chrysene – 166 µg/kg (Unzinger’s Ditch and S101 Siphon Dam),
dibenzo(a,h)anthracene – 33 µg/kg (Unzinger’s Ditch downstream and upstream),
fluoranthene – 423 µg/kg (Unzinger’s Ditch downstream, Outfall 002 and S101 Siphon Dam),
fluorene – 77.4 µg/kg (Unzinger’s Ditch downstream and upstream),
phenanthrene – 204 µg/kg (Unzinger’s Ditch, Outfall 002 and S101 Siphon Dam),
pyrene – 195 µg/kg (Unzinger’s Ditch downstream only), and
bis(2-ethylhexyl)phthalate – 9300 µg/kg (Unzinger’s Ditch downstream, Outfall 002 and S101 Siphon Dam).

A site-specific PRG was derived by equilibrium partitioning for bis(2-ethylhexyl)phthalate in sediment because it may cause risk to ecological receptors in sediment. In addition, the contribution of contaminated sediment to surface water may cause risk to great blue herons from bis(2-ethylhexyl)phthalate in prey. Therefore, a site-specific PRG was developed for bis(2-ethylhexyl)phthalate in sediment.

9.4 RECOMMENDATIONS FOR FURTHER ACTION

9.4.1 Soils

Based on the results of the HHRA, a Corrective Measures Study (CMS) will be required to address metals and various SVOCs and VOCs in soil and the additional “hot spots” of other surface soil constituents in Exposure Unit 1 that may present an elevated risk to site workers and future construction/utility workers based on the calculated ELCR.

The HHRA indicated an elevated risk potential from arsenic in surface soils in Exposure Unit 2. Based on the available evidence, the presence of arsenic is believed to be naturally occurring. The concentration of other inorganic, and concentration and number of SVOC and VOC contaminants that are above background in this area are relatively low and not sufficient to pose an unacceptable risk to human health. No further action is recommended for SWMUs S109 and S201.

9.4.2 Groundwater

Groundwater modeling was conducted for organic constituents in the industrial area (Exposure Unit 1) using soil contaminant concentrations. The results indicate that all modeled constituents attenuate (below EPA Region 9 PRGs) directly beneath the source zones within the soils even with the Jefferson Township Well Field operating at capacity. Based on this information, sources within the industrial area soils minimally impact site groundwater.

Analysis of data through the HHRA identified bis(2-ethylhexyl)phthalate and vinyl chloride in groundwater as COCs for the future construction/utility worker receptor. The site-specific PRGs developed for these constituents are 6 µg/L and 2 µg/L, repetitively. For bis(2-ethylhexyl)phthalate, there have been no detectable concentrations since the groundwater monitoring wells (including the Jefferson Township monitoring wells) were sampled using low-flow sampling techniques in 2006. The previous groundwater sampling method, using bailers for collection, has been connected with concentrations of bis(2-ethylhexyl)phthalate in groundwater samples. This appears to also be the case with historic sampling events at the site. Therefore, this COC is not being considered for further evaluation.

As for vinyl chloride, concentrations have been reported above the MCL for six consecutive sampling events (January 2003 to October 2007) in monitoring well S109-MW06. Prior to January 2003, vinyl chloride was not detected. Monitoring well S109-MW06 is located immediately east of the drainage ditch situated between SWMU 108 (Drum Storage Area #2) and SWMU 109 (Former Drum Storage Area #3). Well S109-MW06 is located within the drinking water source protection area (five-year time-of-travel zone) for the Jefferson Township Water & Sewer District public water system and may require further evaluation during the CMS to address these detected impacts.

9.4.3 Surface Water

Based on the results of the HHRA, arsenic, benzo(a)pyrene, benzo(b)fluoranthene and benzo(k)fluoranthene were identified as COCs in Unzinger's Ditch surface water. The ERA identified aluminum, barium, copper, cyanide, lead, manganese, mercury, zinc, benzo(a) pyrene, butyl benzyl phthalate, fluoranthene, phenanthrene, pyrene and bis(2-ethylhexyl)phthalate as ecoCOCs in this medium (i.e., S101, storm water holding ponds, Unzinger's Ditch, etc.).

The evaluation of surface water is based on a data set consisting of 4 background and 15 Unzinger's Ditch-related surface water samples. The source of these contaminants is not clearly identifiable. All constituents can be found in the industrial area. Only aluminum, barium, copper, lead, mercury, zinc and bis(2-ethylhexyl)phthalate are present in S109 and S201. Fluoranthene, phenanthrene, and pyrene are PAHs that are generally indicative of anthropogenic activities and may be due to runoff from the railroad bed, asphalt areas, or industrial sources not associated with the Franklin Steel site.

No further action is recommended for surface water at this time. Corrective actions at the industrial area are expected to reduce the concentrations of constituents in surface soils to levels that are within acceptable risk ranges. A reduction in surface soil concentrations is expected to reduce concentrations of constituents in surface water runoff that could discharge via the Siphon Dam and Outfall 002 to Unzinger's Ditch. In addition, corrective action for sediment, which also could be a source for surface water COCs, will be evaluated in a CMS (see Section 9.4.4).

9.4.4 Sediment

Based on the results of the HHRA, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene and indeno(1,2,3-cd)pyrene were identified as COCs in Unzinger's Ditch sediment. The ERA identified arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, anthracene, benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenzo(a,h) anthracene, fluoranthene, fluorene, phenanthrene, pyrene, and bis(2-ethylhexyl)phthalate as ecoCOCs in this medium for the S101 holding pond, Outfall 002 and Unzinger's Ditch.

Elevated levels of metals and bis(2-ethylhexyl)phthalate that may be due to on site sources are present in Unzinger's Ditch downstream of the outfall of the 15-inch tile. Because of the presence of these constituents, Unzinger's Ditch will be included within the CMS for Franklin Steel.

9.5 REFERENCES

- B&N. 2006. *RCRA Facility Investigation – Part 2 Workplan for the Franklin Steel Company*.
Revised October 6, 2006
- ERM-Midwest, 1993. *RCRA Facility Investigation, Description of Current Conditions*. Volume 1, February 5, 1993.
- Ohio EPA. 2001. Letter from D. O'Toole, Jr. to Franklin Steel Company RE: Additional Sampling. Unpublished. June 8, 2001.
- SAIC, 2000. Proposed Reduction in Groundwater Monitoring Requirements for the RCRA Facility Investigation at the Franklin Steel Company, Inc. July 17, 2000.