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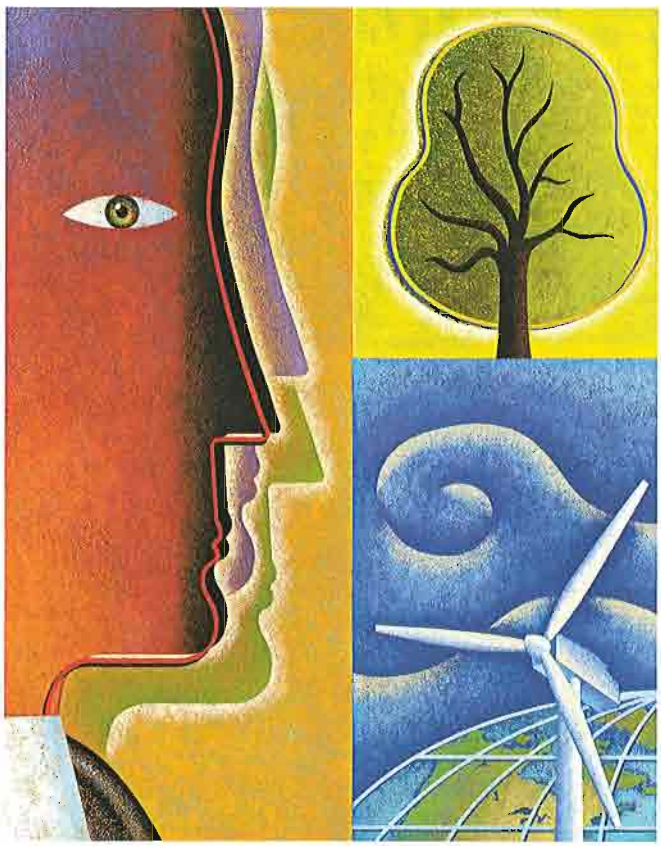
Final RCRA Corrective Measures Study

Franklin Steel Drum Reconditioning Facility

Blacklick, Ohio

December 2008
(Revised April 2009)
(Revised June 2009)

Prepared for
Ohio Environmental Protection Agency
Division of Emergency and Remedial Response
Central District Office



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Executive Summary

The corrective measures study (CMS) provides a description of updated site conditions, establishes corrective measures objectives, screens corrective measures technologies, assembles and evaluates corrective measures alternatives, and recommends area-specific final corrective measures.

This report presents an evaluation of corrective measures alternatives for the Franklin Steel Company, Inc. (Franklin Steel) located in Blacklick, Ohio. The property operates as a drum reconditioning facility. Franklin Steel has conducted a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) that included evaluations of soil, groundwater, sediment, and surface water quality. The *RCRA Facility Investigation Report for the Franklin Steel Company Inc. (*RMT 2008) was approved by Ohio Environmental Protection Agency (EPA) as documented in their March 13, 2009 approval letter. Based on the findings of the RFI, it was concluded that a CMS was warranted for the areas of RFI study: Exposure Unit 1 soil and groundwater and Exposure Unit 3 sediment and surface water. The objectives of the CMS are as follows:

- Develop a range of potential corrective measures using technologies applicable to impacted media and chemicals of concern (COCs) identified for Franklin Steel during the RFI.
- Evaluate potential corrective measures using the evaluation criteria identified in *RCRA Corrective Action Plan* (USEPA 1994).

Site Conditions

The nature and extent of chemicals in soil, sediment, surface water and groundwater on- and off-site have been characterized based on RFI sampling, and by the RFI groundwater monitoring program. A complete discussion of soil, sediment, surface water and groundwater data collection and methodology from Franklin Steel is found in the following documents:

- *Biological and Sediment Quality Study of Unzinger Ditch*, Ohio EPA 2000.
- *RCRA Facility Investigation Report, Part 1 for the Franklin Steel Company Inc.*, SAIC 1998, 2001 and 2003.
- *RCRA Facility Investigation – Part 2 Work Plan for the Franklin Steel Company*, B&N 2006.
- *Draft RCRA Facility Investigation Report Franklin Steel Company Inc., Drum Reconditioning Facility*, B&N 2007.
- *Revised – Draft RCRA Facility Investigation Report for the Franklin Steel Company Inc.*, RMT 2008.

- *Response to September 26, 2008 Ohio EPA Comment Letter of the Addendum to the Final RCRA Facility Investigation Report, Franklin Steel Company, Blacklick, Ohio,* RMT, 2008.
- *Addendum to June 2008 RCRA Facility Investigation Report, Franklin Steel Company, Blacklick, Ohio,* RMT, 2009.
- *Response to February 23, 2009 Ohio EPA Comment Letter of the Addendum to the Final RCRA Facility Investigation Report, Franklin Steel Company, Blacklick, Ohio,* RMT, 2009.

A human health and a screening ecological risk assessment has been conducted for the site and is reported in the *Final RFI* (RMT 2009). These risk assessments conclude that a CMS is warranted for:

- Exposure Unit 1 soil for the protection of site workers, construction workers, and trespassers.
- Exposure Unit 1 groundwater for protection against ingesting groundwater with COCs above Remedial Action Objectives (RAOs).
- Exposure Unit 3 sediment for protection against adverse effects to biological communities.
- Exposure Unit 3 surface water for protection against adverse effects to biological communities.

In addition, the potential for migration of soil impacts to groundwater is evaluated to assess the validity of impacted soils within Exposure Unit 1 exceeding RAOs for groundwater beneath the site. As discussed below, the evaluation indicates a low potential for Exposure Unit 1 soil impacts to migrate and/or impact off-site groundwater.

Corrective Measures Objectives

The corrective measures objectives established for Franklin Steel are as follows:

- Reduce potential direct contact risk by human receptors in areas where COC impact exceed soil RAOs.
- Reduce potential migration of chemicals from soil to groundwater at concentrations exceeding state and federal standards.
- Reduce the potential for off-site migration of COCs in groundwater exceeding state and federal standards.
- Reduce the potential for adverse effects by biological receptors in areas where ecological COCs (ecoCOCs) impact exceed sediment RAOs.
- Reduce the potential for adverse effects by biological receptors in areas where ecoCOCs impact exceed surface water RAOs.

As a risk management decision, selected areas of the site will be restricted against residential development, preventing potential direct contact risk by hypothetical future residents.

RAOs are target concentrations for COCs in media for which evaluation of corrective measures is required. RAOs were established for chemicals in soil, sediment, surface water, and groundwater to address potential exposure to susceptible receptors (*i.e.,* human health and ecological). These risk-based standards are chemical-specific and represent the maximum of risk-based values, United States (US) Environmental Protection Agency (EPA) policy concentrations, or site-specific background concentrations.

Corrective Measures Alternatives Screening

Preliminary screening of corrective measures technologies applicable for Exposure Unit 1 soil and groundwater and Exposure Unit 3 sediment and surface water was performed to eliminate technologies that did not meet basic effectiveness, ease of implementation, and cost considerations.

Following the preliminary screening, retained technologies were formulated into corrective measures alternatives that were evaluated against the following criteria:

- Protection of human health and ecological environments
- Ability to attain RAOs
- Control of release sources
- Compliance with institutional and legal requirements
- Long-term reliability and effectiveness
- Reduction in the toxicity, mobility, or volume of wastes
- Short-term effectiveness
- Ease of implementation
- Cost

Exposure Unit 1 - Soil Corrective Measures Selection

The corrective measures alternatives evaluated for Exposure Unit 1 area soil include no action, capping of impacted soil with land use controls, and excavation and off-site disposal of soil with land use controls. The net present value (capital and operation and maintenance [O&M]) for these corrective measures alternatives ranges from $0 – $707,150. Soil removal and disposal of non-covered areas of Exposure Unit 1 (*i.e.,* active operations area) and the use of existing capping in the other impacted areas along with land use controls best meets the corrective measures selection criteria for a net present value of $666,000.

Exposure Unit 1 - Groundwater Corrective Measures Selection

The corrective measures alternatives evaluated for Exposure Unit 1 area groundwater include no action, monitoring natural attenuation (MNA) with land use controls, and groundwater extraction and treatment with land use controls. The net present value (construction and O&M) for the corrective measures alternatives ranges from $0 – $356,000. MNA with land use controls best meets the corrective measures selection criteria. The cost for the monitoring program results in a net present value of $203,000. This cost includes both compliance monitoring and detection monitoring for Exposure Unit 1 area groundwater. Consistent with *Use of Monitored Natural Attenuation at Superfund, RCRA, Corrective Action, and Underground Storage Tank Sites* (USEPA, 1999), a contingent remedy is proposed as part of this alternative. The contingent remedy would be considered for implementation if repeatable, verified exceedances of RAOs are detected in groundwater samples collected from the site's monitoring wells at the end of 2 years.

Exposure Unit 3 – Sediment Corrective Measures Selection

The corrective measures alternatives evaluated for Exposure Unit 3 sediment include no action; capping, ranging from capping only the five target reaches of Unzinger Ditch to the entire lower segment reach of Unzinger Ditch (extending from S101-SD26 to S101-SD07); and excavating, ranging from excavating only the five target reaches of Unzinger Ditch to the entire lower segment reach of Unzinger Ditch. The net present value (capital and O&M) for these corrective measures alternatives ranges from $0 – $1,079,000. Excavating the Exposure Unit 3 areas of Unzinger Ditch meets the corrective measures selection criteria. Net present values range from a low-end of $444,000 to a high-end of $504,000.

Corrective Measures Study Recommendations

Based on the evaluations conducted in the CMS, the recommended final corrective measures for the site are the following:

- **Exposure Unit 1 - Soil** – Excavate, dispose off-site and backfill localized impacted areas of the active operations area. Impacted areas which are currently beneath a concrete slab will remain under the slab. The slab will act as a cap and will be maintained under an O&M plan. This corrective measure also provides source control for protection of groundwater beneath the active operations area. A land use restriction will be placed on the property to restrict residential land use.
- **Exposure Unit 1 - Groundwater** – MNA for site COCs. This alternative includes 2 years of groundwater monitoring to assess the progress of attenuation and a land use control prohibiting the installation of drinking water wells on the property. As recommended in the MNA guidance, a contingent remedy is provided, should natural attenuation not effectively control COC migration.

- **Exposure Unit 3 - Sediment** – Remove human health and ecoCOC-impacted sediment in the lower segment of Unzinger Ditch.

Section 1
Introduction

The Franklin Steel Company, Inc. (hereinafter Franklin Steel or site) located at 1385 Blatt Blvd., Blacklick, Ohio 43004, owned and operated a drum reconditioning and recycling facility in the Gahanna Industrial Park between 1971 and 1997 under the business name of Columbus Steel Drum Company (Figure 1.1). Franklin Steel operations consisted of reconditioning and recycling of open–head and closed–head 55–gallon steel drums under the Standard Industrial Classification (SIC) code 7699. Prior to 1986, approximately 38-acres of property were utilized for drum storage and processing, holding approximately 450,000 Resource Conservation and Recovery Act (RCRA) empty drums. Since 1988, only an 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.

In June 1997, Franklin Steel sold the drum reconditioning business to Evans Industries, Inc. under the name of Evans Columbus, Corp. and continued the drum reconditioning operation. Evans Industries, Inc. 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 Franklin Steel 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.

Franklin Steel entered into an Administrative Order on Consent with the Ohio Environmental Protection Agency (EPA) that requires in part that Franklin Steel perform a RCRA Facility Investigation (RFI) to document whether or not the site has been impacted from any release of hazardous wastes and/or hazardous chemicals and to determine the nature and extent of any such releases. There are 10 Solid Waste Management Units (SWMUs) that were evaluated under the original RFI investigation.

Initially, Science Applications International Corporation (SAIC) carried out Part 1 of the RFI field investigation and submitted a series of *Draft RCRA Facility Investigation Report for the Franklin Steel Company, Inc.* on October 23, 1998, December 21, 2001, and November 21, 2003. Upon review of these documents, Ohio EPA requested further evaluation of Franklin Steel in a letter dated January 31, 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 various additional Areas of Concern (AOCs) at the site under Section VII, Paragraph O, of the June 22, 1992 Director's Findings and Orders by a 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 2006* (B&N, 2006) to include the evaluation of 12 additional AOCs for Franklin Steel. Based on the completion of the RFI Part 2 evaluation, B&N submitted an updated *Draft RCRA Facility Investigation Report for the Franklin Steel Company, Inc.* in April 2007 (B&N, 2007) to address early RFI comments and findings from the RFI Part 2 evaluation. Based on various comments from Ohio EPA concerning the 2007 RFI report submittal and approval of the submitted *Risk Assessment Assumptions Document, Franklin Steel Drum Reconditioning Facility, Revised February 2008* (RMT, 2008), RMT, Inc. (RMT) submitted a *Revised - Draft RCRA Facility Investigation Report for the Franklin Steel Company, Inc.* on June 19, 2008. In response to Ohio EPA comments on the June submittal, RMT issued two addendums dated January 26, 2009 and March 4, 2009 to the June 2008 *Revised – Draft RFI*. Based on review of the submitted addendums, Ohio EPA approved the *Revised – Draft RFI* in a March 13, 2009 approval letter (herein referred to as the *Final RFI*).

As required by the Order, Franklin Steel has conducted on- and off-site soil, sediment, and surface water sampling. Site-wide groundwater monitoring has also been conducted and is continuing. RFI environmental media sampling and groundwater monitoring results, in conjunction with Ohio EPA analytical results from previous soil and sediment sampling events, provide information about the presence and distribution of related and non-related chemicals of concern (COCs) both on- and off-site. Collected data and information pertaining to the evaluation and development, including methodology, of the RFI have been presented in the *Final RFI* (RMT, 2009).

In addition, the *Final RFI* (RMT, 2009) includes a human health risk assessment (HHRA) and screening ecological risk assessment (SERA) that evaluates both the active and inactive operations areas and Unzinger Ditch. The *Final RFI* (RMT, 2009) concludes that a corrective measure study (CMS) should be conducted to evaluate potential corrective measures for the active operations (*i.e.*, Exposure Unit 1) area soil and Unzinger Ditch (*i.e.*, Exposure Unit 3) sediment.

1.1 Objectives and Scope

The *Final RFI* (RMT, 2009) concluded that a CMS is required to address lead and various chemical (*e.g.*, chromium and polycyclic aromatic hydrocarbons [PAHs]) impacts in surface soil that may present an unacceptable risk to current or future human receptors (*e.g.*, site workers) via ingestion, dermal contact, and inhalation of dust exposure routes. Additionally, the *Final RFI* (RMT, 2009) recommended a CMS to address various metals (*e.g.*, cadmium and lead) and semi-volatile organic compounds (SVOCs) in Unzinger Ditch sediment which may cause adverse effects to biological communities.

Objectives

Pursuant to the Director's Final Findings and Orders for Franklin Steel, the objectives of this CMS are to develop and evaluate corrective action alternatives and to recommend the corrective measure to be taken for the Franklin Steel impacted areas. This CMS builds on the corrective measures technologies identified in the *Alternatives Development Technical Memorandum for the RCRA Facility Investigation at the Franklin Steel Company, Inc.* dated August 21, 2000 (SAIC) and various communications with Ohio EPA including, but not limited to, the most recent letters dated November 7, 2008, November 24, 2008 and February 25, 2009 discussing established remedial action objectives (RAOs), areas of Franklin Steel considered for further focus within the CMS and Ohio EPA comment on the Draft CMS submitted by RMT on December 31, 2008.

The general objectives are summarized as follows:

- Develop a range of potential corrective measures using technologies applicable to impacted environmental media and COCs identified for the site during the RFI.
- Evaluate potential corrective measures using the evaluation criteria pursuant to all Ohio EPA and United States (US) EPA guidance, *e.g.*, *RCRA Corrective Action Plan* (USEPA, 1994).

Scope

The scope of this CMS is to present corrective action alternatives for impacted surface soils and groundwater within the defined Exposure Unit 1 (active operations area) and impacted sediments and surface water within Exposure Unit 3 (Unzinger Ditch), as recommended in the *Final RFI* (RMT, 2009). This CMS does not evaluate corrective actions for any other portion of Franklin Steel (*i.e.*, S109 and S201 areas) outside the above expressed Exposure Units, as it has been determined these areas are within; screening preliminary remediation goals (PRGs), areas of insignificant habitat, or outside the scope of the RAOs based on the *Final RFI* (RMT, 2009) and Ohio EPA's September 26, 2008 letter referencing RAOs and areas of focus.

1.2 Organization of Report

This CMS presents the information needed to support selection of final corrective measures for Franklin Steel. To put the corrective measures selection into perspective, this report includes summaries of past site activities and investigations. This information is summarized from the previous investigations and reports that present the information in much greater detail. The available site data have been interpreted with respect to chemical distribution, comparison to human health and ecological criteria, and the potential for chemical release or migration. The CMS evaluates potential corrective measures for Exposure Unit 1 soil and Exposure Unit 3 sediment. The CMS includes the following sections:

- **Executive Summary** provides a synopsis of the CMS and its conclusions.
- **Section 1 – Introduction** describes the Franklin Steel site and background, along with the project objectives, organization of the report, and sources of information for the report.
- **Section 2 – Current Conditions** provides a summary of the RFI and a description of conditions specific to the areas addressed in the CMS.
- **Section 3 – Development and Application of Remedial Action Objectives** presents specific corrective measures to and other regulatory requirements that may be applied to corrective measures at the site. This section also specifies which site locations require final corrective measures to achieve the RAOs.
- **Section 4 – Corrective Measures Selection Process** evaluates and screens an array of technologies that are potentially useful in meeting RAOs for impacted media. Technologies that pass the screening are assembled into corrective measures alternatives for further evaluation. This section also presents the evaluation criteria for corrective measures alternatives for the various areas of the site.
- **Section 5 – Exposure Unit 1 Soil** presents corrective measures alternatives developed for soil underlying the active operations area from technologies that passed the screening process presented in Section 4. The corrective measures alternatives are then evaluated and compared based on the evaluation criteria presented in Section 4.
- **Section 6 – Exposure Unit 3 Sediment** presents corrective measures alternatives developed for sediment within Unzinger Ditch from technologies that passed the screening process presented in Section 4. The corrective measures alternatives are then evaluated and compared based on the evaluation criteria presented in Section 4.
- **Section 7 – Groundwater** presents corrective measures alternatives developed for groundwater underlying the active operations area from technologies that passed the screening process presented in Section 4. The corrective measures alternatives are then evaluated and compared based on the evaluation criteria presented in Section 4.
- **Section 8 – Recommended Corrective Measures** provides recommendations for corrective measures at the site.
- **Section 9 – References** lists the documents that provide data and information for this CMS.

1.3 Sources

The primary sources of information relied upon in preparation of this CMS are as follows:

- Data and observations from RFI field work conducted by SAIC.
- *RCRA Facility Investigation Report, Part 1 for the Franklin Steel Company Inc.*, SAIC 1998, 2001, and 2003.
- Data and observations from RFI field work conducted by B&N.

- *RCRA Facility Investigation – Part 2 Work Plan for the Franklin Steel Company*, B&N 2006.
- *Draft RCRA Facility Investigation Report Franklin Steel Company Inc., Drum Reconditioning Facility*, B&N 2007.
- Data and observations from continued RFI field work conducted by RMT.
- *Final RCRA Facility Investigation Report for the Franklin Steel Company Inc.*, RMT 2009.
- Data and observation conducted by Ohio EPA.
- *Biological and Sediment Quality Study of Unzinger Ditch*, Ohio EPA 2000.
- Written and verbal communications with Ohio EPA.
- Site visits and visual observations.

Section 2
Current Conditions

This section describes the current conditions at the site and site areas selected for evaluation of corrective measures. As presented in Section 1, Franklin Steel has conducted a multimedia RFI both on- and off-site. Current conditions for soil, sediment and surface water are based on information collected during RFI sampling. Current conditions for groundwater are based on analytical results obtained from the RFI groundwater assessment and the current groundwater monitoring program. RFI soil, sediment, surface water sampling and groundwater monitoring results provide information about the presence and distribution of on- and off-site related (and non-related) COCs at the site. These data points have been presented and evaluated in further detail in the *Final RFI* (RMT, 2009) report.

2.1 Summary of the RCRA Facility Investigation

The objective of the RFI was to characterize the nature and extent of hazardous chemicals, if any, released to environmental media from SWMUs and AOCs. The RFI sampling approach was designed to evaluate the full extent of the site, including all potential exposures (*i.e.*, human and ecological) and to fill in data gaps from previous evaluations. The RFI field activities included the collection of approximately 370 soil samples from site-wide, SWMU and AOC specific sampling locations; 330 groundwater samples from site-wide sample locations; 50 sediment samples from site-wide and Unzinger Ditch sample locations; and 25 surface water samples from site-wide and Unzinger Ditch sample locations. A complete discussion of the RFI sampling design and sampling results sorted by SWMU or AOC is provided in the *Final RFI* (RMT, 2009).

For purposes of evaluation within the RFI, the site was divided into three contiguous areas (*i.e.*, exposure units). The areas are defined as follows:

<u>Contiguous Area #1 (Exposure Unit 1) - Active Operations Area</u>

- Facility active operations area (SWMUs S101 – S108, AOCs - A through J, and AOC – L)
- Truck Trailer Parking Lot (AOC - K)

<u>Contiguous Area #2 (Exposure Unit 2) - Inactive Operations Area</u>

- Historical drum storage (SWMUs S109 and S201)

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

- Upstream of Franklin Steel 15-inch Outfall
- Downstream of Franklin Steel 15-inch Outfall

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 be used in the past yet has been inactive since 1988).

The physical separation of Exposure Unit 3 (Unzinger Ditch) is based on observations regarding potential human use patterns and down-gradient potential of impacts from Franklin Steel 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 original Order of Consent, underwent closure activities under the RCRA program in 1992 and were not considered further during the RFI, nor the CMS. Post-closure sampling at these units indicated small concentrations of chemicals remained. However, a 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). Figure 2.1 and 2.2 illustrates the locations of each of the exposure units. A more detailed site description including the physiographic setting and history of the RFI can be found in the *Final RFI* (RMT, 2009).

Geology

The site geology is based on the observations that have been made on the soil boring logs collected during the various subsurface investigations. Franklin Steel is situated near the western flank of a 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, more permeable and hydraulically conductive outwash deposits are located near the center of the pre-glacial valley, where the faster moving channel flow tends to concentrate. Geologic cross-sections, Figures 2.3 through 2.6, of the site (constructed from boring logs collected during construction of the monitoring wells/piezometers both on- and off-site) illustrate the quickly changing unconsolidated lithologies. Figure 2.7 details the plane-view location of the cross-sections. 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 boring locations have encountered large glacial erratics consisting of granite, limestone, sandstone, and shale.

Hydrogeology

The hydrogeologic setting underlying the site 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.

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 millimeters in size) 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. 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.

Hydraulic Properties

There have been no hydraulic property tests done on the aquifer beneath the 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 gallons per minute. 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/ft^2 (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} centimeters per second (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.

Groundwater flow at Franklin Steel and the immediately surrounding area is generally to the north-northeasterly direction across the site towards the central portion of the buried valley. However, groundwater flow has been tracked in a more easterly trend in past groundwater evaluations (*e.g.*, October 2007) and is highly influenced by recharge. Figure 2.8 presents the current groundwater flow pattern. 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 Franklin Steel; 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.

Waste Characterization

Various hazardous and non-hazardous waste streams were generated throughout the drum reconditioning process. Hazardous wastes include:

- Caustic sludge (D002) generated by applying very hot sodium hydroxide to clean the residue off closed-head RCRA empty drums,
- Oxidizer sludge (D006, D007, D008) generated by thermally cleaning residue off 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.

Groundwater Modeling

A complete groundwater modeling exercise was completed for the Franklin Steel Exposure Units 1 & 2. This evaluation, detailed in the *Final RFI* (RMT 2009), utilized the SESOIL, AT123D and BIOCHOR mathematical models. The RFI modeling effort was conducted to fully assess the potential for current soil impacts to migrate to groundwater beneath the site in excess of PRGs. In doing so, the evaluation lends itself to focusing on those areas (or chemicals) that pose a concern and may need further evaluation under the CMS. In order to correctly model potential on-site soil leaching patterns, several assumptions were made to ensure a conservative migration model. First, adsorption, dispersion, and volatilization were the only mechanisms modeled that could reduce the concentrations of the COCs present within the groundwater column. Second, decay (such as biodegradation) was not used in either the SESOIL or the AT123D models with the exception of benzo(a)pyrene. Third, for compounds which had a range of organic carbon-water partitioning coefficient (K_{oc}) values listed in literature, the lowest value found was used, therefore increasing the potential for the compound to travel in soil. Fourth, modeled impacts were grouped together as one source verses several smaller areas of impact.

The RFI groundwater sampling results show that chloroethane, bis(2-ethylhexyl)phthalate, 1,1-dichloroethane, and vinyl chloride are the only COCs that have appeared in monitoring wells on-site in excess of site established PRGs. The RFI groundwater modeling confirms the presence of these three compounds as well as suggesting other compounds (*e.g.*, xylene) may occur in the groundwater beneath the site source zones. However, the modeling predicts these (and other) compounds entering the groundwater attenuate at concentrations below their respective RAOs directly beneath or within a small radius of their source zone, thus prior to off-site migration. This is verified based on current groundwater monitoring as no detection of these (or other) compounds have been noted within both perimeter and off-site sampling points. Although vinyl chloride has exhibited an increasing trend ranging from 3.0 micrograms per liter (µg/L) to 11.7 µg/L during the last eight sampling events, the BIOCHLOR model indicates vinyl chloride concentrations within S109-MW06 follow the natural groundwater flow and attenuate at concentrations below the MCL prior to reaching off-site. Data indicates that vinyl chloride detections in S109-MW06 are localized based on no detectable concentrations of vinyl chloride in the down-gradient or cross-gradient monitoring wells.

Risk Assessment

A human health risk assessment (HHRA) and a screening ecological risk assessment (SERA) was conducted in conjunction with the RFI. A detailed presentation of these evaluations is provided in the *Final RFI* (RMT, 2009). The risk assessments evaluated

current and hypothetical future exposures to COCs for both on- and off-site media for potential adverse health effects for both human and biological receptors. A summarized risk characterization for both the HHRA and SERA are discussed in the following sections.

Risk Characterization

Risks are characterized by integrating the toxicity and exposure assessments into quantitative expressions of risk based on guidance provided by both Ohio and USEPA. To characterize carcinogenic risks for human health, probabilities that an individual will develop cancer over a lifetime of exposure, are estimated from projected intakes and chemical-specific dose-response information. This probability is expressed as an excess lifetime cancer risk (ELCR). To characterize potential non-carcinogenic effects, comparisons are 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 COCs for which Ohio EPA approves toxicological criteria exist.

Risks to ecological receptors were characterized by evaluating ecological assessment endpoints using HQs. The HQs are calculated for different receptors for every ecological chemical of concern (ecoCOC) for which a toxicity threshold concentration was available from published information. Each HQ compares two concentrations: the estimated preliminary ecoCOC concentration to which a given receptor is exposed, and the toxicity reference value (TRV) for the preliminary ecoCOC 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 ecoCOC in an appropriate medium. Thus, the TRV is a safe, or protective, concentration.

Human Health

The HHRA evaluated current and hypothetical future exposures to COCs in site media for potential health effects. Current exposures were modeled for site worker exposure to on-site surface soil. Hypothetical future exposures were modeled for construction/utility workers exposure to on-site surface (*i.e.*, 0 to 2 feet bgs) and subsurface (*i.e.*, 2 to 10 feet bgs) soil and groundwater, and sediment and surface water for Unzinger Ditch. In addition, hypothetical future exposure was modeled for adolescent trespasser exposure to on-site surface soil and sediment and surface water for Unzinger Ditch.

During the RFI and risk assessment evaluation, it became apparent that various localized areas of Franklin Steel, within the defined SWMUs, exhibited elevated values of target SVOCs and VOCs. These areas (sample locations) and the chemicals identified exhibiting elevated concentrations are as follows:

Active Operation Area – Surface Soil

- Sample location H-GP-20 exhibited elevated concentrations of dibenzo(a,h)anthracene (190 µg/kg), N-nitrosodipheylmine (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-nitrosodipheylmine (370 µg/kg).
- Sample location F-GP-18 exhibited elevated concentrations of dibenzo(a,h)anthracene (960 µg/kg), N-nitrosodipheylmine (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-nitrosodipheylmine (352 µg/kg), 2,4-dinitrophenol (2,535µg/kg), and 4-Nitrophenol (2,290 µg/kg).
- Sample location S107-SB12 exhibited elevated concentrations of bis(2-ethylhexyl)phthalate (110,000 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 (1,300,000 µg/kg).
- Sample location S107-SS05 exhibited an elevated concentration of bis(2-ethylhexyl)phthalate (1,000,000 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).
- Sample location S108-SB16/SS18 exhibited elevated concentrations of bis(2-ethylhexyl)phthalate (230,000 µg/kg).

Active Operations Area – Subsurface Soil

- Sample location S108-SB13/SS15 exhibited elevated concentrations of benzo(a)anthracene (6,200 mg/kg), benzo(a)pyrene (5,100 mg/kg), and benzo(b)fluorathene (5,900 mg/kg). This area will be addressed under CMS remedy.

These localized, or "hot spot," values were excluded from the holistic risk assessment evaluation as these chemical concentrations interfered with the database population distribution. By using this approach, these impacts, or waste samples, were removed from the native soil sample database to allow for proper evaluation. In evaluation of these chemicals (and sample locations) it was apparent these "hot spots" exceed human health risk standards and would be included as individual locations for correction action under the CMS.

Upon completion of the HHRA, it was determined that for soil at Exposure Unit 1, the non–cancer hazard index (HI) for all pathways for site workers is 1.6 and the total ELCR for site workers is $4x10^{-03}$. For construction/utility workers, the HI for all pathways is 2.4 and the total ELCR for construction/utility workers is $3x10^{-03}$. These values are in excess of the acceptable non–cancer and cancer risk limits, HI of 1.0 and ELCR of $1x10^{-5}$. Therefore, areas within Exposure Unit 1 that pose an unacceptable risk are further evaluated for a corrective action within this CMS. In addition, lead was evaluated in the HHRA using a lead–specific USEPA risk model and was determined to be a COC for site workers, thus further evaluated for a corrective action. The RFI concludes that a CMS should be conducted to evaluate potential corrective measures for Exposure Unit 1 soil.

Ecological

In the SERA, Unzinger Ditch was divided into two segments, upstream of river mile (RM) 0.6 and downstream of RM 0.6. The division of Unzinger Ditch was based on Ohio EPA's designation of the stretch downstream of RM 0.6 as warm water habitat (WWH) and the stretch upstream of RM 0.6 as limited resource water (LRW). The 15-inch Outfall from Franklin Steel discharges to Unzinger Ditch just upstream from RM 0.6.

High HQs, in the lower segment of Unzinger Ditch, from exposure to ecoCOCs in surface water came primarily from metal and SVOC impacts and were indicated primarily for aquatic biota. Few inorganic compounds had concentrations high enough to cause ecological concern in the surface water of Unzinger Ditch, and releases of inorganic compounds from the 15-inch Outfall to the downstream segment of Unzinger Ditch does not cause markedly higher concentrations in the downstream segment verses the upstream segment surface water.

Eight inorganic compounds (*i.e.,* arsenic, cadmium, chromium, copper, lead, mercury and nickel) had HQs above 1 for sediment in the downstream segment (below the 15-inch outfall) of Unzinger Ditch. Of those eight compounds, lead and cadmium posed the highest HQ values of 21.6 and 10.2, respectively. The upstream segment sampling indicated only six inorganic compounds, *i.e.,* arsenic, cadmium, copper, lead, mercury

and zinc, with HQ values higher than 1. As with the lower segment, lead and cadmium posed the highest HQ values of 4.3 and 4.1, respectively.

The HQs for PAHs were highest in the downstream segment of Unzinger Ditch. Nine PAHs had HQs above 1 in the sediment in the downstream segment of Unzinger Ditch, while only benzo(a)anthracene had an HQ above 1 in the upstream segment; the HQs for the total PAHs were 225 downstream and 53 upstream. Bis(2-ethylhexyl)phthalate had the highest impact in the downstream segment of Unzinger Ditch with a HQ value of 67.

The SERA concluded sediment within both segments of Unzinger Ditch has been impacted by ecoCOCs. The greatest accumulation of impact is downstream of the 15-inch Outfall, at RM 0.54 (Broughton Road overpass) This area is subject to high sedimentation as the easterly flowing Unzinger Ditch takes a sharp bend south causing a sediment bank on the easterly stream edge. Metals show the greatest impact at RM 0.54, as these compounds tend to settle out in areas of low flow. Various SVOCs tend to lend themselves as indicator compounds of transport, as SVOCs were detected in down-gradient surface water, sediment is likely the source of SVOC impact of surface water in the downstream segment. However, runoff from asphalt roads, parking lots, and the railroad beds likely contribute to the PAH impact in Unzinger Ditch unrelated to Franklin Steel.

Based on the results of the SERA, localized sediment in Unzinger Ditch require a CMS to address various metals and SVOCs. The SERA also identified risks to ecological receptors from surface water contaminants; however, surface water is not addressed directly in the CMS. Instead the CMS addresses sediment, which is the most likely source material for chemical impacts in surface water.

2.2 Descriptions of Areas for Potential Final Corrective Measures

The following subsections provide descriptions of the areas of the site identified in the RFI as warranting consideration for final corrective measures. These areas include Exposure Unit 1, active operations area and Exposure Unit 3, known as Unzinger Ditch. The areas considered for potential corrective measures for Exposure Unit 1 and Exposure Unit 3 are shown on the site map included as Figure 2.9 and 2.10, respectively. The selection of corrective measures alternatives for these areas is described in Subsection 4.0.

2.2.1 Exposure Unit 1 – Active Operations Area – Soil

The active operations area of the site consists of an 18-acre portion of property 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 in semi-trailers.

Figure 2.1 shows the general layout of the active operations area. In general, the Franklin Steel drum reconditioning progresses in the following flow:

Open Head Reconditioning Process

Drums are processed through a thermal oxidizer, which is programmed to maintain a minimum furnace temperature of 1,000°F and a minimum afterburner temperature of 1,800°F. This unit oxidizes drum residues thermally while preparing both the interior and exterior of the drum for shot blasting.

Once processed through the thermal oxidizer, open head drums are passed through a 10-wheel shot-blasting unit to properly clean the interior and exterior surface of the drum prior to the application of new coatings.

Drums are then sent through a series of mechanical machines to reshape the drum and remove all imperfections in the steel. Next, the drum is re-chimed and Department of Transportation (DOT) tested for leaks by inserting 7 pounds per square inch (psi) of air pressure while submerging the container in water. The interior of the drum is then either lined or rust-proofed, depending on customer specifications, and an exterior coating is applied which is also customer specific. A reconditioned cover and ring is then installed on the drum, and the drum is loaded on tractor-trailers for prompt delivery.

Closed Head Reconditioning Process

Closed head drums are cleaned chemically. The exterior paint is stripped from the drum by processing in a 1,500 gallon tank containing a 10-12% caustic soda solution. Any residue left inside the drum is removed by a series of interior flushes with an additional caustic solution application.

Drums then go through an exterior wash to rinse and neutralize any remaining caustic. The drum is then re-chimed and de-dented pneumatically by internally applying 60 psi of air to remove all possible dents in the steel. The interior of the drum is washed again and neutralized through a series of water washes. Next, rust preventative material is applied, and the drums are dried and inspected. Drums that fail the inspection are scrapped or rewashed. Once they have passed the inspection, drums progress through an exterior shot-blasting unit to remove any remaining exterior paint and rust that might still exist. The drum is DOT tested for leaks by inserting 7 psi of air pressure while submerging the container in water.

The drums are then re-inspected, painted (exterior) to customer specification, and loaded on trailers for prompt delivery.

Historical Corrective Actions and Closures

The following preliminary actions/closures have been conducted in the active operations area:

- SWMU S110 (Hazardous Waste Underground Storage Tank) and S111 (Hazardous Waste Storage Pad) closure and removal
  - December 1992, three Underground Storage Tanks (USTs) were removed from an area north of the waste water treatment plant.
  - September 1993, additional over-excavation and confirmatory sampling conducted.
  - May 2001, Bureau of Underground Storage Tank Regulations (BUSTR) – Tier I evaluation completed.
  - June 2007, BUSTR no further action (NFA) requested.
  - June 19, 2007, NFA issued for all three USTs previously located at Franklin Steel.

During the RFI, samples were collected from 114 locations within the active operations area. The deepest of these samples were collected at a depth of 19 feet bgs. Most of the soil samples were analyzed for all or a combination of the Target Compound List (TCL) and Target Analyte List (TAL) VOCs, SVOCs, and metals. Sample analysis indicated shallow (*i.e.*, less than 2-feet bgs) detections of COC in the clay layer throughout the active operations area.

In summary, as further detailed in the *Final RFI* (RMT, 2009), the HHRA identified lead as a COC for site workers in the active operations area. In addition, 13 other chemicals, (*i.e.*, arsenic, chromium, iron, aroclor 1254, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, bis(2–ethylhexyl)phthalate, trichloroethene, and total xylenes) were detected at elevated concentrations in several locations throughout Exposure Unit 1. Locations where these chemicals are present represent "hot spots" within SWMUs as defined during the HHRA; and therefore, were recommended for further corrective measure alternatives. The RAOs for all COCs are presented in Section 3.0.

2.2.2 Exposure Unit 3 – Unzinger Ditch – Sediment/Surface Water

Unzinger Ditch is described in detail in the *Final RFI* (RMT, 2009) report. Exposure Unit 3, Unzinger Ditch, runs from the Franklin Steel 15-inch Outfall south towards the Broad Street overpass. Various streams supply Unzinger Ditch to the north and east. Unzinger Ditch is a wet weather drainage ditch that flows only during periods of sustained or extreme rainfall. The drainage area of Unzinger Ditch has a surface area of approximately 2.3 square miles.

Storm water that falls on the active operations portion of the site is currently collected, treated, and discharged into the siphon dam (settling ponds) at the National Pollutant Discharge Elimination System (NPDES) outfall located in the southeast corner of the Franklin Steel active operations area. The surface area subject to storm water treatment is approximately 18-acres. Unzinger Ditch has received treated storm water and runoff from the Franklin Steel facility since inception. Unzinger Ditch also receives runoff from agricultural, industrial, and commercial land not associated with Franklin Steel. Further investigation of Unzinger Ditch has shown a total of 14 non-Franklin Steel associated outfalls drain to Unzinger Ditch.

Ohio EPA completed a *Biological and Sediment Quality Study of Unzinger Ditch* in 2000 (Ohio EPA, 2000). The Ohio EPA divided Unzinger Ditch into two similarly sized segments, one downstream and one upstream of RM 0.6 (Ohio EPA 2001). These segments are represented chemically by samples collected either upstream or downstream of the Franklin Steel 15-inch Outfall just upstream of RM 0.6. Both segments of Unzinger Ditch failed to meet chemical water quality criteria and biological criteria and have ecoCOCs with HQs above 1. They were thus designated ecoCOCs. Other analytes were designated ecoCOCs because they exceeded Ohio chemical water quality criteria. The Ohio EPA report stated the following characteristics about Unzinger Ditch:

- All 1.1-miles of the Unzinger Ditch are non-attainment for aquatic life, based on stream channel modifications, toxicity of sediments and nutrient enrichment from sewage.
- The biological integrity of Unzinger Ditch was represented by very poor conditions.
- Physical habitat features restrict the upper section (above RM 0.6) of Unzinger Ditch to an aquatic life use of Limited Resource Water.
- The lower segment (below RM 0.6) of Unzinger Ditch was classified with an aquatic life use of Warmwater Habitat.

Findings of the *Final RFI* (RMT, 2009) SERA correlate with both the results from the Ohio EPA *Biological and Sediment Quality Study of Unzinger Ditch* report (Ohio EPA, 2000) and the Ohio EPA's Field Activity report (Ohio EPA, 2001) on Unzinger Ditch, in that hazard index values for organisms that inhabit surface waters and sediments were greater in the lower 0.6 miles of Unzinger Ditch than in its upper segment. In particular, risks to herons from SVOCs in surface water were higher in the downstream segment than the upstream segment, as a result of sediment impacts. In addition, the upper section of Unzinger Ditch is described as an area of poor attainment with low habitat viability. Thus, communities inhabiting areas below RM 0.6 (*i.e.*, 15-inch Outfall) are the focus of ecoCOC impacts and are further consider the areas of evaluation for the CMS.

The SERA identified several ecoCOCs in sediment based on risk to ecological receptors. Eight inorganic chemicals (*i.e.*, arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc) and 10 organic chemicals (*i.e.*, anthracene, benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorine, phenanthrene, pyrene, and bis(2-ethylhexyl)phthalate) exceeded screening criteria within the lower segment of Unzinger Ditch.

Both the SERA and the Ohio EPA field evaluation (2001) stated the potential for sources of PAHs unrelated to Franklin Steel; therefore, only areas impacted by Franklin Steel (*i.e.*, downstream of RM 0.6) will be focused upon for PAH corrective action alternatives.

Based on the SERA, the lower segment of Unzinger Ditch (*i.e.*, downstream of RM 0.6) was recommended for further corrective measure alternatives. However, various portions of the lower segment of Unzinger Ditch are without appreciable sediment. This was documented in the Ohio EPA field evaluation (2001) and observed in the field by RMT.

Ohio EPA (2001) defines five sediment areas (reaches) as target impact areas. These five target reaches are measured upstream from the Unzinger Ditch confluence with Blacklick Creek and are defined as follows:

- Reach 1: Confluence (0) to 150 ft upstream,
- Reach 2: 1,000 to 1,320 ft upstream,
- Reach 3: 2,200 to 2,600 ft upstream,
- Reach 4: 2,750 to 3,100 ft upstream, and
- Reach 5: 3,300 to 3,520 ft upstream.

Based on these findings and in agreement with the SERA, the lower segment with emphasis on the five target reach areas were considered for further evaluation of corrective measure alternatives. These areas of Unzinger Ditch are illustrated on Figure 2.10.

The SERA identified risks to ecological receptors from surface water impacts, however, sediment impacts are most likely the source material for impacts in surface water. Thus, conducting corrective measures on the sediment will reduce impacts of ecoCOCs in surface water. The RAOs for all focused ecoCOCs within the lower segment of Unzinger Ditch are presented in Section 3.2.3.

2.3 Groundwater Evaluation for Soil

Following completion of the RFI, an evaluation was conducted to more fully assess the potential for chemicals in the Exposure Unit 1 soil to migrate to groundwater. The initial phase of this evaluation included a comparison of soil concentrations to PRGs. This comparison identified locations where constituent concentrations in soil require additional evaluation of the potential to migrate to groundwater.

2.3.1 Migration Potential in Exposure Unit 1

To further evaluate the potential for constituents to migrate to groundwater from impacted soil in the future, the vadose zone model SESOIL and the transport model AT123D was used to simulate a more representative potential for migration to groundwater than is provided by the comparison of generic groundwater quality standards to soil impact values, as a conservative PRG calculation assumes an infinite source of chemical extends to the water table and no attenuation capacity exists in the soil column. To more accurately represent site conditions, a representative vadose zone and transport model was used to simulate the potential for chemical migration to groundwater. The models were developed for the active operations area of Franklin Steel where various metals, SVOCs, and VOCs were detected in soil samples at concentrations above PRGs to further evaluate the potential for these compounds to migrate from soil to groundwater. Details of both the vadose zone (SESOIL) and transport (AT123D) models are presented further in the *Final RFI* (RMT, 2009) and a summary of the results is presented below.

SESOIL modeling results indicate that on-site soil impacts are not likely to migrate to groundwater during a 40 – 100-year time frame in excess of PRGs. The exceptions being chloroethane, bis(2-ethylhexyl)phthalate, 1,1-dichloroethane and vinyl chloride. These chemicals are the only COCs that have appeared in monitoring wells on-site in excess of site established PRGs. However, the AT123D model predicts these compounds entering

the groundwater are attenuating at concentrations below their respective PRG directly beneath and/or within a small radius of the source zone, thus, decreasing to within an acceptable level prior to migrating off-site. This has been further verified during recent groundwater monitoring events, in that no detections of these (and other) chemicals have been found within down or cross-gradient monitoring wells.

2.3.2 Summary of Migration Potential Evaluations

In summary, the combination of soil and groundwater data supports the conclusion that migration of site-related metals, SVOCs, and VOCs to groundwater from soil underlying the active operations area has not occurred with the exception of chloroethane, bis(2-ethylhexyl)phthalate, 1,1 dichloroethane and vinyl chloride. However, modeling and aerial sampling efforts support the conclusion that these (and other) chemicals exceeding their respective PRGs are not migrating off-site at an environmentally significant rate and/or pose the potential of migrating off-site in excess of site specific PRGs. These chemicals display limited potential for migration to groundwater under observed site conditions and are not considered for corrective measures.

Section 3
Development and Application of Remedial Action Objectives

This section presents the corrective measures objectives developed to address the areas and chemicals identified in the RFI as warranting consideration of final corrective measures; the development of RAOs to address constituents and media considered for corrective measures; and the application of RAOs to areas under consideration to arrive at specific needs to meet corrective measures objectives.

3.1 Corrective Measures Objectives

Areas at the site requiring consideration of final corrective measures were identified by evaluating the defined SWMUs against risk-based criteria or RAOs. Corrective measures objectives developed for Franklin Steel include the following goals:

- Reduce potential direct contact risk by human receptors in areas where COC impacts exceed soil RAOs.
- Reduce potential migration of chemicals from soil to groundwater at concentrations exceeding state and federal standards by decreasing soil impacts on-site.
- Reduce the potential for off-site migration of COCs in groundwater exceeding state and federal standards by decreasing the soil impacts on-site.
- Reduce potential adverse effects by ecological receptors in areas where ecoCOC impacts exceed Unzinger Ditch sediment and surface water RAOs.

3.2 Development of Remedial Action Objectives

RAOs are target concentrations for COCs in soil, groundwater, sediment, and surface water for which evaluation of corrective measures is required. Specific RAOs applied to meet the corrective measures objectives for soil, groundwater, sediment, and surface water in the areas identified for corrective measures are presented in the following subsections.

3.2.1 Risk-Based Criteria for Soil

The risk–based RAOs for the COCs were developed in Section 8 of the *Final RFI* (RMT, 2009). Site workers were identified as the most sensitive receptor evaluated in the HHRA for the active operations area. Human health PRGs for adult workers were calculated according to the *EPA's Risk Assessment Guidance for Superfund, Volume I, Part B* (EPA, 1991) for all COCs except lead. These PRGs correspond to EPA target risk–levels,

ELCRs of $1x10^{-5}$ for carcinogenic COCs and a non–cancer HQ of 1 for non–carcinogenic COCs.

The PRG for lead was adapted from the Ohio EPA's recommendation based on the studies completed by the Technical Review Workgroup (TRW) (EPA 1996) and the Ohio VAP. The TRW approach for assessing non–residential adult risks utilizes some basic algorithms to relate soil lead intake to blood lead concentrations in women of child bearing age. The basis for the calculation is the relationship between the concentration of lead in soil and the blood lead concentration in a developing fetus of adult women that have occupational site exposures. The TRW model uses a threshold for elevated blood lead concentrations. The highest acceptable fetal blood lead level was set at the 95th percentile of 10 mg/dl, which is the concentration recommended by EPA and the Center for Disease Control. The acceptable concentration of lead in soil was established as 710 mg/kg. Table 3.1 presents the RAOs for all COCs established for Franklin Steel active operations area, and the maximum detected concentrations from the RFI's soil sampling results.

Development of Risk Ratios

To further define the extent of corrective action, human health risk ratios for carcinogens and non-carcinogens were developed for the active operations area of Franklin Steel. For carcinogenic chemicals, the risk associated with exposure to an individual COC is then estimated by multiplying the risk upon which the risk-based concentration (RBC) is based ($1x10^{-6}$) by the simple ratio of the maximum detected concentration (MDC) to the RBC. For example, if the MDC for benzo(a)pyrene is 3.0 mg/kg and the RBC is $7.84x10^{-1}$, the risk ratio is $3.0/0.784 \times 10^{-6}$ or 3.83×10^{-6}. The COC-specific risks are then summed to determine whether the estimated cumulative cancer risk for the assessed exposure route exceeds the benchmark of $1x10^{-5}$. Typically, corrective action is initiated at a site when the cumulative cancer risk for all pathways and routes of exposure surpasses an industrial $1x10^{-4}$, however, a benchmark of $1X10^{-5}$ is established for Franklin Steel to account for potential risks posed by pathways and routes not considered by the risk ratio/toxicological evaluation process.

Similarly, the MDC for non-carcinogens is compared to the RBC and the potential risk estimated by multiplying the hazard index at the RBC (1.0) by the ratio of the MDC to the RBC. The COC-specific risks are then summed to determine whether the estimated cumulative non-cancer risk for the assessed exposure route exceeds the benchmark of 1.0. Action is typically initiated at a site when the cumulative non-cancer risk for all pathways and routes of exposure surpasses the benchmark of 1.0.

For chemicals that have both cancer and non-cancer effects, in general, the RBC is based on cancer risk, and therefore only the cancer risk associated with that COC is included in the risk ratio sum. As a preliminary assessment, the risk-ratio comparison is regarded as a reasonable approach for determining the need for corrective action. If the cancer and non-cancer benchmarks are not exceeded, no additional human health risk assessment and/or corrective action is required. The risk ratio calculations are presented on Table 3.2.

3.2.2 Groundwater Criteria

RAOs for groundwater are based on 100% of the USEPA Region 9 PRGs residential exposures for carcinogens and 10% of the USEPA Region 9 PRGs for non-carcinogens, as recommended by the Ohio EPA (2004) and the USEPA Maximum Contaminant Level (MCL) standards. RAOs for inorganic and organic COCs in groundwater are presented in Table 3.3 and 3.4, respectively.

3.2.3 Risk-based Criteria for Sediment

RAOs for sediment are based on background concentrations and preferred screening values presented in Section 7 of the *Final RFI* (RMT, 2009). Ohio EPA's preferred hierarchy of Environmental Screening Values is: Ohio EPA Sediment Reference Values (2003); Consensus-based Threshold Effects Concentrations (TECs) (MacDonald, Ingersoll, and Berger 2000); and EPA Region 5 Environmental Data Quality Levels (EDQLs). Only TECs were used to develop cleanup goals for sediment. EDQLs were not used as TRVs, and therefore, were not used to develop cleanup goals. Table 3.5 presents the RAOs for all sediment ecoCOCs established for Unzinger Ditch.

3.2.4 Surface Water Criteria

RAOs for surface water are based on background concentrations, chemical water quality criteria, and the screening values presented in Section 7 of the *Final RFI* (RMT, 2009). Ohio EPA Outside Mixing Zone Average (OMZA) water quality criteria (WQC) were the first choice, followed by chronic national ambient water quality criteria (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 cleanup goals because they protect aquatic life over long periods of time. The cleanup goals recommended for the surface water ecoCOCs are presented on Table 3.6.

3.2.5 Land Use Controls

For this CMS, the term "land use controls" with regard to real property means a restriction or control that limits the use of and/or exposure to a portion of that property, including water resources arising from the need to protect human health and the environment. The term encompasses institutional controls, such as those involved in real estate interests, governmental permitting, zoning, public advisories, deed notices, and other legal restrictions. The term also includes restrictions on access, whether achieved by means of engineered barriers (*e.g.,* fence or concrete pad) or by human means (*e.g.,* the presence of security guards). Additionally, the term includes both affirmative measures to achieve the desired restrictions (*e.g.,* night lighting of an area) and prohibitive directives (*e.g.,* no drilling of drinking water wells for the duration of the corrective action). Considered together, land use controls for a facility will provide a tool for how the property should be used in order to maintain the level of protectiveness that one or more corrective measures were designed to achieve.

For this property, and as part of the CMS, three land use controls will be used:

1. Restrict land use to commercial/industrial (prevent residential land use).
2. Prohibit the use of groundwater for drinking water purposes.
3. Implement an engineered barrier, a cap, to prevent direct contact of impacted soil in certain areas.

3.3 Application of Remedial Action Objectives

This section describes the areas selected for corrective measures. Current conditions for soil are based on information collected during RFI sampling. Current conditions for sediment are based on data collected during the RFI. Current conditions for groundwater are based on analytical results obtained from RFI groundwater sampling and the groundwater monitoring program through October 2008. With the exception of the May and October 2008 groundwater sampling results, site data have been previously reported in the *Final RFI* (RMT, 2009) document.

The following discussion presents the areas of impact within both Exposure Unit 1 and Exposure Unit 3 where corrective measures are being proposed.

3.3.1 Exposure Unit 1 - Soil

Impacted soil requiring consideration of final corrective measures was identified by risk-based criteria for the active operations area of Franklin Steel. Soil locations requiring evaluations for further corrective measures were identified using the following steps:

1. Impacted areas (*i.e.*, sample locations) were identified for further consideration if the area met one of the following criteria in the risk assessment presented in *RFI Data Evaluation Report:*

    a) Area poses a cumulative risk of $1x10^{-5}$ or greater; or

    b) Area has a cumulative hazard index greater than 1.0.

    There were 42 soil locations in the active operation areas that met one or more of these criteria.

2. Once identified, these exposure areas were critically evaluated to identify the primary risk driver within the area. Risk drivers are defined as compounds contributing to the calculated risk/hazard to the following extent:

    a) For an area identified for carcinogenic risk, an estimated risk of $1x10^{-5}$ or greater;

    b) For an area identified for non-carcinogenic risk, a HQ greater than 1.0; or

    c) For an area identified for lead, a lead risk assessment exposure concentration greater than 710 mg/kg.

3. Once identified, the chemical risk drivers were critically evaluated to identify:

    a) The specific sample chemical and location which contribute to risk, or

    b) The risk driver concentrations (single and cumulative) detected or calculated on detection limits.

    The summary of risk ratio calculations for the 42 locations are summarized in Table 3.2.

    In evaluation of the 42 identified soil sample locations which met one or more of the above criteria, six locations were determined to have a low risk potential and/or a calculated risk ratio below the risk benchmark of $1X10^{-5}$ and/or HI benchmark of 1.0. In addition, the evaluation of low risk potential, further considered the location and potential of exposure for the area of concern. For example, sample location S100-SS09 is located in an area of limited human interaction, thus, potential exposure is low. This resulted in a total of 36 soil locations warrant further evaluation in the CMS.

    Of the 36 soil locations identified for evaluation, several were located adjacent to one another facilitating the combination of various locations into one area for remediation. The combination of various locations concluded 22 soil areas within the active operations area that warrant corrective measures.

Figure 2.9 shows the site divided into impact zones for which risk was calculated in the risk assessment. The shaded impact zones are those with estimated risks greater than the conservative end of the risk range ($1x10^{-5}$), estimated HI greater than the hazard threshold level (1.0), as based on the holistic site risk ratio calculations.

3.3.2 Exposure Unit 3 – Sediment

The SERA identified 18 ecoCOCs in Unzinger Ditch sediment at concentrations exceeding the RAOs. The SERA along with the Ohio EPA field evaluations (2001) concluded that the lower segment (*i.e.*, downstream of RM 0.6) of Unzinger Ditch pose the greatest sediment impact accumulation and were determined to have the high potential for biological impact. However, based on the Ohio EPA field evaluation (2001) and RMT field observations, various portions of the lower segment are without appreciable sediment.

The Ohio EPA (2001) five target reaches show the greatest sediment impact accumulation. These five target reaches are defined as follows:

- Reach 1: Confluence (0 ft) to 150 ft upstream,
- Reach 2: 1,000 to 1,320 ft upstream,
- Reach 3: 2,200 to 2,600 ft upstream,
- Reach 4: 2,750 to 3,100 ft upstream, and
- Reach 5: 3,300 to 3,520 ft upstream.

Based on these findings and in agreement with the SERA, the lower segment with emphasis on the five target reach areas were considered for further evaluation of corrective measure alternatives.

The lower segment(s) exceeding the RAOs for all ecoCOCs are shown on Figure 2.10. A summary of analytical results for the maximum detected ecoCOCs for Unzinger Ditch sediment is included in Table 3.5.

3.3.3 Groundwater

The RFI identified vinyl chloride exhibiting an increasing trend ranging from 3.0 µg/L to 11.7 µg /L during the last eight sampling events in monitoring well S109-MW06. In addition, monitoring well S109-MW06 has exhibited fluctuating levels of chloroethane ranging from 100 µg/L (2006) to 460 µg/L (1999), and 1,1-dichloroethane ranging from 0.95 (2008) µg/L to 1.7 µg/L (2007). A summary of analytical results for the maximum detected COCs for groundwater is included in Table 3.3 and 3.4.

As a result of the detectable concentrations in the groundwater, a BIOCHLOR transport model was developed to estimate the flow and concentration pattern of these compounds, *i.e.*, with a specific focus on vinyl chloride trends. For purposes of the model, the Jefferson Township well field was designated the down-gradient end point. The model indicated, as detailed in the *Final RFI* (RMT, 2009), vinyl chloride attenuates within the water column below the MCL within approximately 250 ft east of S109-MW06 and thus, prior to reaching the Franklin Steel eastern property boundary. In addition, no detections of vinyl chloride were found in monitoring wells S109-PZ02 and S109-PZ04 located down-gradient of monitoring well S109-MW06, and monitoring wells S108-MW06 and S108-MW05 located cross-gradient of monitoring well S109-MW06. Thus, data indicates that vinyl chloride detections in S109-MW06 are localized based on no detectable concentrations of vinyl chloride in the down-gradient or cross-gradient monitoring wells. To further aid in assessing the extent of the presence of vinyl chloride detected in monitoring well S109-MW06, an additional groundwater monitoring well will be installed approximately 250 to 300 feet down-gradient of S109-MW06 and sampled as part of the compliance and detection monitoring network of wells following remediation of soil within the active operations area.

Historic analytical results indicated one detection of bis(2-ethylhexyl)phthalate and methylene chloride in monitoring well S105-MW01 at concentrations of 10.8 μg/L and 6.7 μg/L, respectively, and one detection of vinyl chloride in monitoring well S101-MW01R at a concentration of 2.06 μg/L. These compounds were only detected once in these monitoring wells and have not been detected in any of the other monitoring wells since November 2006 except for vinyl chloride. Thus, bis(2-ethylhexyl)phthalate and methylene chloride are not considered further for remediation purposes.

Two SVOCs (2-methylnaphthalene and naphthalene) and four inorganic compounds (*i.e.*, aluminum, arsenic, iron and manganese) have been detected during the Franklin Steel sampling events. Both 2-methylnaphthalene and naphthalene were detected in monitoring well JTMW-3S for the first time during the May 2008 sampling event at concentrations of 0.05 μg/L and 0.06 μg/L, respectively. Neither of these compounds have an MCL for groundwater.

Aluminum, iron and manganese are present in on-site wells, but are only secondary MCL compounds. All of which are present in the most up-gradient well, S107-MW02. Aluminum detections range from non-detect to 1.71 mg/L in monitoring well S105-MW01. Iron detections range from 0.0338 mg/L in monitoring well S201-PZ01 to 23.1 in monitoring well S101-MW01R. Manganese detections range from 0.067 mg/L in monitoring well S107-MW02 to 1.48 mg/L in JTMW-1S. Arsenic was present only in the wells located within the area of the main facility operations, and detections range from

non-detect to 0.04 mg/L in monitoring well S101-MW01R. These four compounds have shown no distinct pattern and continue to fluctuate.

3.3.4 Surface Water

Note that no direct remediation of surface water is anticipated. Rather, the remediation of contaminated sediment is expected to address surface water ecoCOCs. A summary of analytical results for the maximum detected COCs for surface water is included in Table 3.6.

Section 4
Corrective Measures Selection Process

The purpose of this section of the CMS is to identify and screen an array of remediation methods that may be appropriate for the areas of the site identified for consideration of final corrective measures. Brief descriptions of the approaches are provided in tabular form. The methods are screened to eliminate those that may prove infeasible to implement or that may be ineffective at those areas of the site requiring additional corrective measures. Relative cost comparisons are also provided in the preliminary screening process. The remediation methods that are not eliminated in this preliminary screening step are further considered for assembly into site-specific corrective measures alternatives discussed in Sections 5 through 7.

4.1 Technology Identification and Screening

The preliminary screening of specific remedial technologies in this CMS was performed with respect to effectiveness, ease of implementation, and relative cost. The preliminary screenings are summarized in Tables 4.1, 4.2, and 4.3. Corrective measures technologies are separated into those that apply to soil (Table 4.1), those that apply to sediment (Table 4.2), and those that apply to groundwater (Table 4.3). General corrective measures technologies that were screened include land use controls, *in situ* treatment, *ex situ* treatment, capping, removal, and natural attenuation. These general response actions may be pooled in many combinations to develop comprehensive corrective measures alternatives that meet the objectives of this CMS. The corrective measures technologies were identified based on the following resources and information:

- USEPA guidance documents
- Recent technical literature
- Site-specific factors
- RMT experience

Characteristics of the site and impacted media were considered in screening the corrective measures technologies. Technical limitations of the methods were also evaluated. These considerations are described below:

- **Site characteristics** – The available site data were evaluated to identify conditions that may limit or promote the use of certain corrective measures. The technologies that were not expected to be effective or implementable based on the site characteristics were eliminated from further consideration. A discussion of current site conditions has been included in Section 2.

- **Characteristics of impacted media** – Soil, groundwater, and sediment characteristics that limit the effectiveness of a given corrective measures technology were identified. Technologies clearly limited by these characteristics were eliminated from consideration.
- **Limitations of the Corrective Measures Method** – During the preliminary screening process, the following issues were reviewed for each corrective measures method under consideration: level of technology development; performance record; failure implications; and inherent constructability, operation, or maintenance issues. Corrective measures used at other sites that have been shown to be ineffective, that have performed poorly, or that have not been fully demonstrated in the field were eliminated from further consideration. State and federal regulations that may limit or preclude the implementation of a specific corrective measures method were also considered.

General screening ratings for the purpose of evaluating effectiveness, ease of implementation, and relative cost are as follows:

- **Effectiveness**
  - ***Effective*** – Corrective measures method has consistently achieved the corrective measures objectives at other sites with similar site and impacted media characteristics. Corrective measures method should achieve the corrective measures objectives specified in this CMS.
  - ***Potentially or partially effective*** – Corrective measures method may achieve the objectives for the media and impacted area of the site, but pre-design testing and/or modifications to the technology would be necessary.
  - ***Not effective*** – Technology limitations preclude this method from effectively achieving the corrective measures objectives.
- **Ease of Implementation**
  - ***Implementable*** – Corrective measures method has been readily implemented at other sites with similar site and impacted media characteristics.
  - ***Moderately implementable*** – Site or impacted media characteristics suggest that some modifications to the traditional technology will be necessary prior to implementation.
  - ***Not implementable*** – Site characteristics preclude this technology from being implemented. Those technologies with a very limited potential for being implementable are given a low rating.
- **Relative Cost**
  - ***Low*** – Corrective measures method has been implemented at a relatively low cost compared to other technologies being considered.

- ***Medium*** – Corrective measures method, in general, can be implemented at a relatively moderate cost compared to other technologies being considered.
- ***High*** – Corrective measures method, in general, can be implemented at a relatively high cost compared to other technologies being considered.

4.2 Potential Soil Technologies for Industrial Land Use

A number of potential technologies have been identified and screened for potential corrective measures applicable to impacted soil across the site for future industrial land use. These technologies include capping, removal, and *in situ* treatment.

Land use controls, defined in Subsection 3.2.5, are generally applicable to corrective measures for soil at this site. Land use controls can include restrictions set in place that are protective of human health and the environment by limiting use or exposure to a portion of the property that is adversely impacted. In this case, land use will be restricted to commercial or industrial. Residential land use will be prohibited for the property. An engineering control will also be used to meet the cleanup requirements for the property. This will invoke placement of a cap over impacted soils to prevent direct contact and leaching to groundwater.

The results of the technology screening for impacted soil are presented in Table 4.1. A brief description of each of the technologies considered is provided below.

- **Capping of Soil** – Covering or capping of impacted soil may consist of a concrete cap, engineered soil cap, or manufactured liner material. A surface cap would serve as a barrier to storm water infiltration and runoff and would reduce the potential for direct contact with soil.

  Covering or capping of impacted soil would be potentially applicable to Exposure Unit 1 soil impacted areas.

- **Soil Removal** – Excavation of impacted soil would remove COCs as a potential source of exposure or migration. Once removed, soil may be transported off the site to a controlled setting (*e.g.*, permitted Subtitle D landfill), which would eliminate the potential for direct contact with COCs and the potential for COCs to migrate.

  Excavation of impacted soil would be applicable for the Exposure Unit 1 soil impacted areas.

- ***In situ* Treatment of Soil** – Various physical, chemical, and biological treatment technologies can be considered for *in situ* treatment of impacted soil at the site. Technologies screened for potential use at the site include phytoremediation, soil flushing, and stabilization.

In situ treatment of impacted soil would not be applicable for Exposure Unit 1 impacted soil because the technology affects constituent mobility but not direct contact human health risk.

4.3 Potential Sediment Technologies

Several technologies were identified and screened for sediment corrective measures, which are presented in Table 4.2. These technologies include dredging, cover or capping, and natural recovery through natural sedimentation. A general description of each of the technologies considered for Unzinger Ditch sediment is provided below.

- **Removal** – Removal of impacted sediment reduces consituent mass, toxicity, volume, or concentration and would remove COCs and ecoCOCs as a potential source of exposure. Once removed, sediment may be transported off the site to a controlled setting (*e.g.*, permitted Subtitle D landfill), which would eliminate the potential for direct contact with both COCs and ecoCOCs. However, removal can result in habitat destruction, remobilization of constituents, and disturbance to the surrounding ecological community.
- **Cover or capping** – This remedy includes the installation of a cover or barrier layer (geogrid/high-strength geotextile plus a soil layer, or a bentonite/clay product). A cover or barrier option would reduce direct contact exposure to Unzinger Ditch sediment by human and ecological receptors but may also lead to significant disturbance of ecological habitats.
- **Natural recovery through natural sedimentation** –The guidance document *Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites* (USEPA, February 2002) recognizes that aggressive sediment management techniques, in addition to high remediation expenditures, have a number of detrimental short-term impacts such as destruction of habitat, remobilization of constituents, and disturbance to the surrounding ecological community. Natural recovery through natural sedimentation is considered applicable to sediment environments where
  - limited ecological risk is present,
  - the biological zone is healthy,
  - the sources are identified and controlled, and
  - the sediments are stable (with minimal downstream transport potential).

  The conditions within Unzinger Ditch are consistent for application of natural recovery through natural sedimentation, however, due to the potential impacts to surface water from sediment, this alternative is not being considered.

4.4 Potential Groundwater Technologies

A number of potential technologies have been identified and screened for groundwater corrective measures surrounding groundwater monitoring well S109-MW06. These technologies include natural attenuation, *in situ* treatment, and groundwater recovery and *ex situ* treatment. Land use controls, as defined in Subsection 3.2.2, would be used in conjunction with each potential groundwater technology. A discussion of land use controls, as they apply to each technology, is included in the description of the alternatives in subsequent sections of this document.

Screening results are provided in Table 4.3. A general description of each of the technologies considered for groundwater is provided below.

- **Natural Attenuation** – Natural attenuation reduces consituent mass, toxicity, mobility, volume, or concentration using naturally occurring processes including biodegradation, dispersion, dilution, adsorption, volatilization, chemical or biochemical stabilization of constituents, and/or destruction of constituents. These processes occur to varying degrees depending on the types and concentrations of constituents and hydrologic and geologic characteristics of the site. Natural attenuation processes would be documented through a coordinated groundwater monitoring program that includes compliance and detection monitoring locations. Natural attenuation is an applicable technology for groundwater surrounding monitoring well S109-MW06.
  - ***Organic Constituents*** – Organic constituents, like vinyl chloride detected in monitoring well S109-MW-06, typically attenuate by means of biological degradation. Biological degradation occurs when microorganisms in the subsurface breakdown constituents into chemical byproducts. Degradation of organic constituents can also occur abiotically through chemical transformation. For example, 1,1-dichloroethene typically degrades to vinyl chloride and ethene through biological degradation.
  - ***Inorganic Constituents*** – Conversely, inorganic constituents such as metals, typically do not degrade biologically. Inorganics do comprise various COCs in the groundwater beneath the site.

  Natural attenuation would be applicable for groundwater.

- ***In situ* Treatment** – Technologies can be applied *in situ* to treat COCs in groundwater using chemical or biological processes. Potential processes and applications considered for site groundwater include phytoremediation, chemical injection, and permeable reactive barriers (PRBs).

  In situ treatment is not applicable for groundwater.

- **Groundwater Recovery and *Ex situ* Treatment** – Physical recovery of groundwater with *ex situ* treatment by air stripping and/or activated carbon, and biological treatment were identified. Only the air stripping and/or carbon adsorption were considered as potential technologies for groundwater.

  Groundwater recovery and *ex situ* treatment is an applicable technology for groundwater.

- **Treated Water Discharge** – Options can be considered for the discharge of treated water generated by application of a groundwater recovery technology. The selection of a water discharge option will be closely tied to and, to a large degree, will dictate the selection of an appropriate treatment method. Discharge to local surface water and to a local publicly-owned treatment works (POTW) are included in the technology screening.

  Treated Water Discharge is applicable for groundwater.

4.5 Criteria for Evaluation of Alternatives

Analysis of the retained corrective measures alternatives included consideration of nine criteria defined in *RCRA Corrective Action Plan* (USEPA, 1994). RCRA guidance requires that alternative corrective measures be evaluated against the criteria listed below. As a baseline, the alternative corrective measures are also compared against a no action alternative, in which no additional corrective measures are conducted on the impacted media at the site.

- **Protection of Human Health and the Environment** – Involves an overall evaluation of the alternative regarding its ability to eliminate, reduce, or control exposures that pose unacceptable risks. The assessment is based on a composite of factors addressed under other evaluation criteria, including long-term effectiveness and permanence, short-term effectiveness, and compliance with institutional and legal requirements.
- **Ability to Attain RAOs** – Examines the ability of the corrective measures alternative to achieve the RAOs to meet the corrective measures objectives.
- **Control of Release Sources** – Examines the extent to which the corrective measures alternative controls or eliminates further releases that may pose a threat to human health and the environment.
- **Compliance with Institutional and Legal Requirements** – Assesses the compliance of an alternative with state and federal requirements.
- **Long-term Reliability and Effectiveness –** Examines the risks and consequences of failure of the corrective measure. This criterion includes an evaluation of the useful life of the overall alternative and its component technologies.
- **Reduction in the Toxicity, Mobility, or Volume of Wastes –** Examines the extent to which the alternative reduces the toxicity, volume, or mobility of hazardous constituents.
- **Short-term Effectiveness –** Evaluates short-term risks associated with implementing the alternative.

- **Ease of Implementation –** Considers the technical and administrative feasibility of each alternative, as well as the availability of required resources. Factors considered include ease of construction, reliability, and O&M of the corrective measures alternative; potential problems which may be encountered during the implementation of an alternative; required approvals and permits from regulatory agencies; availability of required off-site treatment or disposal services; and availability of necessary equipment, materials, and personnel.
- **Cost** – Involves development and evaluation of the capital cost of construction, equipment, land, buildings, engineering services, and project administration. O&M costs of labor, spare parts, materials, and administration are also addressed. The level of detail employed in developing these estimates is considered appropriate for making comparisons between alternatives, but the estimates are not intended for budgetary planning. Cost estimates for the alternatives are provided in Appendix A.

Section 5
Soil

The purpose of this section is to identify, develop, and evaluate an array of corrective measures alternatives that potentially can be used to manage impacted soil. Site-specific areas subject to final corrective measures are identified in Section 3.0 and summarized in Table 3.2.

The corrective measures objectives for soil are focused on reducing potential human health risks to impacted soil specifically associated with industrial or construction worker exposures. Additionally, as discussed in Subsection 4.2, land use controls for the property will be in place to prevent residential development.

There are 22 soil areas that need to be addressed during the CMS as shown on Figure 2.9. Five of these areas are partially capped with concrete, and 17 do not have any capping; their surface is gravel and/or soil. Only one of the impacted soil areas is deeper than 2 feet and not under concrete. This location is the sample collected from boring S108-SB13/SS15, which is approximately at a depth of 7 to 8 feet. This location will be excavated to the depth of the impact during remediation.

Total volume of soil that needs to be remediated in the 22 areas is estimated to be 5,000 tons, based on an excavation depth of 2 feet. This includes a 1.5 conversion factor from cubic yards to tons, and 30% contingency. Of the 5,000 tons, approximately 4,300 tons are in uncapped areas. Soil impacted areas currently capped, are estimated to be 5,000 square feet, and areas currently uncapped are estimated to be 29,450 square feet. Table 5.1 provides the estimate of square footage and tonnage by impacted area.

Several corrective measures alternatives have been identified as having the potential to meet corrective measures objectives for impacted soil. These alternatives are as follows:

- No action.
- Capping of the specified soil, and land use controls to prevent residential development, maintaining long-term cap integrity, and providing notice for construction worker protection should the cap be breached.
- Partial or complete removal of specified soil, and placement of land use controls to prevent residential development. Additional land use controls would be included with a partial removal scenario to maintain long-term cap integrity and provide notice for construction worker protection should the cap be breached.

Brief descriptions of these alternatives are presented in Table 5.2. The preferred corrective measures alternative for the site, including the area covered in this section, is presented in Section 8.

5.1 Development of Alternatives

Technologies that were retained from the initial technology screening process in Subsection 4.2 were examined relative to their applicability for addressing COCs in soil locations identified for corrective measures. Applicable technologies were then combined to develop corrective measures alternatives designed to meet the objectives established in Section 3. The alternatives for impacted soil are detailed in the following subsections.

5.1.1 Alternative 1: No Action

The No Action alternative is evaluated as a baseline for comparison to other corrective measures alternatives. Under this alternative, no active corrective measures would be conducted for impacted soil. The soil would remain in its present condition.

5.1.2 Alternative 2: Capping of Soil

Alternative 2 would consist of a cap system for soil identified as requiring corrective measures in Subsection 3.3.1. This alternative would include a new concrete cap for areas that are currently uncovered and maintenance of the existing concrete cap in areas that are currently covered.

For the currently uncovered areas requiring corrective measures, the top 12 inches of soil would be removed so that the finished cap grade would be level with the surrounding land surface and promote positive drainage. Soil would be stabilized *in situ*, as necessary, to meet landfill acceptance criteria prior to removal and transport for off-site disposal in a permitted, Subtitle D landfill. A 4- to 6-inch thick asphalt cap with a gravel or sand base layer would be constructed over the currently unpaved areas requiring capping. Figure 2.9 presents a conceptual layout of currently uncovered areas where a new concrete cap would be installed and maintained.

For currently covered areas requiring corrective measures, observed defects would be repaired. Annual inspection and repairs to areas that are capped as part of this alternative would be conducted as part of long-term care for the site. Figure 2.9 presents a conceptual layout of areas where existing concrete pavement over impacted soil would be subject to cap maintenance.

Land use controls proposed for this alternative would include restrictive covenants to prevent residential development on the property and maintaining a cap over certain impacted soil areas.

5.1.3 Alternative 3: Removal of Soil

Two design options have been developed for Alternative 3. Alternative 3A would consist of excavating soil only from the currently uncovered (unpaved) areas identified in Subsection 3.3.1 as requiring corrective measures. For Alternative 3A, currently covered (paved) areas would not be removed but would have a land use control for long-term cap maintenance. Alternative 3B would consist of excavating soil from both currently unpaved and paved areas identified in Subsection 3.3.1 as requiring corrective measures. For currently paved areas, existing concrete would be removed prior to initiating soil excavation. For both Alternatives 3A and 3B, up to 2 feet of soil depth would be excavated and transported for off-site landfill disposal. One location will have soil removed to a depth of 7–8 feet. Where removal is conducted in contiguous paved areas, pavement would be replaced as final surface cover.

Excavated areas would be backfilled with compacted fill material. Soil would be treated *in situ*, as necessary, to meet landfill acceptance criteria prior to removal and transport for off-site disposal in a permitted, Subtitle D landfill. Figure 2.9 is a conceptual layout showing the currently uncovered areas targeted for soil removal for Alternative 3. In addition, Figure 2.9 shows the currently covered areas targeted for cap maintenance. Currently covered locations would be subject to notices to workers relative to residual concentrations.

Land use controls proposed for this alternative would include restrictive covenants to prevent residential development on the entire property.

5.2 Comparative Evaluation of Alternatives

The objective for corrective measures for impacted soil is to minimize potential exposure to soil that could contribute to unacceptable human health risks. The ability of the selected alternatives to meet these objectives is evaluated using the criteria outlined in Subsection 4.5. These criteria appear as headings of the following subsections that evaluate and compare the alternatives.

Several issues are considered in the evaluation of alternatives. An evaluation of the effectiveness of a corrective measure must take into account the relative risks presented by the areas in question. In addition, corrective measures alternatives can provide protection of human health in different ways. Land use controls eliminate exposure pathways from sources

to receptors, while source removal reduces constituent toxicity and mass. With the exception of the No Action alternative, each of the alternatives would reduce potential human health risks. The different corrective measures alternatives would present different implementation risks, all of which are considered in the evaluation of overall protection. The reduction of risk for each alternative is evaluated qualitatively but can be further quantified, if needed, to support a final risk management decision.

5.2.1 Protection of Human Health and the Environment

Protection of human health and the environment involves the ability of a corrective measures alternative to eliminate, reduce, or control exposures that pose unacceptable risks. The assessment is based on a composite of factors addressed under other evaluation criteria, including long-term effectiveness and permanence, short-term effectiveness, and compliance with institutional and legal requirements.

5.2.1.1 Alternative 1: No Action

The No Action alternative would not modify or reduce the potential for exposure to COCs. The RAOs established for impacted soil and the corrective measures objectives would not be met under this alternative.

5.2.1.2 Alternative 2: Capping

This alternative would protect human health by preventing direct contact with COCs with risk assessment exposure concentrations above RAOs, thereby rendering the exposure pathway incomplete. The land use controls element of this alternative would protect human health by preventing future residential development of specified areas of the site and by preventing worker contact with impacted soil beneath existing paved areas and newly capped areas.

5.2.1.3 Alternative 3: Soil Removal

Alternative 3A (removal of currently unpaved areas only) would protect human health by removing impacted soil from currently uncovered areas where COCs exceed the criteria established for requiring corrective measures. The land use controls element of Alternative 3A would prevent future residential development of the site and would prevent worker contact with impacted soil beneath paved areas.

Alternative 3B (soil removal from unpaved and paved areas) would protect human health by removing impacted soil where COCs exceed the criteria for requiring corrective measures, thereby rendering the exposure pathway

incomplete. The land use controls element of Alternative 3B would protect human health by preventing future residential development of the site.

5.2.1.4 Comparative Summary

Alternative 1, No Action, would not modify existing site conditions related to protection of human health and the environment. Alternatives 2 and 3 would provide improved protection of human health and the environment by preventing direct contact with impacted soil.

5.2.2 Ability to Attain RAOs

The following assessment examines the ability of the corrective measures alternative to achieve RAOs established to meet corrective measures objectives.

5.2.2.1 Alternative 1: No Action

The RAOs would not be met under the No Action alternative.

5.2.2.2 Alternative 2: Capping

This alternative would not decrease concentrations of COCs in impacted soil, except by incidental removal of soil, as needed, to achieve proper grades on the cap. However, the capping alternative would meet RAOs by rendering the exposure pathway incomplete.

The land use control portion of this alternative would meet RAOs by preventing direct contact with impacted soil and thereby rendering the exposure pathway incomplete and by providing notice to workers to enable them to protect themselves against COC exposure.

5.2.2.3 Alternative 3: Soil Removal

This alternative would achieve RAOs by decreasing COC concentrations at the site via removal to an off-site disposal facility.

The land use control portion of this alternative would meet RAOs by preventing direct contact with impacted soil and thereby rendering the exposure pathway incomplete.

5.2.2.4 Comparative Summary

Alternative 2 would achieve RAOs by providing a barrier to contact with impacted soil. Alternative 3A would achieve RAOs by providing a barrier to contact in currently paved areas and by physically removing COCs from the site in currently unpaved areas. Alternative 3B would achieve RAOs by physically removing COCs from the site. Alternative 1 would not meet RAOs.

5.2.3 Source Control

Potential corrective measures alternatives are evaluated for their ability to control or eliminate further releases that may pose a threat to human health and the environment.

5.2.3.1 Alternative 1: No Action

The No Action alternative would not modify the limited source potential represented by uncovered impacted soil.

5.2.3.2 Alternative 2: Capping

Control of impacted media for Alternative 2 would be provided by capping the impacted soil that is currently uncovered and by maintaining the existing concrete cover over impacted soil that is currently covered. By removing a layer of soil to keep the top of the new concrete cap level with the existing surface, some of the COCs in the impacted soil would be removed, but some would remain in the soil under the cap.

5.2.3.3 Alternative 3: Soil Removal

This alternative would involve active source control through the removal and off-site disposal of impacted soil. For Alternative 3A (removal of currently unpaved areas only), control of impacted soil would also be provided by maintaining the existing concrete cover over the soil that is currently covered.

5.2.3.4 Comparative Summary

Alternative 1 would not include active corrective measures for modifying source potential of impacted soil. Alternatives 2 and 3 would include source control in the form of capping and soil removal, respectively.

5.2.4 Compliance with Institutional and Legal Requirements

Compliance of an alternative with state and federal requirements is evaluated in the following discussion.

5.2.4.1 Alternative 1: No Action

Institutional and legal requirements for the impacted soil would not be met under this alternative.

5.2.4.2 Alternative 2: Capping

Under this alternative, soil would be removed from the site for disposal such that the final elevation of the cap would be consistent with adjacent pavement. This activity would be subject to state and federal regulations for transport. Disposal of COC-impacted soil would be subject to the permit requirements of a landfill facility.

The cap would limit storm water contact with COCs in impacted soil. Therefore, storm water pretreatment prior to discharge from the site would not be required. However, the runoff would be subject to NPDES permit requirements.

The land use control portion of this alternative would require restrictive covenants and notices, which would comply with institutional and legal requirements.

5.2.4.3 Alternative 3: Soil Removal

Under this alternative, COC-impacted soil would be removed from the site for off-site disposal. For alternative 3B, removed concrete pavement over the soil currently covered by pavement would also be removed from the site for off-site disposal. This activity would be subject to state and federal regulations for transport. Disposal of COC-impacted soil and concrete debris would be subject to the permit requirements of the accepting landfill facility.

The land use control portion of this alternative would require restrictive covenants, which would comply with institutional and legal requirements.

5.2.4.4 Comparative Summary

Alternatives 2 and 3 would require the establishment and maintenance of land use controls. Additionally, Alternatives 2 and 3 would involve the removal, and off-site disposal of impacted soil, which would be subject to applicable regulations and permits for transport and landfill disposal.

5.2.5 Long-term Reliability and Effectiveness

Long-term reliability and effectiveness examines the risks and consequences of failure of the corrective measure. This criterion includes an evaluation of the useful life of the overall alternative and its component technologies.

5.2.5.1 Alternative 1: No Action

No active corrective measures component would be included in this alternative.

5.2.5.2 Alternative 2: Capping

The long-term reliability and effectiveness of the capping alternative would depend on the quality of cap construction and the ability to maintain cap integrity over time. Cap maintenance would require long-term management. A well-maintained cap would effectively and reliably minimize exposure to COCs in impacted soil.

The land use control portion of this alternative would rely on long-term maintenance of restrictive covenants and notices to prevent future contact with impacted soil.

5.2.5.3 Alternative 3: Soil Removal

Soil removal is an effective and reliable method of soil remediation. By removing the impacted soil from the site, COC migration and exposure would be prevented. For Alternative 3A, effectiveness would also depend on the quality of cap construction and the ability to maintain cap integrity over time. A well-maintained cap would effectively and reliably minimize exposure to COCs in impacted surface soil.

The land use control portion of this alternative would rely on restrictive covenants remaining in place to prevent residential exposure.

5.2.5.4 Comparative Summary

Alternatives 2 and 3A, that rely upon capping in whole or in part, would provide a well-established and effective barrier to direct contact with impacted soil and would be dependent on long-term maintenance to maintain its reliability over time. Alternative 3 would also provide an effective and reliable remedy, due to the removal of site soil with concentrations of COCs meeting the criteria for requiring corrective measures. Alternatives 2 and 3 would rely to differing degrees on long-term maintenance of land use controls.

5.2.6 Reduction in the Toxicity, Mobility, or Volume of Wastes

In this subsection, proposed corrective measures alternatives were evaluated for their ability to reduce the toxicity, volume, or mobility of hazardous constituents.

5.2.6.1 Alternative 1: No Action

This alternative would not reduce the toxicity, mobility, or volume of COCs present in impacted surface soil.

5.2.6.2 Alternative 2: Capping

Capping of impacted soil would reduce the potential mobility of COCs. However, this alternative would not reduce the volume and toxicity of COCs in impacted soil.

5.2.6.3 Alternative 3: Soil Removal

Under Alternative 3, the volume of COCs remaining on the site would be reduced. Alternative 3A would remove a portion of the impacted soil, while Alternative 3B would remove all impacted soil identified as meeting the criteria established in Subsection 3.3.1 for requiring corrective measures.

5.2.6.4 Comparative Summary

Alternative 1 would not reduce the toxicity, mobility, or volume of impacted soil. Alternative 2 would partially decrease the toxicity, mobility and volume COCs in the impacted soil. Alternative 3 would decrease the toxicity, mobility and volume COCs in the impacted soil.

5.2.7 Short-term Effectiveness

Short-term effectiveness evaluates short-term risks associated with implementation of the alternative.

5.2.7.1 Alternative 1: No Action

No active corrective measures would be included in this alternative. Thus, no short-term exposure issues would be associated with this alternative.

5.2.7.2 Alternative 2: Capping

With installation of a cap, short-term exposure would be limited to workers potentially exposed to uncovered areas of impacted soil. Limited amounts of

materials would be excavated and removed from the site for disposal at an off-site location. Workers involved with cap construction would wear Personal Protective Equipment (PPE) to minimize exposure to COCs in exposed soil.

5.2.7.3 Alternative 3: Soil Removal

Alternative 3 would involve removal of impacted soil. Construction workers removing soil and handling materials during the excavation and treatment process would potentially be exposed to COCs in the soil. Workers at the site would wear PPE, as necessary, to minimize exposure.

5.2.7.4 Comparative Summary

Potential short-term effects during implementation would be lowest with Alternative 1, because no active corrective measures components would be included. Alternative 3 would have the highest potential for short-term exposure due to disruption and active handling of impacted surface soil during process application. For both Alternatives 2 and 3, proper use of PPE and safe construction practices would provide short-term effectiveness.

5.2.8 Ease of Implementation

Ease of implementation considers the technical and administrative feasibility of each alternative, as well as the availability of required resources. Factors considered include ease of construction, reliability, and O&M of the corrective measures alternative; potential problems which may be encountered during the implementation of an alternative; required approvals and permits from regulatory agencies; availability of required off-site treatment or disposal services; and availability of necessary equipment, materials, and personnel.

5.2.8.1 Alternative 1: No Action

The No Action alternative would contain no active corrective measures requiring implementation for impacted soil.

5.2.8.2 Alternative 2: Capping

The equipment, material, technology, and contractors would be readily available to install a cap on the soil impacted areas. Alternative 2 would be readily implemented. For the land use control portion of this alternative to be effective, restrictive covenants and notifications would need to be implemented and maintained over time.

5.2.8.3 *Alternative 3: Soil Removal*

The equipment, material, technology, and contractors would be readily available to implement the treatment and removal of impacted soil. Landfills in the area of the site are also readily available. Alternative 3A would be readily implemented, and the land use control portion of this alternative to be effective (restrictive covenants and notifications) would need to be implemented and maintained over time. Alternative 3B would not be easily implementable, as most of the currently capped portion of the impacted soil is beneath a major operations area, which is supported by a 2 to 3-foot slab of concrete. Removing and excavating soil in this area would be a major disruption to the current business operations.

5.2.8.4 *Comparative Summary*

Alternatives 1, 2, and 3 would be readily implemented.

5.2.9 Cost

Estimates of capital costs associated with construction, equipment, land, buildings, engineering services, and project administration have been developed and evaluated for potential corrective measures alternatives. O&M costs, including long-term inspection, monitoring, maintenance, labor, spare parts, materials, and administration have also been addressed. The level of detail employed in developing these estimates is considered appropriate for making comparisons between alternatives, but the estimates are not intended for budgetary planning.

Estimated costs for evaluated alternatives are summarized below. Cost estimate calculations are provided in Appendix A.

CORRECTIVE MEASURES ALTERNATIVE	CAPITAL COST	ANNUAL O&M COST	30-YEAR NPV COST
1 No Action	$0	$0	$0
2 Capping of Impacted Soil	$408,650	$18,800	$698,000
3 Removal of Impacted Soil			
A. Currently uncovered only	$511,900	$10,000	$666,000
B. Covered and uncovered	$707,150	$0	$707,150

NPV Net present value

5.3 Evaluation Summary

Alternative 3A, removal of impacted soil in currently uncovered areas and land use controls, is the recommended final corrective measure for the identified areas of impacted soil. For currently uncovered soils, removal of soil would provide a proven and readily implemented method that would meet the corrective measures objectives for this area of the site. Removal of impacted soil in currently paved areas (Alternative 3B) would meet corrective measures objectives but would not be sufficiently more protective to justify the additional cost. Land use controls to prevent future residential development at the site, to control worker exposure, and to maintain existing concrete surfaces over soil meeting the criteria established in Subsection 3.3.1 for requiring corrective measures are also included in the recommended corrective measure.

Table 5.3 provides a summary comparing the potential alternatives for impacted soil by the evaluation criteria. The corrective measures alternatives are evaluated as good, fair, or poor based on the ability of the alternative to meet the evaluation criteria.

Section 6
Unzinger Ditch Sediment

The purpose of this section is to identify, develop, and evaluate an array of corrective measures alternatives that potentially can be used to manage sediment in Unzinger Ditch. Site-specific areas subject to final corrective measures are discussed in Section 3.0. The corrective measures objectives for sediment are focused on reducing potential human health (*i.e.*, trespasser exposure) and ecological risks.

As previously stated, the lower segment of Unzinger Ditch is considered for corrective measure alternatives. Theses alternatives are presented within a range (*i.e.*, low-end to high-end) based on the necessary corrective measure action required. This range takes into consideration the following: applying corrective measure alternatives to the five target reaches (low-end action), and applying corrective measure alternatives to the entire lower segment (sample locations from S101-SD26 to S101-SD07) (high-end action). The range of corrective measures taken for the lower segment reach will be a direct result of one or more of the following stream characteristics: remedial confirmation sampling, visual observation, maximum environmental benefit and/or the absence of appreciable sediment.

Lower Segment Reach

The lower segment reach of the ditch to be evaluated for this CMS is shown on Figure 2.10, and include the following:

- Lower Segment Reach: Sample location S101-SD26 to sample location S101-SD07.

Total volume of sediment that needs to be remediated in the lower segment reach area is estimated to be 1,450 tons. This includes a 1.5 conversion factor from cubic yards to tons and 30% contingency. The surface area of these would amount to approximately 20,400 square feet.

Five Target Reaches

The five target reaches of the ditch to be evaluated for this CMS are shown on Figure 2.10, and include the following:

- Reach 1: Confluence (0 feet) to 150 feet, average width of 14 feet
- Reach 2: 1,000 to 1,320 feet (320 feet), average width of 14 feet
- Reach 3: 2,200 to 2,600 feet (400 feet), average width of 8 feet
- Reach 4: 2,750 to 3,100 feet (350 feet), average width of 6 feet
- Reach 5: 3,300 to 3,520 feet (220 feet), average width of 6 feet

Total volume of sediment that needs to be remediated in these five areas is estimated to be 950 tons. This includes a 1.5 conversion factor from cubic yards to tons and 30% contingency. The surface area of these would amount to approximately 13,200 square feet.

Several corrective measures alternatives have been identified as having the potential to meet corrective measures objectives for sediment. These alternatives are as follows:

- No action.
- Capping of the sediment, maintaining long-term cap integrity, and providing notice for trespasser protection should the cap be breached.
- Removal of the sediment.

Brief descriptions of these alternatives are presented in Table 6.1. The preferred corrective measures alternative for the site, including the area covered in this section, is presented in Section 8. As part of the sediment remediation, surface water will be monitored for a period of 2 years to evaluate the positive impact to surface water after sediment remediation has been conducted. Monitoring results will be compared to established RAOs for Unzinger Ditch.

6.1 Development of Alternatives

Technologies that were retained from the initial technology screening process in Subsection 4.3 were examined relative to their applicability for addressing COCs in sediment locations identified for corrective measures. Applicable technologies were then combined to develop corrective measures alternatives designed to meet the objectives established in Section 3. The alternatives for sediment are detailed in the following subsections.

6.1.1 Alternative 1: No Action

The No Action alternative is evaluated as a baseline for comparison to other corrective measures alternatives. Under this alternative, no active corrective measures would be conducted for the sediment. The sediment would remain in its present condition.

6.1.2 Alternative 2: Capping of Sediment

Alternative 2 would consist of a cap system for sediment identified as requiring corrective measures in Section 3.3.2. A 4- to 6-inch thick geomembrane/geotextile clay liner would be constructed over the sediment. Figure 2.10 presents a conceptual layout of current sediment areas to be capped, ranging from capping only the Five Target Reaches to the entire Lower Segment Reach. Annual inspection and repairs to areas that are capped as part of this alternative would be conducted as part of long-term care for the ditch. In addition, surface water will be sampled and monitored for the duration of the cap as an indicator of the remediated sediment.

6.1.3 Alternative 3: Sediment Removal

Sediment would be excavated, dewatered as necessary, transported and disposed at an approved landfill in the areas shown on Figure 2.10.

Five Target Reaches: It is estimated that an average of 12 inches of sediment would be excavated from the five target reaches to an average channel width of 7 feet. Excavated areas may need to be backfilled with compacted fill material, clay and top soil.

Lower Segment Reach: It is estimated that an average of 9 inches of sediment would be excavated from the lower segment of Unzinger Ditch, outside of the Five Target Reaches to an average channel width of 3 feet. Excavated areas may need to be backfilled with compacted fill material, clay and top soil.

6.2 Comparative Evaluation of Alternatives

The objective for corrective measures for sediment is to minimize potential exposure to trespassers and biological communities to sediment in Unzinger Ditch that could contribute to unacceptable human health and ecological risks. The ability of the selected alternatives to meet these objectives is evaluated using the criteria outlined in Subsection 4.5. These criteria appear as headings of the following subsections that evaluate and compare the alternatives.

Several issues are considered in the evaluation of alternatives. An evaluation of the effectiveness of a corrective measure must take into account the relative risks presented by the site areas in question. In addition, corrective measures alternatives can provide protection of human health and ecological risk in different ways. Capping eliminates exposure pathways from sources to receptors, while source removal reduces constituent toxicity and mass. With the exception of the No Action alternative, each of the alternatives would reduce potential human health and ecological risks. The different corrective measures alternatives would present different implementation risks, all of which are considered in the evaluation of overall protection. The reduction of risk for each alternative is evaluated qualitatively but can be further quantified, if needed, to support a final risk management decision.

6.2.1 Protection of Human Health and the Environment

Protection of human health and biological communities involves the ability of a corrective measures alternative to eliminate, reduce, or control exposures that pose unacceptable risks. The assessment is based on a composite of factors addressed under other evaluation criteria, including long-term effectiveness and permanence, short-term effectiveness, and compliance with institutional and legal requirements.

6.2.1.1 Alternative 1: No Action

The No Action alternative would not modify or reduce the potential for exposure to COCs. The RAOs established for impacted sediment and the corrective measures objectives would not be met under this alternative.

6.2.1.2 Alternative 2: Capping

This alternative would protect human health and biological communities by preventing direct contact with COCs and ecoCOCs with risk assessment exposure concentrations above RAOs, thereby rendering the exposure pathway incomplete.

6.2.1.3 Alternative 3: Sediment Removal

Sediment removal would protect human health and biological communities by removing impacted sediment where COCs and ecoCOCs exceed the criteria for requiring corrective measures, thereby rendering the exposure pathway incomplete.

6.2.1.4 Comparative Summary

Alternative 1, No Action, would not modify existing site conditions related to protection of human health and/or ecological receptors. Alternatives 2 and 3 would provide improved protection of human health and biological communities by preventing direct contact with impacted sediment.

6.2.2 Ability to Attain RAOs

The following assessment examines the ability of the corrective measures alternative to achieve RAOs established to meet corrective measures objectives.

6.2.2.1 Alternative 1: No Action

The RAOs would not be met under the No Action alternative.

6.2.2.2 Alternative 2: Capping

This alternative would not decrease concentrations of COCs or ecoCOCs in impacted sediment. However, the capping alternative would meet RAOs by rendering the exposure pathway incomplete.

6.2.2.3 Alternative 3: Sediment Removal

This alternative would achieve RAOs by decreasing COC and ecoCOC concentrations in Unzinger Ditch via removal to an off-site disposal facility.

6.2.2.4 Comparative Summary

Alternative 2 would achieve RAOs by providing a barrier to contact with impacted sediment. Alternative 3 would achieve RAOs by physically removing COCs and ecoCOCs from the Unzinger Ditch. Alternative 1 would not meet RAOs.

6.2.3 Source Control

Potential corrective measures alternatives are evaluated for their ability to control or eliminate further releases that may pose a threat to human health and the environment.

6.2.3.1 Alternative 1: No Action

The No Action alternative would not modify the limited source potential represented by uncovered impacted sediment.

6.2.3.2 Alternative 2: Capping

Control of impacted media for Alternative 2 would be provided by capping the impacted sediment.

6.2.3.3 Alternative 3: Sediment Removal

This alternative would involve active source control through the removal and off-site disposal of impacted sediment.

6.2.3.4 Comparative Summary

Alternative 1 would not include active corrective measures for modifying source potential of impacted sediment. Alternatives 2 and 3 would include source control in the form of capping and soil removal, respectively.

6.2.4 Compliance with Institutional and Legal Requirements

Compliance of an alternative with state and federal requirements is evaluated in the following discussion.

6.2.4.1 Alternative 1: No Action

Institutional and legal requirements for the impacted soil would not be met under this alternative.

6.2.4.2 Alternative 2: Capping

The cap would be subject to surface water permit requirements.

6.2.4.3 Alternative 3: Sediment Removal

Under this alternative, both COC- and ecoCOC-impacted sediment would be removed from Unzinger Ditch for off-site disposal. This activity would be subject to state and federal regulations for transport. Disposal of COC- and ecoCOC impacted sediment would be subject to the permit requirements of the accepting landfill facility.

6.2.4.4 Comparative Summary

Alternatives 2 and 3 would involve the removal, and off-site disposal of impacted sediment, which would be subject to applicable regulations and permits for transport and landfill disposal.

6.2.5 Long-term Reliability and Effectiveness

Long-term reliability and effectiveness examines the risks and consequences of failure of the corrective measure. This criterion includes an evaluation of the useful life of the overall alternative and its component technologies.

6.2.5.1 Alternative 1: No Action

No active corrective measures component would be included in this alternative.

6.2.5.2 Alternative 2: Capping

The long-term reliability and effectiveness of the capping alternative would depend on the quality of cap construction and the ability to maintain cap integrity over time. Cap maintenance would require long-term management. A well-maintained cap would effectively and reliably minimize exposure to impacted sediment.

6.2.5.3 Alternative 3: Sediment Removal

Sediment removal is an effective and reliable method of sediment remediation. By removing the impacted sediment from the ditch, COC and ecoCOC migration and exposure would be prevented.

6.2.5.4 Comparative Summary

Alternatives 2 relies on capping, which would provide a good barrier to direct contact with impacted sediment, but would be dependent on long-term maintenance to maintain its reliability over time. Alternative 3 would provide an effective and reliable remedy, because it would remove impacted sediment from Unzinger Ditch with concentrations of both human health COCs and ecoCOCs above established RAOs. Alternatives 2 and 3 would rely to differing degrees on long-term maintenance.

6.2.6 Reduction in the Toxicity, Mobility, or Volume of Wastes

In this subsection, proposed corrective measures alternatives were evaluated for their ability to reduce the toxicity, volume, or mobility of hazardous constituents.

6.2.6.1 Alternative 1: No Action

This alternative would not reduce the toxicity, mobility, or volume of impacted sediment.

6.2.6.2 Alternative 2: Capping

Capping of impacted sediment would reduce the potential mobility of COCs and ecoCOCs. However, this alternative would not reduce the volume and toxicity of impacted sediment.

6.2.6.3 Alternative 3: Soil Removal

Under Alternative 3, the volume of COCs and ecoCOCs within Unzinger Ditch would be reduced, and will meet the criteria established in Section 3.0 for requiring corrective measures.

6.2.6.4 Comparative Summary

Alternative 1 would not reduce the toxicity, mobility, or volume of impacted sediment. Both Alternatives 2 and 3 would decrease the mobility of COCs and ecoCOCs in impacted sediment. Alternative 3 would also reduce the volume of COCs and ecoCOCs in sediment remaining in Unzinger Ditch.

6.2.7 Short-term Effectiveness

Short-term effectiveness evaluates short-term risks associated with implementation of the alternative.

6.2.7.1 Alternative 1: No Action

No active corrective measures would be included in this alternative. Thus, no short-term exposure issues would be associated with this alternative.

6.2.7.2 Alternative 2: Capping

With installation of a cap, short-term exposure would be limited to workers potentially exposed to the sediments prior to capping. Workers involved with cap construction would wear PPE to minimize exposure to COCs and ecoCOCs in sediment.

6.2.7.3 Alternative 3: Sediment Removal

Alternative 3 would involve removal of impacted sediment. Construction workers removing sediment and handling materials during the excavation and potential dewatering process would potentially be exposed to COCs and ecoCOCs in the sediment. Workers would wear PPE, as necessary, to minimize exposure.

6.2.7.4 Comparative Summary

Potential short-term effects during implementation would be lowest with Alternative 1, because no active corrective measures components would be included. Alternative 3 would have the highest potential for short-term exposure due to disruption and active handling of impacted sediment. For both Alternatives 2 and 3, proper use of PPE and safe construction practices would provide short-term effectiveness.

6.2.8 Ease of Implementation

Ease of implementation considers the technical and administrative feasibility of each alternative, as well as the availability of required resources. Factors considered include ease of construction, reliability, and O&M of the corrective measures alternative; potential problems which may be encountered during the implementation of an alternative; required approvals and permits from regulatory agencies; availability of required off-site treatment or disposal services; and availability of necessary equipment, materials and personnel.

6.2.8.1 Alternative 1: No Action

The No Action alternative would contain no active corrective measures requiring implementation for impacted sediment.

6.2.8.2 Alternative 2: Capping

Although more complicated than capping soil, the equipment, material, technology, and contractors would be relatively available to install a cap on the impacted areas of sediment.

6.2.8.3 Alternative 3: Sediment Removal

The equipment, material, technology, and contractors would be readily available to implement the potential dewatering and removal of impacted sediment. Landfills in the area of the site are also readily available. Alternative 3 would be readily implemented.

6.2.8.4 Comparative Summary

Alternative 3 would be most readily implemented. Capping of sediment would be a more cumbersome to implement than removal.

6.2.9 Cost

Estimates of capital costs associated with construction, equipment, land, buildings, engineering services, and project administration have been developed and evaluated for potential corrective measures alternatives. O&M costs, including long-term inspection, monitoring, maintenance, labor, spare parts, materials, and administration have also been addressed. The level of detail employed in developing these estimates is considered appropriate for making comparisons between alternatives, but the estimates are not intended for budgetary planning.

Estimated costs for evaluated alternatives are summarized below. Cost estimate calculations are provided in Appendix A.

CORRECTIVE MEASURES ALTERNATIVE	CAPITAL COST	ANNUAL O&M COST	30-YEAR NPV COST
1 No Action	$0	$0	$0
2 Capping of Sediment	$473,300 - $540,900	$23,800 - $35,000	$839,000 - $1,079,000
3 Removal of Sediment	$432,500 - $482,500	$6,300 - $11,300	$444,000 - $541,000

NPV Net present value

6.3 Evaluation Summary

Alternative 3, removal of impacted sediment, is the recommended final corrective measure for the identified areas in Unzinger Ditch. Removal of impacted sediment would provide a proven and readily implemented method that would meet the corrective measures objectives for Unzinger Ditch. The range of costs will be a based on remedial confirmation sampling, visual observation, maximum environmental benefit and/or the absence of appreciable sediment.

Table 6.2 provides a summary comparing the potential alternatives for impacted sediment by the evaluation criteria. The corrective measures alternatives are evaluated as good, fair, or poor based on the ability of the alternative to meet the evaluation criteria.

Section 7
Groundwater

The purpose of this section of the CMS is to identify, develop, and evaluate an array of potential corrective measures alternatives that can be used to manage impacted groundwater in the area of groundwater monitoring well S109-MW06. The corrective measures alternatives presented in this section incorporate the technologies presented in the preliminary screening process in Subsection 4.4. The technologies included were screened to eliminate those that are infeasible to implement or that will likely be ineffective in achieving the corrective measures objectives.

Several alternatives have been identified as having the potential to meet corrective measures objectives for Exposure Unit 1 groundwater. These corrective measures alternatives are as follows:

- No Action.
- Monitored Natural Attenuation (MNA), with land use controls to prevent installation of drinking water wells on the site.
- Groundwater recovery and treatment, with land use controls to prevent installation of drinking water wells on the site.

Brief descriptions of these alternatives are provided in Table 7.1. The preferred corrective measures alternative for the site, including the area covered in this section, is presented in Section 8.

7.1 Development of Alternatives

Selected technologies retained from the initial technology screening process in Subsection 4.4 were examined relative to their potential applicability to address groundwater located around groundwater monitoring well S109-MW06, where concentrations of chloroethane, 1,1-dichloroethane, and vinyl chloride are greater than the RAOs. Applicable technologies were then combined to develop corrective measures alternatives, which are designed to meet the objectives established in Section 3.0. The alternatives for groundwater in the area of S109-MW06 are detailed in the following subsections.

7.1.1 Alternative 1: No Action

The No Action alternative is evaluated as a baseline for comparison to other alternatives. Under this alternative, no corrective measures would be implemented at the site. However, this alternative would involve passive remediation of impacted groundwater by natural attenuation, which would occur in the absence of active measures.

Additionally, groundwater monitoring specific for the northeast corner groundwater would not be conducted.

7.1.2 Alternative 2: Monitored Natural Attenuation

Alternative 2 would consist of natural attenuation as the primary mechanism to address COC concentrations in groundwater. Natural attenuation would rely on naturally occurring physical, chemical, and biological processes (*i.e.,* dilution, dispersion, adsorption, various chemical transformations, and biological transformations) to limit migration and reduce concentrations of organic constituents in groundwater over time.

Under this alternative, a coordinated groundwater monitoring program for the site would be developed. The program would include compliance monitoring followed by a period of detection monitoring. The compliance monitoring would be used to verify that natural attenuation is occurring, and to evaluate the effectiveness of natural attenuation in achieving RAOs for groundwater. It would last for a period of 2 years following soil remediation. After the compliance period and RAOs for groundwater have been achieved in the area's monitoring wells, then detection monitoring would be implemented for a one-year period to confirm that the RAOs continue to be met.

During the first year of the 2-year compliance monitoring program, groundwater samples would be collected quarterly from five monitoring wells (S107-MW02, S101-MW01R, S109-MW06, S109-PZ02, and the newly install groundwater monitoring well) and analyzed for VOCs, PAHs, and inorganics. During the second year, samples will be collected from the five wells semi-annually and analyzed for VOCs only if trend analysis shows that PAHs and inorganics are below RAOs. Then detection monitoring would begin for a one-year period with semi-annual sampling events for VOCs to confirm that the area's groundwater continues to meet the RAOs.

A land use control to prevent installation of drinking water wells would be implemented for the entire site.

7.1.3 Alternative 3: Groundwater Extraction and Treatment

Alternative 3 would consist of the extraction of COC-impacted groundwater followed by *ex situ* treatment and discharge of the treated groundwater. Groundwater from S109-MW06 where chloroethane, 1,1-dichloroethane, and vinyl chloride concentrations are greater than its RAO would be recovered through one or more extraction wells. The area targeted for groundwater recovery is defined by chloroethane, 1,1-dichloroethane, and vinyl chloride concentrations detected in groundwater samples collected from monitoring well S109-MW06. Recovered groundwater would be treated, if necessary, and then discharged under an NPDES permit.

An *ex situ* treatment component for this alternative may be required to meet NPDES permit requirements. If required, treatment could be accomplished using a packaged treatment system designed to remove chloroethane, 1,1-dichloroethane, and vinyl chloride from the recovered groundwater. The system would likely use a low profile air stripping unit to strip the chloroethane, 1,1-dichloroethane, and vinyl chloride from the groundwater. The stripped chloroethane, 1,1-dichloroethane, and vinyl chloride would be part of the vapor stream, and captured in a carbon polishing unit before discharge to the atmosphere. After passing through the packaged system, the treated groundwater would be discharged under the NPDES permit.

Land use controls and groundwater monitoring proposed for this alternative would be the same as those described for Alternative 2.

7.2 Comparative Evaluation of Alternatives

The objectives for corrective measures for groundwater are to prevent use of groundwater containing COCs above state or federal standards, and to reduce the concentration of COCs in groundwater below the RAOs. The ability of the selected alternatives to meet these objectives is evaluated using criteria outlined in Subsection 4.5. These criteria appear as headings for the following subsections that evaluate and compare the alternatives.

Several issues are considered in the evaluation of alternatives. An evaluation of the effectiveness of a corrective measure must take into account the relative risks presented by the site areas in question. In addition, corrective measures alternatives can provide protection of human health in different ways. Land use controls prevent exposure pathways from sources to receptors, while migration control and groundwater withdrawal prevent further migration and reduce constituent toxicity and mass. With the exception of the No Action alternative, each of the alternatives would reduce potential human health risks. The different corrective measures alternatives would present different implementation risks, all of which are considered in the evaluation of overall protection. The reduction of risk for each alternative is evaluated qualitatively but can be further quantified, if needed, to support a final risk management decision.

7.2.1 Protection of Human Health and the Environment

Protection of human health and the environment involves the ability of a corrective measures alternative to eliminate, reduce, or control exposures that pose unacceptable risks. The assessment is based on a combination of factors addressed under other evaluation criteria, including long-term effectiveness and permanence, short-term effectiveness, and compliance with institutional and legal requirements.

7.2.1.1 Alternative 1: No Action

Alternative 1 would protect human health and the environment through the natural reduction of COCs with time and with distance from the current location (S109-MW06) of impacted groundwater.

7.2.1.2 Alternative 2: Monitored Natural Attenuation

Alternative 2 would protect human health and the environment through the natural reduction of COCs over time. This alternative would rely on the ability of the organic constituent in groundwater to naturally attenuate over time. Land use controls would prevent the installation of drinking water wells on the site. The combination of land use controls and natural attenuation would provide overall protection of human health and the environment.

7.2.1.3 Alternative 3: Groundwater Extraction and Treatment

The groundwater recovery system would protect human health and the environment by reducing on-site concentrations of chloroethane, 1,1-dichloroethane, and vinyl chloride above the RAOs, and in return reduce concentrations of the other VOCs. However, groundwater pump and treat effectiveness reduces in time as COCs reach asymtopic concentrations. Groundwater in the vicinity of S109-MW06 with detectable COC concentrations would be recovered by the extraction system. Once chloroethane, 1,1-dichloroethane, and vinyl chloride concentrations in groundwater have been reduced and attenuation mechanisms become effective on the site, active groundwater extraction may not be required. At that time, constituent migration control would rely on the ability of the organic constituents in groundwater to continue to attenuate. Concentrations of chloroethane, 1,1-dichloroethane, and vinyl chloride in groundwater would be reduced to below the RAOs by natural attenuation.

The groundwater recovery system would be supplemented by land use controls to prevent the installation of drinking water wells at the site. The groundwater recovery system and land use controls would provide overall protection of human health and the environment.

7.2.1.4 Comparative Summary

Each of the alternatives would provide improved protection of human health and the environment by reducing constituent concentrations and further migration of COCs in groundwater. Land use controls associated with Alternatives 2 and 3 would also provide overall protection of human health and the environment on the site.

7.2.2 Ability to Attain RAOs

The following assessment examines the ability of the corrective measures alternative to achieve RAOs established to meet corrective measures objectives.

Alternative 1: No Action

RAOs would be met under this alternative through the physical, chemical, and biological attenuation processes. However, under the No Action alternative the effectiveness of these natural attenuation processes in achieving this goal would not be monitored through routine groundwater sampling.

Alternative 2: Monitored Natural Attenuation

The concentrations of chloroethane, 1,1-dichloroethane, and vinyl chloride in groundwater would be reduced to below the MCLs (*i.e.*, RAOs) by natural physical, chemical, and biological attenuation mechanisms that would reduce COC concentrations over time.

7.2.2.1 Alternative 3: Groundwater Extraction and Treatment

The concentration of chloroethane, 1,1-dichloroethane, and vinyl chloride in groundwater would be reduced to below the MCLs (*i.e.*, RAOs) by groundwater extraction and treatment.

7.2.2.2 Comparative Summary

Each of the alternatives would meet RAOs. However, recovery and treatment has proven not to be a very efficient method to restore groundwater to RAOs, primarily due to the affinity of organic constituents to adsorb to and later desorb from organic compounds present in the aquifer. Therefore, since groundwater recovery and treatment would rely on natural attenuation to address the COCs of the plume, this alternative would likely attain RAOs within a time frame comparable to Alternative 2. Alternative 1 would not meet RAOs.

7.2.3 Source Control

Based on the soil data collected during the RFI and the groundwater data collected during both the RFI and transition groundwater monitoring events, a specific continuing source of the chlorinated solvents was not identified. Therefore, source control is not a criterion by which the corrective measures alternatives can be differentiated.

7.2.4 Compliance with Institutional and Legal Requirements

Compliance of an alternative with state and federal requirements is evaluated in the following subsections.

Alternative 1: No Action

Institutional and legal requirements would not be met under this alternative.

Alternative 2: Monitored Natural Attenuation

Groundwater in Ohio is subject to state groundwater quality standards (*i.e.,* MCLs). For Alternatives 1 and 2, compliance with state groundwater quality standards is currently met at the property boundary. Over time, groundwater quality standards would be met on the property through natural attenuation.

Alternative 3: Groundwater Extraction and Treatment

Alternative 3 would include *ex situ* treatment involving the extraction and treatment of groundwater. Installation of extraction wells would be regulated by state well installation requirements, and construction of the extraction and treatment components would require state construction and operating permits. Discharge permits, such as an NPDES permit, would also be required.

Comparative Summary

Alternatives 2 and 3 would involve compliance with institutional and legal requirements. These obligations would be addressed during corrective measures design and implementation. Institutional and legal requirements would not be met under Alternative 1, No Action.

7.2.5 Long-term Reliability and Effectiveness

Long-term reliability and effectiveness examines the risks and consequences of failure of the corrective measure. This criterion includes an evaluation of the useful life of the overall alternative and its component technologies.

7.2.5.1 Alternative 1: No Action

Use of natural attenuation would be an effective and reliable method of reducing concentrations of vinyl chloride in groundwater. However, under the No Action alternative the effectiveness of these natural attenuation processes in achieving this goal would not be monitored through routine groundwater sampling.

7.2.5.2 Alternative 2: Monitored Natural Attenuation

The use of natural attenuation would be an effective and reliable method of reducing chloroethane, 1,1-dichloroethane, and vinyl chloride concentrations in groundwater. The primary mechanisms that contribute to decreases in organic COC concentrations in groundwater include chemical and biological transformations, dispersion, dilution, volatilization, and adsorption of the organic COC onto aquifer materials. Under Alternative 2, compliance monitoring in the area of impacted groundwater would be used to assess the effectiveness of this alternative.

This groundwater remedy would be reliable, because it is based on natural processes. These alternatives would rely on land use controls remaining in place to prevent exposure to impacted groundwater while natural attenuation is occurring.

7.2.5.3 Alternative 3: Groundwater Extraction and Treatment

Groundwater extraction, as a sole remedy to control COC migration, would not provide a long-term, permanent remedy for groundwater. Historically, groundwater extraction and treatment has proven to be an inefficient method by which to decrease concentrations of organic constituents in groundwater to below RAOs. This would be especially true with a dilute plume whose concentrations are less than an order of magnitude above the RAO, such as the concentrations of chloroethane, 1,1-dichloroethane, and vinyl chloride.

The long-term effectiveness and permanence of this alternative for groundwater would be dependent upon maintaining hydraulic control to maximize recovery. In addition to maintaining hydraulic control, continuous withdrawal of groundwater from the aquifer would need to be maintained. Compliance monitoring would be necessary to evaluate the effectiveness of migration control.

7.2.5.4 Comparative Summary

Alternatives 2 and 3 would rely on maintaining land use controls to prevent potential exposure to impacted groundwater. Alternative 3 would include an active remediation component that would need to be maintained over a long period of time to be effective, while Alternatives 1 and 2 would rely on natural processes. Since each of the alternatives would rely on natural attenuation to reduce COCs in a dilute plume to below RAOs, the remediation time frames for each of these three alternatives would not be expected to be appreciably different.

7.2.6 Reduction in the Toxicity, Mobility, or Volume of Wastes

In this subsection, proposed corrective measures alternatives are evaluated for their ability to reduce the toxicity, volume, or mobility of hazardous constituents.

7.2.6.1 Alternative 1: No Action

The toxicity, mobility, and volume of COCs would be reduced under this alternative through the physical, chemical, and biological attenuation processes. However, under the No Action alternative, the effectiveness of these natural attenuation processes in achieving this goal would not be monitored through routine groundwater sampling.

7.2.6.2 Alternative 2: Monitored Natural Attenuation

This alternative would naturally reduce the toxicity, mobility, and volume of the COC in groundwater through combined physical, chemical, and biological transformation processes.

7.2.6.3 Alternative 3: Groundwater Extraction and Treatment

This alternative would reduce the toxicity, mobility, and volume of the COC in groundwater by removal from the aquifer. In addition, constituent concentrations in groundwater would decline due to natural attenuation processes as described in Subsection 4.4.

7.2.6.4 Comparative Summary

Alternatives 1 and 2 would reduce the toxicity, mobility, and volume of the COC in the groundwater via natural processes. Although Alternative 3 would actively reduce the volume of the COC by removal, the dilute nature of the area of impacted groundwater would result in this being a very gradual process.

7.2.7 Short-term Effectiveness

Short-term effectiveness evaluates short-term risks associated with implementation of the alternative.

7.2.7.1 Alternative 1: No Action

No active corrective measures would be included in this alternative. Thus, no short-term exposure issues would be associated with implementation of this alternative.

7.2.7.2 Alternative 2: Monitored Natural Attenuation

The only potential short-term exposure to the COC under these alternatives would be exposure to workers during groundwater sampling of monitoring wells. Alternative 2 includes both compliance and detection groundwater monitoring. Workers involved with groundwater sampling would wear PPE during sampling events to minimize exposure to the COC in groundwater.

7.2.7.3 Alternative 3: Groundwater Extraction and Treatment

Potential exposure to COCs in groundwater would be likely during the installation and operation of the groundwater extraction and treatment system and groundwater sampling. Workers involved with construction, system operation, and groundwater sampling would wear PPE to minimize exposure to COCs in soil and groundwater.

7.2.7.4 Comparative Summary

None of the alternatives would pose significant potential exposure issues with the exception of short-term exposure to site workers, which can be addressed by proper use of PPE. Alternative 3 would introduce a somewhat greater level of short-term exposure than Alternatives 1 and 2 due to implementation of an active groundwater extraction and treatment system. Alternative 1 would include no corrective measures component and, as such, would have no short-term exposure considerations.

7.2.8 Ease of Implementation

Ease of implementation considers the technical and administrative feasibility of each alternative, as well as the availability of required resources. Factors considered include ease of construction, reliability, and O&M of the corrective measures alternative; potential problems which may be encountered during the implementation of an alternative; required approvals and permits from regulatory agencies; availability of

required off-site treatment or disposal services; and availability of necessary equipment, materials, and personnel.

Alternative 1: No Action

The No Action alternative would contain no active corrective measures requiring implementation for groundwater.

Alternative 2: Monitored Natural Attenuation

Under this alternative, restrictive covenants and access restrictions would be implemented and maintained over time.

Monitoring groundwater quality through sampling, laboratory analysis, and evaluation of the extent of natural attenuation would be technically feasible. Alternative 2 includes both compliance and detection groundwater monitoring.

7.2.8.1 Alternative 3: Groundwater Extraction and Treatment

The technology, equipment, material, and contractors would be readily available to construct the groundwater extraction and treatment system included in this corrective measures alternative. Additional hydraulic testing may be required to properly design the recovery system. Effective pre-treatment to meet permit requirements for acceptance of the discharged water could be achieved using standard industrial wastewater treatment equipment. State and local permits for treating and discharging groundwater would need to be obtained prior to implementing this alternative.

Depending on the rate of COC reduction achieved over time, the extraction system would likely need to remain operational for an extended period (estimated at 2 years), and system repairs and component replacement would need to be addressed throughout the life of the system.

Monitoring groundwater quality (compliance and detection monitoring) through sampling, laboratory analysis, and evaluation of the extent of natural attenuation would be technically feasible.

Restrictive covenants would need to be implemented and maintained over time.

7.2.8.2 Comparative Summary

Alternatives 2 and 3 would require maintenance of long-term land use controls. None of the three alternatives would have any significant technical implementation issues that preclude their implementation. The long-term

maintenance of operating equipment would make Alternative 3 somewhat more costly to implement. Alternative 1 would include no corrective measures component.

7.2.9 Cost

Estimated capital costs for construction, equipment, land, buildings, engineering services, and project administration have been developed and evaluated for the potential corrective measures alternatives. O&M costs, including long-term inspection, monitoring, maintenance, labor, spare parts, materials, and administration have also been addressed. The level of detail employed in developing these estimates is considered appropriate for making comparisons between alternatives, but the estimates are not intended for budgetary planning.

Monitoring for MNA and groundwater remediation alternatives is planned to continue for a 3-year period after completion of the soil remediation activities at the site. Compliance monitoring would consist of a 2-year period; one year of quarterly sampling, and one year of semi-annual sampling. Then detection monitoring would begin for a one-year period with semi-annual sampling events to confirm that the area's ground water continues to meet the RAOs.

Estimated costs for the alternatives evaluated are summarized below. Cost estimate calculations are provided in Appendix A.

CORRECTIVE MEASURES ALTERNATIVE		CAPITAL COST	ANNUAL O&M COST	30-YEAR NPV COST
1	No Action	$0	$0	$0
2	MNA with Land Use Controls	$18,800	$67,500	$203,000
3A	Groundwater Recovery, Treatment and Direct Discharge to Storm Water System	$142,500	$78,100	$356,000

NPV Net present value

7.3 Evaluation Summary

Alternative 2, MNA with land use controls, is recommended for remediation of groundwater around monitoring well S109-MW-06. Natural attenuation would provide a proven and readily implemented method to meet corrective measures objectives for this area of the site.

Consistent with *Use of Monitored Natural Attenuation at Superfund, RCRA, Corrective Action, and Underground Storage Tank Sites* (USEPA, 1999), a contingent remedy is proposed for groundwater as part of this alternative. At the end of the 2-year detection monitoring period,

the contingent remedy would be considered for implementation if repeatable, verified exceedances of RAOs are detected in groundwater samples collected from the area's groundwater monitoring wells. This may involve active remediation, such as Alternative 3. The contingent remedy would be developed, if necessary, at the point in time that the conditions triggering action is met. The contingent remedy would be based on the specific conditions encountered at that time. Alternative response actions for groundwater would be reviewed and submitted for agency approval.

Alternative 3 (extraction and treatment) would potentially meet corrective measures objectives for groundwater, however, potential shortfalls would be associated with successful implementation. Although extraction of the groundwater would decrease the volume of constituents present, this method has generally been considered ineffective due to the affinity of organic constituents to adsorb to and subsequently desorb from organic compounds in the soil. Because of this, the reduction of dilute concentrations of constituents present in groundwater would still rely upon natural physical and chemical attenuation mechanisms. As such, remediation time frames for Alternatives 1, 2, and 3 are comparable. Preliminary remediation timeframe estimates for Alternatives 1 and 2 are comparable as each relies on passive migration of COCs.

Table 7.2 provides a summary comparing the potential alternatives for impacted groundwater by the evaluation criteria. The corrective measures alternatives are evaluated as good, fair, or poor based on the ability of the alternative to meet the evaluation criteria.

Section 8
Recommended Corrective Measures

Based on the evaluations presented in Section 4 through Section 7 of this report, the following corrective measures are recommended for the three areas identified for corrective measures evaluation. Long-term maintenance and monitoring requirements for other specific areas are also presented.

8.1 Soil

The recommended alternative for impacted soil is Alternative 3A, which consists of removal of COC-impacted soil in uncovered (unpaved) areas where constituent concentrations are greater than RAOs. This alternative would also include the inspection and maintenance of existing paved areas of the site where COC concentrations in soil meet the criteria for requiring corrective measures. In addition, land use controls to prevent residential development in areas where COCs meet the corrective measures criteria, and notices for construction workers concerning contact with soil in specified areas would be included.

This alternative would be cost effective, relatively easy to implement, would meet RAOs, and would be protective of human health and the environment. This alternative would provide the most cost effective and reliable method of meeting the corrective measures objective of reducing exposure to surface soil having risk assessment exposure concentrations of COCs at concentrations greater than RAOs.

8.2 Sediment

Alternative 3, removal of impacted sediment, is the recommended corrective measure for Unzinger Ditch. This alternative would be cost effective, relatively easy to implement, would meet RAOs, and would be protective of human and ecological receptors.

8.3 Groundwater

MNA for chloroethane, 1,1-dichloroethane, and vinyl chloride, Alternative 2, is the recommended corrective measure for groundwater located around S109-MW-06. The lack of chlorinated solvents in other areas of the property suggests that there is not a specific continuing source of chlorinated solvents around S109-MW06 or other areas of the property.

With the absence of a continuing source, the concentration of chloroethane, 1,1-dichloroethane, and vinyl chloride are expected to decline through other physical and chemical processes. The presence of vinyl chloride, which is a degradation product of 1,1-dichloroethene, and chloroethane, which is a degradation product of 1,1-dichloroethane, indicates that natural attenuation is already taking place. However, to further evaluate the specific attenuation mechanisms, additional analyses will be performed on groundwater samples collected from the area of S109-MW06.

Consistent with *Use of Monitored Natural Attenuation at Superfund, RCRA, Corrective Action, and Underground Storage Tank Sites* a contingent remedy is proposed as part of this alternative. After the 2-year compliance monitoring period, the contingent remedy would be considered for implementation if repeatable, verified exceedances of RAOs are detected in groundwater samples in the area's groundwater monitoring wells. The contingent remedy would be developed, if necessary, at the time the condition triggering action is met, and would probably involve a groundwater pump and treat system similar to Alterative 3. The contingent remedy would be based on the specific conditions encountered at that time. Alternative response actions for groundwater would be reviewed and submitted for agency approval.

This alternative includes additional monitoring to assess the progress of natural attenuation and land use controls to prevent the installation of drinking water wells at the property. Due to the low concentrations of organic COCs present in the groundwater, natural attenuation would be the most appropriate method of achieving RAOs.

Groundwater monitoring is proposed for compliance and detection monitoring of groundwater located in the area of S109-MW06. Chloroethane, 1,1-dichloroethane, and vinyl chloride above RAOs have been identified in S109-MW06. As such, groundwater compliance monitoring has been developed.

The objectives of compliance monitoring are to monitor groundwater quality around S109-MW06 and the entire site after the completion of the soil remediation activities at the site. The following monitoring wells are proposed for compliance monitoring:

- S107-MW02, S109-MW06, S109-PZ02, S101-MW01R, and one new groundwater monitoring well, which will be located approximately 250 to 300 feet down-gradient of S109-MW06.

The objectives of detection monitoring are to monitor groundwater quality up-gradient, around and down-gradient of S109-MW06. The following monitoring wells are proposed for detection monitoring:

- S107-MW02, S109-MW06, S109-PZ02, S101-MW01R, and one new groundwater monitoring well, which will be located approximately 250 to 300 feet down-gradient of S109-MW06.

Compliance monitoring will consist of analysis for VOCs, PAHs, and inorganics on a quarterly basis for Year One using the same procedures implemented during the RFI. During Year Two, only VOCs will be analyzed if trend analysis shows that PAHs and inorganics are below RAOs. After no detection of contaminants above the RAOs in the area's groundwater monitoring wells during the one-year detection monitoring period, the monitoring program will be considered complete.

Section 9
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Tables

Table 3.1
Remedial Action Objectives - Soil/Active Operations Area
Franklin Steel, Blacklick, Ohio

Chemical	Units	Maximum Site Concentration	Remedial Action Objectives[1]
Metals			
Arsenic	mg/kg	93.7	39
Chromium	mg/kg	1,120	450
Iron	mg/kg	166,000	100,000
Lead	mg/kg	5,060	710
PCBs			
Aroclor 1254	mg/kg	1.0	0.74
SVOCs			
Benzo(a)anthracene	mg/kg	24.4	2.1
Benzo(a)pyrene	mg/kg	24.2	0.21
Benzo(b)fluoranthene	mg/kg	28.1	2.1
Benzo(k)fluoranthene	mg/kg	24.2	21.1
Dibenzo(a,h)anthracene	mg/kg	0.96	0.21
Indeno(1,2,3-cd)pyrene	mg/kg	3.5	2.1
bis(2-Ethylhexyl) phthalate	mg/kg	1,300	120
VOCs			
Trichloroethene	mg/kg	0.69	0.11
Xylenes, Total	mg/kg	720	420

Notes:
mg/kg = milligrams per kilogram
[1] Remedial action objectives based on Region 9 Preliminary Remediation Goals

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Table 3.2
Risk Ratio Calculations - Soil/Active Operations Area
Franklin Steel, Blacklick, Ohio

NON-CARCINOGEN

Chemical	Units	RAO	S100-SS12		S103-SB02		S103-SB03		S104-SS01		S105-SB04		S106-SB02		S106-SB03		S106-SB06		S106-SS02		S106-SS03		S107-SB07		S107-SB12	
Soil																										
Metals																										
Iron	mg/kg	100,000			166,000	1.66E+00																				
Lead	mg/kg	710	1,070	1.51E+00	1,110	1.56E+00	1,010	1.42E+00	810	1.14E+00	4,070	5.73E+00	830	1.17E+00	769	5.10E+02	846	1.19E+00	2,190	3.08E+00	4,310	6.07E+00	878	1.24E+00		
VOCs																										
Xylenes, Total	mg/kg	420																							720	1.71E+00
Risk Ratio per Location				**1.51E+00**		**3.22E+00**		**1.42E+00**		**1.14E+00**		**5.73E+00**		**1.17E+00**		**5.10E+02**		**1.19E+00**		**3.08E+00**		**6.07E+00**		**1.24E+00**		**1.71E+00**
Risk Ratio per Cleanup				**-**		**-**		**-**		**1.14E+00**		**-**		**-**		**-**		**-**		**-**		**-**		**-**		**-**

CARCINOGEN

Chemical	Units	RAO	S100-SS09		S101-SD35		S105-SB04		S106-SS02		S107-SB07		S107-SB10		S107-SB11		S107-SS05		S108-SD01		S108-SD02		S108-SS03		S108-SB07/SS09	
Soil																										
Metals																										
Arsenic	mg/kg	39																								
Chromium	mg/kg	450					461	1.02E-06	1,120	2.49E-06																
PCBs																										
Aroclor 1254	mg/kg	0.74											1.0	1.35E-06											0.84	1.14E-06
SVOCs																										
Benzo(a)anthracene	mg/kg	2.1			4.2	2.00E-06																				
Benzo(a)pyrene	mg/kg	0.21	0.81	3.86E-06	5.0	2.38E-05													1.6	7.62E-06	1.1	5.24E-06	0.32	1.52E-06		
Benzo(b)fluoranthene	mg/kg	2.1			6.1	2.90E-06													2.6	1.24E-06						
Benzo(k)fluoranthene	mg/kg	21.1																								
Dibenzo(a,h)anthracene	mg/kg	0.21																								
Indeno(1,2,3-cd)pyrene	mg/kg	2.1			3.5	1.67E-06																				
bis(2-Ethylhexyl) phthalat	mg/kg	120									230	1.92E-06			1,300	1.08E-05	1,000	8.33E-06								
VOCs																										
Trichloroethene	mg/kg	0.11									0.69	6.27E-06														
Risk Ratio per Location				**3.86E-06**		**3.04E-05**		**1.02E-06**		**2.49E-06**		**8.19E-06**		**1.35E-06**		**1.08E-05**		**8.33E-06**		**8.86E-06**		**5.24E-06**		**1.52E-06**		**1.14E-06**
Risk Ratio Based per Cleanup				**3.86E-06**		**-**		**-**		**-**		**-**		**1.35E-06**		**-**		**-**		**-**		**-**		**1.52E-06**		**1.14E-06**

Notes:

Risk Ratio = maximum detected concentration/remediation action goal*$1x10^{-6}$

RAO - Remedial Action Objective

mg/kg = milligrams per kilogram

- = indicates chemical/source removed

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Table 3.2 (continued)
Risk Ratio Calculations - Soil/Active Operations Area
Franklin Steel, Blacklick, Ohio

NON-CARCINOGEN

Chemical	Units	RAO	S108-SS01		S108-SB05/SS06		S108-SB06/SS08		S108-SB08/SS10		S108-SB10		S108-SB13/SS15		F-GP-17		F-GP-18		F-HA-2		H-GP-23		J-HA-4		CSD-ASH002		CSD-ASH003		Risk Ratio/Chemical
Soil																													
Metals																													
Iron	mg/kg	100,000															154,000	1.54E+00					165,000	1.65E+00					**4.85E+00**
Lead	mg/kg	710	972	1.37E+00	968	1.36E+00	783	1.10E+00	1,020	1.44E+00	1,020	1.44E+00	1,840	1.22E+03	4,610	6.49E+00	758	1.07E+00	2,860	4.03E+00	1,540	2.17E+00	5,060	7.13E+00	1,550	2.18E+00	1,490	2.10E+00	**5.32E+01**
VOCs																													
Xylenes, Total	mg/kg	420																											**1.71E+00**
Risk Ratio per Location				**1.37E+00**		**1.36E+00**		**1.10E+00**		**1.44E+00**		**1.44E+00**		**1.22E+03**		**6.49E+00**		**2.61E+00**		**4.03E+00**		**2.17E+00**		**8.78E+00**		**2.18E+00**		**2.10E+00**	**5.98E+01**
Risk Ratio per Cleanup				**-**		**-**		**-**		**-**		**-**		**-**		**-**		**-**		**-**		**-**		**-**		**-**		**-**	**1.14E+00**

CARCINOGEN

Chemical	Units	RAO	S108-SB13/SS15		S108-SB16/SS18		A-GP-6		B-GP-8		F-GP-18		F-HA-2		H-GP-20		J-HA-4		L-HA-8		CSD-ASH001		Risk Ratio/Chemical
Soil																							
Metals																							
Arsenic	mg/kg	39							93.7	2.40E-06													**2.40E-06**
Chromium	mg/kg	450											732	1.63E-06			546	1.21E-06					**6.35E-06**
PCBs																							
Aroclor 1254	mg/kg	0.74																					**2.49E-06**
SVOCs																							
Benzo(a)anthracene	mg/kg	2.1	6.2	2.95E-06																	24.4	1.16E-05	**1.66E-05**
Benzo(a)pyrene	mg/kg	0.21	5.1	2.43E-05			0.49	2.33E-06							0.33	1.55E-06			0.49	2.33E-06	24.2	1.15E-04	**1.88E-04**
Benzo(b)fluoranthene	mg/kg	2.1	5.9	2.81E-06							2.1	1.00E-06									28.1	1.34E-05	**2.13E-05**
Benzo(k)fluoranthene	mg/kg	21.1																			24.2	1.15E-06	**1.15E-06**
Dibenzo(a,h)anthracene	mg/kg	0.21	0.45	2.14E-06							0.96	4.57E-06											**6.71E-06**
Indeno(1,2,3-cd)pyrene	mg/kg	2.1																			5.11	2.43E-06	**4.10E-06**
bis(2-Ethylhexyl) phthalat	mg/kg	120			230	1.92E-06																	**2.61E-04**
VOCs																							
Trichloroethene	mg/kg	0.11																					**6.27E-06**
Risk Ratio per Location				**3.22E-05**		**1.92E-06**		**2.33E-06**		**2.40E-06**		**5.58E-06**		**1.63E-06**		**1.55E-06**		**1.21E-06**		**2.33E-06**		**1.44E-04**	**2.78E-04**
Risk Ratio Based per Cleanup				**-**		**-**		**-**		**-**		**-**		**-**		**-**		**-**		**2.33E-06**		**-**	**1.02E-05**

Notes:

Risk Ratio = maximum detected concentration/remediation action goal*$1x10^{-6}$

RAO - Remedial Action Objective

mg/kg = milligrams per kilogram

- = indicates chemical/source removed

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Table 3.3
Groundwater Remedial Action Objectives - Inorganics
Franklin Steel, Blacklick, Ohio

Chemical	Units	Filtered Samples[1]		Remedial Action Objectives[3]
		Maximum Site Concentration	Background (S107 MW02)[2]	
Metals				
Aluminum	mg/L	8.87	0.38	3.6
Antimony	mg/L	0.0072	0.0048	0.006[4]
Arsenic	mg/L	0.405	ND**(0.00072)	0.01
Barium	mg/L	0.78	0.09	2.0[4]
Beryllium	mg/L	0.4	0.0004	0.004
Cadmium	mg/L	0.0103	0.0004	0.005
Lead	mg/L	0.0116	0.00009 J***	0.015
Manganese	mg/L	5.6	0.38	0.88
Nickel	mg/L	0.34	0.018	0.73
Thallium	mg/L	0.012	0.000105 J*	0.002[4]
Vanadium	mg/L	0.0081	ND (0.00042)	0.036
Zinc	mg/L	0.2	0.036	5.0[4]

mg/L - milligrams per liter

[1] Filtered sample results prior to 2006; Low flow (unfiltered) sample results from 2006 to 2008

[2] Background calculated per DERR-00-RR-039P using data from 12 most recent sampling events (3/00 - 5/08), unless otherwise noted

[3] Remedial action objectives based on U.S. EPA Region 9 PRGs for tap water, unless noted otherwise

[4] USEPA Maximum Contaminant Level

* Highest detect in background well (majority of results are ND)

** ND = not detected in background well (lowest detect on limit in parentheses)

*** Single detection in background well for this parameter

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Table 3.4
Groundwater Remedial Action Objectives - Organics
Franklin Steel, Blacklick, Ohio

Chemical	Units	Maximum Site Concentration	Remedial Action Objectives[1]
SVOCs			
Benzo(a)anthracene	µg/L	0.14	0.092
Benzo(b)fluoranthene	µg/L	0.21	0.092
Bis(2-ethylhexyl)phthalate	µg/L	250	6.0[2]
Dibenz(a,h)anthracene	µg/L	0.14	0.0092
1,1-Dichloroethane	µg/L	18	7.0
2,4-Dinitrotoluene	µg/L	16.6	7.3
Indeno(1,2,3-cd)pyrene	µg/L	2.5	0.092
VOCs			
Chloroethane	µg/L	540	217
Chloroform	µg/L	0.97	0.17
Methylene Chloride	µg/L	6.7	4.3
Vinyl Chloride	µg/L	11.7	2.0[2]

µg/L - micrograms per liter

[1] Remedial action objectives based on U.S. EPA Region 9 PRGs for tap water, unless noted otherwise.

[2] USEPA Primary Maximum Contaminant Level

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Table 3.5
Remedial Action Objectives - Sediment/Unzinger Ditch
Franklin Steel, Blacklick, Ohio

Chemical	Units	Maximum Site Concentration	Remedial Action Objectives[1]
Metals			
Arsenic	mg/kg	37.7	18
Cadmium	mg/kg	10.1	0.90
Chromium	mg/kg	164	40
Copper	mg/kg	164	34
Lead	mg/kg	775	34
Mercury	mg/kg	0.57	0.12
Nickel	mg/kg	152	42
Zinc	mg/kg	954	160
SVOCs			
Anthracene	µg/kg	3,400	57.2
Benzo(a)anthracene	µg/kg	9,900	108
Benzo(a)pyrene	µg/kg	16,000	150
Chrysene	µg/kg	19,000	166
Dibenzo(a,h)anthracene	µg/kg	1,900	33
Fluoranthene	µg/kg	13,000	423
Fluorene	µg/kg	540	77.4
Phenanthrene	µg/kg	7,100	204
Pyrene	µg/kg	9,700	195
bis(2-Ethylhexyl) phthalate	µg/kg	620,000	9,300
Total, PAHs	µg/kg	-	1,600

Notes:
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
[1] Remedial action objectives based on Ohio EPA Sediment Reference Values (2003)

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Table 3.6
Remedial Action Objectives - Surface Water/Unzinger Ditch
Franklin Steel, Blacklick, Ohio

Chemical	Units	Maximum Site Concentration	Remedial Action Objectives[1]
Surface Water			
Metals			
Aluminum	µg/l	29,500	250
Barium	µg/l	450	220
Copper	µg/l	190	10
Cyanide	µg/l	50	12
Lead	µg/l	61	6.4
Manganese	µg/l	2,600	100
Zinc	µg/l	490	120
SVOCs			
Benzo(a)pyrene	µg/l	4.0	0.014
Fluoranthene	µg/l	7.5	0.80
Pyrene	µg/l	5.9	4.6

Notes:
µg/l = micrograms per liter
[1] Remedial action objectives based on Ohio EPA Surface Water Quality Criteria (2007)

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Table 4.1
Indentification and Screening of Corrective Measures for Soil
Franklin Steel, Blacklick, Ohio

GENERAL RESPONSE ACTION	CORRECTIVE MEASURES TECHNOLOGY	DESCRIPTION	IMPLEMENTABILITY	EFFECTIVENESS	RELATIVE COST	ACCEPTABLE FOR FURTHER CONSIDERATION
Capping	Capping	Covering of selected surface areas with a concrete, engineered soil, or geosynthetic capping material.	Implementable	Effective, potential to: - Effectively mitigate human and ecological receptor exposure to COCs in surface soil. - Mitigate COC transport in storm water runoff. - Mitigate COC transport to groundwater.	Moderate to High	Yes
Removal of Impacted Soil	Excavation and off-site disposal	Conventional excavation using backhoes and standard earth-moving equipment. Excavated material may be disposed of at an off-site facility. Includes placement of clean fill material over the area where material was removed.	Implementable	Effective, potential to: - Mitigate COC transport in storm water runoff. - Mitigate COC transport to groundwater. - Mitigate COC exposure to human and ecological receptors.	Moderate to High	Yes
	Excavation , treatment, and on-site disposal	Conventional excavation using backhoes and standard earth-moving equipment. Most or all soils may require chemical stabilization pretreatment.	Not implementable: - Placement of treated soils as on-site backfill likely not acceptable. - Construction of on-site disposal cell is cost-prohibitive and difficult to permit.	Potentially effective to reduce COC mobility and availability to receptors. However, less effective than off-site disposal where COCs are removed from the site.	High	No
In situ Treatment	Phytoremediation	Plants and microorganisms are used to remove, degrade, or stabilize constituents in soil.	Not implementable: - Impractical because of operating facility. - Soils impacted by COCs are scattered over large areas of the site.	Limited effectiveness: - Limited history. - Harvesting and disposal of plant tissue may be required to permanently remove COCs from the site. - Plantings continue to allow storm water to infiltrate through the soil not limiting migration.	Moderate	No
	Soil Flushing	Adding water or a chemically engineered solution to mobilize the COCs for collection as an aqueous solution at a downgradient location.	Moderately implementable	Effective: - Limited proven history as an *in situ* technique for the array of site COCs. - Laboratory and/or site pilot testing would be required to verify effectiveness.	High	No
	Stabilization	Mixing the soil with an engineered product that will chemically bind or physically encase the COCs, such that the COCs are not available to exposure or leaching to groundwater. Technology options include a cement-based process (solidification) or chemical agents (chemical fixation).	Moderately implementable: - Application technique will vary for different site areas.	Effective: - Well practiced for surface soils (<2 feet deep) and excavated soil piles. - Somewhat limited history for *in situ* injection to address subsurface soils.	High	No

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Table 4.2
Identification and Screening of Corrective Measures for Sediment
Franklin Steel, Blacklick, Ohio

GENERAL RESPONSE ACTION	CORRECTIVE MEASURES TECHNOLOGY	DESCRIPTION	IMPLEMENTABILITY	EFFECTIVENESS	RELATIVE COST	ACCEPTABLE FOR FURTHER CONSIDERATION
Natural Recovery	Monitored natural recovery through natural sedimentation.	Relies on naturally occurring sedimentation to reduce over time the concentration of COCs available for exposure to ecological receptors. Includes periodic sediment monitoring to verify effectiveness.	Implementable	Limited effectiveness: - COPC source control is limited.	Low	No
Capping	Installation of a barrier to ecological receptors	Barrier includes a geotextile and a soil layer to limit exposure of ecological receptors to COCs in underlying sediment.	Moderately implementable: - Difficult to apply cover in deeper water. - May require ditch to be temporarily drained.	Potentially effective: - Will provide an effective barrier to COPCs. - May disrupt current ecosystem, which will likely reestablish itself over time.	Moderate to High	Yes
Removal of impacted sediment	Dredging	Impacted sediments would be removed by dredging and disposed of off site.	Implementable: - May require either temporary draining of the ditch or management of large quantities of water.	Effective: - Will effectively remove COPCs from the pond. - May disrupt current ecosystem, which will likely reestablish itself over time.	High	Yes

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Table 4.3
Identification and Screening of Corrective Measures for Groundwater
Franklin Steel, Blacklick, Ohio

GENERAL RESPONSE ACTION	CORRECTIVE MEASURES TECHNOLOGY	DESCRIPTION	IMPLEMENTABILITY	EFFECTIVENESS	RELATIVE COST	ACCEPTABLE FOR FURTHER CONSIDERATION
Natural Attenuation	MNA	Relies on naturally occurring physical, chemical, and biological processes to reduce the concentration of COCs over time. Includes periodic groundwater monitoring to verify effectiveness.	Implementable	Potentially effective	Low	Yes
In situ Treatment	Chemical treatment (injection)	Treatment chemicals are injected as a solution or slurry into the aquifer to stabilize or modify COC geochemistry to limit migration of COCs in groundwater.	Moderately implementable	Potentially effective: - Laboratory and/or site pilot testing would be required to verify effectiveness.	High	No
	PRBs	Forms a physical, subsurface wall through which groundwater passes and undergoes biological or chemical reactions that reduce aqueous COC concentrations.	Moderately implementable: - Depth to groundwater will limit construction methods available for consideration. - Design issues related to media selection and construction depth will need to be addressed.	Potentially effective: - Laboratory and/or site pilot testing would be required to verify effectiveness.	High	No
Groundwater Recovery and Hydraulic Control	Groundwater extraction	Recovery wells or trenches outfitted with submersible pumps to remove groundwater that contains COCs. The recovery pumps or trenches can be oriented to achieve hydraulic control to mitigate COC migration in groundwater.	Implementable	Potentially effective: - Generally effective as a hydraulic control mechanism. - Limited effectiveness for long-term mass removal of site COCs without enhancement (*i.e.,* chemical flushing agent)	Moderate to High	No
Ex situ Treatment	Chemical treatment - air stripping	Low profile multiple tray air stripper with carbon polishing.	Implementable: - Combined with groundwater extraction.	Effective: Pilot test would be required to verify effectiveness.	Moderate	Yes
	Biological Treatment	Degradation of COCs using naturally occurring microorganisms.	Implementable: - Combined with groundwater extraction.	Limited effectiveness: - COCs not amenable to available biological treatment technologies.	High	No
Treated Water Discharge	Surface water discharge	Water is treated to meet site-specific concentration standards for site COCs.	Implementable: - Modification of existing NPDES permit or new NPDES permit required. - Outfalls for connection to local surface water are available.	Effective	Moderate	Yes
	POTW discharge	Water is conveyed to local public wastewater facility via connection to local sewer lines or by tanker transport.	Moderately implementable: - May be preferred option if existing storm water treatment system is not available to treat groundwater. - Location and capacity of sewer lines and capacity and COC limits of wastewater plant would need to be verified.	Effective: - Likely that POTW pretreatment standards can be achieved for collected groundwater.	Moderate to High	Yes

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Table 5.1
Quantities of Impacted Soils
Franklin Steel, Blacklick, Ohio

Area	Closest Boring No.	Square Footage Uncovered	Square Footage Covered	Total Square Footage	Tonnage Uncovered[1]	Tonnage Covered[1]	Total Tonnage[1]
1	SS08	900	0	900	130.00	0.00	130.00
2	SS10	1,125	0	1,125	162.50	0.00	162.50
3	SS12	1,225	0	1,225	176.94	0.00	176.94
4	SD02	400	0	400	57.78	0.00	57.78
5	SD01	400	0	400	57.78	0.00	57.78
6	SS01	400	0	400	57.78	0.00	57.78
7	SB01	1,600	0	1,600	231.10	0.00	231.10
8	SS05	1,600	0	1,600	231.10	0.00	231.10
9	SB11	1,600	0	1,600	231.10	0.00	231.10
10	SB12	1,600	0	1,600	231.10	0.00	231.10
11	SB10	400	0	400	57.78	0.00	57.78
12	SS15	1,225	0	1,225	176.94	0.00	176.94
13	SB06	400	400	800	57.78	57.78	115.55
14	GP6	1,225	0	1,225	176.94	0.00	176.94
15	GP8	1,600	0	1,600	231.10	0.00	231.10
16	GP20	400	400	800	57.78	57.78	115.55
17	GP22	1,225	0	1,225	176.94	0.00	176.94
18	SB02	2,500	0	2,500	361.10	0.00	361.10
19	HA4	1,750	800	2,550	252.77	115.55	368.32
20	SB03	1,225	400	1,625	176.94	57.78	234.72
21	GP18	1,200	0	1,200	173.33	0.00	173.33
21	SS03	1,250	0	1,250	180.55	0.00	180.55
21	ASH003	1,600	0	1,600	231.10	0.00	231.10
21	SS02		3,000	3,000	0.00	433.32	433.32
22	SS06	2,600	0	2,600	375.54	0.00	375.54
Totals		**29,450**	**5,000**	**34,450**	**4,253.76**	**722.20**	**4,975.96**

1. Tonnage = (sq feet x 2 ft depth)/27 x 1.5 (conv from sf to ton) x 1.3 (contingency)

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Table 5.2
Description of Soil Corrective Measures Alternatives
Franklin Steel, Blacklick, Ohio

SOIL - ALTERNATIVE 1 NO ACTION	
ACTION	**DESCRIPTION**
No Action	Alternative would include no active corrective measures component.
SOIL - ALTERNATIVE 2 CAPPING OF IMPACTED SOIL	
ACTION	**DESCRIPTION**
Land Use Controls	Alternative would include placing controls (restrictive covenants) to prevent residential development of impacted soil areas, providing long-term maintenance of the cap, and providing notice to protect worker exposure.
On-site Capping of Impacted Soil	A 4- to 6-inch thick concrete cap with a gravel or sand base course would be constructed over impacted soil targeted for remediation. Soil would be removed to achieve a finished cap grade level with the existing ground surface. Soil excavated for cap placement, may be stabilized *in situ* and transported for off-site disposal. Existing concrete surface repairs would be implemented where warranted.
SOIL - ALTERNATIVE 3 REMOVAL OF IMPACTED SOIL	
ACTION	**DESCRIPTION**
Land Use Controls	Alternatives 3A and 3B would include placing controls (restrictive covenants) to prevent residential development of specified impacted soil areas. For Alternative 3A only, long-term cap maintenance and notices to protect worker exposure would also be included.
Removal of Impacted Soil	Alternative 3A: Currently uncovered areas with COC-impacted soil targeted for remediation would be excavated up to a depth of 2 feet below grade. Alternative 3B: Currently uncovered and covered areas with COC-impacted soil targeted for remediation would be excavated up to a depth of 2 feet below grade.
Backfill Excavated Areas	Backfill would be obtained and placed to bring the excavated area up to existing grade. Where contiguous concrete cover surrounds the areas where soil removal is to be conducted, final surface cover may be concrete

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Table 5.3
Comparison of Corrective Measures Alternatives - Soil
Franklin Steel, Blacklick, Ohio

CRITERIA	ALTERNATIVE 1 NO ACTION	ALTERNATIVE 2 CAPPING	ALTERNATIVE 3 SOIL REMOVAL
Overall Protection of Human Health and the Environment	Poor	Good	Good
Ability to Attain Media Cleanup Standards	Poor	Good	Good
Control of Release Sources	Poor	Good	Good
Compliance with Institutional and Legal Requirements	Poor	Good	Good
Long-term Reliability and Effectiveness	Poor	Good	Good
Reduction in the Toxicity, Mobility, or Volume of Wastes	Poor	Fair	Good
Short-term Effectiveness	Good	Fair	Fair
Ease of Implementation	Good	Good	Good (3A), Poor (3B)
Cost	Low	Moderate	Moderate (3A) to High (3B)

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Table 6.1
Description of Sediment Corrective Measures Alternatives
Franklin Steel, Blacklick, Ohio

SEDIMENT - ALTERNATIVE 1 NO ACTION	
ACTION	**DESCRIPTION**
No Action	Alternative would include no active corrective measures component.
SEDIMENT - ALTERNATIVE 2 CAPPING OF IMPACTED SEDIMENT	
ACTION	**DESCRIPTION**
Capping of Sediments	A 4- to 6-inch thick bentonite cap would be constructed over impacted sediment targeted for remediation.
SEDIMENT - ALTERNATIVE 3 REMOVAL OF IMPACTED SEDIMENT	
ACTION	**DESCRIPTION**
Removal of Impacted Sediments	Sediments would be excavated to an average depth of 6 to 12 inches, and an average channel width of 5 to 7 feet, dewatered as needed, and loaded, transported, and disposed at an approved solid waste landfill.
Backfill Excavated Areas	Backfill, clay and/or top soil, would be obtained and placed to bring the excavated area up to existing grade.

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Table 6.2
Comparison of Corrective Measures Alternatives
Sediment
Franklin Steel, Blacklick, Ohio

CRITERIA	ALTERNATIVE 1 NO ACTION	ALTERNATIVE 2 CAPPING	ALTERNATIVE 3 SEDIMENT REMOVAL
Overall Protection of Human Health and the Environment	Poor	Good	Good
Ability to Attain Media Cleanup Standards	Poor	Good	Good
Control of Release Sources	Poor	Good	Good
Compliance with Institutional and Legal Requirements	Poor	Good	Good
Long-term Reliability and Effectiveness	Poor	Good	Good
Reduction in the Toxicity, Mobility, or Volume of Wastes	Poor	Fair	Good
Short-term Effectiveness	Good	Fair	Fair
Ease of Implementation	Good	Fair	Good
Cost	Low	High	Moderate

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Table 7.1
Description of Groundwater Corrective Measures Alternatives
Franklin Steel, Blacklick, Ohio

GROUNDWATER - ALTERNATIVE 1 NO ACTION	
ACTION	**DESCRIPTION**
No Action	Alternative would include no active corrective measures component.
GROUNDWATER - ALTERNATIVE 2 MONITORED NATURAL ATTENUATION	
ACTION	**DESCRIPTION**
Land Use Controls	Alternative would include placing restrictive covenants to prevent installation of drinking water wells at the site.
MNA	Groundwater in the area of groundwater monitoring well S109-MW06 would be sampled and analyzed to monitor potential COC migration and to track COC concentration trends (compliance monitoring). Indicator parameters and COC concentration trends would be monitored for 2 years time to assess natural attenuation of the COC. If COCs above action levels at property boundary wells within 2 years, then contingency remedy will be proposed similar to Alternative 3.
Groundwater Monitoring	Groundwater would be sampled and analyzed to monitor effectiveness of natural attenuation and track COC concentration trends. Alternative would include detection groundwater monitoring at the site perimeter.
GROUNDWATER - ALTERNATIVE 3 GROUNDWATER RECOVERY AND TREATMENT	
ACTION	**DESCRIPTION**
Land Use Controls	Alternative would include placing restrictive covenants to prevent installation of drinking water wells at the site.
Groundwater Recovery and Treatment	A groundwater recovery system would be installed in the area of impacted groundwater around S109-MW06. Recovered groundwater would be treated to remove the COC under an amended NPDES permit.
Groundwater Monitoring	Groundwater would be sampled and analyzed to monitor system performance and track COC concentration trends. Detection monitoring at site perimeter would also be conducted under this alternative.

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Table 7.2
Comparison of Corrective Measures Alternatives
Groundwater
Franklin Steel, Blacklick, Ohio

CRITERIA	ALTERNATIVE 1 NO ACTION	ALTERNATIVE 2 MNA	ALTERNATIVE 3 EXTRACTION AND TREATMENT
Overall Protection of Human Health and the Environment	Fair	Good	Good
Ability to Attain Media Cleanup Standards	Fair	Fair	Fair
Control of Release Sources	Not Applicable	Not Applicable	Not Applicable
Compliance with Institutional and Legal Requirements	Poor	Good	Good
Long-term Reliability and Effectiveness	Poor	Fair	Fair
Reduction in the Toxicity, Mobility, or Volume of Wastes	Poor	Fair	Fair
Short-term Effectiveness	Good	Good	Fair
Ease of Implementation	Good	Good	Fair
Cost	Low	Low	High

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Figures

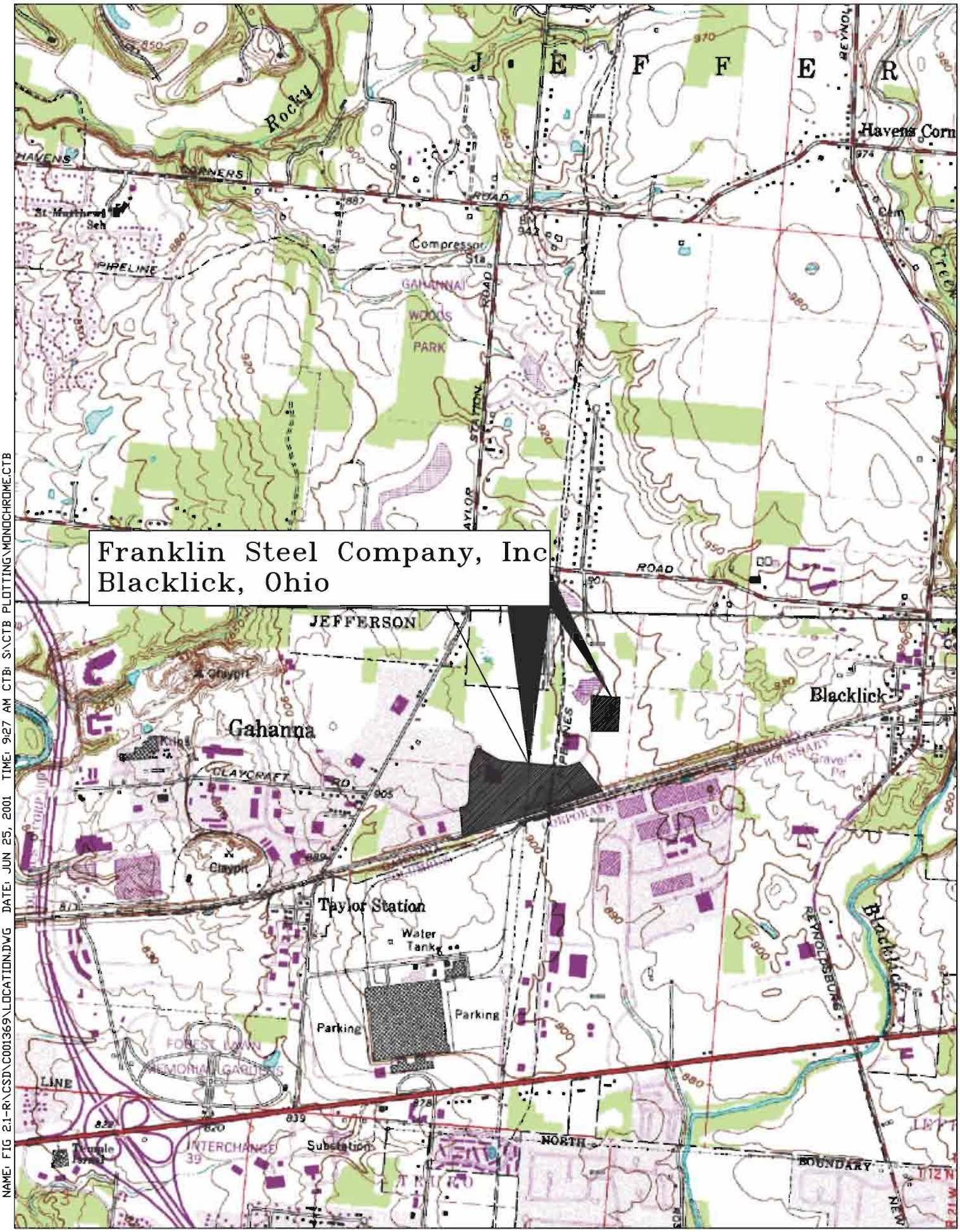
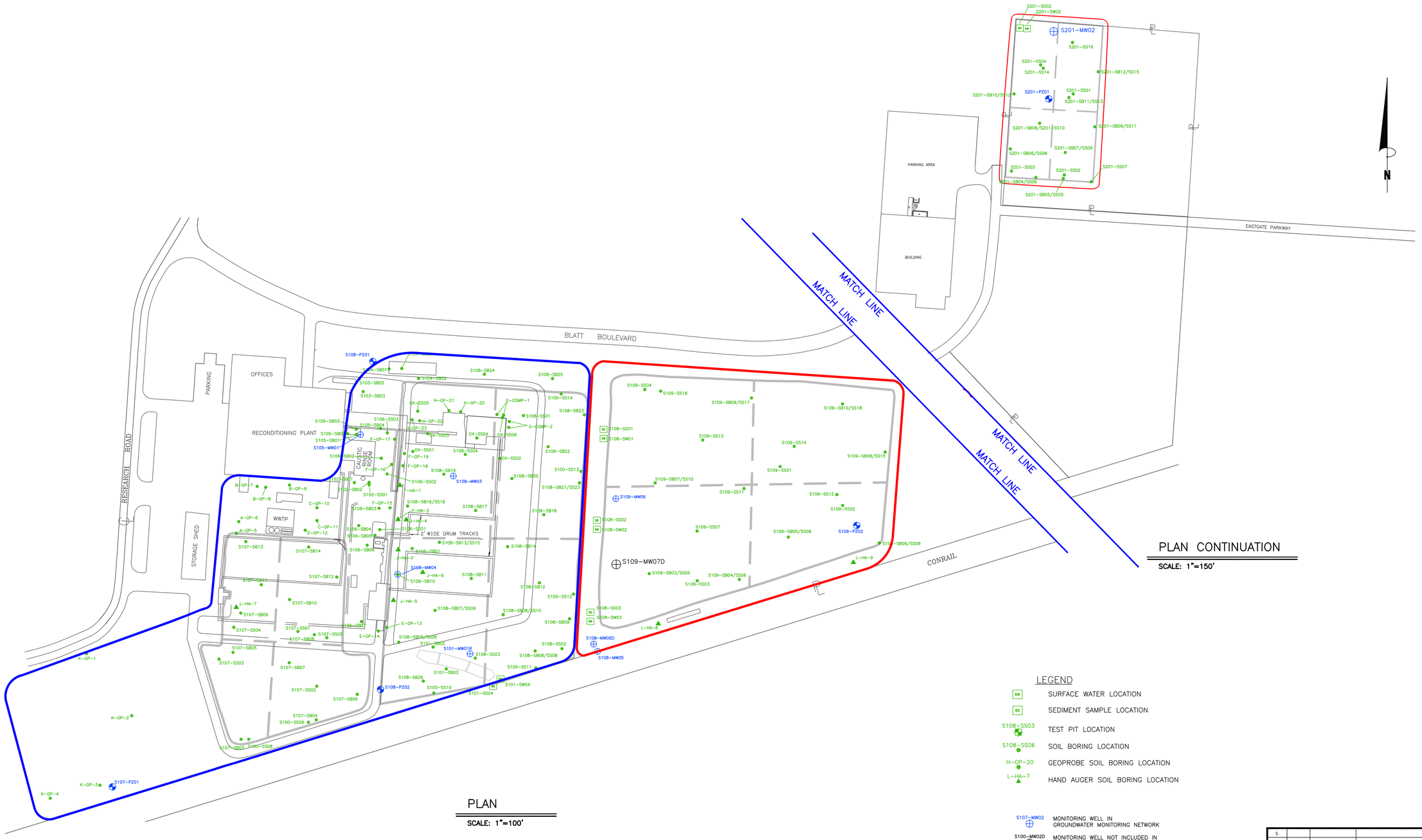


Figure 1.1 Location Map For Franklin Steel Company

NAME: FIG 2.1-R:\CSD\C001369\LOCATION.DWG DATE: JUN 25, 2001 TIME: 9:27 AM CTB: S:\CTB PLOTTING\MONOCHROME.CTB



PLAN CONTINUATION

SCALE: 1"=150'

PLAN

SCALE: 1"=100'

LEGEND

SW	SURFACE WATER LOCATION
SD	SEDIMENT SAMPLE LOCATION
S108-SS03	TEST PIT LOCATION
S108-SS06	SOIL BORING LOCATION
H-GP-20	GEOPROBE SOIL BORING LOCATION
L-HA-7	HAND AUGER SOIL BORING LOCATION
S107-MW02	MONITORING WELL IN GROUNDWATER MONITORING NETWORK
S100-MW02D	MONITORING WELL NOT INCLUDED IN GROUNDWATER MONITORING NETWORK
S201-PZ01	PIEZOMETER IN GROUNDWATER MONITORING NETWORK
S109-PZ03	PIEZOMETER NOT INCLUDED IN GROUNDWATER MONITORING NETWORK
	EXPOSURE UNIT # 1 (ACTIVE OPERATIONS AREA)
	EXPOSURE UNIT # 2 (INACTIVE OPERATIONS AREA)

NO.	BY	DATE	REVISION	APP'D.
5.				
4.				
3.				
2.				
1.				

FRANKLIN STEEL COMPANY
BLACKLICK, OHIO

FIGURE 2.1
EXPOSURE UNITS 1 (ACTIVE OPERATIONS AREA) AND 2 (INACTIVE OPERATIONS AREA)

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CHECKED BY: TL	SHOWN	FILE NO: Figure 2.1.dwg	
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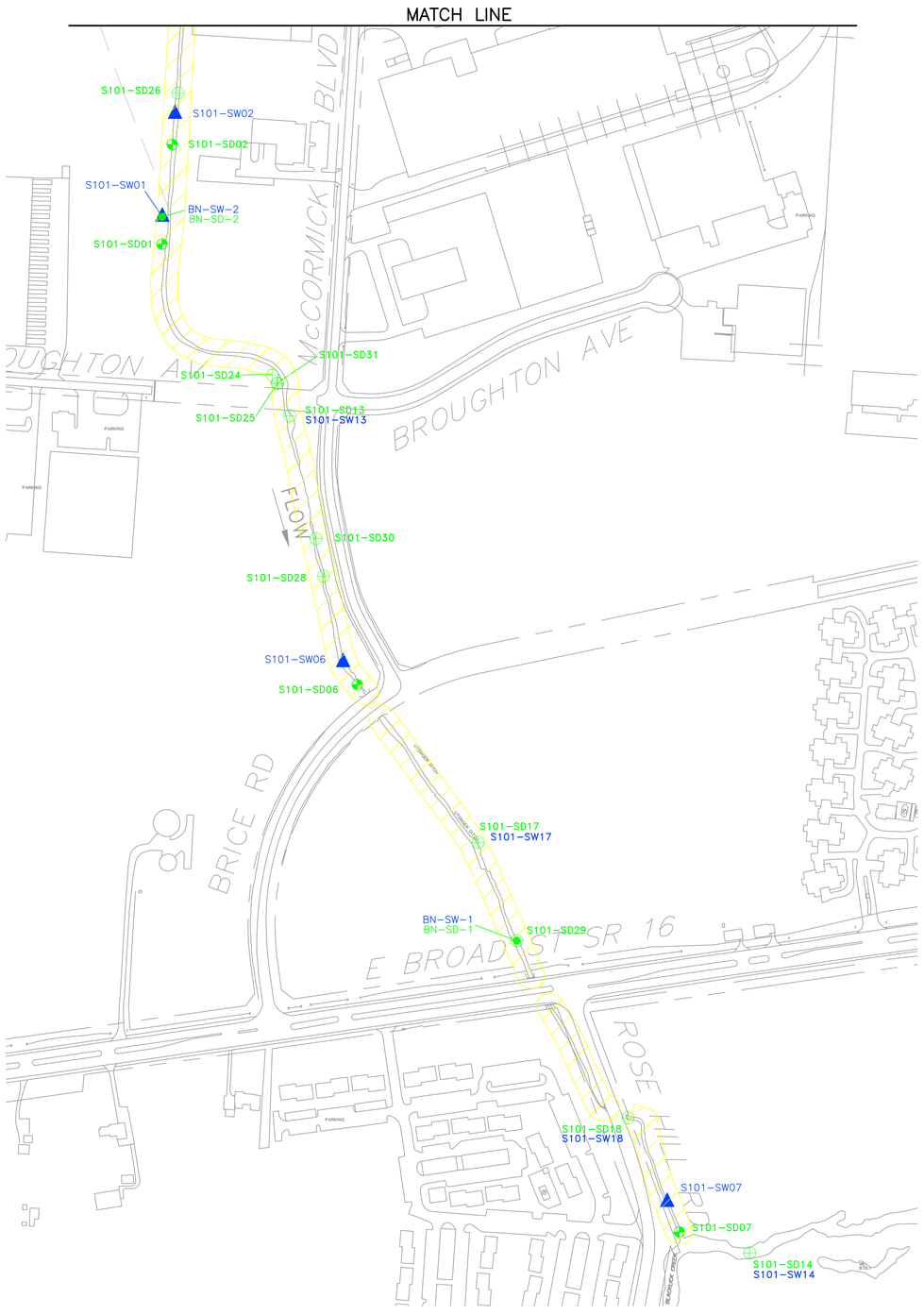
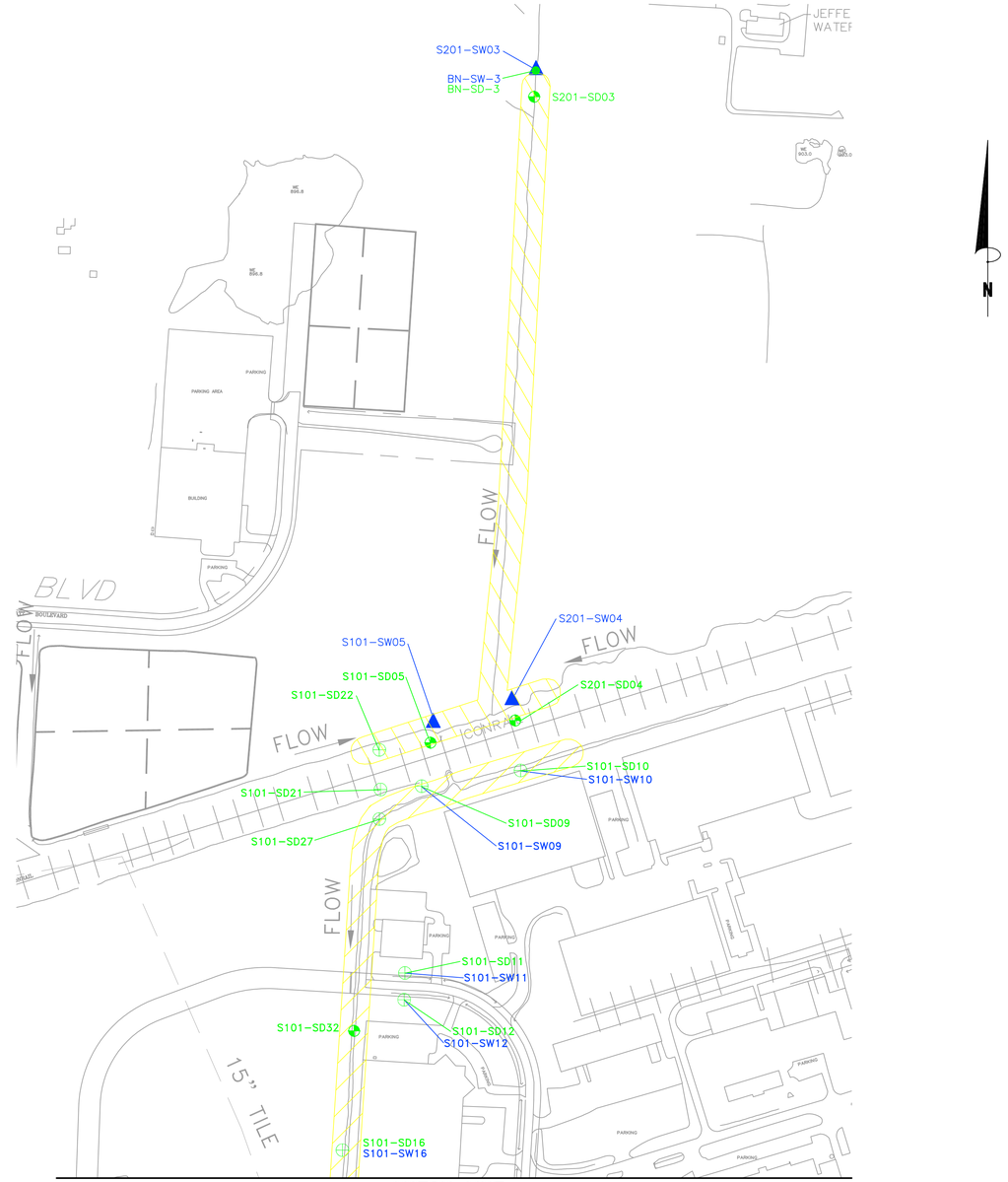
Drawing Name: J:\067711\51\CMS Report\Figure 2.1.dwg/Dwg Size: Operator Name: RONILANDS Plot Date: December 22, 2008 Drawing XY Scale: 1:19.98 Plot Time: 2:41:54 Attached Xref's: Attached Images: Layout: SITE





MATCH LINE

PLAN

SCALE: 1"=300'

LEGEND

- SURFACE WATER SAMPLE LOCATION
- SEDIMENT SAMPLE LOCATION
- EXPOSURE UNIT#3 (UNZINGERS DITCH)
- APRIL SEDIMENT AND/OR SURFACE WATER SAMPLE LOCATION; MARCH 2000 SOIL OR SEDIMENT SAMPLE LOCATION; NOVEMBER 2000, MARCH 2001, AND MAY 2001 SEDIMENT SAMPLE LOCATION
- SEDIMENT SAMPLE LOCATION (COLLECTED BY BURGESS & NIPLE)

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FIGURE 2.2
EXPOSURE UNIT 3 (UNZINGERS DITCH)

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APPROVED BY: TL	DATE PRINTED:	**FIGURE 2.2**	
DATE: December 2008			

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Drawing Name: J:\06771\51\CMS Report\Figure 2.2.dwg Size: 2.37 Mb
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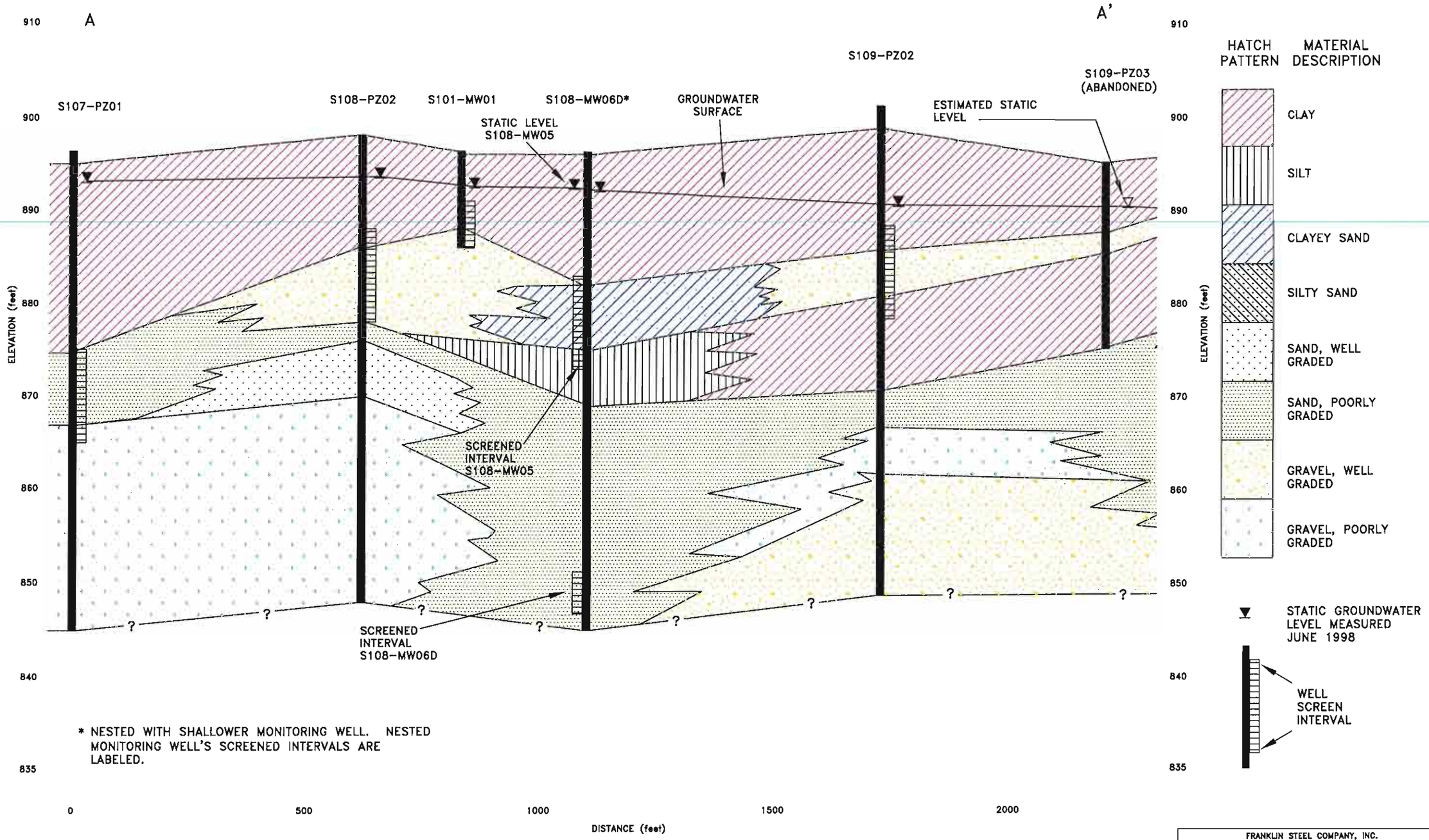
Attached Images: Layers



* NESTED WITH SHALLOWER MONITORING WELL. NESTED MONITORING WELL'S SCREENED INTERVALS ARE LABELED.

REFER TO FIGURE 2.4 DRAWING FOR CROSS SECTION LOCATION.

CROSS SECTION A – A'

FRANKLIN STEEL COMPANY, INC.
GAHANNA, OHIO

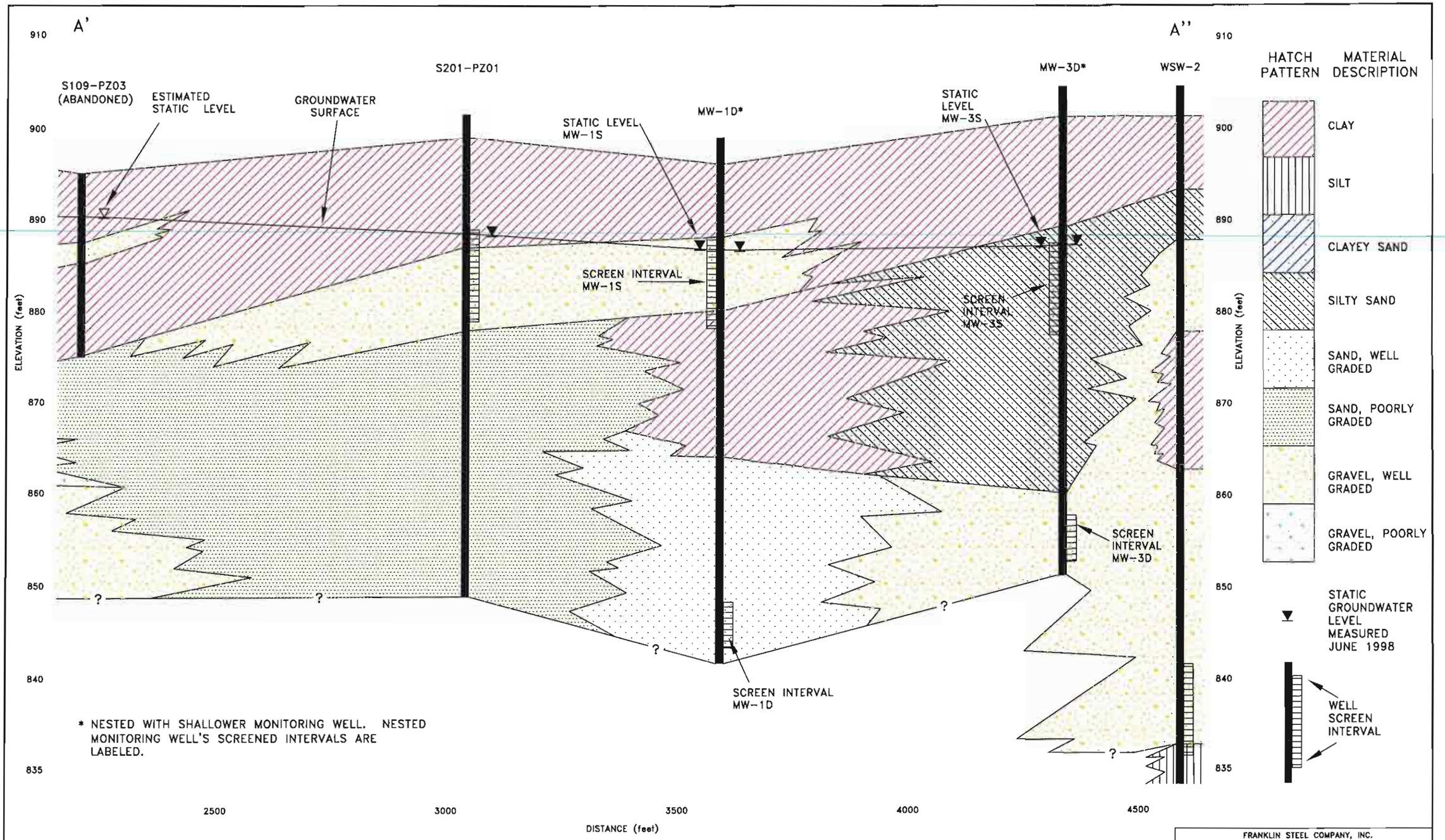
RCRA Facility Investigation Report

Cross Section A – A'

SAIC Science Applications International Corporation Columbus, Ohio

FIGURE 2.3

NAME: FIGURE 2.2-R:\CSD\C002759\101\COMPOSIT.DWG DATE: DEC 06, 2001 TIME: 7:58 AM CTB: S:\CTB PLOTTING\FULLCOLR.CTB



REFER TO FIGURE 2.4 DRAWING FOR CROSS SECTION LOCATION.

Cross Section A' – A''

FRANKLIN STEEL COMPANY, INC.
GAHANNA, OHIO

RCRA Facility Investigation Report

Cross Section A' – A''

SAIC Science Applications International Corporation Columbus, Ohio

FIGURE 2.4

NAME: FIGURE 2.3-R:\CSD\C002759\101\COMPOSIT.DWG DATE: DEC 06, 2001 TIME: 7:59 AM CTB: S:\CTB PLOTTING\FULLCOLR.CTB

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Plot Date: December 23, 2008
Plot Time: 5:19 AM
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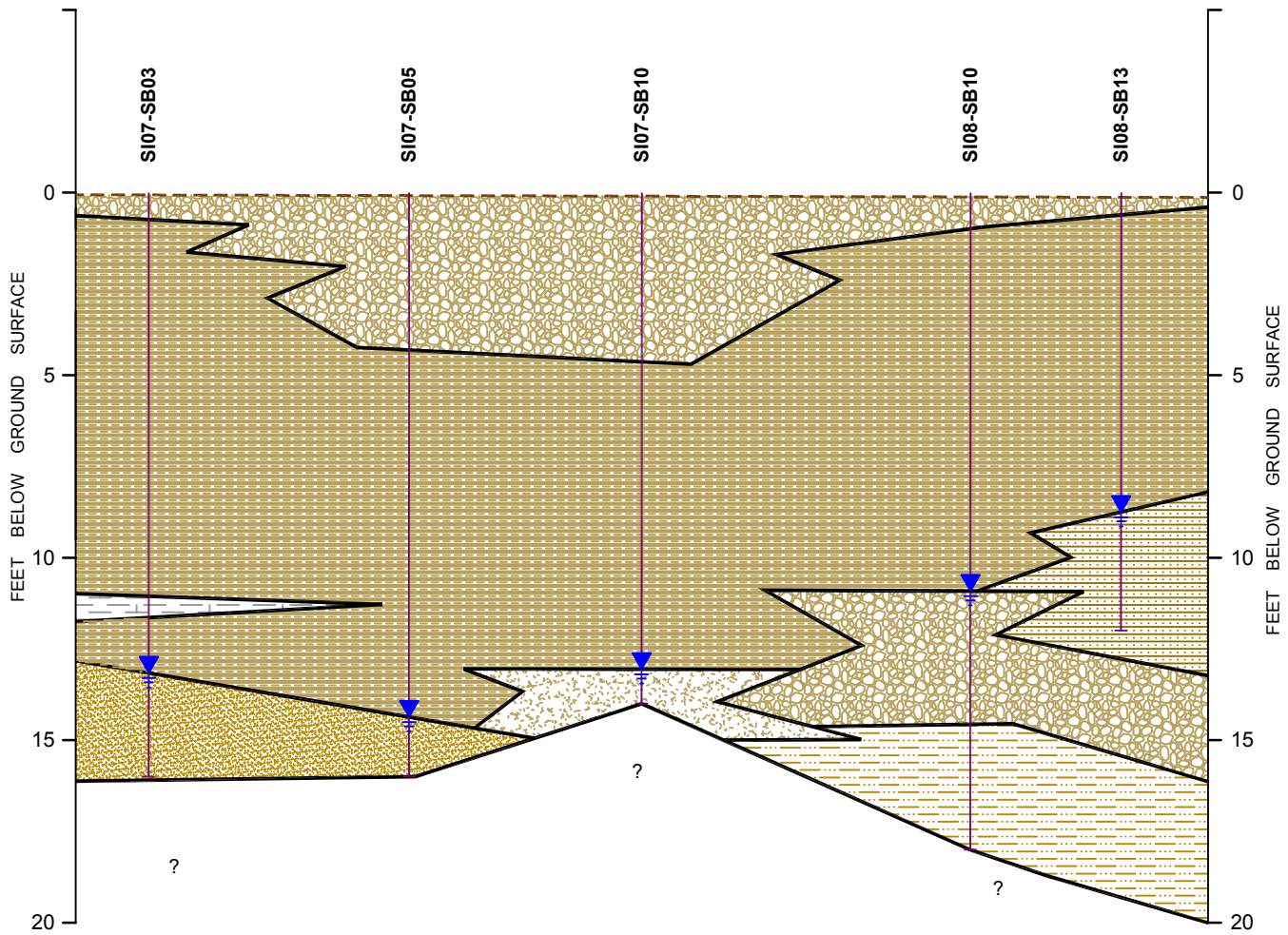
Attached Images: Dams 1.jpg, Dams 2.jpg
Layout:

RMT COMPUTER AIDED DESIGN AND DRAFTING

GEOLOGIC CROSS SECTION B - B'



LEGEND

- APPROXIMATE GROUND SURFACE
- STRATIGRAPHIC CONTACT (DASHED WHERE INFERRED)
- WATER LEVEL
- CLAYEY GRAVEL
- CLAY
- SAND (WELL- SORTED)
- SILT
- SAND (POORLY-GRADED)
- CLAYEY SAND
- SHALE

VERTICAL SCALE: 0 – 5'

HORIZONTAL SCALE: 0 – 200'

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GEOLOGIC CROSS SECTION B-B'

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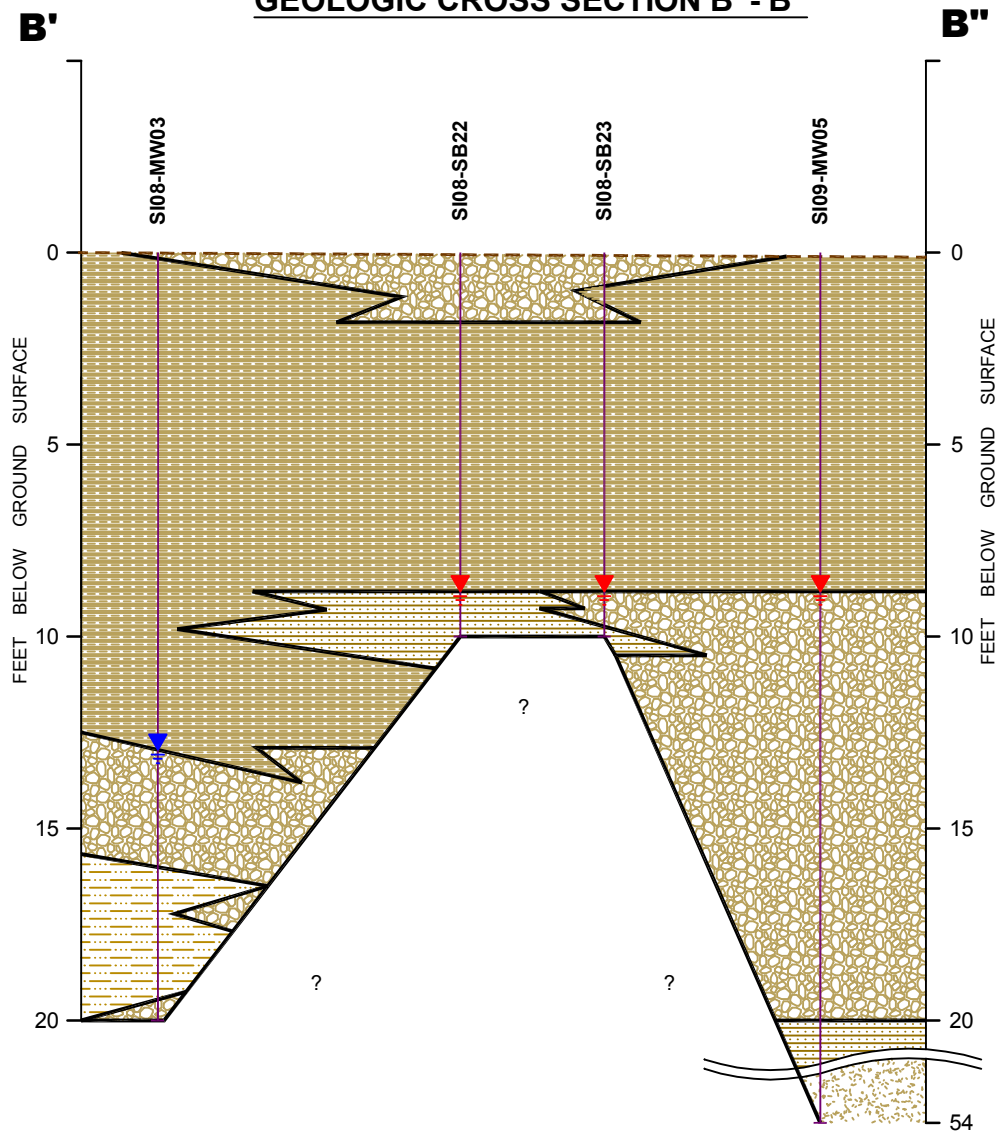
FILE NUMBER:	Figure 2.5.dwg
DATE:	June 2008

FIGURE 2.5

Drawing Name: J:\06771\51\CMS Report\Figure 2.5.dwg
Operator Name: ROWLANDS
Drawing Plot Scale: 1:40
Dwg Size: 0.17 Mb
Plot Date: December 23, 2008
Plot Time: 5:21 AM
Attached Xref's:
Attached Images: Dams 1.jpg, Dams 2.jpg
Layout:

RMT COMPUTER AIDED DESIGN AND DRAFTING

GEOLOGIC CROSS SECTION B' - B"



LEGEND

- APPROXIMATE GROUND SURFACE
- STRATIGRAPHIC CONTACT (DASHED WHERE INFERRED)
- WATER LEVEL
- PERCHED WATER LEVEL
- CLAYEY GRAVEL
- CLAY
- SAND (WELL- SORTED)
- SILT
- SAND (POORLY-SORTED)
- CLAYEY SAND

VERTICAL SCALE: 0 – 5'

HORIZONTAL SCALE: 0 – 200'

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BLACKLICK, OHIO

GEOLOGIC CROSS SECTION B'-B"

DRAWN BY:	QR
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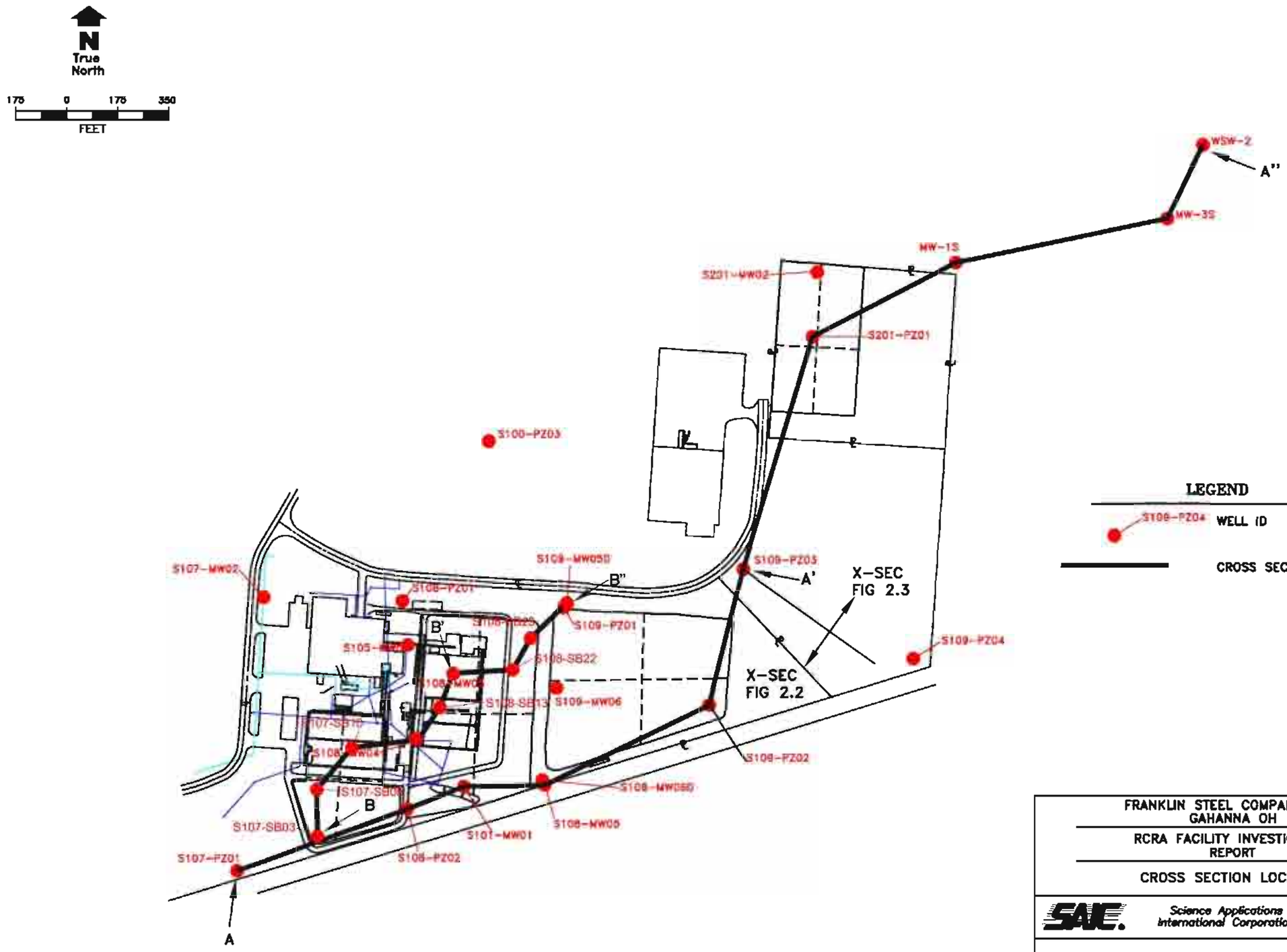
APPROVED BY:	TL
PROJECT #	J:\06771\51\CMS REPORT
FILE NUMBER:	Figure 2.5.dwg
DATE:	June 2008

FIGURE 2.6



FRANKLIN STEEL COMPANY, INC.
GAHANNA OH

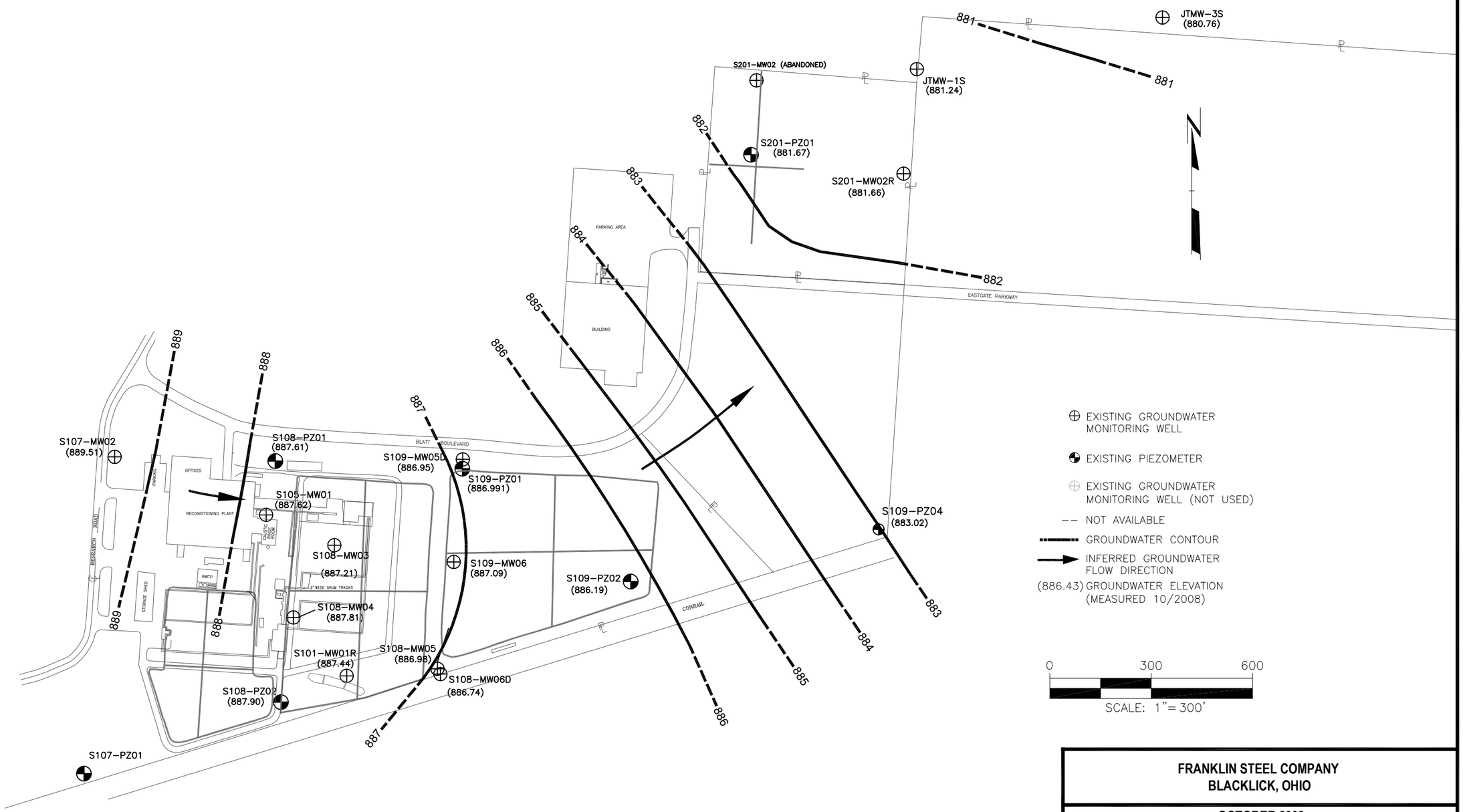
RCRA FACILITY INVESTIGATION REPORT

CROSS SECTION LOCATION

SAIC. Science Applications International Corporation Columbus, Ohio

FIGURE 2.7

NAME: LAYOUT1-R1\(3D)\WELLY\CROSS.DWG DATE: DEC 04, 2001 TIME: 8:01 AM CTB: S:\CTB PLOTTING\POTS-99.CTB



FRANKLIN STEEL COMPANY
BLACKLICK, OHIO

OCTOBER 2008
POTENTIOMETRIC
SURFACE MAP

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CHECKED BY:	ML	FILE NUMBER:	Figure 2.8.dwg
APPROVED BY:	ML	DATE:	December 2008
DRAWING SCALE:	SHOWN	FIGURE NO.	**FIGURE 2.8**

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Operator Name: ROWLANDS
Drawing Plot Scale: 1:1
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Plot Date: December 22, 2008
Plot Time: 2:03PM
Attached Xrefs: D4700712061605A;
Attached Images:
Layout: Layout1

Parameter	Units	Direct Contact Industrial Soil	F-GP-17 (0-1') 10/16/06
Lead	mg/kg	750	4,610 B

Parameter	Units	Direct Contact Industrial Soil	S103-SB03 8/7/1997 0-1
Lead	mg/kg	750	1,010 J

Parameter	Units	Direct Contact Industrial Soil	S103-SB02 8/7/1997 0-1
Iron	mg/kg	100,000	166,000 J
Lead	mg/kg	750	1,110 J

Parameter	Units	Direct Contact Industrial Soil	F-GP-18 10/16/2006 0-1
Lead	mg/kg	710	758
Iron	mg/kg	100,000	154,000
Benzo(a)fluoranthene	mg/kg	2.1	2.1
Dibenz(ah)anthracene	mg/kg	0.21	0.96

Parameter	Units	Direct Contact Industrial Soil	H-GP-20 10/16/2006 0-1
Benzo(a)pyrene	mg/kg	0.21	0.32

Parameter	Units	Direct Contact Industrial Soil	S106-SS03 10/23/1993 0-1
Lead	mg/kg	750	4,310 J

Parameter	Units	Direct Contact Industrial Soil	H-GP-23 (0-1') 10/16/2006
Lead	mg/kg	750	1,540 B

Parameter	Units	Direct Contact Industrial Soil	J-HA-4 (0.0'-0.5') 10/18/2006
Chromium	mg/kg	450	546
Iron	mg/kg	100,000.00	165,000
Lead	mg/kg	750	5,060 B

Parameter	Units	Direct Contact Industrial Soil	CSD-ASH002 3/24/2003 0-1
Lead	mg/kg	750	1,550

Parameter	Units	Direct Contact Industrial Soil	S105-SB04 08/06/1997 0-1
Chromium	mg/kg	450	461
Lead	mg/kg	750	4,070

Parameter	Units	Direct Contact	G-Comp-1 (0-1') 10/16/2006
Benzo(a)prene	mg/kg	0.21	0.33

Parameter	Units	Direct Contact Industrial Soil	S104-SS01 10/23/1993 0-1
Lead	mg/kg	750	810.0 J

Parameter	Units	Direct Contact Industrial Soil	S108-SS01 09/21/1993 0-1
Lead	mg/kg	750	972 J

Parameter	Units	Direct Contact Industrial Soil	CSD-ASH003 3/24/2003 0-1
Lead	mg/kg	750	1,490

Parameter	Units	Direct Contact Industrial Soil	S106-SB02 8/6/1997 0-1
Lead	mg/kg	750	830

Parameter	Units	Direct Contact Industrial Soil	S108-SD01 1/31/1995 0-1
Benzo(a)pyrene	mg/kg	0.21	1.6
Benzo(b)fluoranthene	mg/kg	2.1	2.6

Parameter	Units	Direct Contact Industrial Soil	S106-SS02 10/23/1993 0-1
Chromiom	mg/kg	450	1,120 J
Lead	mg/kg	750	2,190 J

Parameter	Units	Direct Contact Industrial Soil	S108-SD02 1/31/1995 0-1
Benzo(a)pyrene	mg/kg	0.21	1.1

Parameter	Units	Direct Contact Industrial Soil	B-GP-8 10/16/2006 0-1
Arsenic	mg/kg	39	93.7

Parameter	Units	Direct Contact Industrial Soil	S108-SB18 9/23/1997 0-1
Bis(2-Ethylhexyl)phthalate	mg/kg	120	230

Parameter	Units	Direct Contact Industrial Soil	S106-SB03 8/5/1997 0-1
Lead	mg/kg	750	769

Parameter	Units	Direct Contact Industrial Soil	A-GP-6 (0-1') 10/16/2006
Benzo(a)pyrene	mg/kg	0.21	0.491

Parameter	Units	Direct Contact Industrial Soil	S108-SB13/SS15 9/23/1997 0-1
Lead	mg/kg	750	1,840
Benzo(a)anthracene	mg/kg	2.1	6.2
Benzo(a)pyrene	mg/kg	0.21	5.1
Benzo(b)fluoranthene	mg/kg	2.1	5.9
Dibenzo(a,h)anthracene	mg/kg	0.21	0.45 J

Parameter	Units	Direct Contact Industrial Soil	F-HA-2 (0-1') 10/18/06
Chromium	mg/kg	450	732 B
Lead	mg/kg	750	2,860 B

Parameter	Units	Direct Contact Industrial Soil	S107-SB11 03/21/1998 0-1
bis(2-Ethylhexyl) phthalate	mg/kg	120	1,300

Parameter	Units	Direct Contact Industrial Soil	S100-SS12 10/23/01993 0-1
Lead	mg/kg	750	1,070

Parameter	Units	Direct Contact Industrial Soil	L-HA-8 10/18/2006 0-1
Benzo(a)pyrene	mg/kg	0.21	0.49

Parameter	Units	Direct Contact Industrial	S106-SB06 08/05/1997 0-1
Lead	mg/kg	750	846 J

Parameter	Units	Direct Contact Industrial Soil	S108-SB06/SS08 9/22/1997 0-1
Lead	mg/kg	750	783

Parameter	Units	Direct Contact Industrial Soil	S108-SB09 09/23/1997 0-1
Aroclor 1254 (ug/kg)	mg/kg	0.74	0.84

Parameter	Units	Direct Contact Industrial Soil	S108-SB08/SS10 9/24/1997 0-1
Lead	mg/kg	750	1,020

Parameter	Units	Direct Contact Industrial Soil	S108-SS03 09/22/1993 0-1
Benzo(a)pyrene	mg/kg	0.21	0.32 J

Parameter	Units	Direct Contact Industrial Soil	S108-SB05/SS06 9/22/1997 0-1
Lead	mg/kg	750	968

Parameter	Units	Direct Contact Industrial Soil	S101-SD35 5/22/2001 0-1
Benzo(a)anthracene	mg/kg	2.1	4.2
Benzo(a)pyrene	mg/kg	0.21	5.0
Benzo(b)fluoranthene	mg/kg	2.1	6.1
Indeno(1,2,3-cd)pyrene	mg/kg	2.1	3.5

Parameter	Units	Direct Contact Industrial Soil	S107-SB10 03/21/1998 0-1
Aroclor 1254	mg/kg	0.74	1

Parameter	Units	Direct Contact Industrial Soil	S100-SS09 10/23/1993 0-1
Benzo(a)pyrene	mg/kg	0.21	0.81

Parameter	Units	Direct Contact Industrial Soil	CSD-ASH001 3/24/2003 0-1
Benzo(a)anthracene	mg/kg	2.1	24.4
Benzo(a)pyrene	mg/kg	0.21	24.2
Benzo(b)fluoranthene	mg/kg	2.1	28.1
Benzo(k)fluoranthene	mg/kg	21.1	24.2
Indeno(1,2,3-cd)pyrene	mg/kg	2.1	5.1

Parameter	Units	Direct Contact Industrial Soil	S107-SS05 10/23/1993 0-1
bis(2-Ethylhexyl) phthalate	mg/kg	120	1,000

Parameter	Units	Direct Contact Industrial Soil	S107-SB12 03/20/1998 0-1
Xylenes, Total	mg/kg	420	720

Parameter	Units	Direct Contact Industrial Soil	S107-SB07 3/23/1998 0-1
bis(2-Ethylhexyl)phthalate	mg/kg	120	230
Trichloroethene	mg/kg	0.11	0.69
Lead	mg/kg	750	878

AREAS CURRENTLY UNDER CONCRETE CAP
AREAS NOT CURRENTLY UNDER CONCRETE CAP
SW SURFACE WATER LOCATION
SD SEDIMENT SAMPLE LOCATION
H-GP-20 SOIL SAMPLE LOCATION
L-HA-7 HAND AUGER LOCATION
S108-EPA HOT SPOT 2 1988 OHIO REMEDIAL/REMOVAL ACTVITIES
SEA-36 BACKGROUND SOIL SAMPLE LOCATIONS
S107-MW02 EXISTING MONITORING WELL
S201-PZ01 EXISTING PIEZOMETER
S109-PZ03 EXISTING PIEZOMETER (NOT USED)

A HAZARDOUS WASTE STORAGE AREA
B SHOT BLAST DUST COLLECTOR AREA
C SHOT BLAST DUST BAGS STORAGE AREA
D FILTER PRESS SLUDGE STORAGE PAD
E FORMER HAZARDOUS WASTE STORAGE PAD
F DRUM CONVEYOR CHAIN ASH FALL-OFF AREA
G THERMAL OXIDIZER BUILDING DOORWAY AREAS
H THERMAL OXIDIZER SLUDGE STORAGE AREA
I HEAVY DRUMS STORAGE PAD
J OLD OXIDIZER QUENCH PIT AREA
K FORMER DRUM STORAGE AREA
L NEWLY DISCOVERED STORM WATER OUTFALL

CONTIGUOUS AREA #1

S101 – STORM WATER (ST) DRAINAGE SYSTEM
S102 – SANITARY SEWER LINES (SAN) AND VALVE PIT
S103 – SHOT BLAST DUST COLLECTORS
S104 – FORMER SHOT BLAST STORAGE AREA
S105 – FORMER CAUSTIC RINSE SYSTEM AND CAUSTIC SLUDGE HOLDING TANK
S106 – OXIDIZER SYSTEM
S107 – DRUM STORAGE AREA #1
S108 – DRUM STORAGE AREA #2
S109 – DRUM STORAGE AREA #3
S110 – FORMER HWUST
S111 – FORMER HWDP

CONTIGUOUS AREA #2

S201 – DRUM STORAGE AREA #4

NOTES: –SHADED RESULTS EXCEED THE REMEDIAL ACTION OBJECTIVES FOR SOIL.

NO.	BY	DATE	REVISION	APP'D.
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FRANKLIN STEEL COMPANY
BLACKLICK, OH

FIGURE 2.9
EXPOSURE UNIT 1 (AREAS OF REMEDIATION)

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APPROVED BY: TL	DATE PRINTED:	FIGURE 2.9	
DATE: December 2008			

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Drawing Name: J:\06771\51\CMS Report\Figure 2.9.dwg
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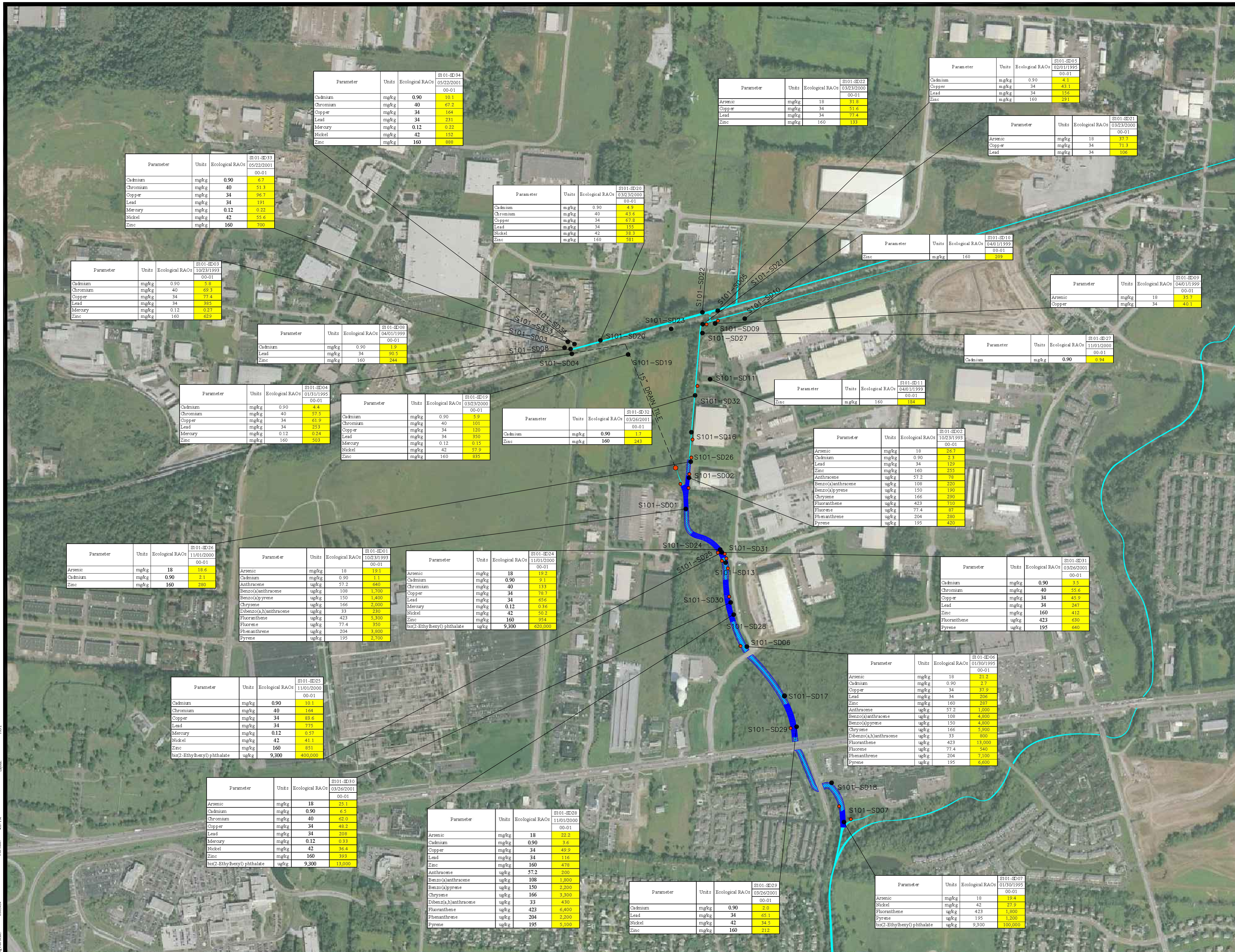
Layout: SITE



Parameter	Units	Ecological RAOs	S101-SD34
			05/22/2001
			00-01
Cadmium	mg/kg	0.90	10.1
Chromium	mg/kg	40	67.2
Copper	mg/kg	34	164
Lead	mg/kg	34	231
Mercury	mg/kg	0.12	0.22
Nickel	mg/kg	42	152
Zinc	mg/kg	160	888

Parameter	Units	Ecological RAOs	S101-SD33
			05/22/2001
			00-01
Cadmium	mg/kg	0.90	6.7
Chromium	mg/kg	40	51.3
Copper	mg/kg	34	96.7
Lead	mg/kg	34	191
Mercury	mg/kg	0.12	0.22
Nickel	mg/kg	42	55.6
Zinc	mg/kg	160	700

Parameter	Units	Ecological RAOs	S101-SD03
			10/23/1993
			00-01
Cadmium	mg/kg	0.90	5.8
Chromium	mg/kg	40	69.3
Copper	mg/kg	34	77.4
Lead	mg/kg	34	385
Mercury	mg/kg	0.12	0.27
Zinc	mg/kg	160	629

Parameter	Units	Ecological RAOs	S101-SD08
			04/01/1999
			00-01
Cadmium	mg/kg	0.90	1.9
Lead	mg/kg	34	90.5
Zinc	mg/kg	160	244

Parameter	Units	Ecological RAOs	S101-SD04
			01/31/1995
			00-01
Cadmium	mg/kg	0.90	4.4
Chromium	mg/kg	40	57.5
Copper	mg/kg	34	61.9
Lead	mg/kg	34	253
Mercury	mg/kg	0.12	0.24
Zinc	mg/kg	160	503

Parameter	Units	Ecological RAOs	S101-SD19
			03/23/2000
			00-01
Cadmium	mg/kg	0.90	5.9
Chromium	mg/kg	40	101
Copper	mg/kg	34	120
Lead	mg/kg	34	350
Mercury	mg/kg	0.12	0.15
Nickel	mg/kg	42	57.9
Zinc	mg/kg	160	835

Parameter	Units	Ecological RAOs	S101-SD20
			03/23/2000
			00-01
Cadmium	mg/kg	0.90	4.9
Chromium	mg/kg	40	43.6
Copper	mg/kg	34	67.8
Lead	mg/kg	34	155
Nickel	mg/kg	42	38.3
Zinc	mg/kg	160	581

Parameter	Units	Ecological RAOs	S101-SD22
			03/23/2000
			00-01
Arsenic	mg/kg	18	31.8
Copper	mg/kg	34	51.6
Lead	mg/kg	34	77.4
Zinc	mg/kg	160	133

Parameter	Units	Ecological RAOs	S101-SD05
			02/01/1995
			00-01
Cadmium	mg/kg	0.90	4.1
Copper	mg/kg	34	43.1
Lead	mg/kg	34	156
Zinc	mg/kg	160	291

Parameter	Units	Ecological RAOs	S101-SD21
			03/23/2000
			00-01
Arsenic	mg/kg	18	37.7
Copper	mg/kg	34	71.3
Lead	mg/kg	34	106

Parameter	Units	Ecological RAOs	S101-SD10
			04/01/1999
			00-01
Zinc	mg/kg	160	209

Parameter	Units	Ecological RAOs	S101-SD09
			04/01/1999
			00-01
Arsenic	mg/kg	18	35.7
Copper	mg/kg	34	40.1

Parameter	Units	Ecological RAOs	S101-SD27
			11/01/2000
			00-01
Cadmium	mg/kg	0.90	0.94

Parameter	Units	Ecological RAOs	S101-SD11
			04/01/1999
			00-01
Zinc	mg/kg	160	184

Parameter	Units	Ecological RAOs	S101-SD32
			03/26/2001
			00-01
Cadmium	mg/kg	0.90	1.7
Zinc	mg/kg	160	243

Parameter	Units	Ecological RAOs	S101-SD02
			10/23/1993
			00-01
Arsenic	mg/kg	18	26.7
Cadmium	mg/kg	0.90	2.3
Lead	mg/kg	34	129
Zinc	mg/kg	160	255
Anthracene	ug/kg	57.2	78
Benzo(a)anthracene	ug/kg	108	220
Benzo(a)pyrene	ug/kg	150	190
Chrysene	ug/kg	166	290
Fluoranthene	ug/kg	423	710
Fluorene	ug/kg	77.4	87
Phenanthrene	ug/kg	204	280
Pyrene	ug/kg	195	420

Parameter	Units	Ecological RAOs	S101-SD26
			11/01/2000
			00-01
Arsenic	mg/kg	18	18.6
Cadmium	mg/kg	0.90	2.1
Zinc	mg/kg	160	280

Parameter	Units	Ecological RAOs	S101-SD01
			10/23/1993
			00-01
Arsenic	mg/kg	18	19.1
Cadmium	mg/kg	0.90	1.1
Anthracene	ug/kg	57.2	640
Benzo(a)anthracene	ug/kg	108	1,700
Benzo(a)pyrene	ug/kg	150	1,400
Chrysene	ug/kg	166	2,000
Dibenzo(a,h)anthracene	ug/kg	33	230
Fluoranthene	ug/kg	423	5,300
Fluorene	ug/kg	77.4	350
Phenanthrene	ug/kg	204	3,800
Pyrene	ug/kg	195	2,700

Parameter	Units	Ecological RAOs	S101-SD24
			11/01/2000
			00-01
Arsenic	mg/kg	18	19.2
Cadmium	mg/kg	0.90	9.1
Chromium	mg/kg	40	133
Copper	mg/kg	34	78.7
Lead	mg/kg	34	656
Mercury	mg/kg	0.12	0.36
Nickel	mg/kg	42	50.2
Zinc	mg/kg	160	954
bis(2-Ethylhexyl) phthalate	ug/kg	9,300	620,000

Parameter	Units	Ecological RAOs	S101-SD31
			03/26/2001
			00-01
Cadmium	mg/kg	0.90	3.5
Chromium	mg/kg	40	55.6
Copper	mg/kg	34	45.9
Lead	mg/kg	34	247
Zinc	mg/kg	160	412
Fluoranthene	ug/kg	423	630
Pyrene	ug/kg	195	640

Parameter	Units	Ecological RAOs	S101-SD25
			11/01/2000
			00-01
Cadmium	mg/kg	0.90	10.1
Chromium	mg/kg	40	164
Copper	mg/kg	34	83.6
Lead	mg/kg	34	775
Mercury	mg/kg	0.12	0.57
Nickel	mg/kg	42	41.1
Zinc	mg/kg	160	851
bis(2-Ethylhexyl) phthalate	ug/kg	9,300	400,000

Parameter	Units	Ecological RAOs	S101-SD30
			03/26/2001
			00-01
Arsenic	mg/kg	18	25.1
Cadmium	mg/kg	0.90	6.5
Chromium	mg/kg	40	62.0
Copper	mg/kg	34	48.2
Lead	mg/kg	34	208
Mercury	mg/kg	0.12	0.33
Nickel	mg/kg	42	36.4
Zinc	mg/kg	160	393
bis(2-Ethylhexyl) phthalate	ug/kg	9,300	13,000

Parameter	Units	Ecological RAOs	S101-SD28
			11/01/2000
			00-01
Arsenic	mg/kg	18	22.2
Cadmium	mg/kg	0.90	3.6
Copper	mg/kg	34	49.9
Lead	mg/kg	34	116
Zinc	mg/kg	160	478
Anthracene	ug/kg	57.2	200
Benzo(a)anthracene	ug/kg	108	1,800
Benzo(a)pyrene	ug/kg	150	2,200
Chrysene	ug/kg	166	3,300
Dibenz(a,h)anthracene	ug/kg	33	430
Fluoranthene	ug/kg	423	6,400
Phenanthrene	ug/kg	204	2,200
Pyrene	ug/kg	195	5,100

Parameter	Units	Ecological RAOs	S101-SD06
			01/30/1995
			00-01
Arsenic	mg/kg	18	21.2
Cadmium	mg/kg	0.90	2.7
Copper	mg/kg	34	37.9
Lead	mg/kg	34	206
Zinc	mg/kg	160	287
Anthracene	ug/kg	57.2	1,000
Benzo(a)anthracene	ug/kg	108	4,800
Benzo(a)pyrene	ug/kg	150	4,800
Chrysene	ug/kg	166	5,900
Dibenzo(a,h)anthracene	ug/kg	33	800
Fluoranthene	ug/kg	423	13,000
Fluorene	ug/kg	77.4	540
Phenanthrene	ug/kg	204	7,100
Pyrene	ug/kg	195	6,600

Parameter	Units	Ecological RAOs	S101-SD29
			03/26/2001
			00-01
Cadmium	mg/kg	0.90	2.0
Lead	mg/kg	34	65.1
Nickel	mg/kg	42	34.5
Zinc	mg/kg	160	212

Parameter	Units	Ecological RAOs	S101-SD07
			01/30/1995
			00-01
Arsenic	mg/kg	18	19.4
Nickel	mg/kg	42	27.9
Fluoranthene	ug/kg	423	1,800
Pyrene	ug/kg	195	1,200
bis(2-Ethylhexyl) phthalate	ug/kg	9,300	100,000

LEGEND

- SEDIMENT SAMPLE LOCATION S101−SD13
- OUTFALL
- FRANKLIN STEEL 15" DRAIN TILE
- LOWER SEGMENT REACH: DARK BLUE REQUIRING REMEDIATION. LIGHT BLUE POTENTIALLY REQUIRING REMEDIATION
- FIVE REACHES TARGETED FOR REMEDIATION

NOTE: SHADED RESULTS EXCEED THE REMEDIAL ACTION OBJECTIVES FOR SEDIMENT.

RAOs—REMEDIAL ACTION OBJECTIVES

SOURCE OF MAP: SAIC DRAWING DATED DECEMBER 2002.

N

0 400 800
SCALE: 1"= 400

NO.	BY	DATE	REVISION	APP'D.
5.				
4.				
3.				
2.				
1.				

FRANKLIN STEEL COMPANY
BLACKLICK, OH

FIGURE 2.10
EXPOSURE UNIT 3 (AREAS OF REMEDIATION)

DRAWN BY: QR	DRAWING SCALE: 1" = 400'	PRJ # 6771\51\CMS REPORT	
CHECKED BY: TL		FILE NO: Figure 2.10.dwg	
APPROVED BY: TL	DATE PRINTED:	FIGURE 2.10	
DATE: May 2009			

RMT
655 Metro Place South, Suite 750
Dublin, Ohio 43017-5306
Phone: 614-793-0026 • Fax: 614-793-0151

Drawing Name: J:\06771\51\CMS Report\Figure 2.10.dwg
Operator Name: ROWLAND, STEVEN
Drawing Plot Scale: 0.009454
Dwg Size: 0.81 Mb
Plot Date: May 27, 2009
Plot Time: 4:07 PM
Attached Xref's: SED-SURF-BASE
Attached Images: 210958-183828-80579; aerial 4;
Layout: FIG 2

Appendix A
Opinions of Probable Costs

Soil
Removal of Uncovered and Capped Areas

Soil
Franklin Steel
RMT Project No. 06771.51

By: LSS
Checked: TSL
Date: Dec-08

Capital Cost Estimate

ITEM NUMBER	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COSTS	BASIS OF COST
1	**Fees/Services Associated with Land Use Controls**	1	LS	$5,000	$5,000	Legal and real estate fees
2	**Workplans & Design, Procurement, Construction Management**					
2.1	Engineering plans	1	Est.	$40,000	$40,000	Development of work plan including Health and Safety Plan, Design of plan of action for soil removal of all areas
2.2	Contracting, Procurement, Construction Management	1	Est.	$75,000	$75,000	Subcontractor contracting, permitting, equipment rental, material procurement, and construction management oversight; Cost based on preliminary estimate for 6 weeks of oversight.
3	**Construction**					
3.1	Mobilization, Site Preparation, De-Mobilization	1	LS	$15,000	$15,000	Contractor travel, equipment arrival and setup
3.2	Excavate top 2 feet, 34,450 sq ft	5,000	Tons	$10	$50,000	remove all areas, capped and non capped, 30% contingency
3.3	Transport & Disposal of excavated material	5,000	Tons	$40	$200,000	Assumes use of Subtitle D Landfill for disposal in Columbus - non haz waste
	Remove 16,000 sf concrete 1 ft thick	5,000	sf	$15	$75,000	remove areas of existing concrete cap
	Dispose concrete - 5,000 sf, 185 cy, 375 ton	375	tons	$20	$7,500	CD&D landfill
	Pour new concrete, 1 ft thick, 600 cy	185	cy	$150	$27,750	replace former concrete areas
3.5	Fill, and Place & Compact with 2 feet of aggregate	700	Tons	$15	$10,500	Backfill former areas which were uncapped with 2 ft aggregate
3.6	confiirmation sampling	150	each	$400	$60,000	3 to 4 samples in all the excavated areas
	SUBTOTAL				**$565,750**	
	Contingency (% of Estimated Subtotal)		25%		$141,400	
	CAPITAL TOTAL				**$707,150**	

Operations and Maintenance Cost Estimate

ITEM NUMBER	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COSTS	BASIS OF COST
4	**Pavement cover inspection**	0	YEAR	$1,000	$0	
5	**Estimated repair**	0	YEAR	$2,000	$0	
6	**Report inspection and maintenance activities**	0	YEAR	$500	$0	Annual Report
	SUBTOTAL				$0	
	Contingency (% of Estimated Subtotal)		25%		$0	
	ANNUAL OPERATIONS AND MAINTENANCE COST				**$0**	
Total Net Present Value (Capital and Long Term O&M)					**$707,000**	

(ASSUMING 5% INTEREST, AND 30 YEAR POST CLOSURE CARE)

NOTE: *1. The presented cost opinion has been prepared for the purpose of evaluating the costs of capital, operations and maintenance.*
2. Net Present Value costs assume a 5% rate of return and 30-year O&M period.

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Soil
Cap All Impacted Soil Areas

Soil
Franklin Steel
RMT Project No. 06771.51

By: LSS
Checked: TSL
Date: Dec-08

Capital Cost Estimate

ITEM NUMBER	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COSTS	BASIS OF COST
1	**Fees/Services Associated with Land Use Controls**	1	LS	$5,000	$5,000	Legal and real estate fees
2	**Workplans & Design, Procurement, Construction Management**					
2.1	Engineering plans	1	Est.	$30,000	$30,000	Development of work plan including Health and Safety Plan, Design of plan of action for capping all soil areas
2.2	Contracting, Procurement, Construction Management	1	Est.	$50,000	$50,000	Subcontractor contracting, permitting, equipment rental, material procurement, and construction management oversight; Cost based on preliminary estimate for 4 weeks of oversight.
3	**Construction**					
3.1	Mobilization, Site Preparation, De-Mobilization	1	LS	$15,000	$15,000	Contractor travel, equipment arrival and setup
3.2	Excavate top 1 feet	2,150	Tons	$10	$21,500	29,450 sq ft of uncovered areas, 30% contingency
3.3	Transport & Disposal of excavated material	2,150	Tons	$40	$86,000	Assumes use of Subtitle D Landfill for disposal in Columbus, non haz waste
3.5	Fill, place & Compact aggregate to within 4 inches of surface	1,630	Tons	$15	$24,450	Backfill comprised of compactable fill soil, 1,630 cy
3.6	Asphalt cap, 4inch, 220 cy, 400 ton placed	650	Tons	$100	$65,000	asphalt areas to be capped, 29,450 sq ft
3.7	confirmation sampling	75	each	$400	$30,000	3 to 4 samples per capped area
	SUBTOTAL				**$326,950**	
	Contingency (% of Estimated Subtotal)		25%		$81,700	
	CAPITAL TOTAL				**$408,650**	

Operations and Maintenance Cost Estimate

ITEM NUMBER	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COSTS	BASIS OF COST
4	**Pavement cover inspection**	1	YEAR	$2,000	$2,000	
5	**Estimated repair**	1	YEAR	$10,000	$10,000	
6	**Report inspection and maintenance activities**	1	YEAR	$3,000	$3,000	Annual Report
	SUBTOTAL				$15,000	
	Contingency (% of Estimated Subtotal)		25%		$3,800	
	ANNUAL OPERATIONS AND MAINTENANCE COST				**$18,800**	
Total Net Present Value (Capital and Long Term O&M)					**$698,000**	

(ASSUMING 5% INTEREST, AND 30 YEAR POST CLOSURE CARE)

NOTE: *1. The presented cost opinion has been prepared for the purpose of evaluating the costs of capital, operations and maintenance.*
2. Net Present Value costs assume a 5% rate of return and 30-year O&M period.

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Soil
Removal of Uncovered Areas
Maintenance of Covers

Soil
Franklin Steel
RMT Project No. 06771.51

By: LSS
Checked: TSL
Date: Dec-08

Capital Cost Estimate

ITEM NUMBER	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COSTS	BASIS OF COST
1	**Fees/Services Associated with Land Use Controls**	1	LS	$5,000	$5,000	Legal and real estate fees
2	**Workplans & Design, Procurement, Construction Management**					
2.1	Engineering plans	1	Est.	$30,000	$30,000	Development of work plan including Health and Safety Plan, Design of plan of action for soil removal of uncapped areas
2.2	Contracting, Procurement, Construction Management	1	Est.	$50,000	$50,000	Subcontractor contracting, permitting, equipment rental, material procurement, and construction management oversight; Cost based on preliminary estimate for 4 weeks of oversight.
3	**Construction**					
3.1	Mobilization, Site Preparation, De-Mobilization	1	LS	$15,000	$15,000	Contractor travel, equipment arrival and setup
3.2	Excavate top 2 feet	4,300	Tons	$10	$43,000	uncapped areas, 18,000 sq ft, 2 feet deep - 33% contingency
3.3	Transport & Disposal of excavated material	4,300	Tons	$40	$172,000	Assumes use of Subtitle D Landfill for disposal in Columbus, non haz waste
3.5	Aggegate and placement	4,300	Tons	$15	$64,500	Backfill comprised of compactable fill aggregate
3.6	confirmation sampling	75	each	$400	$30,000	3 to 4 samples per excavated area
	SUBTOTAL				**$409,500**	
	Contingency (% of Estimated Subtotal)		25%		$102,400	
	CAPITAL TOTAL				**$511,900**	

Operations and Maintenance Cost Estimate

ITEM NUMBER	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COSTS	BASIS OF COST
4	**Pavement cover inspection**	1	YEAR	$1,000	$1,000	
5	**Estimated repair**	1	YEAR	$5,000	$5,000	
6	**Report inspection and maintenance activities**	1	YEAR	$2,000	$2,000	Annual Report
	SUBTOTAL				$8,000	
	Contingency (% of Estimated Subtotal)		25%		$2,000	
	ANNUAL OPERATIONS AND MAINTENANCE COST				**$10,000**	
Total Net Present Value (Capital and Long Term O&M)					**$666,000**	

(ASSUMING 5% INTEREST, AND 30 YEAR POST CLOSURE CARE)

NOTE: *1. The presented cost opinion has been prepared for the purpose of evaluating the costs of capital, operations and maintenance.*
2. Net Present Value costs assume a 5% rate of return and 30-year O&M period.

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Unzinger Ditch Sediment - Five Target Reaches
Capping of Sediment

Sediment
Franklin Steel
RMT Project No. 06771.51

By: LSS
Checked: TSL
Date: Dec-08

Capital Cost Estimate

ITEM NUMBER	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COSTS	BASIS OF COST
1	**Fees/Services Associated with Land Use Controls**	1	LS	$5,000	$5,000	
1a	Permitting/Easement for Adjacent Properties	1	LS	$30,000	$30,000	
2	**Workplans & Design, Procurement, Construction Management**					
2.1	Engineering plans	1	Est.	$50,000	$50,000	Development of work plan including Health and Safety Plan, Design of plan of action for sediment capping
2.2	Contracting, Procurement, Construction Management	1	Est.	$50,000	$50,000	Subcontractor contracting, permitting, equipment rental, material procurement, and construction management oversight; Cost based on preliminary estimate for 4 weeks of oversight.
3	**Construction**					
3.1	Mobilization, Site Preparation, De-Mobilization	1	LS	$15,000	$15,000	Contractor travel, equipment arrival and setup
3.2	Reroute Ditch/drain work area	1	LS	$50,000	$50,000	
3.3	Clear and Grub vegetation from stream	1	LS	$50,000	$50,000	
3.4	Erosion Control/stabilization, vegetation & landscaping	1	LS	$25,000	$25,000	
3.5	Stone/Rip Rap	1,200	tons	$50	$60,000	
3.6	Liner, placed	13,200	sq ft	$3	$39,600	geomembrane, geotextile clay liner
3.7	Reseed for 2 years	2	Year	$2,000	$4,000	
	SUBTOTAL				**$378,600**	
	Contingency (% of Estimated Subtotal)		25%		$94,700	
	CAPITAL TOTAL				**$473,300**	

Operations and Maintenance Cost Estimate

ITEM NUMBER	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COSTS	BASIS OF COST
4	**Cap inspection**	2	EACH	$1,500	$3,000	
5	**Sampling Cap, every 5 years**	1	EACH	$1,000	$1,000	
6	**Estimated repair**	1	YEAR	$10,000	$10,000	
7		0	EACH	$2,000	$0	
8	**Report inspection and maintenance activities**	1	YEAR	$5,000	$5,000	Annual Report
	SUBTOTAL				$19,000	
	Contingency (% of Estimated Subtotal)		25%		$4,800	
	ANNUAL OPERATIONS AND MAINTENANCE COST				**$23,800**	
Total Net Present Value (Capital and Long Term O&M)					**$839,000**	

(ASSUMING 5% INTEREST, AND 30 YEAR POST CLOSURE CARE)

NOTE: *1. The presented cost opinion has been prepared for the purpose of evaluating the costs of capital, operations and maintenance.*
2. Net Present Value costs assume a 5% rate of return and 30-year O&M period.

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Unzinger Ditch Sediment - Lower Reach
Capping of Sediment

Sediment
Franklin Steel
RMT Project No. 06771.51

By: LSS
Checked: TSL
Date: Dec-08

Capital Cost Estimate

ITEM NUMBER	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COSTS	BASIS OF COST
1	**Fees/Services Associated with Land Use Controls**	1	LS	$5,000	$5,000	
1a	Permitting/Easement for Adjacent Properties	1	LS	$30,000	$30,000	
2	**Workplans & Design, Procurement, Construction Management**					
2.1	Engineering plans	1	Est.	$50,000	$50,000	Development of work plan including Health and Safety Plan, Design of plan of action for sediment capping
2.2	Contracting, Procurement, Construction Management	1	Est.	$50,000	$50,000	Subcontractor contracting, permitting, equipment rental, material procurement, and construction management oversight; Cost based on preliminary estimate for 4 weeks of oversight.
3	**Construction**					
3.1	Mobilization, Site Preparation, De-Mobilization	1	LS	$15,000	$15,000	Contractor travel, equipment arrival and setup
3.2	Reroute Ditch/drain work area	1	LS	$50,000	$50,000	
3.3	Clear and Grub vegetation from stream	1	LS	$50,000	$50,000	
3.4	Erosion Control/stabilization, vegetation & landscaping	1	LS	$25,000	$25,000	
3.5	Stone/Rip Rap	1,850	tons	$50	$92,500	
3.6	Liner, placed	20,400	sq ft	$3	$61,200	geomembrane, geotextile clay liner
3.7	Reseed for 2 years	2	Year	$2,000	$4,000	
	SUBTOTAL				**$432,700**	
	Contingency (% of Estimated Subtotal)		25%		$108,200	
	CAPITAL TOTAL				**$540,900**	

Operations and Maintenance Cost Estimate

ITEM NUMBER	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COSTS	BASIS OF COST
4	**Cap inspection**	2	EACH	$3,000	$6,000	
5	**Sampling Cap, every 5 years**	1	EACH	$2,000	$2,000	
6	**Estimated repair**	1	YEAR	$15,000	$15,000	
7		0	EACH	$2,000	$0	
8	**Report inspection and maintenance activities**	1	YEAR	$5,000	$5,000	Annual Report
	SUBTOTAL				$28,000	
	Contingency (% of Estimated Subtotal)		25%		$7,000	
	ANNUAL OPERATIONS AND MAINTENANCE COST				**$35,000**	
Total Net Present Value (Capital and Long Term O&M)					**$1,079,000**	

(ASSUMING 5% INTEREST, AND 30 YEAR POST CLOSURE CARE)

NOTE: *1. The presented cost opinion has been prepared for the purpose of evaluating the costs of capital, operations and maintenance.*
2. Net Present Value costs assume a 5% rate of return and 30-year O&M period.

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Unzinger Ditch Sediment - Five Target Reaches
Removal

Sediment
Franklin Steel
RMT Project No. 06771.51

By: LSS
Checked: TSL
Date: Dec-08

Capital Cost Estimate

ITEM NUMBER	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COSTS	BASIS OF COST
1	**Fees/Services Associated with Land Use Controls**	1	LS	$5,000	$5,000	
1a	Permitting/Easement for Adjacent Properties	1	LS	$30,000	$30,000	access agreement from adjacent property owners during remediation
2	**Workplans & Design, Procurement, Construction Management**					
2.1	Engineering plans	1	Est.	$30,000	$30,000	Development of work plan including Health and Safety Plan, Design of plan of action for sediment removal
2.2	Contracting, Procurement, Construction Management	1	Est.	$35,000	$35,000	Subcontractor contracting, permitting, equipment rental, material procurement, and construction management oversight; Cost based on preliminary estimate for 4 weeks of oversight.
3	**Construction**					
3.1	Mobilization, Site Preparation, De-Mobilization	1	LS	$15,000	$15,000	Contractor travel, equipment arrival and setup
3.2	Reroute Ditch/drain work area	1	LS	$50,000	$50,000	4-week time period during fall season
3.3	Excavate top 6 to 12 inches	950	Tons	$15.00	$14,250	1,500 feet, average 7 feet wide ditch, 1 ft deep, 33% contingency
3.4	Transport & Disposal of excavated material	950	Tons	$40.00	$38,000	Assumes use of Subtitle D Landfill for disposal - non haz waste
3.5	Place & Compact clean fill/aggregate to existing grade	950	Tons	$25.00	$23,750	Backfill comprised of compactable fill soil/aggregate
3.6	Erosion Control/stabilization, vegetation & landscaping	1	LS	$50,000	$50,000	
3.7	Clear and Grub vegetation from stream	1	LS	$50,000	$50,000	preparation of stream for remediation, clearing and grubbing
3.8	Confirmation Sampling	1	LS	$5,000	$5,000	
	SUBTOTAL				**$346,000**	
	Contingency (% of Estimated Subtotal)		25%		$86,500	
	CAPITAL TOTAL				**$432,500**	

Operations and Maintenance Cost Estimate

ITEM NUMBER	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COSTS	BASIS OF COST
4	**Reseed**	1	EACH	$2,000	$2,000	
		0	EACH	$2,000	$0	
6	**Report**	1	YEAR	$3,000	$3,000	Annual Report
	SUBTOTAL				$5,000	
	Contingency (% of Estimated Subtotal)		25%		$1,300	
	ANNUAL OPERATIONS AND MAINTENANCE COST				**$6,300**	
Total Net Present Value (Capital and Long Term O&M)					**$444,000**	

(ASSUMING 5% INTEREST, AND 2 YEAR POST CLOSURE CARE)

NOTE: *1. The presented cost opinion has been prepared for the purpose of evaluating the costs of capital, operations and maintenance.*
2. Net Present Value costs assume a 5% rate of return and 30-year O&M period.

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Unzinger Ditch Sediment - Lower Reach
Removal

Sediment
Franklin Steel
RMT Project No. 06771.51

By: LSS
Checked: TSL
Date: Dec-08

Capital Cost Estimate

ITEM NUMBER	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COSTS	BASIS OF COST
1	**Fees/Services Associated with Land Use Controls**	1	LS	$5,000	$5,000	
1a	Permitting/Easement for Adjacent Properties	1	LS	$30,000	$30,000	access agreement from adjacent property owners during remediation
2	**Workplans & Design, Procurement, Construction Management**					
2.1	Engineering plans	1	Est.	$30,000	$30,000	Development of work plan including Health and Safety Plan, Design of plan of action for sediment removal
2.2	Contracting, Procurement, Construction Management	1	Est.	$35,000	$35,000	Subcontractor contracting, permitting, equipment rental, material procurement, and construction management oversight; Cost based on preliminary estimate for 4 weeks of oversight.
3	**Construction**					
3.1	Mobilization, Site Preparation, De-Mobilization	1	LS	$15,000	$15,000	Contractor travel, equipment arrival and setup
3.2	Reroute Ditch/drain work area	1	LS	$50,000	$50,000	4-week time period during fall season
3.3	Excavate top 6 to 12 inches	1,450	Tons	$15.00	$21,750	1,500 feet, average 7 feet wide ditch, 1 ft deep AND 2,400 feet, average 3 feet wide ditch, 9 inches deep, 33% contingency
3.4	Transport & Disposal of excavated material	1,450	Tons	$40.00	$58,000	Assumes use of Subtitle D Landfill for disposal - non haz waste
3.5	Place & Compact clean fill/aggregate to existing grade	1,450	Tons	$25.00	$36,250	Backfill comprised of compactable fill soil/aggregate
3.6	Erosion Control/stabilization, vegetation & landscaping	1	LS	$65,000	$65,000	
3.7	Clear and Grub vegetation from stream	1	LS	$65,000	$65,000	preparation of stream for remediation, clearing and grubbing
3.8	Confirmation Sampling	1	LS	$5,000	$5,000	
	SUBTOTAL				**$416,000**	
	Contingency (% of Estimated Subtotal)		25%		$104,000	
	CAPITAL TOTAL				**$520,000**	

Operations and Maintenance Cost Estimate

ITEM NUMBER	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COSTS	BASIS OF COST
4	**Reseed**	1	EACH	$6,000	$6,000	
		0	EACH	$2,000	$0	
6	**Report**	1	YEAR	$3,000	$3,000	Annual Report
	SUBTOTAL				$9,000	
	Contingency (% of Estimated Subtotal)		25%		$2,300	
	ANNUAL OPERATIONS AND MAINTENANCE COST				**$11,300**	
Total Net Present Value (Capital and Long Term O&M)					**$541,000**	

(ASSUMING 5% INTEREST, AND 2 YEAR POST CLOSURE CARE)

NOTE: *1. The presented cost opinion has been prepared for the purpose of evaluating the costs of capital, operations and maintenance.*
2. Net Present Value costs assume a 5% rate of return and 30-year O&M period.

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Groundwater in Vicinity of S109-MW06
Monitored Natural Attenuation

Groundwater
Franklin Steel
RMT Project No. 6771.51

By: LSS
Checked: TSL
Date: Dec-08

Capital Cost Estimate

ITEM NUMBER	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COSTS	Basis of Cost
1	**Administrative/Legal Controls**	1	1	$5,000	$5,000	
2	**Design Monitoring Plan**	1	1	$10,000	$10,000	
3	**Groundwater monitoring for MNA parameters**	0	Each	$3,000	$0	VOCs
	SUBTOTAL				**$15,000**	
	Contingency (% of Estimated Subtotal)		25%		$3,800	
	TOTAL CAPITAL				**$18,800**	

Operations and Maintenance Cost Estimate

ITEM NUMBER	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COSTS	
4	**Sampling and Analysis for 3 years**	8	3 years	$4,500	$36,000	Average sampling event for the 3 years and 8 sampling events. Basis: Year 1, quarterly sampling VOCs, PAHs, metals from 5 wells; Year 2 semi-annual sampling, VOCs only for 5 wells; Year 3 semi-annual sampling, VOCs only for 5 wells
5	**Reporting**	3	YEAR	$6,000	$18,000	Annual Report, includes data validation and reporting
	SUBTOTAL				$54,000	
	Contingency (% of Estimated Subtotal)		25%		$13,500	
	ANNUAL OPERATIONS AND MAINTENANCE COST				**$67,500**	
Total Net Present Value (Capital and Long Term O&M)					**$203,000**	

(ASSUMING 5% INTEREST, AND 3 YEAR POST CLOSURE CARE)

NOTE: *1. The presented cost opinion has been prepared for the purpose of evaluating the costs of capital, operations and maintenance.*
2. Net Present Value costs assume a 5% rate of return and 30-year O&M period.

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Groundwater in Vicinity of S109-MW06
Groundwater Treatment System

Groundwater
Franklin Steel
RMT Project No. 6771.51

By: LSS
Checked: TSL
Date: Dec-08

Capital Cost Estimate

ITEM NUMBER	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COSTS	BASIS OF COST
1	**Admin/Legal Fees Associated with Land Use Controls**	1	1	$5,000	$5,000	
1a	Permiting Requirements, NPDES	1	1	$5,000	$5,000	
2	**Design Monitoring Plan**	1	1	$10,000	$10,000	
2a	**Design/Pilot Test Pump and Treat System**	1	1	$50,000	$50,000	
3	**Install Recovery Well Well and Treatment System**					Assume 1 new MW, 1 recovery well
3.1	Install new monitoring well	1	Each	$2,000	$2,000	15 feet deep, 2-inch diameter
3.2	Recovery Well Installation	1	Each	$5,000	$5,000	20 feet deep, 4-inch diameter
3.3	Force Main to building with pump	1	LS	$7,000	$7,000	
3.4	Air stripper Installation	1	LS	$30,000	$30,000	2 - 5 gpm pump and treat system
	SUBTOTAL				**$114,000**	
	Contingency (% of Estimated Subtotal)		25%		$28,500	
	TOTAL CAPITAL				**$142,500**	

Operations and Maintenance Cost Estimate

ITEM NUMBER	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COSTS	BASIS OF COST
4	**GW Remediation System Sampling and Analysis**	4	quarterly	$1,000	$4,000	quarterly remediation system sampling and analysis
5	**Remediation System Operate/Maintain**	12	month	$1,500	$18,000	
6	**Carbon Replacement**	1	5 years	$1,000	$1,000	
7	**System Reporting**	1	YEAR	$8,000	$8,000	Annual Report, includes data validation and reporting
8	**GW Monitoring - Sampling and Analysis**	3	YEAR	$4,500	$13,500	Average sampling event for the 3 years and 8 sampling events. Basis: Year 1, quarterly sampling VOCs, PAHs, metals from 5 wells; Year 2 semi-annual sampling, VOCs only for 5 wells; Year 3 semi-annual sampling, VOCs only for 5 wells
9	**GW Monitoring and System Reporting**	3	YEAR	$6,000	$18,000	Annual Report, includes data validation and reporting
	SUBTOTAL				**$62,500**	
	Contingency (% of Estimated Subtotal)		25%		$15,600	
	ANNUAL OPERATIONS AND MAINTENANCE COST				**$78,100**	
Total Net Present Value (Capital and Long Term O&M)					**$356,000**	

(ASSUMING 5% INTEREST, AND 3 YEAR POST CLOSURE CARE WHICH INCLUDES 1 YEAR REMEDIATION SYSTEM AND 2 YEARS MONITORING)

NOTE: *1. The presented cost opinion has been prepared for the purpose of evaluating the costs of capital, operations and maintenance.*
2. Net Present Value costs assume a 5% rate of return and 30-year O&M period.

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