

REPORT ON THE
SITE CHARACTERIZATION
OF THE
FORMER WASTE DISPOSAL SITE

LEEDS ASSEMBLY PLANT
GENERAL MOTORS CORPORATION
KANSAS CITY, MISSOURI

VOLUME I OF II

Jan., 1992

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PREPARED AT GM COUNSEL'S REQUEST

EMPLOYEE - OWNED
Burns & McDonnell
ENGINEERS - ARCHITECTS - CONSULTANTS
Kansas City, Missouri

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LIST OF ACRONYMS AND ABBREVIATIONS

ATSDR	Agency for Toxic Substances and Disease Registry
ARAR	Applicable or Relevant and Appropriate Requirements
ASTM	American Society for Testing and Materials
BTEX	Benzene, Toluene, Ethyl Benzene, and Xylene
BOC	Buick - Oldsmobile - Cadillac
Cd	Cadmium
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
Cl	Chlorine
CLP	Contract Laboratory Program
cm	Centimeter
CME	Central Mines and Equipment
DNAPLs	Dense Non-Aqueous Phase Liquids
DOH	Department of Health
EMS	Electromagnetic Survey
EPA	Environmental Protection Agency
ERB	Equipment Rinsate Blank
F	Fahrenheit
ft	Feet
g	Gram
GM	General Motors Corporation
IRIS	Integrated Risk Information System
Kg	Kilogram
L	Liter
LDVI	Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses
LDVO	Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses
MCL	Maximum Contaminated Level
MDNR	Missouri Department of Natural Resources
mg	Milligram
MO	Missouri
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NPL	National Priority List
OVM	Organic Vapor Monitor
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PCE	Tetrachloroethene
PI	Preliminary Investigation
ppm	Parts Per Million
PVC	Poly Vinyl Chloride
QA	Quality Assurance
QC	Quality Control
QL	Quantitation Limit
RCRA	Resource, Conservation and Recovery Act
REC	Percent Recovery
RPD	Relative Percent Difference
SC	Site Characterization

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LIST OF ACRONYMS AND ABBREVIATIONS (cont'd)

SOW	Statement of Work
su	Standard Units
SVOCs	Semi-Volatile Organic Compounds
SWLO	Southwest Laboratory of Oklahoma
TPH	Total Petroleum Hydrocarbons
TSS	Total Suspended Solids
USDHHS	United States Department of Health and Human Services
USGS	United States Geologic Survey
VOCs	Volatile Organic Compounds
µg	Microgram

EXECUTIVE SUMMARY

Two investigations have been conducted at the General Motors Leeds Assembly Plant, Former Waste Disposal Site. These investigations, conducted during the fall of 1990 and the summer of 1991, were carried out to characterize potential surface and subsurface contamination resulting from past landfilling activities. The data from both investigations is included in this document and was considered in reaching the determinations made herein.

The site area is roughly bounded by the Blue River on the west, Round Grove Creek on the south, an abandoned railroad line on the east, and rail and truck loading/shipping areas on the north. The thickness of fill material in the area of investigation is variable, ranging from 0 to 22 feet. The fill is underlain by relatively tight clays and gravel. Shale bedrock exists approximately 55 to 60 feet below the surface.

Groundwater exists below the surface at depths of approximately 13 to 22 feet. Groundwater flow is generally to the southwest at a velocity of 0.2 to 1.7 feet per year.

Investigation activities included non-intrusive surveying using magnetometer and electromagnetic methods, installation of shallow and deep monitoring wells, and sampling and analysis of surface and subsurface soils, sediment, groundwater, and surface water. Samples were analyzed for various parameters, including volatile and semivolatile organic compounds, inorganic constituents, and general indicators of contamination.

The results of the magnetometer and electromagnetic surveys were used to define the approximate boundaries of the fill area. The areal extent of the landfill is approximately 9.5 acres.

Volatile and semivolatile organic compounds were detected at low to moderate levels in subsurface soil on the west-central edge of the former landfill. Low to moderate levels of total petroleum hydrocarbons were detected in most surface soil and sediment samples.

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Inorganic results indicated elevated levels of beryllium, iron, and manganese in soils throughout the site. These levels are considered to be a result of naturally occurring background concentrations and are not considered to present a risk to human health or the environment.

Iron and manganese levels in groundwater exceeded Missouri Class VII secondary standards for groundwater quality. However, the levels observed are considered to be directly related to naturally occurring sources. Water quality standards for these parameters are predominantly for aesthetic considerations. Their presence most probably does not present a health risk. Barium and selenium were each detected at marginally elevated levels in separate wells.

Arsenic in groundwater was detected at elevated levels in most of the monitoring wells screened in the deep portion of the aquifer. It is significant that arsenic was also detected above water quality standards in the deep upgradient well. Given the lack of appreciable arsenic levels in the soils or shallow wells, an off-site source (perhaps naturally-occurring) is suspected.

Low levels of volatile and semivolatile organic compounds were detected in one shallow groundwater monitoring well on the west-central edge of the landfill.

Given the nature of the site geology, hydrogeology, and contaminant chemical and physical characteristics, no significant migration of the relatively low levels of contaminants is expected to occur.

A Baseline Risk Assessment was conducted to review the chemicals detected and their toxicity, as well as the potential for exposure pathways and exposed populations. The risk assessment concluded that no complete exposure pathways exist and therefore no significant health risk exists to on-site or off-site populations.

The quality control/quality assurance review conducted on the data generated during these investigations determined that the data was of adequate quality upon which to base the conclusions reached in this report.

Given the lack of a significant risk to the environment or human health, no further investigation is recommended for this site.

* * * * *

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

This document presents the results of two investigations conducted to characterize the nature and extent of potential contamination at the Former Waste Disposal Site at the General Motors (GM) Leeds Assembly Plant in Kansas City, Missouri. A Site Characterization (SC) was performed as a follow-up to the Preliminary Investigation (PI), and as part of the voluntary plant-wide environmental assessment process related to the closure and potential sale of the facility.

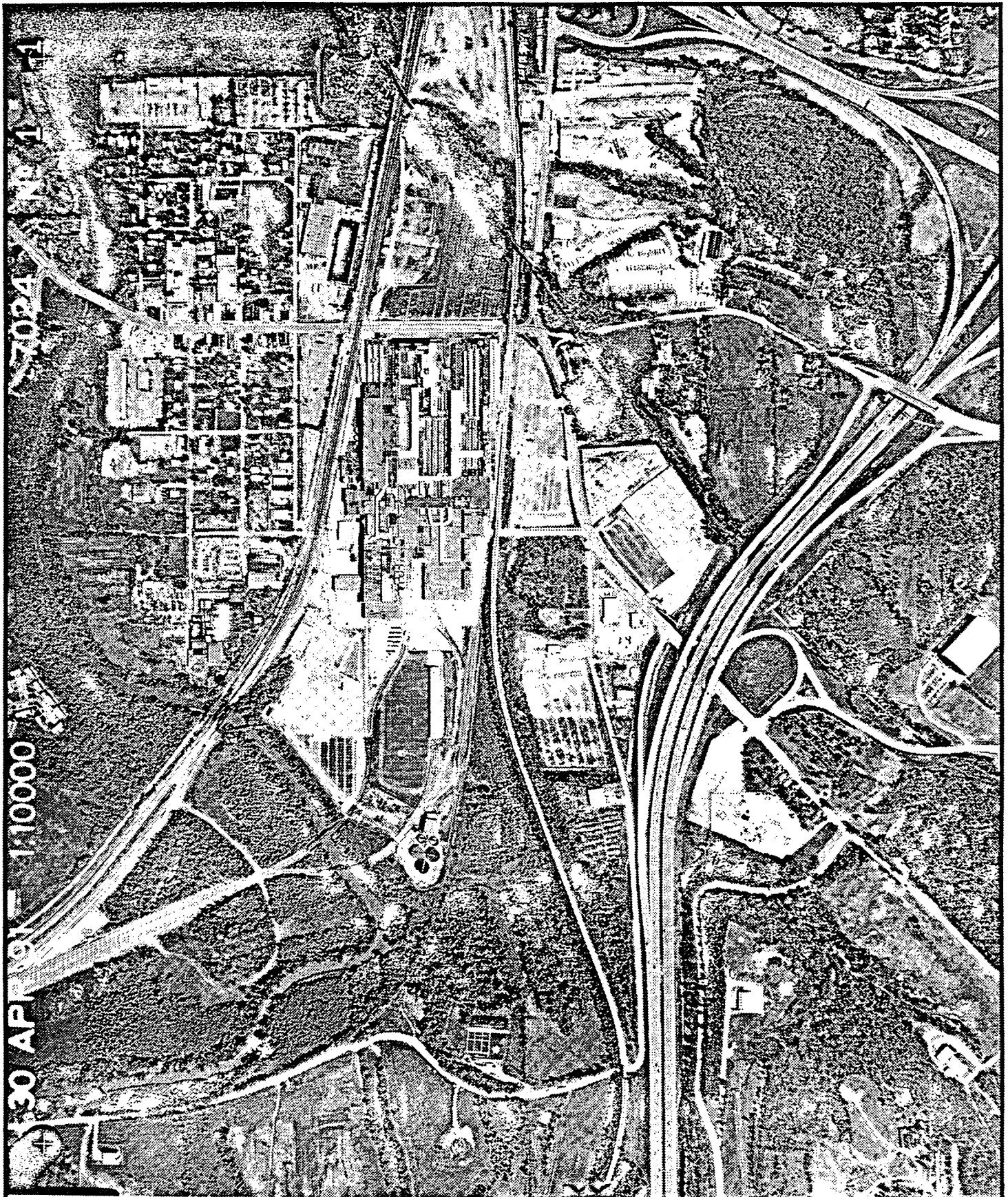
References will be made to the Site Characterization Work Plan for the Former Waste Disposal Site (SC Work Plan), June 1991. The SC Work Plan contains the detailed procedures and specifications used during the field investigation phase of the SC. The SC Work Plan was developed using CERCLA guidance criteria in order to obtain high quality data.

1.2 SITE BACKGROUND

A description of the site, site history, and previous investigations are discussed to provide the background necessary to evaluate the investigation area.

1.2.1 Site Description

The investigation area is located on the property of the GM Leeds Assembly Plant in Kansas City, Missouri, which is shown in Figure 1-1. An aerial photograph (April 1991) of the GM Leeds Assembly Plant is provided in Figure 1-2. The investigation area at Leeds falls within the boundaries of the area legally described as is the NE 1/4, SW 1/4, SECTION 24, T49N, R33W, Jackson County, Missouri. The Former Waste Disposal Site is roughly bounded by the Blue River on the west, Round Grove Creek on the south, an abandoned railroad line on the east, and the plant rail and truck loading facilities on the north.



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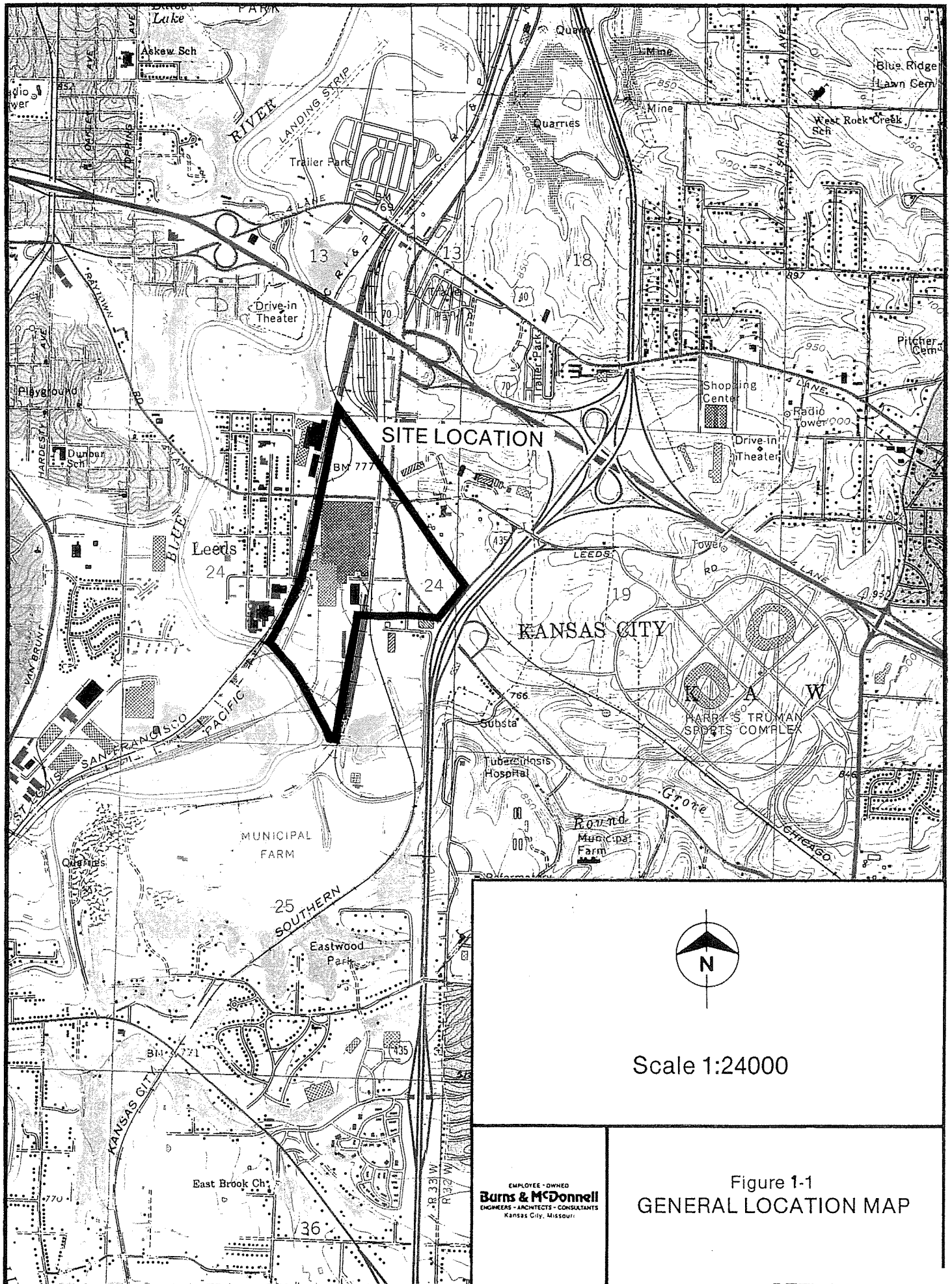
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Figure 1-2
AERIAL PHOTOGRAPH

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Figure 1-1
GENERAL LOCATION MAP

A wastewater treatment plant has been constructed on the southeastern portion of the investigation area. The southwestern portion is unpaved and consists of a wooded area and overgrown vegetation.

1.2.2 Site History

A solid waste disposal unit (landfill) was operated on the southern end of the property at the Leeds Assembly Plant from the early 1950s to 1968. When the disposal site was closed, the area was covered with soil and several inches of asphalt were placed over the northern half of the site to allow for its use as a parking area. No records were kept of the exact type or amount of wastes buried in the landfill.

A "Notification of Hazardous Waste Site" was submitted by GM to the U.S. Environmental Protection Agency (EPA) in June of 1981 (see Appendix A). EPA placed the closed landfill on a "site log" in 1981, and a preliminary assessment was conducted by the Agency at that time. The assessment consisted of a literature search, phone calls, and off-site viewing of the area. An on-site inspection was conducted in 1982. In 1985, the EPA sent a letter to GM indicating that the landfill site did not pose a current threat to the public or to the environment and that no further action by the EPA was anticipated. This letter is also included in Appendix A.

1.2.3 Preliminary Investigation

A preliminary investigation of the Former Waste Disposal Site was conducted by Burns & McDonnell in 1990. The primary objectives of the PI were to evaluate whether contamination is present in soil or groundwater at the disposal site and to determine the general extent of the landfill boundary. A secondary objective was to determine whether contamination, if present, is migrating off of the site.

The PI consisted of a magnetometer survey of the entire investigation area, installation of seven groundwater monitoring wells, drilling two soil borings, and collection of two sediment samples. Physical and chemical analyses were performed on the soil and groundwater samples collected during these activities.

The investigation procedures and corresponding results from the PI are presented in detail in the report entitled The Preliminary Investigation of the Former Waste Disposal Site, February 1991 (PI Report). The PI results are also discussed in later sections of this report. Tabular results from the PI are presented in detail in Appendix B. The results of the PI were used to determine the sampling strategy for the SC.

1.3 REPORT ORGANIZATION

In order to present and interpret the results of the SC and PI most clearly, the remainder of this report is organized in the following manner:

Site Characterization Activities (Section 2.0)

The activities proposed in the SC Work Plan are summarized in this section. Deviations from this work plan are also stated.

Physical Characteristics (Section 3.0)

The geology, hydrogeology, and climatology of the site are described in this section.

Nature and Extent of Contamination (Section 4.0)

This section discusses the contamination encountered in the soil, groundwater, and surface water during the SC. The contamination encountered during the PI is also summarized and is used to aid in the overall characterization of the site. Potential sources of contamination are also discussed.

Contaminant Fate and Transport (Section 5.0)

Potential routes of exposure to the contamination at the site are given in this section. Contaminant persistence and migration are also discussed.

Baseline Risk Assessment Summary (Section 6.0)

A Baseline Risk Assessment was performed to evaluate potential danger to human health and the environment. This document is given in Appendix C. A summary of the Baseline Risk Assessment is given in Section 6.0.

Summary, Conclusions, and Recommendations (Section 7.0)

In addition to summarizing all of the above, recommendations regarding future work are presented.

* * * * *

2.0 SITE CHARACTERIZATION ACTIVITIES

The SC field activities were performed during the summer of 1991 and consisted of the following activities:

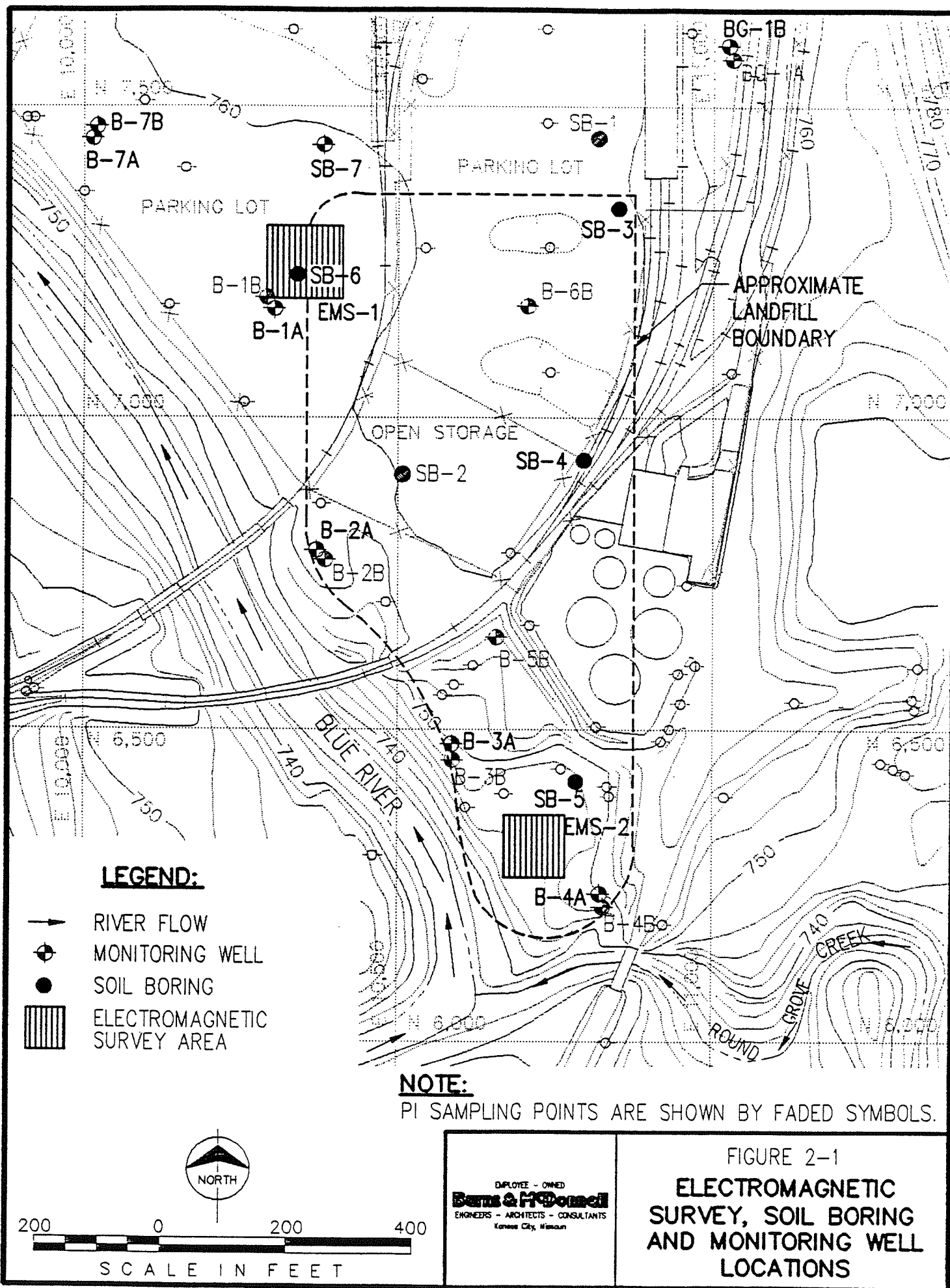
- Conducting an electromagnetic survey (EMS) over two specific areas at the Former Waste Disposal Site.
- Drilling five soil borings for subsurface soil sampling.
- Drilling and installing seven monitoring wells for subsurface soil and groundwater sampling.
- Collecting nine surface soil samples.
- Collecting three sediment samples.
- Collecting three surface water samples.

Sections 5.0 and 6.0 of the SC Work Plan discuss the planned scope of work and field investigation methods, respectively. The actual field investigation activities (including deviations from the original scope of work) are given in this section. Field notes from the SC are provided in Appendix E. The prescribed quality assurance/quality control (QA/QC) samples were collected. The results of QA/QC sampling are discussed in the QA/QC Evaluation given in Appendix D of this report.

2.1 ELECTROMAGNETIC SURVEYING

Prior to the commencement of intrusive field activities at the site, an EMS was conducted in two areas. These areas were identified in the PI as potentially containing buried fill material.

A survey grid was established over each of the suspected fill areas. Each grid consisted of survey lines on 10-foot spacings as indicated on Figure 2-1. An EMS device (Geonics EM31-D non-contacting terrain conductivity meter) was



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used in conjunction with a digital data logger (Geonics DL 55/31 data logging system) to collect the EMS readings. The resulting data was then contoured by computer using Surfer software. The EMS results are discussed in Section 4.2 of this report.

2.2 DRILLING AND MONITORING WELL INSTALLATION

In order to characterize subsurface soil and groundwater contamination at the Former Waste Disposal Site, two soil borings (SB-1 and SB-2), six bedrock monitoring well borings (B-1B through B-6B), and one shallow monitoring well boring (BG-1A) were installed during the PI.

NOTE: The "A" and "B" suffixes denoting shallow and deep monitoring well borings, respectively, were not used for PI samples prior to this report. These well borings, previously named B-1 through B-6, and BG-1, were referred to in the PI Work Plan, the PI Report, and the SC Work Plan using the old designation. However, for clarification and consistency, "A" and "B" suffixes have been added and the original PI drilling logs and laboratory data tables have been modified by hand to reflect this change using blue ink. Shallow and deep well borings installed during the SC were distinguished in the SC Work Plan. All future references to the well borings from the PI will utilize the "A" and "B" suffix nomenclature.

According to PI boring logs and monitoring well construction diagrams (Appendix F), Monitoring Well B-3B was installed to 45 feet below grade. However, during SC sampling activities, the field personnel determined that the total depth of this well was only 36 feet. Review of PI boring logs and field notes showed that gravel had been sliding into the boring during drilling. This caused the lower 9 feet of the boring to collapse before installation of the well. Consequently, Monitoring Well B-3B is actually a 36-foot well rather than a 45-foot well. Fortunately this cluster is surrounded by three deep monitoring wells (B-2B, B-5B, and B-4B) which can be used to characterize the deep aquifer in this area.

In order to resolve data gaps left by the PI, five soil borings (SB-3 through SB-7), five shallow well borings (B-1A through B-4A, and B-7A), and two deep

well borings (BG-1B and B-7B) were included in the SC Work Plan. An additional boring (SB-8) was planned but not drilled due to the inaccessibility of the proposed location. The SC well borings were designed to form clusters with similarly named PI well borings. An entirely new cluster was located in the northwest corner of the investigation area by the placement of well borings B-7A and B-7B. All new monitoring wells were spaced at least 10 feet from existing PI wells.

All seven soil borings and fourteen well borings drilled during the PI and SC (see Figure 2-1) were advanced to a minimum depth of 20 feet using a 7-5/8 inch outer-diameter hollow-stem auger equipped with Central Mines and Equipment (CME) continuous samplers. Bedrock and shallow boring installation procedures are described in the SC Work Plan (Sections 6.3.1 and 6.3.2, respectively). Monitoring wells were constructed using stainless steel riser pipe and 10 foot screens. Installation procedures are given in Section 6.3.3 of the SC Work Plan. Boring logs and monitoring well construction diagrams for the SC can be found in Appendix G.

2.3 SUBSURFACE SOIL SAMPLING

2.3.1 Physical Analysis

Table 5-4 of the SC Work Plan summarizes the subsurface soil physical sampling strategy that was followed during the field investigation. Soil samples for physical analysis were collected from borings SB-4, SB-5, SB-7, B-7B and BG-1B at depths of nine to 20 feet. The undisturbed samples were collected by pushing a thin-walled Shelby Tube according to ASTM D1587. Sample analyses included:

- Consolidation Characteristics
- Moisture Content
- Grain-Size Distribution
- Atterberg Limits

The results of the physical soil tests are contained in Appendix H.

2.3.2 Chemical Analysis

Soil samples were collected for chemical analysis from nine of the borings drilled during the SC, as discussed in Section 5.1.4 of the SC Work Plan. A CME continuous sampler was used according to Section 6.4.2 of the SC Work Plan. The portion of the continuous sample that was submitted for analysis was determined by visual screening and/or by screening with an organic vapor monitor (OVM). Chemical results from subsurface soil sampling are discussed in Section 4.2 of this report.

2.4 GROUNDWATER

Subsequent to monitoring well installation, well development and slug testing were performed for all newly installed monitoring wells. Field measurements, water level measurements, and analytical samples were collected from all PI and SC monitoring wells shown on Figure 2-1.

2.4.1 Well Development

Monitoring well development was performed on all newly installed wells to remove residual fluids and fine-grained material near the screen in order to improve the hydraulic connection between the well and the aquifer. Monitoring well development was accomplished by repeatedly removing water from the well, thereby drawing aquifer water through the filterpack and screen. Bailing techniques were used for well development as described in Section 6.5.1 of the SC Work Plan. All monitoring wells were purged of three saturated well volumes prior to sampling. This volume was calculated using the depth of the water column and the diameter of the well casing.

Water generated during development was collected in 55 gallon drums. This water will be managed by GM as stated in Section 6.10.3 of the SC Work Plan.

2.4.2 Field Measurements

An electronic water level indicator was used to measure groundwater levels in all monitoring wells. Measurements were made to the nearest 0.01 foot. Field measurements of temperature, pH, and specific conductivity were performed during the collection of samples for chemical analysis. These measurements

were taken according to Sections 6.5.2 and 6.5.6 of the SC Work Plan. Water level data and field measurements are presented in Appendix I of this report.

Slug tests (bail-down method) were conducted on all of the new monitoring wells using the procedures described in Section 6.5.3 of the SC Work Plan. The results are given in Appendix J and were evaluated based on the Hvorslev method to obtain estimates of hydraulic conductivity. This evaluation is presented in Section 3.2 of this report.

2.4.3 Sampling

After the monitoring wells were developed/purged and field measured parameters had stabilized, groundwater samples were collected from the wells as discussed in Sections 5.1.9 and 6.5.4 of the SC Work Plan. All 14 monitoring wells were sampled for chemical analysis using disposable PVC bailers. Analytical results from groundwater sampling are discussed in Section 4.4 of this report.

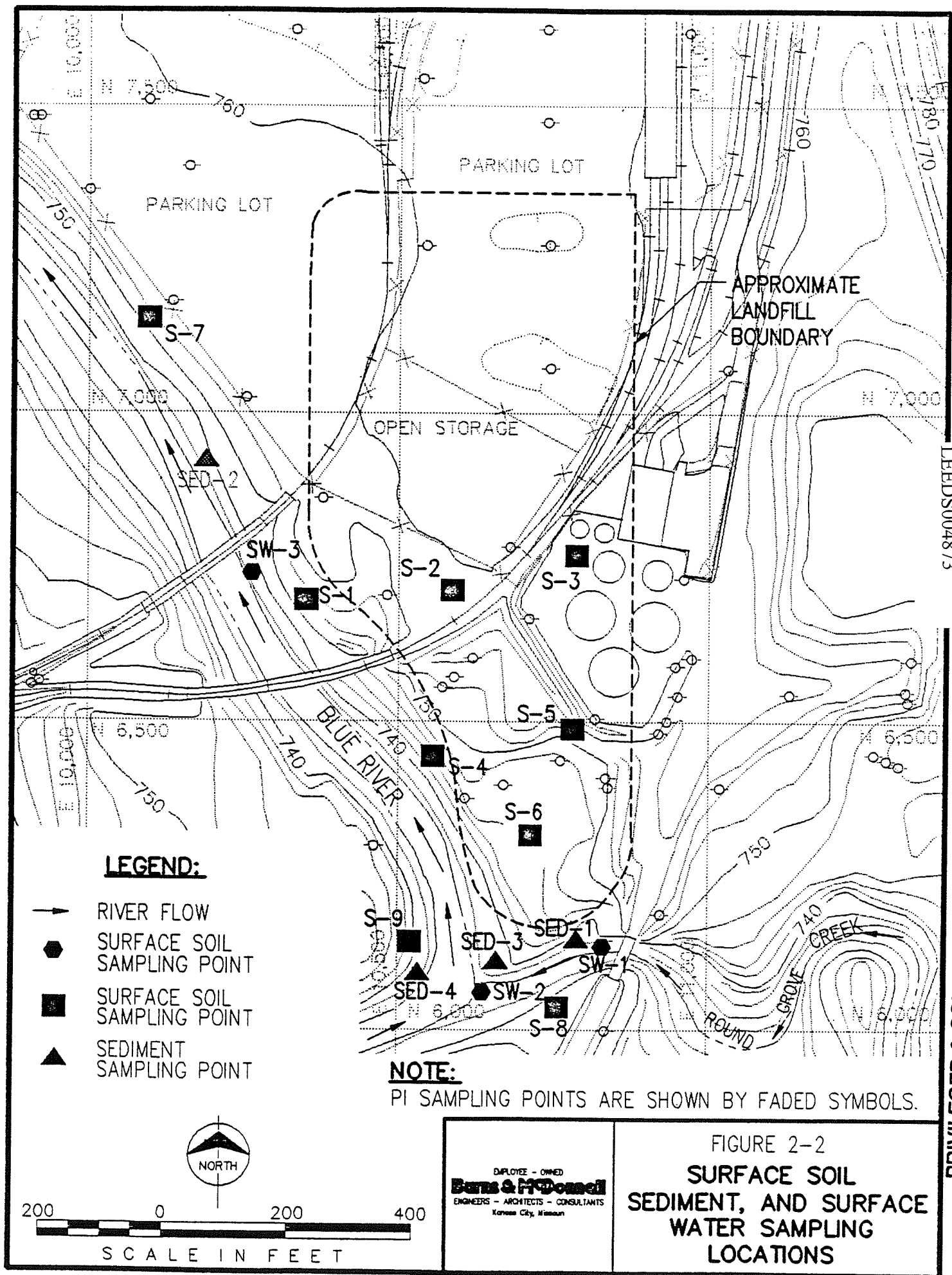
2.5 SURFACE SOIL/SEDIMENT SAMPLING

Nine surface soil (S-1 through S-9) and three sediment (SED-1, SED-3, and SED-4) samples were collected from the vicinity of the Former Waste Disposal Site as shown in Figure 2-2. A clean spade was used to collect these samples between two and three inches below the surface. The procedures used are given in Section 6.6 of the SC Work Plan. Analytical results from this sampling are discussed in Sections 4.5 and 4.6 of this report.

2.6 SURFACE WATER

Surface water samples (SW-1 through SW-3) were collected from the Blue River, Round Grove Creek, and the confluence of these streams as shown in Figure 2-2.

Field conditions required some deviation from the sampling procedures described in Section 6.7 of the SC Work Plan for surface water. It was discovered that a disposable bailer could be used to retrieve surface water more efficiently than a polyethylene ladle on an extension handle. Therefore, a disposable bailer was placed in the water at each location and allowed to fill. The water was then poured from the bailer with minimal entry turbulence



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into the appropriate sample containers until all required containers were filled.

Sample SW-3 was collected from the Blue River while standing on the railroad bridge. Disposable polypropylene rope was tied to the bailer and the bailer was lowered from the bridge to the water surface and allowed to fill. The bailer was then carefully raised and the containers filled as described above. Since disposable bailers were used, an equipment rinsate blank (ERB) was not required.

Field filtration for dissolved metals was performed using the method described in Section 6.5.5 of the SC Work Plan. Analytical results from surface water sampling are discussed in Section 4.7.

Measurement of the depth of the surface water using disposable yard sticks was also found to be impractical. Blue River elevations, measured during the sampling period at a point upstream and a point downstream from the site, were obtained from the USGS and are found in Appendix K. These measurements should be of much higher accuracy than any taken with the prescribed method.

2.7 MAPPING AND SURVEYING

Subcontractors were procured to provide photogrammetry and ground-surveying services at the site as specified in Section 5.1.2 of the SC Work Plan.

An aerial photograph was taken as part of these activities. This is shown in Figure 1-2. A topographic map with two-foot contours was generated from the aerial photograph.

Surveyed monitoring well and soil boring locations were placed on the topographic map to create the figures for this report. The results of this survey data and the topographic map are given in Appendix L.

2.8 DECONTAMINATION

All non-dedicated drilling and sampling equipment used at the site were properly decontaminated using the procedures described in Section 6.8 of the

SC Work Plan. Drilling equipment was decontaminated using fresh water in a high-pressure steam cleaner. Stiff-bristle brushes and detergent (Alconox) were used to clean sampling equipment followed by rinses with tap water, 0.1N hydrochloric acid, distilled water, pesticide-grade methanol, and pesticide-grade hexane.

2.9 SAMPLE CONTAINER PACKAGING AND SHIPPING

Properly labeled containers were securely packaged and shipped to the laboratory for analysis in coolers as described in Section 6.9 of the SC Work Plan.

Chain-of-Custody forms were also placed in these coolers to keep track of all samples sent to the laboratory. These Chain-of-Custody forms are in Appendix M.

2.10 MANAGEMENT OF INVESTIGATION-DERIVED WASTE MATERIALS

Investigation-derived waste materials included: soil cuttings, disposable equipment, decontamination fluids, and groundwater from well development/purging. These materials were drummed as described in Section 6.10 of the SC Work Plan.

* * * * *

3.0 PHYSICAL CHARACTERISTICS

3.1 CLIMATOLOGY

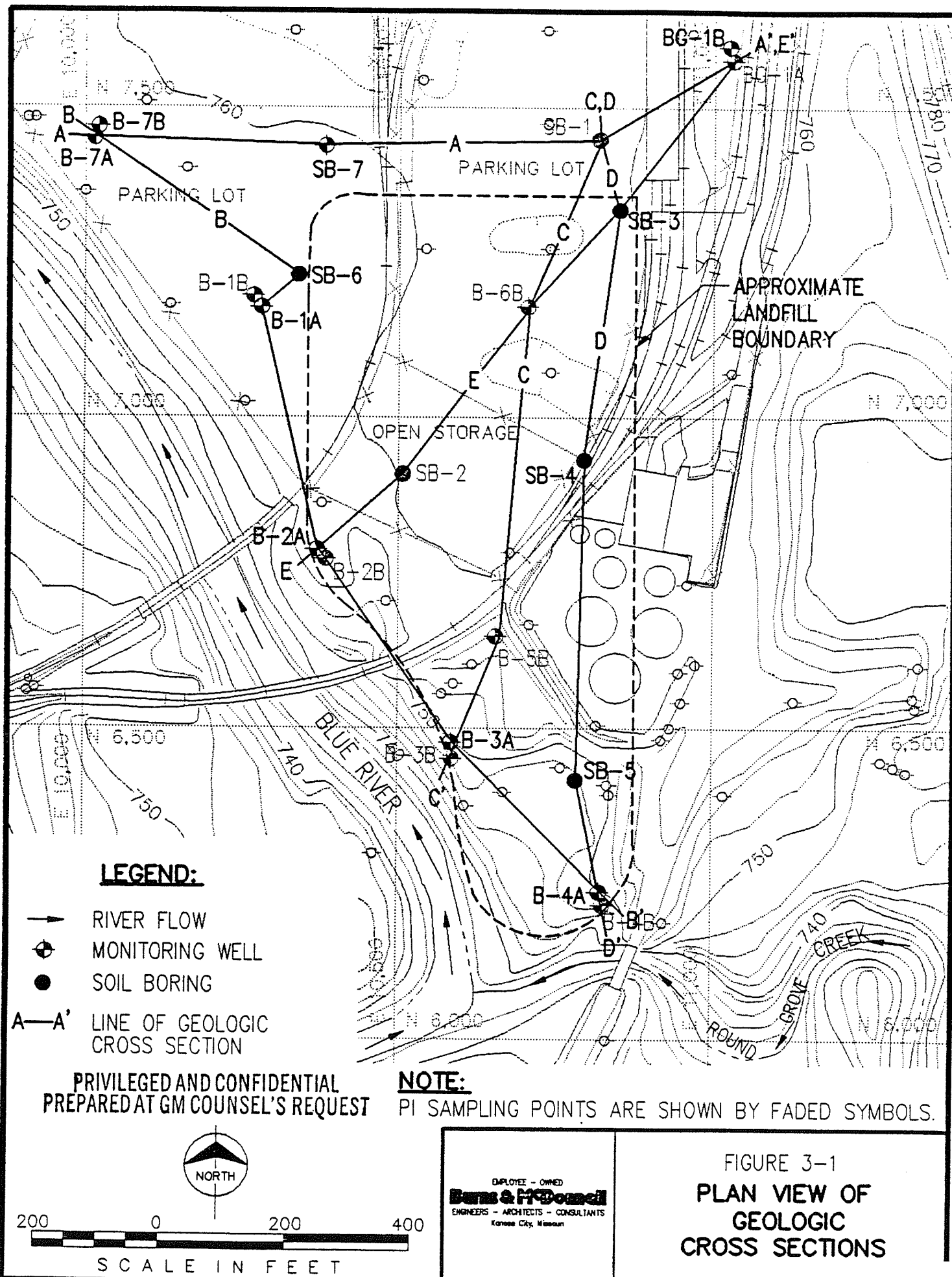
The climate of west-central Missouri is continental and is characterized by wide variations in temperature and humidity. Warm humid air masses often collide with cool dry air to produce severe weather in the summer. Summertime temperatures in Missouri typically range from 85 to 95°F, however temperatures of 100°F and greater are not uncommon. Winter temperatures often fall below 0°F, however extended periods of daytime temperatures below freezing temperatures are rare.

The average yearly precipitation for west-central Missouri is approximately 36 inches. The winter months in western Missouri are comparatively dry, with most of the precipitation occurring in the spring, summer, and fall.

3.2 GEOLOGY

Leeds is located within the alluvial valley of the Blue River. Based on boring logs from the current investigation, and additional borings installed as part of the PI (Figure 3-1), the soils beneath the site are found to consist predominantly of fine-grained alluvial material. Boring logs for the PI and SC are contained in Appendices F and G. The alluvial soils are silty clays, clayey silts, and fine sands. These fine-grained soils range in thickness from approximately 26 to 50 feet where fully penetrated by a boring. The fine-grained soils are underlain by a layer of silty and clayey gravel that varies from approximately 2.5 to 6 feet in thickness. The clayey gravel layer encountered beneath the GM Leeds facility is locally absent elsewhere in the Blue River valley. Underlying the clayey gravel is the shale bedrock of the Pleasanton Group.

Fill material was encountered in several of the borings (B-2A, B-2B, B-3A, B-3B, B-4A, B-4B, B-5B, B-6B, SB-3, SB-4 and SB-5) located within the estimated boundary of the Former Waste Disposal Site. The fill material consisted of reworked native soils mixed with waste debris. Borings B-1B, B-7A, B-7B, BG-1A, BG-1B, SB-1, SB-6 and SB-7 contained no fill material and are most likely beyond the boundaries of past landfilling activities. The



stratigraphic relationship between the various soils and the bedrock can be seen in Figures 3-2, 3-3, 3-4, 3-5, and 3-6 (Geologic cross sections A-A', B-B', C-C', D-D' and E-E', respectively). The lines of cross section are indicated on Figure 3-1. Based on data from all borings and the EMS surveys, the horizontal extent of fill material is indicated on Figure 3-1 (Approximate Landfill Boundary).

The geologic profiles (Figures 3-2, 3-3, 3-4, 3-5, and 3-6) illustrate the principal geologic units beneath the site. These are: (1) artificial fill, (2) predominantly fine-grained alluvial materials, (3) coarse-grained clayey gravel immediately above shale bedrock, and (4) the shale bedrock.

3.3 HYDROLOGY

Upon completion, borings B-1A, B-2A, B-3A, B-4A, B-7A, B-7B and BG-1B were converted to monitoring wells. The piezometric surface contour map for the alluvium directly above bedrock is shown on Figure 3-7 using water level data from October 29, 1991. The piezometric surface generally slopes to the southwest beneath the site.

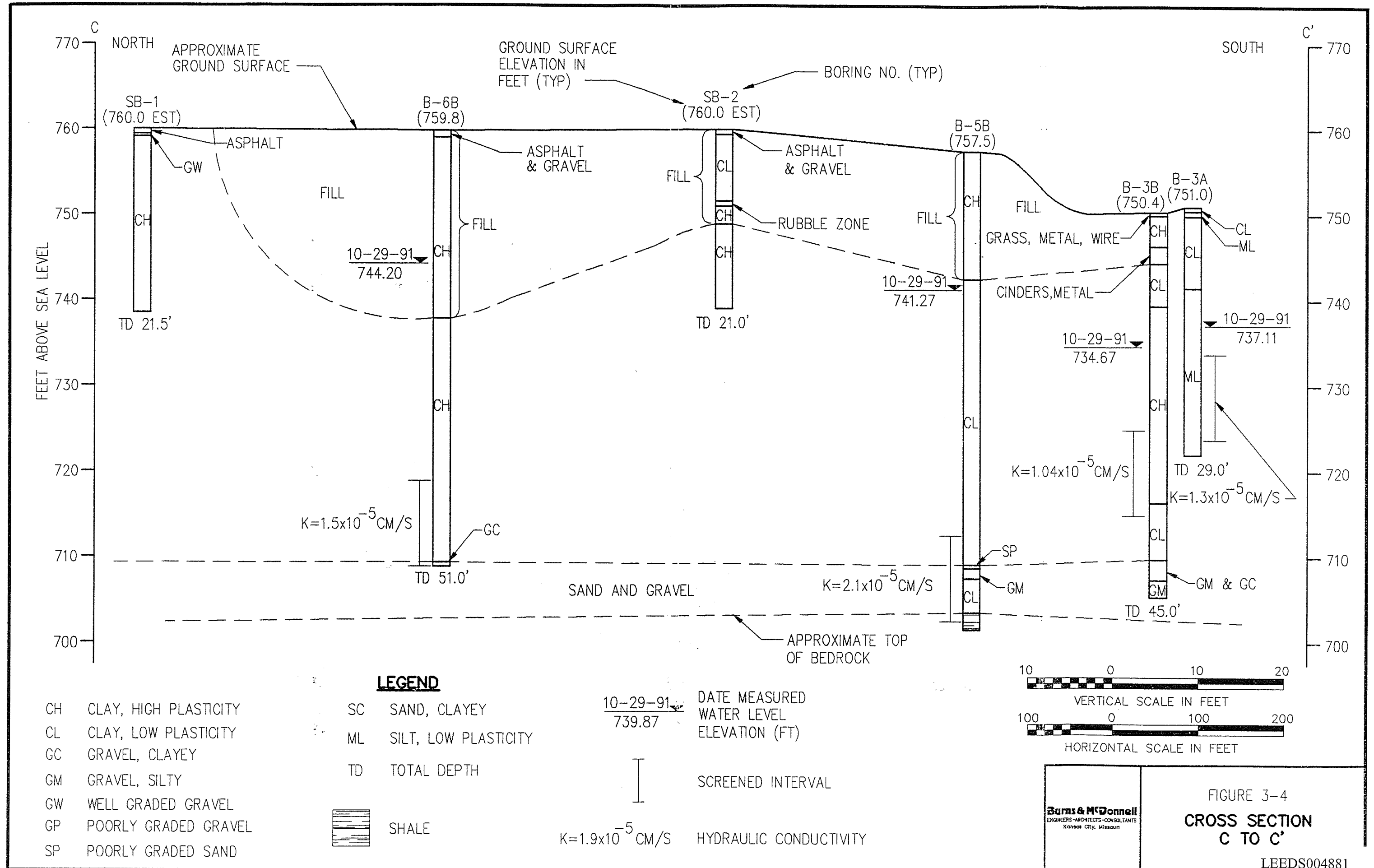
The hydrologic properties of the soil were determined by in-situ slug testing for hydraulic conductivity and from physical testing of soil samples (Slug test results are in Appendix J and physical soil test results are in Appendix H). The bail-down method was used on all wells tested for hydraulic conductivity. Additional hydraulic conductivities were obtained from physical laboratory tests using the consolidation method. Values obtained for hydraulic conductivity from both investigations are summarized in Table 3-1.

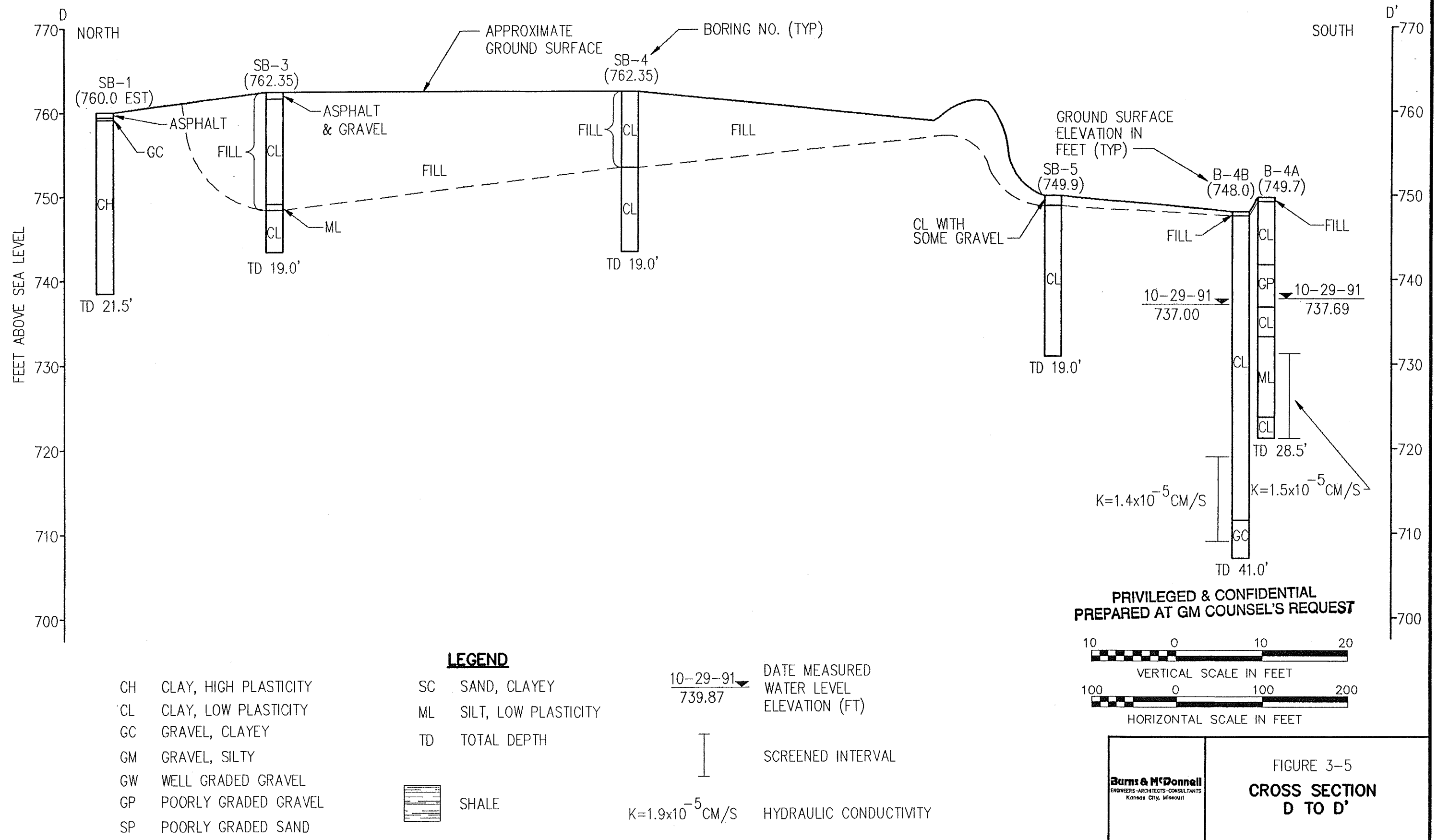
It should be noted that values obtained by laboratory methods are typically lower than hydraulic conductivities determined from in-situ field methods. This is due to the fact that in-situ testing is performed on a larger volume of soil material and thus reflects the effects of fractures and discontinuities in the soil. Field methods generally yield results which are more reflective of actual site conditions.

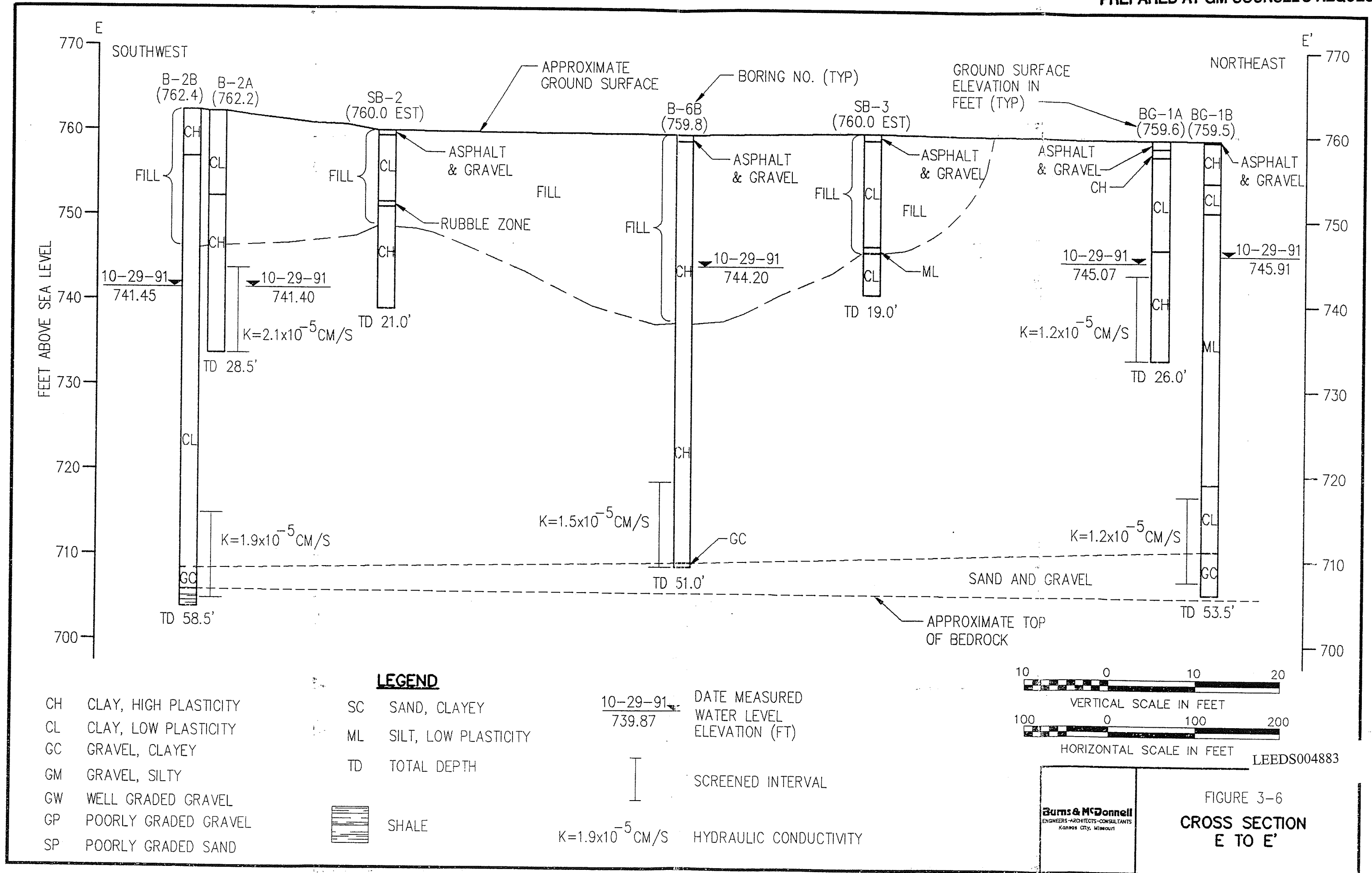
10-29-91	DATE MEASURED
739.87	WATER LEVEL
	ELEVATION (FT)
I	SCREENED INTERVAL
$K=1.9 \times 10^{-5}$ CM/S	HYDRAULIC CONDUCTIVITY

SCREENED INTERVAL

GMLPRF01.DWG 11-29-1991 09:18 EAS







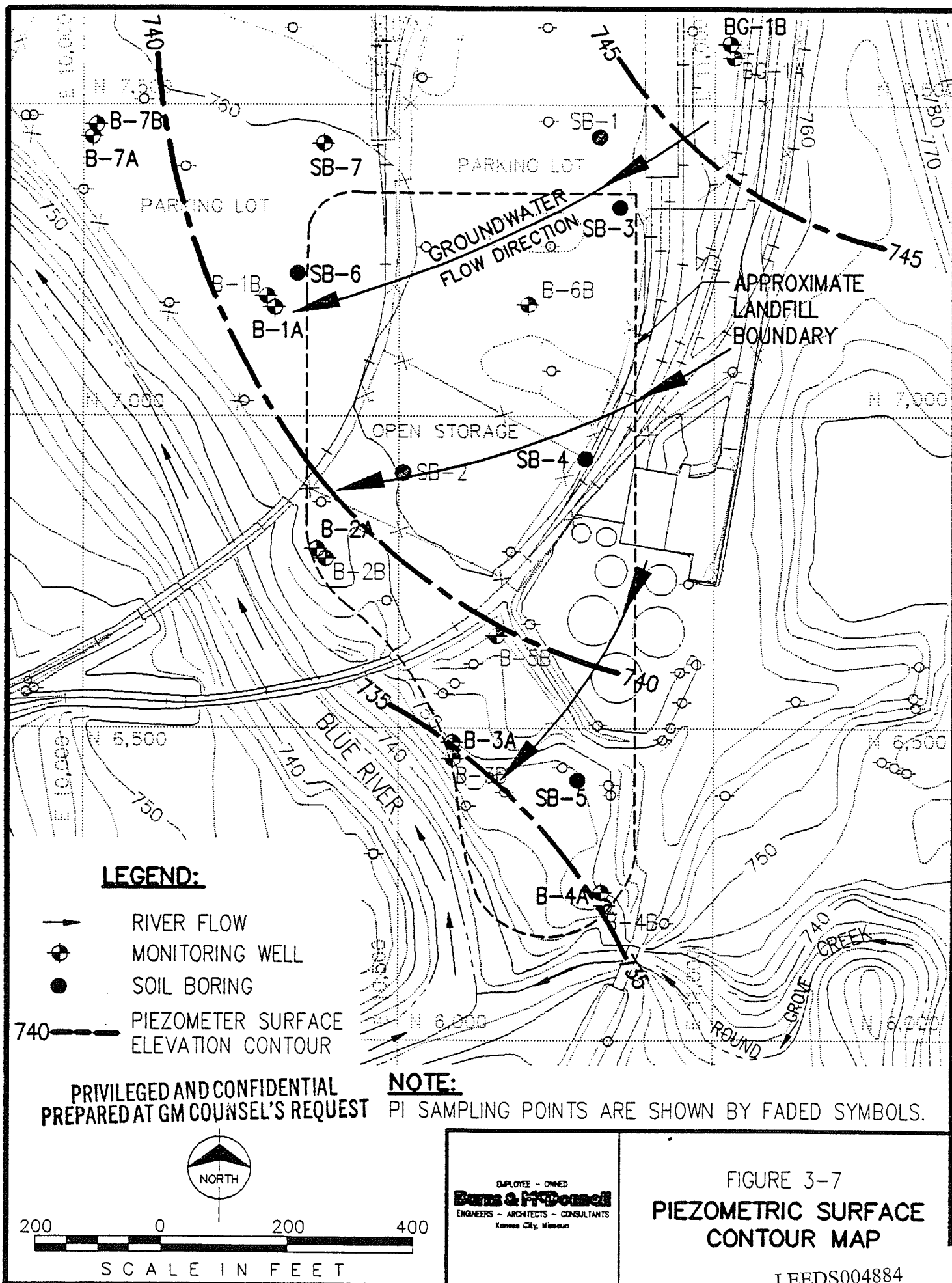


TABLE 3-1
SUMMARY OF HYDRAULIC CONDUCTIVITIES
FOR THE GM LEEDS FORMER WASTE DISPOSAL SITE

Well/Boring	Elevation of Sample or Screened Interval (Ft.)	Soil Type	Hydraulic Conductivity (cm/sec)	Test Method
B-1A	733.56 - 743.56	Silty Clay	1.0×10^{-5}	Slug Test
*B-1B	743.67 - 745.67	Silty Clay	5.2×10^{-8}	Consolidation
*B-1B	705.70 - 715.70	Sand, Gravel, Silty Clay	2.2×10^{-5}	Slug Test
B-2A	733.70 - 743.70	Silty Clay	2.1×10^{-5}	Slug Test
*B-2B	711.86 - 721.86	Silty, Sandy Clay, Gravel	1.9×10^{-5}	Slug Test
B-3A	723.75 - 733.75	Clayey Silt	1.3×10^{-5}	Slug Test
*B-3B	714.90 - 724.90	Silty Clay	1.0×10^{-5}	Slug Test
B-4A	721.22 - 731.22	Silty Clay, Clayey Silt	1.5×10^{-5}	Slug Test
*B-4B	720.00 - 722.00	Sandy Clay	3.4×10^{-7}	Consolidation
*B-4B	709.00 - 719.00	Gravel, Silty Sandy Clay	1.4×10^{-5}	Slug Test
*B-5B	739.48 - 741.48	Silty Clay	2.0×10^{-7}	Consolidation
*B-5B	702.50 - 712.50	Sand, Gravel, Clay	2.1×10^{-5}	Slug Test
*B-6B	708.80 - 718.80	Gravelly Clay, Silty Clay	1.5×10^{-5}	Slug Test
B-7A	732.83 - 742.83	Silty Clay	8.5×10^{-6}	Slug Test
B-7B	741.42 - 743.42	Clay	7.3×10^{-9}	Consolidation
B-7B	704.42 - 714.42	Gravel, Silty Clay	1.5×10^{-5}	Slug Test
*BG-1A	733.60 - 743.60	Silty Clay	1.2×10^{-5}	Slug Test
BG-1B	744.04 - 746.04	Clay	3.4×10^{-8}	Consolidation
BG-1B	707.54 - 717.54	Silty Clay Cobbles, Gravel Pebbles	1.2×10^{-5}	Slug Test
SB-4	751.35 - 753.35	Clay with Organics	1.5×10^{-9}	Consolidation
SB-5	738.90 - 740.90	Clay with Trace Sand	7.8×10^{-9}	Consolidation
SB-7	750.16 - 752.16	Clay with Trace Sand	6.8×10^{-9}	Consolidation

* Results from preliminary investigation.

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The monitoring wells were installed in one of two stratigraphic zones. Wells B-1A, B-2A, B-3A, B-3B, B-4A, B-7A and BG-1A were installed in the fine-grained alluvial soil, with bottom-of-screen elevations ranging from 716.42 to 733.7 feet. The average value of hydraulic conductivity obtained from this zone is 1.3×10^{-5} centimeter per second (cm/sec) as determined by in-situ slug test methods. Results obtained from the consolidation method for these fine-grained alluvial soils yielded an average hydraulic conductivity value of 8.0×10^{-8} cm/sec. As previously noted, values of hydraulic conductivity as determined by the consolidation method are typically lower than those obtained by in-situ well tests.

Wells B-1B, B-2B, B-4B, B-5B, B-6B, B-7B and BG-1B were installed in the silty/clayey sand and gravel above bedrock, with bottom-of-screen elevations ranging from 702.48 to 709.00 feet. The average hydraulic conductivity for wells screened in the silty/clayey gravel was 1.7×10^{-5} cm/sec. Due to its low permeability, the shale bedrock beneath the site is expected to hinder deep vertical migration of groundwater. The horizontal gradient at the site ranges from 0.007 to 0.04 within the gravel layer above bedrock, and from 0.005 to 0.03 for groundwater moving within the upper saturated alluvium. The gradient tends to increase with proximity to the river in both the shallow and the deep zones. Groundwater velocity, based on Darcy's law, was found to range from 3×10^{-8} to 1.7×10^{-6} cm/sec (0.3 to 1.7 ft/yr) to the southwest in the gravel zone above bedrock. The velocity calculated for the shallow fine-grained soil ranged from 1.4×10^{-7} to 8.7×10^{-7} cm/sec (0.2 to 0.90 ft/yr) to the southwest. In both the deep and shallow zones, the greatest groundwater velocity occurs near the Blue River.

Vertical gradients were calculated for all nested well clusters and ranged from 0.43 downward to 0.03 upwards. The ratio of vertical to horizontal gradient ranged from 6.0 (upward) on the east edge of the site to 14.3 (downward) on the west edge of the site. Therefore, significant vertical flow components could exist. Downward vertical flow will be restricted by the presence of shales of the Pleasanton Group beneath the alluvium. Generally groundwater will flow in a southwesterly direction until it reaches the center of the Blue River alluvial channel. Ultimately, the flow within the alluvium

moves to the northwest where the water will discharge into the Missouri River alluvium.

3.4 CONCLUSIONS

Leeds is located within the alluvial valley of the Blue River. The alluvial soils beneath the site consist of fine gravel, silty clays, and clayey silts (26 to 50 feet thick). These soils are underlain by silty and clayey gravels (2.5 to 6.0 feet thick) which are, in turn, underlain by shale bedrock of the Pleasanton Group. Fill material was encountered in 11 of 19 borings and ranged in thickness from zero to 22 feet. Groundwater was encountered beneath the site at depths of 13.36 to 22.19 feet below the ground surface. The piezometric surface map indicates that the predominant horizontal components of groundwater flow are to the southwest beneath the site at velocities ranging from 3×10^{-7} to 1.7×10^{-6} cm/sec (0.3 to 1.7 ft/yr) in the gravel zone above bedrock and 1.4×10^{-7} to 8.7×10^{-7} cm/sec (0.2 to 0.9 ft/yr) in the shallow clayey silt and silty clay alluvium.

* * * * *

4.0 NATURE AND EXTENT OF CONTAMINATION

Subsurface soil, groundwater, and sediment at the site were first sampled in the summer of 1990 as part of the PI, which is discussed in Section 1.2.3 of this report. The SC was conducted one year later to further characterize the Former Waste Disposal Site. In addition to the media mentioned above, surface soils and surface waters were sampled during the SC. An EMS was also performed as part of the SC to identify the extent of the fill material in the Former Waste Disposal Site.

The findings from the PI are utilized in conjunction with the results of the SC to assess the nature and extent of contamination at the site. The PI results are presented in Appendices B and N, and are discussed in detail in the PI Report. Laboratory data from the SC is presented in Appendices O through S. Tables 4-1 through 4-10 summarize the results of the SC. Qualifiers were added to the data during the data validation phase of the SC. These qualifiers are defined in Table 4-11 at the end of this section.

QA/QC samples (blanks, spikes, and duplicates) were collected during the SC to verify the quality of the laboratory and field procedures. These sample results are evaluated in the QA/QC Evaluation (Appendix D).

4.1 ELECTROMAGNETIC SURVEY

An EMS was performed at two localized areas within the site boundaries (Figure 2-1) to further define the results of the PI magnetometer survey. The locations of both EMS investigation areas were based on anomalies encountered in the magnetometer survey results.

An EMS device measures the resistance of the ground to an electric current (resistivity) and displays the inverse of this value (conductivity). This value is a direct function of the density of the ground, and since fill material generally varies in density from native soil, the EMS is often useful to delineate fill from non-fill material.

Upon completion of the EMS, the data readings were downloaded to an IBM AT microcomputer and contour maps of electromagnetic readings were generated (Appendix T). These figures were used to determine the presence of fill material.

Results of the EMS in the north area indicate that Monitoring Well B-1B is located outside of, but adjacent to, the suspected edge of fill material. The apparent distribution of fill material is indicated on the contour map from EMS-1 (Appendix T).

At least two localized areas of probable fill material were discovered in the south survey areas as indicated on the EMS-2 contour map. No further subsurface investigation activities were carried out in this EMS investigation area.

4.2 SUBSURFACE SOIL

A total of 17 boreholes were drilled for the purpose of collecting subsurface soil samples in these investigations. Most of these boreholes were placed within and down-gradient from the Former Waste Disposal Site. Two of the boreholes were placed upgradient from the Former Waste Disposal Site.

The purpose of sampling the subsurface soil is to provide information concerning: 1) site stratigraphy, 2) the landfill boundary, 3) physical properties of the soils, and 4) the type and depth of potential contamination in the soil below the site. The upgradient borings provide this information for subsurface soil which was probably not affected by landfilling activities.

Boring logs from the drilling activities at the site are found in Appendices F and G. These logs provide a lithological description of the subsurface as well as OVM readings. OVM readings were a factor in determining the exact sampling intervals of the soil cores to be sampled. All subsurface soil samples were analyzed for at least one of the following parameters:

- Total Metals
- pH

- Volatile Organic Compounds (VOCs)
- Semivolatile Organic Compounds (SVOCs)
- Total Petroleum Hydrocarbons (TPH)
- Total Phenols

The findings from these analyses are summarized in this section.

4.2.1 Inorganics

Soil samples from all seven soil borings (SB-1 through SB-7) and from selected samples at each monitoring well cluster were analyzed for the 23 CERCLA metals and pH. Results of inorganic analyses performed for the SC are summarized in Table 4-1. Subsurface soil data were compared to available levels which have been specified by the Missouri Department of Health (DOH) as safe. The DOH values satisfy "any use" levels and generally assume lifetime residential exposure (including ingestion) at the stated level. These values were not available for all parameters. DOH levels have been included, where available, in Table 4-1 for reference only.

The DOH level for beryllium is 0.176 mg/Kg. This value was exceeded in all SC subsurface soil samples, ranging from a low of 0.46 mg/Kg in sample SB-3 CME3 (9-14 feet) to 1.7 mg/Kg in SB-6 CME2 (4-9 feet). The levels of beryllium in Boring BG-1B, which is considered not to have been impacted by landfilling activities, ranged from 0.6 to 0.82 mg/Kg. No other metals were detected above DOH levels in the SC subsurface soil samples.

DOH recommended levels for beryllium were also exceeded in all subsurface soil samples collected during the PI. Both the highest and lowest levels of beryllium were observed in Boring B-1B, with the high at 31.5-36.5 feet (1.2 mg/Kg) and the low at 51.5-56.2 feet (0.52 mg/Kg). Elevated lead values were detected in Borings B-2B (276 mg/Kg), B-6B (526 mg/Kg and 481 mg/Kg in the shallow and deep samples, respectively), and SB-2 (4,490 mg/Kg). An elevated barium level of 10,800 mg/Kg was also detected during the PI in Boring SB-2 at 1-6 feet. None of the other PI metals levels exceeded any known guidance for soil contamination.

Table 4-1
Site Characterization Subsurface Soil Data
Indicators & CLP Inorganics

Laboratory Number: Sample Number: Sample Matrix: Sample Depth From: Sample Depth To:	6617.06 S-B3 CME2 Soil 4.00 9.00	6617.07 SB-3 CME3 Soil 9.00 14.00	6617.08 SB-3 CME33 Soil 9.00 14.00	6652.01 SB-4 CME3 Soil 11.00 14.00	6652.02 SB-4 CME4 Soil 14.00 19.00	6652.03 SB-5 CME1 Soil 0.00 4.00	DOH Recommended Levels
PARAMETER	UNITS						
INDICATORS							
Total Petroleum Hydrocarbons	68	93	33	10 U	12	10 U	16667
Total Phenols	0.6	1.4	1.8	1.4	2.4	1.4	
pH	8.14	8.39	8.34	6.88	6.79	7.5	
CLP INORGANICS							
Aluminum	9390	5110	7650	14300	12200	14100	230-238
Antimony	12.5 U	12.1 U	11.4 U	12.2 U	12.5 U	11.8 U	
Arsenic	4.5 J*	1.6 BJ*	3.8 J*	7.4 J*	4.4 J*	11.9 J*	
Barium	222	119	219	118	142	251	4670
Beryllium	0.8 B	0.46 B	0.63 B	0.99 B	0.67 B	0.66 B	0.176
Cadmium	1 U	0.97 U	0.91 U	3.3	1 U	0.94 U	23.8-47.6
Calcium	18700 F	13700 F	12700 F	4520	3800	4390	570-571
Chromium	12.9	6.8	10	16.5	11.2	9.4	
Cobalt	6.3 B	3.5 B	6.3 B	8.4 B	6.4 B	10.8 B	
Copper	31.9 J*	11.4 J*	14.1 J*	33.9 J*	22.6 J*	23.3 J*	6190
Iron	14300 F	7870 F	10300 F	19500	18000	22100	230-238
Lead	53.4 J*	22 J*	37.4 J*	39.3 J*	12.8 J*	16.8 J*	
Magnesium	2870	1520	2110	3400	3120	3500	
Manganese	317 FJ*	178 FJ*	157 FJ*	943 J*	764 J*	657 J*	14.3
Mercury	0.11 U	0.12 U	0.1 U	0.12 U	0.12 U	0.12 U	
Nickel	18.4	8.5 B	14.5	36.6	21.9	24.4	
Potassium	1520	849 B	1270	2340	1820	1330	714
Selenium	0.75 U	0.73 U	0.68 UJ*	0.73 U	0.75 U	0.71 U	47.6
Silver	1.6 B	0.94 B	1.2 B	0.73 U	0.75 U	0.71 U	
Sodium	412 B	381 U	358 U	384 U	392 U	371 U	
Thallium	0.75 U	0.73 U	0.68 U	0.73 UJ*	0.75 U	0.71 UJ*	62
Vanadium	19.7	9.1 B	12.9	33.8	23.6	26.1	23800
Zinc	90.6	29.6	42.5	136	64.3	63.6	

Note: Data qualifier symbols are defined in Table 4-11.

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Table 4-1 (continued)
Site Characterization Subsurface Soil Data
Indicators & CLP Inorganics

PARAMETER	UNITS	6652.04 SB-5 CME4 Soil	6617.09 SB-6 CME2 Soil	6617.1 SB-6 CME4 Soil	6617.05 SB-7 CME2 Soil	6617.02 SB-7 CME4 Soil	6680.02 BG-1B CME5 Soil	DOH Recommended Levels
INDICATORS								
Total Petroleum Hydrocarbons	mg/Kg	10 U	10 U	10 U	10 U	10 U	10 U	
Total Phenols	mg/Kg	1.3	0.9	1.4	2.4	2.1	2	16667
pH	S.U.	7.53	6.67	7.86	5.59	6.64	7.19	
CLP INORGANICS								
Aluminum	mg/Kg	12600	21900	17900	10800	13100	8710 F	
Antimony	mg/Kg	13.1 U	12.8 U	12.6 U	12.4 U	13 U	13.2 U	
Arsenic	mg/Kg	5.1 J*	10.3 J*	4 J*	4.1 J*	5 J*	2.1 UJ*	230-238
Barium	mg/Kg	163	147	208	161	186	146 F	4670
Beryllium	mg/Kg	0.69 B	1.7	1 B	0.99 B	0.88 B	0.82 B	0.176
Cadmium	mg/Kg	1 U	1 U	1 U	0.99 U	1 U	1.1 U	23.8-47.6
Calcium	mg/Kg	4680	6420 F	4630 F	4320 F	4230 F	3660 F	
Chromium	mg/Kg	12	26.2	22.1	18.4	17.5	12.9	570-571
Cobalt	mg/Kg	9.4 B	9.1 B	10.5 B	8.2 B	6.3 B	5.2 B	
Copper	mg/Kg	19.3 J*	30.1 J*	23.3 J*	23.6 J*	33.7 J*	29.3	6190
Iron	mg/Kg	17500	31600 F	21300 F	16200 F	18900 F	11400 F	
Lead	mg/Kg	12.4 J*	34.1 J*	22.9 J*	22.9 J*	15.4 J*	9.9 J*	230-238
Magnesium	mg/Kg	2590	4780	3970	3110	3420	2530 F	
Manganese	mg/Kg	964 J*	503 FJ*	1070 FJ*	522 J*	551 FJ*	126	
Mercury	mg/Kg	0.12 U	0.13 U	0.13 U	0.12 UF	0.13 UJ*	0.13 U	14.3
Nickel	mg/Kg	25.2	32.1	23.5	27	21	16.8	714
Potassium	mg/Kg	1900	2810	2770	1840	2010	1980	
Selenium	mg/Kg	0.78 U	7.7 U	7.5 U	7.4 U	0.78 UJ*	1.9	47.6
Silver	mg/Kg	0.78 U	3.9	2.5 B	2 B	2.2 B	1.3 B	230-238
Sodium	mg/Kg	410 U	403 U	395 U	388 U	410 U	414 U	
Thallium	mg/Kg	0.78 U	0.77 UJ*	0.75 U	0.74 U	0.78 U	0.79 U	62
Vanadium	mg/Kg	27.5	32.7	23.1	17	22.1	16.8	
Zinc	mg/Kg	64.8	94	75.1	58	64.9	59.1	23800

Note: Data qualifier symbols are defined in Table 4-11.

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Table 4-1 (continued)
Site Characterization Subsurface Soil Data
Indicators & CLP Inorganics

Laboratory Number:	6680.03	6653.02	6653.03	6653.04	6653.05	DOH Recommended Levels
Sample Number:	BG-1B CME10	B-7B CME1	B-7B CME31	B-7B CME8	B-7B CME11	
Sample Matrix:	Soil	Soil	Soil	Soil	Soil	
Sample Depth From:	0.00	3.00	3.00	33.00	48.00	
Sample Depth To:	0.00	8.00	8.00	38.00	53.00	
PARAMETER	UNITS		Duplicate			
INDICATORS						
Total Petroleum Hydrocarbons	mg/Kg	10 U	10 U	10 U	10 U	
Total Phenols	mg/Kg	1.8 U	1.3	1.1	2.2	16667
pH	S.U.	8.48	6.11	6.56	7.75	
CLP INORGANICS						
Aluminum	mg/Kg	4660 F	12200 F	13700 F	11700 F	
Antimony	mg/Kg	11.7 U	12.5 U	13.4 U	13.1 U	
Arsenic	mg/Kg	7.7 J*	5.9 J*	4.2 J*	14.9 J*	230-238
Barium	mg/Kg	62.3 F	130	187	195	4670
Beryllium	mg/Kg	0.6 B	0.88 B	0.93 B	0.84 B	0.176
Cadmium	mg/Kg	0.94 U	1 U	1.2 B	3.7	23.8-47.6
Calcium	mg/Kg	91600 F	3170 F	3470 F	3960 F	
Chromium	mg/Kg	13 J*	16.3	18.9	18.6	570-571
Cobalt	mg/Kg	11.6 B	10.4 B	8.9 B	12.5 B	
Copper	mg/Kg	17.2	26 J*	25.3 J*	23.8 J*	6190
Iron	mg/Kg	14200 F	17100 F	17900 F	21400 F	
Lead	mg/Kg	8.9	9.9 J*	12.5 J*	14.1 J*	230-238
Magnesium	mg/Kg	1830 F	2390	3310	3050	
Manganese	mg/Kg	724	499 FJ*	379 FJ*	540 FJ*	
Mercury	mg/Kg	0.11 U	0.12 U	0.13 U	0.13 U	14.3
Nickel	mg/Kg	25.4	19.3	27.7	32.1	714
Potassium	mg/Kg	760 B	1520	2180	1560	
Selenium	mg/Kg	0.7 U	0.75 U	0.8 UJ*	0.78 UJ*	47.6
Silver	mg/Kg	1.4 B	1.9 B	2.2 B	2.6 B	230-238
Sodium	mg/Kg	368 U	393 U	421 U	411 U	
Thallium	mg/Kg	0.7 U	0.75 UJ*	0.8 UJ*	0.78 UJ*	62
Vanadium	mg/Kg	17.3	16.3	27.3	24.5	
Zinc	mg/Kg	49.6	53.8	93	71.7	23800

Note: Data qualifier symbols are defined in Table 4-11.

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The pH values from both investigations were typical of the soils encountered and do not indicate any appreciable contamination.

4.2.2 Organics

4.2.2.1 VOCs and SVOCs

An OVM was used to screen soil samples for collection and to obtain borehole readings during drilling operations for both investigations. OVM borehole readings generally ranged from 0 to 20 ppm during drilling. Readings were noted in the "Remarks" column of the boring logs. These boring logs are located in Appendices F and G for the PI and SC, respectively.

The highest OVM readings (up to 1,500 ppm) during the SC were from Boring B-7B at 3.5 to 7.5 feet below the surface. Boring B-7A did not show similar levels of organic vapor readings (a 144.5 ppm reading was detected at 1.5 feet). Organic vapors ranging from 96 to 265 ppm were encountered between 23 and 26 feet below the surface in Boring B-1A.

The highest readings encountered during the PI were from Boring B-2B. Readings of 500 ppm were detected between 16 and 26 feet below the surface. OVM readings of 150 ppm were encountered down to 56 feet below the surface. High organic vapors were also detected between six and 11 feet below the surface at Boring SB-2. These ranged from 100 to 200 ppm. Most subsurface soil samples collected during the SC were sampled for VOCs. Minimal VOCs were detected in most samples. These results are summarized in Table 4-2. Methylene chloride, acetone, tetrachloroethene, toluene, and xylene were frequently detected in subsurface soil, although the three latter parameters were detected at 4 $\mu\text{g}/\text{Kg}$ or less. The highest methylene chloride reading in SC subsurface soil samples was 12 $\mu\text{g}/\text{Kg}$. Acetone was detected up to 77 $\mu\text{g}/\text{Kg}$ in SB-7. Both methylene chloride and acetone are common laboratory compounds which often contaminate samples during analysis.

SC subsurface soil samples from BG-1B, B-2A, B-4A, and B-7B were analyzed for SVOCs. Total SVOCs of 14,960 $\mu\text{g}/\text{Kg}$ were detected in the 23 to 25 foot interval of B-2A. The 13 to 18 foot interval of Boring B-4A had total SVOCs at 990 $\mu\text{g}/\text{Kg}$. These results are shown in Table 4-3.

Table 4-2
Site Characterization Subsurface Soil Data
CLP Volatiles

Laboratory Number: Sample Number: Sample Matrix: Sample Depth From: Sample Depth To:	6617.06 SB-3 CME2 Soil 4.00 9.00	6617.07 SB-3 CME3 Soil 9.00 14.00	6617.08 SB-3 CME33 Soil 9.00 14.00	6652.01 SB-4 CME3 Soil 11.00 14.00	6652.02 SB-4 CME4 Soil 14.00 19.00	6652.03 SB-5 CME1 Soil 0.00 4.00
PARAMETER	UNITS	Duplicate	Duplicate	Duplicate	Duplicate	Duplicate
Chloromethane	µg/Kg	13 U	10 U	13 U	12 U	12 U
Bromomethane	µg/Kg	13 U	10 U	13 U	12 U	12 U
Vinyl Chloride	µg/Kg	13 U	10 U	13 U	12 U	12 U
Chloroethane	µg/Kg	13 U	10 U	13 U	12 U	12 U
Methylene Chloride	µg/Kg	7	5 U	10	6 U	3 J
Acetone	µg/Kg	39	16	24	47	12 U
Carbon Disulfide	µg/Kg	6 U	5 U	5 U	6 U	6 U
1,1-Dichloroethene	µg/Kg	6 U	5 U	5 U	6 U	6 U
1,1-Dichloroethane	µg/Kg	6 U	5 U	5 U	6 U	6 U
1,2-Dichloroethene (total)	µg/Kg	6 U	5 U	5 U	6 U	6 U
Chloroform	µg/Kg	6 U	5 U	5 U	6 U	6 U
1,2-Dichloroethane	µg/Kg	6 U	5 U	5 U	6 U	6 U
2-Butanone	µg/Kg	13 U	10 U	10 U	12 U	12 U
1,1,1-Trichloroethane	µg/Kg	6 U	1 J	1 J	2 J	0.6 J
Carbon Tetrachloride	µg/Kg	6 U	5 U	5 U	6 U	6 U
Vinyl Acetate	µg/Kg	13 U	10 U	10 U	12 U	12 U
Bromodichloromethane	µg/Kg	6 U	5 U	5 U	6 U	6 U
1,2-Dichloropropane	µg/Kg	6 U	5 U	5 U	6 U	6 U
cis-1,3-Dichloropropene	µg/Kg	6 U	5 U	5 U	6 U	6 U
Trichloroethene	µg/Kg	6 U	5 U	5 U	6 U	2 J
Dibromochloromethane	µg/Kg	6 U	5 U	5 U	6 U	6 U
1,1,2-Trichloroethane	µg/Kg	6 U	5 U	5 U	6 U	6 U
Benzene	µg/Kg	6 U	5 U	5 U	6 U	1 J
trans-1,3-Dichloropropene	µg/Kg	6 U	5 U	5 U	6 U	6 U
Bromoform	µg/Kg	6 U	5 U	5 U	6 U	6 U
4-Methyl-2-Pentanone	µg/Kg	13 U	10 U	4 J	12 U	12 U
2-Hexanone	µg/Kg	13 U	10 U	10 U	12 U	12 U
Tetrachloroethene	µg/Kg	2 J	3 J	3 J	2 J	6 U
1,1,2,2-Tetrachloroethane	µg/Kg	6 U	5 U	5 U	6 U	6 U
Toluene	µg/Kg	2 F	3 F	2 F	2 J	3 J
Chlorobenzene	µg/Kg	6 U	5 U	5 U	6 U	2 J
Ethylbenzene	µg/Kg	6 U	5 U	5 U	6 U	6 U
Styrene	µg/Kg	6 U	5 U	5 U	6 U	6 U
Xylene (total)	µg/Kg	2 F	4 F	4 F	0.9 J	6 U

Note: Data qualifier symbols are defined in Table 4-11.

Table 4-2 (continued)
Site Characterization Subsurface Soil Data
CLP Volatiles

PARAMETER	UNITS	6652.04 SB-5 CME4 Soil 14.00 19.00	6617.09 SB-6 CME2 Soil 4.00 9.00	6617.1 SB-6 CME4 Soil 14.00 19.00	6617.05 SB-7 CME2 Soil 4.00 9.00	6617.02 SB-7 CME4 Soil 14.00 19.00	6680.02 BG-1B CME5 Soil 23.50 28.50
Chloromethane	µg/Kg	13 U	13 U	13 U	13 U	13 U	13 U
Bromomethane	µg/Kg	13 U	13 U	13 U	13 U	13 U	13 U
Vinyl Chloride	µg/Kg	13 U	13 U	13 U	13 U	13 U	13 U
Chloroethane	µg/Kg	13 U	13 U	13 U	13 U	13 U	13 U
Methylene Chloride	µg/Kg	7 U	12	8	6 U	10	5 J
Acetone	µg/Kg	13 U	47	13 U	16	77	44
Carbon Disulfide	µg/Kg	7 U	6 U	6 U	6 U	6 U	1 J
1,1-Dichloroethane	µg/Kg	7 U	6 U	6 U	6 U	6 U	7 U
1,1-Dichloroethane	µg/Kg	7 U	6 U	6 U	6 U	6 U	7 U
1,2-Dichloroethane (total)	µg/Kg	7 U	6 U	6 U	6 U	6 U	7 U
Chloroform	µg/Kg	7 U	6 U	6 U	6 U	6 U	7 U
1,2-Dichloroethane	µg/Kg	7 U	6 U	6 U	6 U	6 U	7 U
2-Butanone	µg/Kg	13 U	13 U	13 U	13 U	13 U	13 U
1,1,1-Trichloroethane	µg/Kg	2 J	6 U	6 U	2 J	6 U	7 U
Carbon Tetrachloride	µg/Kg	7 U	6 U	6 U	6 U	6 U	7 U
Vinyl Acetate	µg/Kg	13 U	13 U	13 U	13 U	13 U	13 U
Bromodichloromethane	µg/Kg	7 U	6 U	6 U	6 U	6 U	7 U
1,2-Dichloropropane	µg/Kg	7 U	6 U	6 U	6 U	6 U	7 U
cis-1,3-Dichloropropene	µg/Kg	7 U	6 U	6 U	6 U	6 U	7 U
Trichloroethene	µg/Kg	7 U	6 U	6 U	6 U	6 U	7 U
Dibromochloromethane	µg/Kg	7 U	6 U	6 U	6 U	6 U	7 U
1,1,2-Trichloroethane	µg/Kg	7 U	6 U	6 U	6 U	6 U	7 U
Benzene	µg/Kg	7 U	6 U	6 U	6 U	6 U	7 U
trans-1,3-Dichloropropene	µg/Kg	7 U	6 U	6 U	6 U	6 U	7 U
Bromoform	µg/Kg	7 U	6 U	6 U	6 U	6 U	7 U
4-Methyl-2-Pentanone	µg/Kg	13 U	13 U	13 U	13 U	13 U	13 U
2-Hexanone	µg/Kg	13 U	13 U	13 U	13 U	13 U	13 U
Tetrachloroethene	µg/Kg	3 J	6 U	3 J	3 J	4 J	12
1,1,2,2-Tetrachloroethane	µg/Kg	7 U	6 U	6 U	6 U	6 U	7 U
Toluene	µg/Kg	2 J	1 FJ	2 FJ	2 FJ	4 FJ	4 J
Chlorobenzene	µg/Kg	7 U	6 U	6 U	6 U	6 U	7 U
Ethylbenzene	µg/Kg	7 U	6 U	6 U	6 U	6 U	7 U
Styrene	µg/Kg	7 U	6 U	6 U	6 U	6 U	7 U
Xylene (total)	µg/Kg	1 J	6 U	10 F	2 FJ	2 F	7 U

Note: Data qualifier symbols are defined in Table 4-11.

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Table 4-2 (continued)
Site Characterization Subsurface Soil Data
CLP Volatiles

Laboratory Number:		6680.03	6653.02	6653.03	6653.04	6653.05
Sample Number:		BG-1B CME10	B-7B CME1	B-7B CME31	B-7B CME8	B-7B CME11
Sample Matrix:		Soil	Soil	Soil	Soil	Soil
Sample Depth From:		48.50	3.00	3.00	33.00	48.00
Sample Depth To:		53.30	8.00	8.00	38.00	53.00
PARAMETER	UNITS	Duplicate				
Chloromethane	µg/Kg	12 U	12 U	12 U	13 U	13 U
Bromomethane	µg/Kg	12 U	12 U	12 U	13 U	13 U
Vinyl Chloride	µg/Kg	12 U	12 U	12 U	13 U	13 U
Chloroethane	µg/Kg	12 U	12 U	12 U	13 U	13 U
Methylene Chloride	µg/Kg	3 J	9	6 U	8	6 U
Acetone	µg/Kg	35	10 J	12 U	49	72
Carbon Disulfide	µg/Kg	6 U	6 U	6 U	7 U	6 U
1,1-Dichloroethene	µg/Kg	6 U	6 U	6 U	7 U	6 U
1,1-Dichloroethane	µg/Kg	6 U	6 U	6 U	7 U	6 U
1,2-Dichloroethene (total)	µg/Kg	6 U	6 U	6 U	7 U	6 U
Chloroform	µg/Kg	6 U	6 U	6 U	7 U	6 U
1,2-Dichloroethane	µg/Kg	6 U	6 U	6 U	7 U	6 U
2-Butanone	µg/Kg	12 U	12 U	12 U	13 U	13 U
1,1,1-Trichloroethane	µg/Kg	6 U	6 U	6 U	7 U	6 U
Carbon Tetrachloride	µg/Kg	6 U	6 U	6 U	7 U	6 U
Vinyl Acetate	µg/Kg	12 U	12 U	12 U	13 U	13 U
Bromodichloromethane	µg/Kg	6 U	6 U	6 U	7 U	6 U
1,2-Dichloropropane	µg/Kg	6 U	6 U	6 U	7 U	6 U
cis-1,3-Dichloropropene	µg/Kg	6 U	6 U	6 U	7 U	6 U
Trichloroethene	µg/Kg	6 U	6 U	6 U	7 U	6 U
Dibromochloromethane	µg/Kg	6 U	6 U	6 U	7 U	6 U
1,1,2-Trichloroethane	µg/Kg	6 U	6 U	6 U	7 U	6 U
Benzene	µg/Kg	6 U	6 U	6 U	7 U	6 U
trans-1,3-Dichloropropene	µg/Kg	6 U	6 U	6 U	7 U	6 U
Bromoform	µg/Kg	6 U	6 U	6 U	7 U	6 U
4-Methyl-2-Pentanone	µg/Kg	12 U	12 U	12 U	13 U	13 U
2-Hexanone	µg/Kg	12 U	12 U	12 U	13 U	13 U
Tetrachloroethene	µg/Kg	6 U	6 U	0.9 J	7 U	3 J
1,1,2,2-Tetrachloroethane	µg/Kg	6 U	6 U	6 U	7 U	6 U
Toluene	µg/Kg	6 U	6 U	0.9 J	7 U	2 J
Chlorobenzene	µg/Kg	6 U	6 U	6 U	7 U	6 U
Ethylbenzene	µg/Kg	6 U	6 U	6 U	7 U	6 U
Styrene	µg/Kg	6 U	6 U	6 U	7 U	6 U
Xylene (total)	µg/Kg	6 U	6 U	6 U	7 U	1 FJ

Note: Data qualifier symbols are defined in 4-11.

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Table 4-3
Site Characterization Subsurface Soil Data
CLP Semivolatiles

Laboratory Number: Sample Number Sample Matrix: Sample Depth From: Sample Depth To:	6680.01 BG-1B CME3 Soil 15.50 18.50	6653.01 B-2A CME4 Soil 23.50 28.50	6652.05 B-4A CME4 Soil 13.50 18.50	6653.02 B-7B CME1 Soil 3.00 8.00	6653.03 B-7B CME31 Soil 3.00 8.00
PARAMETER	UNITS				Duplicate
Phenol	µg/kg	850 U	870 U	800 U	800 U
bis(2-Chloroethyl)ether	µg/kg	850 U	870 U	800 U	800 U
2-Chlorophenol	µg/kg	850 U	870 U	800 U	800 U
1,3-Dichlorobenzene	µg/kg	850 U	870 U	800 U	800 U
1,4-Dichlorobenzene	µg/kg	850 U	870 U	800 U	800 U
Benzyl alcohol	µg/kg	850 U	870 U	800 U	800 U
1,2-Dichlorobenzene	µg/kg	850 U	870 U	800 U	800 U
2-Methylphenol	µg/kg	850 U	870 U	800 U	800 U
bis(2-Chloroisopropyl)ether	µg/kg	850 U	870 U	800 U	800 U
4-Methylphenol	µg/kg	850 U	870 U	800 U	800 U
N-Nitroso-di-n-propylamine	µg/kg	850 U	870 U	800 U	800 U
Hexachloroethane	µg/kg	850 U	870 U	800 U	800 U
Nitrobenzene	µg/kg	850 U	870 U	800 U	800 U
Isophorone	µg/kg	850 U	870 U	800 U	800 U
2-Nitrophenol	µg/kg	850 U	870 U	800 U	800 U
2,4-Dimethylphenol	µg/kg	850 U	870 U	800 U	800 U
Benzoic acid	µg/kg	4100 U	4200 U	3900 U	3900 U
bis(2-Chloroethoxy)methane	µg/kg	850 U	870 U	800 U	800 U
2,4-Dichlorophenol	µg/kg	850 U	870 U	800 U	800 U
1,2,4-Trichlorobenzene	µg/kg	850 U	870 U	800 U	800 U
Naphthalene	µg/kg	850 U	870 U	800 U	800 U
4-Chloroaniline	µg/kg	850 U	870 U	800 U	800 U
Hexachlorobutadiene	µg/kg	850 U	870 U	800 U	800 U
4-Chloro-3-methylphenol	µg/kg	850 U	870 U	800 U	800 U
2-Methylnaphthalene	µg/kg	850 U	870 U	800 U	800 U
Hexachlorocyclopentadiene	µg/kg	850 U	870 U	800 U	800 U
2,4,6-Trichlorophenol	µg/kg	850 U	870 U	800 U	800 U
2,4,5-Trichlorophenol	µg/kg	4100 U	4200 U	3900 U	3900 U
2-Chloronaphthalene	µg/kg	850 U	870 U	800 U	800 U
2-Nitroaniline	µg/kg	4100 U	4200 U	3900 U	3900 U
Dimethylphthalate	µg/kg	850 U	870 U	800 U	800 U
Acenaphthylene	µg/kg	850 U	870 U	800 U	800 U
2,6-Dinitrotoluene	µg/kg	850 U	870 U	800 U	800 U

Note: Data qualifier symbols are defined in Table 4-11.

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Table 4-3 (continued)
Site Characterization Subsurface Soil Data
CLP Semivolatiles

PARAMETER	Laboratory Number: Sample Number Sample Matrix: Sample Depth From: Sample Depth To:	UNITS	6680.01	6653.01	6652.05	6653.02	6653.03
			BG-1B CME3 Soil 15.50 18.50	B-2A CME4 Soil 23.50 28.50	B-4A CME4 Soil 13.50 18.50	B-7B CME1 Soil 3.00 8.00	B-7B CME31 Soil 3.00 8.00
3-Nitroaniline	µg/kg		4100 U	4100 U	4200 U	3900 U	3900 U
Acenaphthene	µg/kg		850 U	850 U	870 U	800 U	800 U
2,4-Dinitrophenol	µg/kg		4100 U	4100 U	4200 U	3900 U	3900 U
4-Nitrophenol	µg/kg		4100 U	4100 U	4200 U	3900 U	3900 U
Dibenzofuran	µg/kg		850 U	850 U	870 U	800 U	800 U
2,4-Dinitrotoluene	µg/kg		850 U	850 U	870 U	800 U	800 U
Diethylphthalate	µg/kg		850 U	850 U	870 U	800 U	800 U
4-Chlorophenyl-phenylether	µg/kg		850 U	850 U	870 U	800 U	800 U
Fluorene	µg/kg		850 U	850 U	870 U	800 U	800 U
4-Nitroaniline	µg/kg		4100 U	4100 U	4200 U	3900 U	3900 U
4,6-Dinitro-2-methylphenol	µg/kg		4100 U	4100 U	4200 U	3900 U	3900 U
N-Nitrosodiphenylamine	µg/kg		850 U	850 U	870 U	800 U	800 U
4-Bromophenyl-phenylether	µg/kg		850 U	850 U	870 U	800 U	800 U
Hexachlorobenzene	µg/kg		850 U	850 U	870 U	800 U	800 U
Pentachlorophenol	µg/kg		4100 U	4100 U	4200 U	3900 U	3900 U
Phenanthrene	µg/kg		850 U	250 J	870 U	800 U	800 U
Anthracene	µg/kg		850 U	850 U	870 U	800 U	800 U
Di-n-butylphthalate	µg/kg		850 U	850 U	870 U	800 U	800 U
Fluoranthene	µg/kg		850 U	290 J	870 U	800 U	800 U
Pyrene	µg/kg		850 U	240 J	870 U	800 U	800 U
Butylbenzylphthalate	µg/kg		850 U	5900	310 J	800 U	800 U
3,3'-Dichlorobenzidine	µg/kg		1700 U	1700 U	1700 U	1600 U	1600 U
Benzo(a)anthracene	µg/kg		850 U	150 J	870 U	800 U	800 U
Chrysene	µg/kg		850 U	150 J	870 U	800 U	800 U
bis(2-Ethylhexyl)phthalate	µg/kg		850 U	850 U	680 JU*	800 U	800 U
Di-n-octylphthalate	µg/kg		850 U	850 U	870 U	800 U	800 U
Benzo(b)fluoranthene	µg/kg		850 U	850 U	870 U	800 U	800 U
Benzo(k)fluoranthene	µg/kg		850 U	850 U	870 U	800 U	800 U
Benzo(a)pyrene	µg/kg		850 U	850 U	870 U	800 U	800 U
Indeno(1,2,3-cd)pyrene	µg/kg		850 U	850 U	870 U	800 U	800 U
Dibenz(a,h)anthracene	µg/kg		850 U	850 U	870 U	800 U	800 U
Benzo(g,h,i)perylene	µg/kg		850 U	850 U	870 U	800 U	800 U

Note: Data qualifier symbols are defined in Table 4-11.

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Minimal levels (less than 5.4 mg/Kg) of various SVOCs, VOCs, and alkylbenzenes were detected in the shallow samples of B-1B and SB-2 during the PI. These were attributed to residues from asphalt paving. Organics were encountered in the 26 to 31 foot interval of Boring B-5B at approximately 10.9 mg/Kg. The highest detections of organics (50.7 mg/Kg) were in the 16 to 21 foot interval of Boring B-2B. The majority of these (35.5 mg/Kg) were alkylbenzenes. No significant levels of organics were encountered from this boring in the samples collected above or below this interval.

4.2.2.2 TPH and Phenols

The majority of the SC subsurface soil samples were analyzed for TPH content. Most of the samples showed no detections. TPH was only encountered in samples from SB-3 and SB-4. The highest TPH value (93 mg/Kg) was encountered in Boring SB-3 between 9 and 14 feet. The TPH value in the duplicate of this sample was considerably less (33 mg/Kg).

Minimal total phenols (less than 2.5 mg/Kg) were detected in the SC subsurface soil samples. TPH and total phenols results are summarized in Table 4-1.

There were no TPH detections in most of the PI subsurface soil samples. Borings B-1B and B-2B contained minimal TPH levels (less than 33 mg/Kg). The highest TPH reading encountered from both investigations was in the one to six-foot interval of Boring B-6B (190 mg/Kg). The highest total phenols reading was also detected in this sample at 3.7 mg/Kg.

4.3 GROUNDWATER

Once subsurface soil samples were collected, monitoring wells were installed in designated borings. Monitoring wells can be used to evaluate: 1) hydraulic conductivity of the subsurface soil, 2) the direction of groundwater flow, and 3) the type and extent of potential contaminants which may have been released into the groundwater. During the PI, groundwater samples were collected from the seven monitoring wells installed in the investigation area. During the SC, the seven existing wells from the PI were resampled and the seven new monitoring wells were sampled for the first time.

An upgradient monitoring well was installed during each of the two investigations (monitoring wells BG-1A and BG-1B). The upgradient groundwater sampling results will help determine the quality of the groundwater prior to passing through the Former Waste Disposal Site.

All groundwater samples collected during both investigations were analyzed for the following parameters:

- Total Metals
- Dissolved Metals
- Total Suspended Solids (TSS)
- VOCs

Groundwater samples collected as part of the SC were also analyzed for SVOCs and Total Phenols. The chemical results of groundwater sampling were compared with available Missouri Water Quality Standards for a Class VII groundwater. The Class VII standards are included for reference with the groundwater data presented in Tables 4-4 through 4-6.

Field measurements of temperature, specific conductivity, and pH were also conducted during both investigations. These results are given in Appendix B for the PI, and Appendix I for the SC.

4.3.1 Inorganics

All groundwater samples collected during both investigations were analyzed for the 23 CERCLA metals. A filtered sample was also collected at each well for dissolved metals analysis. Table 4-4 summarizes the results obtained from the inorganic analyses performed on groundwater during the SC.

The Class VII groundwater standards of 300 $\mu\text{g/L}$ for total iron and 50 $\mu\text{g/L}$ for total manganese were exceeded in every monitoring well sampled during the SC. The highest levels encountered for both of these metals were in the groundwater collected from B-2A. Total iron was detected at 70,300 $\mu\text{g/L}$, and manganese at 34,700 $\mu\text{g/L}$. Both iron and manganese are typical constituents of

Table 4-4
Site Characterization Groundwater Data
Indicators & CLP Inorganics

Laboratory Number: Sample Number: Sample Matrix:	6756.15 BG-1A Water	6756.16 BG-1A(F) Water	6756.19 BG-1B Water	6756.20 BG-1B(F) Water	6756.03 B-1A Water	6756.04 B-1A(F) Water	6756.01 B-1B Water	6756.02 B-1B(F) Water	Class VII Standards
PARAMETER UNITS									
INDICATORS									
Total Phenols mg/L	0.18		0.14		0.18		0.16		
TSS mg/L	842		294		944		8360		
CLP INORGANICS		Filtered		Filtered		Filtered		Filtered	
Aluminum µg/L	1350 J*	116 B	910 J*	108 B	1590 J*	99 B	110 BJ*	97.1 B	
Antimony µg/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	14
Arsenic µg/L	3.1 B	2.5 B	61.5	57.3	3.1 B	2 U	244	178	50
Barium µg/L	189 B	102 B	508	375	279	235	1050	678	1000
Beryllium µg/L	1 B	1 U	1 U	1 U	1.1 B	1 U	1 U	1 U	100
Cadmium µg/L	4 U	4 U	7.6 J*	4 U	4 U	4 U	4 U	4 U	10
Calcium µg/L	105000	95800	101000	88300	149000	149000	286000	117000	
Chromium µg/L	7 U	7 U	7 U	7 U	7 U	7 U	7 U	7 U	50
Cobalt µg/L	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	1000
Copper µg/L	8 U	8 U	8 U	8 U	8 U	8 U	8 U	8 U	1000
Iron µg/L	1090 J*	48.5 B	16700 J*	8290	398 J*	37.4 B	21000 J*	7440	300
Lead µg/L	4 J*	2 UJ*	7.5 J*	2 BJ*	7.8 J*	3.2 J*	2.2 BJ*	7.8 J*	50
Magnesium µg/L	17700	16300	13100	12600	34300	34700	19900	17500	
Manganese µg/L	2090	1930	1650	1400	1330	1010	3530	2600	50
Mercury µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	2
Nickel µg/L	21.9 B	16.1 B	15 U	15 U	28.8 B	20.8 B	15 U	15 U	200
Potassium µg/L	1800 B	1630 B	2450 B	2370 B	3620 B	3520 B	3330 B	3350 B	
Selenium µg/L	3 U	3 U	3 UJ*	3 U	3 U	3 UJ*	3 U	3 U	10
Silver µg/L	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	50
Sodium µg/L	15000	13900	28300	27900	93600	98200	34900	34400	
Thallium µg/L	2 UJ*	2 UJ*	2 UJ*	2 UJ*	2 U	2 UJ*	2 UJ*	2 UJ*	2
Vanadium µg/L	10.1 B	3.7 B	7.8 B	3 U	9.8 B	6.7 B	3.5 B	3 U	
Zinc µg/L	23.3	17 U	32.3	17 U	23.5	20.6	17 U	17 U	5000

Note: Data qualifier symbols are defined in Table 4-11.

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Table 4-4 (continued)
Site Characterization Groundwater Data
Indicators & CLP Inorganics

Laboratory Number: Sample Number: Sample Matrix:	6756.11 B-2A Water	6756.12 B-2A(F) Water	6756.13 B-32A Water	6756.14 B-32A(F) Water	6756.09 B-2B Water	6756.10 B-2B(F) Water	6776.03 B-3A Water	6776.04 B-3A(F) Water	Class VII Standards
PARAMETER UNITS			Duplicate	Duplicate					
INDICATORS									
Total Phenols mg/L	0.28		0.26		0.07		0.2		
TSS mg/L	635		745		41		2230		
CLP INORGANICS									
Aluminum µg/L	80 BJ*	68 U	68 UJ*	68 U	184 BJ*	114 B	401 J*	68 U	
Antimony µg/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	14
Arsenic µg/L	25.4	22.1	19.7	19.2	131	137	2 U	2 U	50
Barium µg/L	316	340	341	333	267	221	356	249	1000
Beryllium µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	100
Cadmium µg/L	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	10
Calcium µg/L	290000	288000	301000	293000	83300	82700	229000	229000	
Chromium µg/L	7 U	7 U	7 U	7 U	7 U	7 U	7 U	7 U	50
Cobalt µg/L	6 U	6.9 B	6 U	6.4 B	6 U	6 U	15.1 B	7.6 B	1000
Copper µg/L	8 U	8 U	8 U	8 U	8 U	8 U	8 U	8 U	1000
Iron µg/L	70300 J*	52100	66500 J*	51700	9460 J*	8140	525 J*	42.5 B	300
Lead µg/L	2 U	2 U	2 U	2 U	2 U	2 UJ*	2 U	2 UJ*	50
Magnesium µg/L	41200	41100	43500	41900	14500	14700	16000	16100	
Manganese µg/L	33400	32500	34700	33200	2480	2490	9760	8830	50
Mercury µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	2
Nickel µg/L	15 U	15 U	15 U	15 U	15 U	15 U	24.9 B	15 U	200
Potassium µg/L	1870 B	2270 B	2050 B	2170 B	1920 B	1910 B	1220 B	1400 B	
Selenium µg/L	3 U	3 U	3 UJ*	3 UJ*	3 U	3 U	3 U	3 U	10
Silver µg/L	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	50
Sodium µg/L	111000	116000	116000	118000	31700	32100	75200	77600	
Thallium µg/L	2 UJ*	2 UJ*	2 UJ*	2 UJ*	2 UJ*	2 UJ*	2 UJ*	2 UJ*	2
Vanadium µg/L	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 B	
Zinc µg/L	17 U	17 U	17 U	17 U	24.8	17 U	370	195	5000

Note: Data qualifier symbols are defined in Table 4-11.

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Table 4-4 (continued)
Site Characterization Groundwater Data
Indicators & CLP Inorganics

Laboratory Number: Sample Number: Sample Matrix:	6776.01 B-3B Water	6776.02 B-3B(F) Water	6776.07 B-4A Water	6776.08 B-4A(F) Water	6776.09 B-4B Water	6776.10 B-4B(F) Water	6776.05 B-5B Water	6776.06 B-5B(F) Water	Class VII Standards
PARAMETER UNITS									
INDICATORS									
Total Phenols mg/L	0.14		0.14		0.14		0.06		
Total Suspended mg/L	760		1160		104		62		
CLP INORGANICS		Filtered		Filtered		Filtered		Filtered	
Aluminum µg/L	2360 J*	68 U	1700 J*	68 U	350 J*	68 U	147 BJ*	68 U	
Antimony µg/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	14
Arsenic µg/L	49.7	46.7	21.3	17.2	10.9	9.1 B	48.6	50.2	50
Barium µg/L	535	382	358	437	298	301	453	441	1000
Beryllium µg/L	1 U	1 U	1.1 B	1 U	1 U	1 U	1 U	1 U	100
Cadmium µg/L	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	10
Calcium µg/L	171000	131000	233000	217000	181000	176000	111000	109000	
Chromium µg/L	7 U	7 U	7 U	7 U	7 U	7 U	7 U	7 U	50
Cobalt µg/L	6 U	6 U	10.1 B	6 U	6 U	6 U	6 U	6 U	1000
Copper µg/L	8 U	8 U	8 U	8 U	8 U	8 U	8 U	8 U	1000
Iron µg/L	23800 J*	8130	22500 J*	14100	8580 J*	6850	17100 J*	16700	300
Lead µg/L	8.3 J*	2 U	6.9 J*	2 UJ*	2 UJ*	2 UJ*	2 U	2 U	50
Magnesium µg/L	20600	19100	29400	28100	26800	26200	18500	18100	
Manganese µg/L	4360	2460	3190	2980	5530	5340	1650	1620	50
Mercury µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	2
Nickel µg/L	19.3 B	15 U	16.9 B	15 U	15 U	15 U	15 U	15 U	200
Potassium µg/L	4960 B	4480 B	4140 B	3780 B	3220 B	3290 B	3920 B	3990 B	
Selenium µg/L	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 UJ*	10
Silver µg/L	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	50
Sodium µg/L	36000	34900	52500	51200	42500	42000	29800	29400	
Thallium µg/L	2 UJ*	2 UJ*	2 UJ*	2 UJ*	2 UJ*	2 UJ*	2 UJ*	2 UJ*	2
Vanadium µg/L	20.7 B	3 U	18.1 B	4.2 B	5.9 B	3 U	3 U	3 B	
Zinc µg/L	73.5	17 U	78.7	17 U	20	17 U	17 U	17 U	5000

Note: Data qualifier symbols are defined in Table 4-11.

LEFSDS004904

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Table 4-4 (continued)
Site Characterization Groundwater Data
Indicators & CLP Inorganics

Laboratory Number: Sample Number: Sample Matrix:	6776.11 B-6B Water	6776.12 B-6B(F) Water	6756.05 B-7A Water	6756.06 B-7A(F) Water	6756.07 B-7B Water	6756.08 B-7B(F) Water	Class VII Standards
PARAMETER UNITS							
INDICATORS							
Total Phenols mg/L	0.17		0.22		0.14		
Total Suspended mg/L	1760		734		390		
CLP INORGANICS		Filtered		Filtered		Filtered	
Aluminum µg/L	1810	69.4 B	1400 J*	104 B	1100 J*	93 B	
Antimony µg/L	50 U	50 U	50 U	50 U	50 U	50 U	14
Arsenic µg/L	139	101	2 UJ*	2.9 B	184	187	50
Barium µg/L	523	332	480	322	483	390	1000
Beryllium µg/L	1.1 B	1 U	1 U	1 U	1 U	1 U	100
Cadmium µg/L	4 U	4 U	4 U	4 U	4 U	4 U	10
Calcium µg/L	120000	103000	84800	79000	103000	91700	
Chromium µg/L	7 U	7 U	7 U	7 U	7 U	7 U	50
Cobalt µg/L	6.4 B	6 U	6 U	6 U	6 U	6 U	1000
Copper µg/L	8 U	8 U	8 U	8 U	8 U	8 U	1000
Iron µg/L	21600	10900	887	21.7 B	12400 J*	8080	300
Lead µg/L	30.7	2 U	2.7 BJ*	2 UJ*	4.5 J*	2 UJ*	50
Magnesium µg/L	15000	13800	17600	16300	12100	11600	
Manganese µg/L	3600	3150	884	415	6120	5840	50
Mercury µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	2
Nickel µg/L	15 U	15 U	22.8 B	18.3 B	15 U	15 U	200
Potassium µg/L	2150 B	2100 B	4110 B	3920 B	2640 B	2180 B	
Selenium µg/L	3 UJ*	3 U	3 U	3 UJ*	3 U	3 UJ*	10
Silver µg/L	3 U	3 U	3 U	3 U	3 U	3 U	50
Sodium µg/L	21400	20600	18600	18300	19400	19400	
Thallium µg/L	2 UJ*	2 UJ*	2 UJ*	2 UJ*	2 UJ*	2 UJ*	2
Vanadium µg/L	17 B	3.7 B	6.4 B	3 U	7.9 B	3 U	
Zinc µg/L	91.4	17 U	21.4	17 U	38.2	17 U	5000

Note: Data qualifiers symbols are defined in Table 4-11.

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Table 4-5
Site Characterization Groundwater Data
CLP Volatiles

PARAMETER	Laboratory Number: Sample Number: Sample Matrix:	6756.15 BG-1A Water	6756.19 BG-1B Water	6756.03 B-1A Water	6756.01 B-1B Water	6756.11 B-2A Water	6756.13 B-32A Water	6756.09 B-2B Water	Class VII Standards
	UNITS						Duplicate		
Chloromethane	µg/L	10 U	10 U	10 U	10 U	5000 U	3300 U	10 U	5.7
Bromomethane	µg/L	10 U	10 U	10 U	10 U	5000 U	3300 U	10 U	48
Vinyl Chloride	µg/L	10 U	10 U	10 U	10 U	5000 U	3300 U	10 U	2
Chloroethane	µg/L	10 U	10 U	10 U	10 U	5000 U	3300 U	10 U	
Methylene Chloride	µg/L	5 U	5 U	5 U	5 U	2500 U	1700 U	1 J	4.7
Acetone	µg/L	10 U	10 U	10 U	10 U	5000 U	3300 U	10 U	
Carbon Disulfide	µg/L	5 U	5 U	5 U	5 U	2500 U	1700 U	5 U	
1,1-Dichloroethene	µg/L	5 U	5 U	5 U	5 U	2500 U	1700 U	5 U	7
1,1-Dichloroethane	µg/L	5 U	5 U	5 U	5 U	2500 U	1700 U	5 U	
1,2-Dichloroethene (total)	µg/L	5 U	5 U	5 U	5 U	2500 U	1700 U	5 U	
Chloroform	µg/L	5 U	5 U	5 U	5 U	230 JT	170 JT	5 U	
1,2-Dichloroethane	µg/L	5 U	5 U	5 U	5 U	2500 U	1700 U	5 U	5
2-Butanone	µg/L	10 U	10 U	10 U	10 U	5000 U	3300 U	10 U	
1,1,1-Trichloroethane	µg/L	5 U	5 U	5 U	5 U	2500 U	1700 U	5 U	200
Carbon Tetrachloride	µg/L	5 U	5 U	5 U	5 U	2500 U	1700 U	5 U	5
Vinyl Acetate	µg/L	10 U	10 U	10 U	10 U	5000 U	3300 U	10 U	
Bromodichloromethane	µg/L	5 U	5 U	5 U	5 U	2500 U	1700 U	5 U	
1,2-Dichloropropane	µg/L	5 U	5 U	5 U	5 U	2500 U	1700 U	5 U	
cis-1,3-Dichloropropene	µg/L	5 U	5 U	5 U	5 U	2500 U	1700 U	5 U	
Trichloroethene	µg/L	5 U	5 U	5 U	5 U	2500 U	1700 U	5 U	5
Dibromochloromethane	µg/L	5 U	5 U	5 U	5 U	2500 U	1700 U	5 U	
1,1,2-Trichloroethane	µg/L	5 U	5 U	5 U	5 U	2500 U	1700 U	5 U	0.6
Benzene	µg/L	5 U	5 U	5 U	5 U	2500 U	1700 U	5 U	5
trans-1,3-Dichloropropene	µg/L	5 U	5 U	5 U	5 U	2500 U	1700 U	5 U	
Bromoform	µg/L	5 U	5 U	5 U	5 U	2500 U	1700 U	5 U	
4-Methyl-2-Pentanone	µg/L	10 U	10 U	10 U	10 U	5000 U	3300 U	10 U	
2-Hexanone	µg/L	10 U	10 U	10 U	10 U	5000 U	3300 U	10 U	
Tetrachloroethene	µg/L	5 U	5 U	5 U	5 U	2500 U	1700 U	5 U	0.8
1,1,2,2-Tetrachloroethane	µg/L	5 U	5 U	5 U	5 U	2500 U	1700 U	5 U	0.17
Toluene	µg/L	5 U	5 U	5 U	5 U	54000	48000	5 U	10000
Chlorobenzene	µg/L	5 U	5 U	5 U	5 U	2500 U	1700 U	5 U	20
Ethylbenzene	µg/L	5 U	5 U	5 U	5 U	1300 J	1300 J	5 U	
Styrene	µg/L	5 U	5 U	5 U	5 U	2500 U	1700 U	5 U	
Xylene (total)	µg/L	5 U	5 U	5 U	5 U	9700 B	8200 B	5 U	

Note: Data qualifier symbols are defined in Table 4-11.

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Table 4-5 (Continued)
Site Characterization Groundwater Data
CLP Volatiles

PARAMETER	Laboratory Number: Sample Number: Sample Matrix:	6776.03 B-3A Water	6776.01 B-3B Water	6776.07 B-4A Water	6776.09 B-4B Water	6776.05 B-5B Water	6776.11 B-6B Water	6756.05 B-7A Water	6756.07 B-7B Water	Class VII Standards
	UNITS									
Chloromethane	µg/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	5.7
Bromomethane	µg/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	48
Vinyl Chloride	µg/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	2
Chloroethane	µg/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	
Methylene Chloride	µg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	4.7
Acetone	µg/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	
Carbon Disulfide	µg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	
1,1-Dichloroethene	µg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	7
1,1-Dichloroethane	µg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	
1,2-Dichloroethene (total)	µg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	
Chloroform	µg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	
1,2-Dichloroethane	µg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5
2-Butanone	µg/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	
1,1,1-Trichloroethane	µg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	200
Carbon Tetrachloride	µg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5
Vinyl Acetate	µg/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	
Bromodichloromethane	µg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	
1,2-Dichloropropane	µg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	
cis-1,3-Dichloropropene	µg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5
Trichloroethene	µg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	
Dibromochloromethane	µg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	
1,1,2-Trichloroethane	µg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.6
Benzene	µg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5
trans-1,3-Dichloropropene	µg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	
Bromoform	µg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	
4-Methyl-2-Pentanone	µg/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	
2-Hexanone	µg/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	
Tetrachloroethene	µg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.8
1,1,2,2-Tetrachloroethane	µg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.17
Toluene	µg/L	5	1 J	5 U	5 U	2 J	5 U	5 U	5 U	10000
Chlorobenzene	µg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	20
Ethylbenzene	µg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	
Styrene	µg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	
Xylene (total)	µg/L	0.8 BUJ*	5 U	5 U	5 U	0.6 BUJ	5 U	5 U	5 U	

Note: Data qualifier symbols are defined in 4-11.

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Table 4-6
Site Characterization Groundwater Data
CLP Semivolatiles

PARAMETER	Laboratory Number: Sample Number: Sample Matrix:	6756.15 BG-1A Water	6756.19 BG-1B Water	6756.03 B-1A Water	6756.01 B-1B Water	6756.11 B-2A Water	6756.13 B-32A Water	6756.09 B-2B Water	Class VII Standards
	UNITS						Duplicate		
Phenol	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	300
bis(2-Chloroethyl)ether	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	
2-Chlorophenol	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	
1,3-Dichlorobenzene	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	
1,4-Dichlorobenzene	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	
Benzyl alcohol	µg/L	10 U	10 U	10 U	10 U	50	10 U	10 U	
1,2-Dichlorobenzene	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	
2-Methylphenol	µg/L	10 U	10 U	10 U	10 U	420	300 E	10 U	
bis(2-Chloroisopropyl)ether	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	
4-Methylphenol	µg/L	10 U	10 U	10 U	10 U	290	200 E	10 U	
N-Nitroso-di-n-propylamine	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	
Hexachloroethane	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	
Nitrobenzene	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	
Isophorone	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	
2-Nitrophenol	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	
2,4-Dimethylphenol	µg/L	10 U	10 U	10 U	10 U	45	25	10 U	
Benzoic acid	µg/L	50 U	50 U	50 U	50 U	200 U	50 U	50 U	
bis(2-Chloroethoxy)methane	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	
2,4-Dichlorophenol	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	
1,2,4-Trichlorobenzene	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	
Naphthalene	µg/L	10 U	10 U	10 U	10 U	59	54	10 U	
4-Chloroaniline	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	
Hexachlorobutadiene	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	
4-Chloro-3-methylphenol	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	
2-Methylnaphthalene	µg/L	10 U	10 U	10 U	10 U	22 J	21	10 U	
Hexachlorocyclopentadiene	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	
2,4,6-Trichlorophenol	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	
2,4,5-Trichlorophenol	µg/L	50 U	50 U	50 U	50 U	200 U	50 U	50 U	
2-Chloronaphthalene	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	
2-Nitroaniline	µg/L	50 U	50 U	50 U	50 U	200 U	50 U	50 U	
Dimethylphthalate	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	313000
Acenaphthylene	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	
2,6-Dinitrotoluene	µg/L	10 U	10 U	10 U	10 U	40 U	10 U	10 U	

Note: Data qualifier symbols are defined in Table 4-11.

Table 4-6
Site Characterization Groundwater Data
CLP Semivolatiles

PARAMETER	Laboratory Number: Sample Number: Sample Matrix:	6756.15 BG-1A Water	6756.19 BG-1B Water	6756.03 B-1A Water	6756.01 B-1B Water	6756.11 B-2A Water	6756.13 B-32A Water	6756.09 B-2B Water	Class VII Standards
	UNITS						Duplicate		
3-Nitroaniline	µg/L	50 U	50 U	50 U	50 U	200 U	50 UR	50 U	
Acenaphthene	µg/L	10 U	10 U	10 U	10 U	40 U	10 UR	10 U	
2,4-Dinitrophenol	µg/L	50 U	50 U	50 U	50 U	200 U	50 UR	50 U	
4-Nitrophenol	µg/L	50 U	50 U	50 U	50 U	200 U	50 UR	50 U	
Dibenzofuran	µg/L	10 U	10 U	10 U	10 U	40 U	10 UR	10 U	
2,4-Dinitrotoluene	µg/L	10 U	10 U	10 U	10 U	40 U	10 UR	10 U	
Diethylphthalate	µg/L	10 U	10 U	1 J	10 U	40 U	10 UR	10 U	23000
4-Chlorophenyl-phenylether	µg/L	10 U	10 U	10 U	10 U	40 U	10 UR	10 U	
Fluorene	µg/L	10 U	10 U	10 U	10 U	40 U	10 UR	10 U	
4-Nitroaniline	µg/L	50 U	50 U	50 U	50 U	200 U	50 UR	50 U	
4,6-Dinitro-2-methylphenol	µg/L	50 U	50 U	50 U	50 U	200 U	50 UR	50 U	
N-Nitrosodiphenylamine	µg/L	10 U	10 U	10 U	10 U	40 U	10 UR	10 U	
4-Bromophenyl-phenylether	µg/L	10 U	10 U	10 U	10 U	40 U	10 UR	10 U	
Hexachlorobenzene	µg/L	10 U	10 U	10 U	10 U	40 U	10 UR	10 U	
Pentachlorophenol	µg/L	50 U	50 U	50 U	50 U	200 U	50 UR	50 U	
Phenanthrene	µg/L	10 U	10 U	10 U	10 U	40 U	10 UR	10 U	
Anthracene	µg/L	10 U	10 U	10 U	10 U	40 U	10 UR	10 U	
Di-n-butylphthalate	µg/L	10 U	10 U	1 J	0.9 J	40 U	0.5 J	0.7 J	2700
Fluoranthene	µg/L	10 U	10 U	10 U	10 U	40 U	10 UR	10 U	
Pyrene	µg/L	10 U	10 U	10 U	10 U	40 U	10 UR	10 U	
Butylbenzylphthalate	µg/L	10 U	10 U	10 U	10 U	20 J	9 JR	10 U	3000
3,3'-Dichlorobenzidine	µg/L	20 U	20 U	20 U	20 U	80 U	20 UR	20 U	
Benzo(a)anthracene	µg/L	10 U	10 U	10 U	10 U	40 U	10 UR	10 U	
Chrysene	µg/L	10 U	10 U	10 U	10 U	40 U	10 UR	10 U	
bis(2-Ethylhexyl)phthalate	µg/L	24	2 J	2 J	10 U	8 J	10 UR	3 J	1.8
Di-n-octylphthalate	µg/L	10 U	10 U	10 U	10 U	40 U	10 UR	10 U	
Benzo(b)fluoranthene	µg/L	10 U	10 U	10 U	10 U	40 U	10 UR	10 U	
Benzo(k)fluoranthene	µg/L	10 U	10 U	10 U	10 U	40 U	10 UR	10 U	
Benzo(a)pyrene	µg/L	10 U	10 U	10 U	10 U	40 U	10 UR	10 U	
Indeno(1,2,3-cd)pyrene	µg/L	10 U	10 U	10 U	10 U	40 U	10 UR	10 U	
Dibenz(a,h)anthracene	µg/L	10 U	10 U	10 U	10 U	40 U	10 UR	10 U	
Benzo(g,h,i)perylene	µg/L	10 U	10 U	10 U	10 U	40 U	10 UR	10 U	

Note: Data qualifier symbols are defined in Table 4-11.

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Table 4-6 (continued)
Site Characterization Groundwater Data
CLP Semivolatiles

PARAMETER	Laboratory Number: Sample Number: Sample Matrix:	6776.03 B-3A Water	6830.01 B-3B Water	6776.07 B-4A Water	6776.09 B-4B Water	6776.05 B-5B Water	6776.11 B-6B Water	6756.05 B-7A Water	6756.07 B-7B Water	Class VII Standards
UNITS										
Phenol	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	300
bis(2-Chloroethyl)ether	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
2-Chlorophenol	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
1,3-Dichlorobenzene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
1,4-Dichlorobenzene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
Benzyl alcohol	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
1,2-Dichlorobenzene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
2-Methylphenol	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
bis(2-Chloroisopropyl)ether	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
4-Methylphenol	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
N-Nitroso-di-n-propylamine	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
Hexachloroethane	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
Nitrobenzene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
Isophorone	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
2-Nitrophenol	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
2,4-Dimethylphenol	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
Benzoic acid	µg/L	50 UR	50 U	50 U	50 UR	50 U	50 U	50 U	50 U	
bis(2-Chloroethoxy)methane	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
2,4-Dichlorophenol	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
1,2,4-Trichlorobenzene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
Naphthalene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
4-Chloroaniline	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
Hexachlorobutadiene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
4-Chloro-3-methylphenol	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
2-Methylnaphthalene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
Hexachlorocyclopentadiene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
2,4,6-Trichlorophenol	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
2,4,5-Trichlorophenol	µg/L	50 UR	50 U	50 U	50 UR	50 U	50 U	50 U	50 U	
2-Chloronaphthalene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
2-Nitroaniline	µg/L	50 UR	50 U	50 U	50 UR	50 U	50 U	50 U	50 U	
Dimethylphthalate	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	313000
Acenaphthylene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
2,6-Dinitrotoluene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	

Note: Data qualifier symbols are defined in Table 4-11

Table 4-6 (continued)
Site Characterization Groundwater Data
CLP Semivolatiles

PARAMETER	Laboratory Number: Sample Number: Sample Matrix:	6776.03 B-3A Water	6830.01 B-3B Water	6776.07 B-4A Water	6776.09 B-4B Water	6776.05 B-5B Water	6776.11 B-6B Water	6756.05 B-7A Water	6756.07 B-7B Water	Class VII Standards
3-Nitroaniline	µg/L	50 UR	50 U	50 U	50 UR	50 U	50 U	50 U	50 U	
Acenaphthene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
2,4-Dinitrophenol	µg/L	50 UR	50 U	50 U	50 UR	50 U	50 U	50 U	50 U	
4-Nitrophenol	µg/L	50 UR	50 U	50 U	50 UR	50 U	50 U	50 U	50 U	
Dibenzofuran	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
2,4-Dinitrotoluene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
Diethylphthalate	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	23000
4-Chlorophenyl-phenylether	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
Fluorene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
4-Nitroaniline	µg/L	50 UR	50 U	50 U	50 UR	50 U	50 U	50 U	50 U	
4,6-Dinitro-2-methylphenol	µg/L	50 UR	50 U	50 U	50 UR	50 U	50 U	50 U	50 U	
N-Nitrosodiphenylamine	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
4-Bromophenyl-phenylether	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
Hexachlorobenzene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
Pentachlorophenol	µg/L	50 UR	50 U	50 U	50 UR	50 U	50 U	50 U	50 U	
Phenanthrene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
Anthracene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
Di-n-butylphthalate	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	0.9 J	1 J	2700
Fluoranthene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
Pyrene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
Butylbenzylphthalate	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	0.7 J	1 J	3000
3,3'-Dichlorobenzidine	µg/L	20 UR	20 U	20 U	20 UR	20 U	20 U	20 U	20 U	
Benzo(a)anthracene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
Chrysene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
bis(2-Ethylhexyl)phthalate	µg/L	47 J*	10 U	4 J	10 UR	6 J	10 U	3 J	17	1.8
Di-n-octylphthalate	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
Benzo(b)fluoranthene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
Benzo(k)fluoranthene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
Benzo(a)pyrene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
Indeno(1,2,3-cd)pyrene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
Dibenz(a,h)anthracene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	
Benzo(g,h,i)perylene	µg/L	10 UR	10 U	10 U	10 UR	10 U	10 U	10 U	10 U	

Note: Data qualifier symbols are defined in Table 4-11

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Missouri groundwater and may not be related to landfilling activities. These constituents are generally only considered for aesthetic reasons.

Although elevated beryllium levels were found in all subsurface soil samples, no SC groundwater sample contained beryllium at levels above the Class VII standard of 100 $\mu\text{g/L}$.

A total barium concentration of 1,050 $\mu\text{g/L}$ was detected in sample B-1B, which is marginally above the Class VII standard of 1,000 $\mu\text{g/L}$.

Arsenic was detected at levels exceeding Class VII standards in SC groundwater samples from every deep well except B-4B. None of the shallow groundwater samples showed arsenic above the Class VII standard of 50 $\mu\text{g/L}$. The highest detected total arsenic level was in groundwater from B-1B at 244 $\mu\text{g/L}$.

Dissolved arsenic was detected at 178 $\mu\text{g/L}$ in the filtered sample from B-1B. The nearby deep monitoring wells (B-7B, B-6B, and B-2B) also showed relatively high arsenic levels. Arsenic levels in the deep aquifer decreased toward the southern part of the site.

Groundwater from Monitoring Wells B-3B and B-5B showed arsenic levels of approximately 50 $\mu\text{g/L}$. B-4B (the southern-most monitoring well) contained total arsenic at only 10.9 $\mu\text{g/L}$. Upgradient groundwater sample BG-1B also had an elevated arsenic level (61.5 $\mu\text{g/L}$). The apparent absence of arsenic in the shallow aquifer, and its presence in the upgradient sample, suggest a potential off-site source for this contamination. Detections in the filtered samples were very similar to those in the unfiltered samples for arsenic, indicating that the contaminant was in a dissolved, and therefore more mobile, state.

No other metals were elevated above Class VII standards in SC groundwater samples.

Arsenic levels also exceeded Class VII standards in the deep groundwater samples during the PI from Monitoring Wells B-1B, B-2B, and B-6B at concentrations of 270 $\mu\text{g/L}$, 143 $\mu\text{g/L}$, and 80.2 $\mu\text{g/L}$, respectively.

As in the SC, iron and manganese were consistently detected above Class VII standards in PI groundwater samples.

Selenium (10.3 $\mu\text{g/L}$) and barium (1,300 $\mu\text{g/L}$) marginally exceeded Class VI standards (100 $\mu\text{g/L}$ and 1,000 $\mu\text{g/L}$, respectively) in Monitoring Well B-4B during the PI.

4.3.2 Organics

VOCs and SVOCs were detected at minimal concentrations in several SC groundwater samples (Tables (4-5 and 4-6)). The highest detections were in B-2A groundwater. Toluene, ethylbenzene, and xylenes (no benzene) were encountered at a combined level of 65 mg/L. A total SVOC concentration of 0.9 mg/L was also detected in the well. Ethylbenzene and xylenes were encountered in B-3A, B-5B, and B-2B, but at significantly lower levels (less than 6 $\mu\text{g/L}$). The SVOCs encountered were mainly phenols and phthalates. Bis (2-ethylhexyl) phthalate was detected in most of the groundwater samples. This is a common laboratory compound.

The only organics detected in PI groundwater samples were 15 $\mu\text{g/L}$ of ethylbenzene, 320 $\mu\text{g/L}$ of toluene, and 160 $\mu\text{g/L}$ of xylene in Monitoring Well B-2B.

4.4 SURFACE SOIL

Nine surface soil samples were collected during the SC. The samples were located in the Former Waste Disposal Site area and immediately downgradient from this area. One off-site surface soil sample was collected across the Blue River. The samples were collected to detect potential contaminants near the ground surface which might negatively impact the environment or human health due to direct release, leaching, or surface water runoff. All surface soil samples were analyzed for the following:

- Total Metals
- pH
- VOCs
- TPH
- Total Phenols

Surface soil sampling locations were also visually inspected for oil staining. If oil stains had been encountered in the investigation area, a sample of the stained soil would have been collected and analyzed for PCBs. No visible oil stains were encountered.

4.4.1 Inorganics

The results of the inorganic analyses on surface soil samples were compared with DOH levels. For reference, DOH values are listed with the inorganic results of surface soil sampling in Table 4-7.

Beryllium levels exceeded DOH levels (0.176 mg/Kg) in all surface soil samples. These levels ranged from 0.32 mg/Kg (in S-7) to 0.99 mg/Kg (in S-2).

A lead value of 242 mg/Kg was detected in sample S-2. This is marginally above the DOH value of 238 mg/Kg.

No other metals exceeded DOH values in surface soil samples.

The pH values ranged from 7.48 (S-9) to 8.95 (S-33) in surface soil samples. These values indicate neutral to slightly alkaline soil conditions.

4.4.2 Organics

The results of VOCs analyses on surface soil samples are summarized in Table 4-8. Minimal VOCs were detected in most surface soil samples. In most of these samples, methylene chloride and tetrachloroethene were the only VOCs encountered (methylene chloride is a common lab compound). The highest level of total VOCs encountered in surface soil was 128 μ g/Kg in sample S-2. Tetrachloroethene accounted for 100 μ g/L of this total.

TPH and total phenols results for surface soil samples are summarized in Table 4-7. TPH values ranged from 31 mg/Kg in S-8 to 702 mg/Kg in S-4. With the exception of S-1 and S-6, all samples had TPH values greater than 100 mg/Kg. Total phenols were detected between 1.3 mg/Kg (S-9) and 2.9 mg/Kg (S-3).

Table 4-7
Site Characterization Surface Soil/Sediment Data
Indicators & CLP Inorganics

Laboratory Number: Sample Number: Sample Matrix:	6680.08	6680.09	6680.10	6680.11	6680.12	6680.15	6680.07	6680.16	DOH Recommended Levels
PARAMETER	S-1 Soil	S-2 Soil	S-3 Soil	S-33 Soil	S-4 Soil	S-5 Soil	S-6 Soil	S-7 Soil	
INDICATORS				Duplicate					
Total Petroleum Hydrocarbons	56	180	120	140	702	200	57	260	16667
Total Phenols	2.2	1.8	2.9	2.7	2.2	2.5	2.8	1.7	
pH	8.27	8.16	8.63	8.95	8.29	8.43	8.13	8.6	
CLP INORGANICS									
Aluminum	13800 F	12500 F	5130 F	2840 F	13300 F	7970 F	12200 F	2980 F	
Antimony	11.1 U	11.3 U	10.2 U	10.2 U	11.7 U	10.5 U	11.8 U	10.4 U	
Arsenic	5.7 J*	9.2 J*	1.7 BJ*	1.6 UJ*	7.3	7.6	6.4 J*	6	230-238
Barium	174 F	209 F	166 F	140 F	192 F	171 F	191 F	69.1 F	4670
Beryllium	0.91 B	0.99 B	0.44 B	0.3 B	0.93 B	0.72 B	0.86 B	0.32 B	0.176
Cadmium	0.89 U	2	0.82 U	0.82 U	0.94 U	2	0.94 U	6.2	23.8-47.6
Calcium	42300 F	23300 F	245000 F	322000 F	19700 F	81300 F	12700 F	24700 F	
Chromium	17.3 J*	20.5 J*	20.8 J*	18.8 J*	19.6	13.5	20.2 J*	7.7	570-571
Cobalt	7.1 B	8.5 B	3.1 B	2.2 B	7.7 B	6 B	8.3 B	2.6 B	
Copper	22.1	29	17	13.4	22.7	19	24	11.1	6190
Iron	16400 F	18400 F	7710 F	5580 F	16700 F	12800 F	16100 F	5470 F	
Lead	108 J*	242 J*	43.8 J*	41.8	123 J*	73.9 J*	114 J*	130 J*	230-238
Magnesium	2870 F	3230 F	5130 F	5280 F	2980 F	4110 F	2720 F	1910 F	
Manganese	500	636	348	299	643	511	647	196	
Mercury	0.11 U	0.11 U	0.1 U	0.1 U	0.11 U	0.11 U	0.12 U	0.09 U	14.3
Nickel	21.9	25.4	19.8	18.6	22.6	17.2	22.5	7.8 B	714
Potassium	2840	2360	957 B	651 B	2150	1310	2070	686 B	
Selenium	0.67 U	0.68 U	0.61 U	0.61 U	0.7 U	0.63 U	0.71 UJ*	0.62 U	47.6
Silver	1.8 B	2.2 B	0.61 U	0.61 U	1.9 B	1.3 B	2.3 B	0.62 U	230-238
Sodium	350 U	355 U	322 U	321 U	369 U	330 U	371 U	326 U	
Thallium	0.67 U	0.68 UJ*	0.61 UJ*	0.61 U	0.7 UJ*	0.63 U	0.71 U	0.62 U	62
Vanadium	23.2	21.9	9.7 B	6.1 B	22.7	14.5	22	6.4 B	
Zinc	124	261	128	110	111	346	105	994	23800

Note: Data qualifier symbols are defined in Table 4-11.

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Table 4-7 (continued)
Site Characterization Surface Soil/Sediment Data
Indicators & CLP Inorganics

Laboratory Number: Sample Number: Sample Matrix:		6680.06	6680.17	6744.01	6744.07	6744.08	6680.18	DOH
PARAMETER		UNITS						Recommended Levels
INDICATORS								
Total Petroleum Hydrocarbons		mg/Kg						
Total Phenols		mg/Kg	31	200	47	53	200	
pH		S.U.	2.4	1.3	1.6	1.54	1.8	16667
			8.1	7.48	8	8.13	7.69	
CLP INORGANICS								
Aluminum	mg/Kg	9430 F	7530 F	12300 F	12000 F	9490 F	11900 F	
Antimony	mg/Kg	12.6 U	13.7 U	14.6 U	13 U	13.2 U	15.2 U	
Arsenic	mg/Kg	5.9 J*	9.4	6.4	5.7	6.2	8.7	230-238
Barium	mg/Kg	177 F	224 F	199	207	215	229 F	4670
Beryllium	mg/Kg	0.81 B	0.83 B	0.67 B	0.78 B	0.71 B	0.87 B	0.176
Cadmium	mg/Kg	1 U	6.2	1.2 U	1 U	1.1 U	1.5 B	23.8-47.6
Calcium	mg/Kg	11000 F	28200 F	18000 F	16300 F	21900 F	34600 F	
Chromium	mg/Kg	16.1 J*	22.5	20	18.9	19.2	23.4	
Cobalt	mg/Kg	8.3 B	9.1 B	9.5 B	8.4 B	9.8 B	9.6 B	
Copper	mg/Kg	22.9	36.2	32.1	25	26.9	64.8	6190
Iron	mg/Kg	15000 F	15600 F	18200 F	17700 F	16500 F	21100 F	
Lead	mg/Kg	39.3 J*	127 J*	43.3 FJ*	65.1 FJ*	797 FJ*	205 J*	230-238
Magnesium	mg/Kg	2450 F	2340 F	3220	2760	2670	2960 F	
Manganese	mg/Kg	762	785	919 J*	751 J*	849 J*	634	
Mercury	mg/Kg	0.13 U	0.19	0.14 U	0.12 U	0.13 U	0.15 U	14.3
Nickel	mg/Kg	21.1	23.2	23.3	21.9	23.1	22.3	714
Potassium	mg/Kg	1570	1300 B	1890	1610	1390	1750	
Selenium	mg/Kg	0.75 U	0.82 U	0.88 UJ*	0.78 UJ*	0.79 UJ*	1.1 B	47.6
Silver	mg/Kg	1.9 B	2.1 B	0.88 U	0.78 U	0.79 U	2.9 B	230-238
Sodium	mg/Kg	395 U	429 U	459 U	408 U	416 U	479 U	
Thallium	mg/Kg	0.75 U	0.82 UJ*	0.88 UJ*	0.78 U	0.79 U	0.91 U	62
Vanadium	mg/Kg	17.5	18.1	26.5	25.8	23.2	23.2	
Zinc	mg/Kg	75.8	168	118 J*	105 J*	131 J*	169	23800

Note: Data qualifier symbols are defined in Table 4-11.

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Table 4-8
Site Characterization Surface Soil/Sediment Data
CLP Volatiles

PARAMETER	Laboratory Number: Sample Number: Sample Matrix:	6680.08 S-1 Soil	6680.09 S-2 Soil	6680.10 S-3 Soil	6680.11 S-33 Soil	6680.12 S-4 Soil	6680.15 S-5 Soil	6680.07 S-6 Soil	6680.16 S-7 Soil
	UNITS				Duplicate				
Chloromethane	µg/Kg	11 U	11 U	10 U	10 U	12 U	11 UJ*	12 U	10 UJ*
Bromomethane	µg/Kg	11 U	11 U	10 U	10 U	12 U	11 UJ*	12 U	10 UJ*
Vinyl Chloride	µg/Kg	11 U	11 U	10 U	10 U	12 U	11 UJ*	12 U	10 UJ*
Chloroethane	µg/Kg	11 U	11 U	10 U	10 U	12 U	11 UJ*	12 U	10 UJ*
Methylene Chloride	µg/Kg	6	12	3 J	4 J	3 J	4 J	7	2 J
Acetone	µg/Kg	11 U	11 U	10 U	10 U	5 J	11 UJ*	12 U	10 UJ*
Carbon Disulfide	µg/Kg	6 U	6 U	5 U	5 U	6 U	5 UJ*	6 U	5 UJ*
1,1-Dichloroethene	µg/Kg	6 U	6 U	5 U	5 U	6 U	5 UJ*	6 U	5 UJ*
1,1-Dichloroethane	µg/Kg	6 U	6 U	5 U	5 U	6 U	5 UJ*	6 U	5 UJ*
1,2-Dichloroethene (total)	µg/Kg	6 U	6 U	5 U	5 U	6 U	5 UJ*	6 U	5 UJ*
Chloroform	µg/Kg	6 U	6 U	5 U	5 U	6 U	5 UJ*	6 U	5 UJ*
1,2-Dichloroethane	µg/Kg	6 U	6 U	5 U	5 U	6 U	5 UJ*	6 U	5 UJ*
2-Butanone	µg/Kg	11 U	11 U	10 U	10 U	12 U	11 UJ*	12 U	10 UJ*
1,1,1-Trichloroethane	µg/Kg	6 U	6 U	5 U	5 U	6 U	5 UJ*	6 U	5 UJ*
Carbon Tetrachloride	µg/Kg	6 U	6 U	5 U	5 U	6 U	5 UJ*	6 U	5 UJ*
Vinyl Acetate	µg/Kg	11 U	11 U	10 U	10 U	12 U	11 UJ*	12 U	10 UJ*
Bromodichloromethane	µg/Kg	6 U	6 U	5 U	5 U	6 U	5 UJ*	6 U	5 UJ*
1,2-Dichloropropane	µg/Kg	6 U	6 U	5 U	5 U	6 U	5 UJ*	6 U	5 UJ*
cis-1,3-Dichloropropene	µg/Kg	6 U	6 U	5 U	5 U	6 U	5 UJ*	6 U	5 UJ*
Trichloroethene	µg/Kg	6 U	6 U	5 U	5 U	6 U	5 UJ*	6 U	5 UJ*
Dibromochloromethane	µg/Kg	6 U	6 U	5 U	5 U	6 U	5 UJ*	6 U	5 UJ*
1,1,2-Trichloroethane	µg/Kg	6 U	6 U	5 U	5 U	6 U	5 UJ*	6 U	5 UJ*
Benzene	µg/Kg	2 J	6 U	5 U	5 U	6 U	5 UJ*	6 U	5 UJ*
trans-1,3-Dichloropropene	µg/Kg	6 U	6 U	5 U	5 U	6 U	5 UJ*	6 U	5 UJ*
Bromoform	µg/Kg	6 U	6 U	5 U	5 U	6 U	5 UJ*	6 U	5 UJ*
4-Methyl-2-Pentanone	µg/Kg	11 U	11 U	10 U	10 U	12 U	11 UJ*	12 U	10 UJ*
2-Hexanone	µg/Kg	11 U	11 U	10 U	10 U	12 U	11 UJ*	12 U	10 UJ*
Tetrachloroethene	µg/Kg	40	100	15	7	33	24 J*	29	23 J*
1,1,2,2-Tetrachloroethane	µg/Kg	6 U	6 U	5 U	5 U	6 U	5 UJ*	6 U	5 UJ*
Toluene	µg/Kg	6 U	7	5 U	5 U	6 U	5 UJ*	6 U	5 UJ*
Chlorobenzene	µg/Kg	6 U	6 U	5 U	5 U	6 U	5 UJ*	6 U	5 UJ*
Ethylbenzene	µg/Kg	6 U	2 J	5 U	5 U	6 U	5 UJ*	6 U	5 UJ*
Styrene	µg/Kg	6 U	6 U	5 U	5 U	6 U	5 UJ*	6 U	5 UJ*
Xylene (total)	µg/Kg	6 U	9	5 U	5 U	6 U	5 UJ*	6 U	5 UJ*

Note: Data qualifier symbols are defined in Table 4-11.

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Table 4-8 (continued)
Site Characterization Surface Soil/Sediment Data
CLP Volatiles

Laboratory Number: Sample Number: Sample Matrix:	6680.06 S-8 Soil	6680.17 S-9 Soil	6744.01 SED-1 Sediment	6744.07 SED-3 Sediment	6744.08 SED-33 Sediment	6680.18 SED-4 Sediment
PARAMETER	UNITS					
Chloromethane	µg/Kg	13 UJ*	14 U	13 U	13 U	14 UJ*
Bromomethane	µg/Kg	13 UJ*	14 U	13 U	13 U	14 UJ*
Vinyl Chloride	µg/Kg	13 UJ*	14 U	13 U	13 U	14 UJ*
Chloroethane	µg/Kg	13 UJ*	14 U	13 U	13 U	14 UJ*
Methylene Chloride	µg/Kg	3 J*	4 J	10 FJ	10	7 UJ*
Acetone	µg/Kg	13 UJ*	14 U	13 U	13 U	14 UJ*
Carbon Disulfide	µg/Kg	6 UJ*	7 U	6 U	6 U	7 UJ*
1,1-Dichloroethene	µg/Kg	6 UJ*	7 U	6 U	6 U	7 UJ*
1,1-Dichloroethane	µg/Kg	6 UJ*	7 U	6 U	6 U	7 UJ*
1,2-Dichloroethene (total)	µg/Kg	6 UJ*	7 U	6 U	6 U	7 UJ*
Chloroform	µg/Kg	6 UJ*	7 U	0.8 J	6 U	7 UJ*
1,2-Dichloroethane	µg/Kg	6 UJ*	7 U	6 U	6 U	7 UJ*
2-Butanone	µg/Kg	13 UJ*	14 U	13 U	13 U	14 UJ*
1,1,1-Trichloroethane	µg/Kg	6 UJ*	7 U	5 J	3 J	7 UJ*
Carbon Tetrachloride	µg/Kg	6 UJ*	7 U	6 U	6 U	7 UJ*
Vinyl Acetate	µg/Kg	13 UJ*	14 U	13 U	13 U	14 UJ*
Bromodichloromethane	µg/Kg	6 UJ*	7 U	6 U	6 U	7 UJ*
1,2-Dichloropropane	µg/Kg	6 UJ*	7 U	6 U	6 U	7 UJ*
cis-1,3-Dichloropropene	µg/Kg	6 UJ*	7 U	6 U	6 U	7 UJ*
Trichloroethene	µg/Kg	6 UJ*	7 U	6 U	6 U	7 UJ*
Dibromochloromethane	µg/Kg	6 UJ*	7 U	6 U	6 U	7 UJ*
1,1,2-Trichloroethane	µg/Kg	6 UJ*	7 U	6 U	6 U	7 UJ*
Benzene	µg/Kg	6 UJ*	7 U	6 U	6 U	7 UJ*
trans-1,3-Dichloropropene	µg/Kg	6 UJ*	7 U	6 U	6 U	7 UJ*
Bromoform	µg/Kg	6 UJ*	7 U	6 U	6 U	7 UJ*
4-Methyl-2-Pentanone	µg/Kg	13 UJ*	14 U	13 U	13 U	14 UJ*
2-Hexanone	µg/Kg	13 UJ*	14 U	13 U	13 U	14 UJ*
Tetrachloroethene	µg/Kg	21 J*	4 J	37	20	20 J*
1,1,2,2-Tetrachloroethane	µg/Kg	6 UJ*	7 U	6 U	6 U	7 UJ*
Toluene	µg/Kg	6 UJ*	7 U	6 U	6 U	7 UJ*
Chlorobenzene	µg/Kg	6 UJ*	7 U	6 U	6 U	7 UJ*
Ethylbenzene	µg/Kg	6 UJ*	7 U	6 U	6 U	7 UJ*
Styrene	µg/Kg	6 UJ*	7 U	6 U	6 U	7 UJ*
Xylene (total)	µg/Kg	6 UJ*	7 U	6 U	6 U	7 UJ*

Note: Data qualifier symbols are defined in Table 4-11.

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4.5 SEDIMENT

As part of the PI, a sediment sample was collected from along the Blue River and one from along Round Grove Creek. During the SC, one of these locations (SED-1) was resampled and two new sediment samples were collected. One of the new SC sediment samples was collected at the confluence of the two streams. The other was an off-site sample collected on the west side of the Blue River. The purpose of collecting these samples was to identify contamination of the sediment which may have resulted from discharges to the Blue River or Round Grove Creek from on-site or off-site sources. All sediment samples were analyzed for the following:

- Total Metals
- pH
- VOCs
- TPH
- Total Phenols

4.5.1 Inorganics

The results of inorganics analyses on sediment samples were compared with DOH levels. The values are shown on Table 4-7.

Beryllium levels ranged from 0.67 mg/Kg (SED-1) to 0.87 mg/Kg (SED-4) during the SC. All beryllium values in sediment exceeded the DOH level of 0.176 mg/Kg.

A lead value of 797 mg/Kg was detected in the duplicate of sample SED-3 (SED-33) during the SC. This exceeds the DOH value of 238 mg/Kg for lead. However, the lead level reported for SED-3 was 65.1 mg/Kg, indicating the variability of results observed when attempting to collect duplicates of solid matrices.

No other metals exceeded DOH values for sediment in the SC.

The pH values for sediment samples collected during the SC ranged from 7.47 to 8.13.

During the PI, sample SED-2 contained lead at 1,190 mg/Kg. This value exceeds the DOH level of 238 mg/Kg. Other metals were detected in PI sediment samples, but did not exceed Class VII standards.

4.5.2 Organics

Methylene chloride and tetrachloroethene were detected at minimal concentrations in all SC sediment samples. These values are shown in Table 4-8.

TPH values in SC sediment samples ranged from 47 mg/Kg in SED-3 to 200 mg/Kg in SED-4. The highest total phenols value in these samples was in SED-4 (1.8 mg/Kg). These results are summarized in Table 4-7.

Methylene chloride was the only VOC detected in PI sediment samples. Both detections were less than 1 μ g/Kg. Methylene chloride, which is a common laboratory compound, was also detected in blank samples during the PI.

TPH was encountered in both PI sediment samples at 205 mg/Kg. Total phenols were not detected in these samples.

4.6 SURFACE WATER

During the SC, a total of three surface water samples were collected: one from Round Grove Creek, one at the confluence of the Blue River and Round Grove Creek, and one from the Blue River downstream from the Former Waste Disposal Area. The analytical results from these samples were used to determine the effects on surface water quality from stormwater runoff, drainage, and groundwater migration from the site and upstream sources. All surface water samples were analyzed for the following:

- Total Metals
- Dissolved Metals
- TSS
- VOCs
- Total Phenols
- TPH

The Blue River near the Leeds facility is designated for the following beneficial uses: Livestock and Wildlife Waterways, Protection of Warm Water Aquatic Life and Human Health Fish Consumption, Boating and Canoeing, and Industrial Use (10 CSR 20-7.031 Table H).

Results from surface water sampling were compared to available Class I or Class II standards set by the Missouri Department of Natural Resources (MDNR). Class I standards are for surface water bodies designated for aquatic life protection. Class II standards apply to surface waters designated for human health protection and fish consumption. Only one of these class standards is provided for any given analyte. No applicable standards are currently published for Livestock and Wildlife Watering or Industrial Use.

4.6.1 Inorganics

Several metals were detected in surface water samples and are summarized in Table 4-9. However, none of these detections exceeded Class I or Class II standards.

4.6.2 Organics

Table 4-10 summarizes the results of VOC analyses on surface water samples. The highest total VOCs value (6 $\mu\text{g/L}$ in sample SW-2), taken at the confluence of the Blue River and Round Grove Creek, is considered insignificant. No VOCs were encountered in SW-3, downstream from the Former Waste Disposal Site.

TPH was not detected in surface water samples. Total phenols were encountered at 0.07 mg/L in SW-1 and SW-32. These values are given in Table 4-9.

4.7 CONCLUSIONS

Contamination encountered at the site is thought to be primarily due to the landfilling activities discussed in Section 1.2 of this report. The wastes that were disposed were related to automobile manufacturing. Other possible sources of contamination include upstream (off-site) sources along the Blue River and Round Grove Creek, and potential subsurface contamination hydraulically upgradient from the Former Waste Disposal Site.

* * * * *

Table 4-9
Site Characterization Surface Water Data
CLP Inorganics

Laboratory Number: Sample Number: Sample Matrix:	6744.02 SW-1 Water	6744.14 SW-1(F) Water	6744.09 SW-2 Water	6744.17 SW-2(F) Water	6744.10 SW-32 Water	6744.18 SW-32(F) Water	6744.12 SW-3 Water	6744.19 SW-3(F) Water	Class I or II Standards
PARAMETER	UNITS					Duplicate			
Total Petroleum Hydrocarbons	mg/L	0.5 U	0.5 U		0.5 U		0.5 U		
Total Phenols	mg/L	0.07	0.05 U		0.07		0.05 U		
Total Suspended Solids	mg/L	41	23		23		16		
CLP INORGANICS									
Aluminum	µg/L	285	197 B	100 B	193 B	111 B	212	110 B	
Antimony	µg/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	4300
Arsenic	µg/L	3 U	5.2 B	6.8 BJ*	5 B	6.7 BJ*	4.7 B	3.9 B	20
Barium	µg/L	88.4 B	86.6 B	76.6 B	86.1 B	77.9 B	90.5 B	79.1 B	
Beryllium	µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	5
Cadmium	µg/L	4 U	4 U	4 U	4 U	4 U	4 U	4 U	72
Calcium	µg/L	48000	64200	62500	64500	63500	66800	64400	
Chromium	µg/L	7 U	7 U	7 U	7 U	7 U	7 U	7 U	190
Cobalt	µg/L	6 U	6 U	6 U	6 U	6 U	6 U	6 U	
Copper	µg/L	8 U	8 U	8 U	8 U	8 U	8 U	8 U	67
Iron	µg/L	409	341	36.5 B	314	36.6 B	365	33.5 B	1000
Lead	µg/L	3.9	7.1 J*	1.8 BJ*	3 B	2 BJ*	22.4	1.9 BJ*	130
Magnesium	µg/L	5180	10800	10400	10800	10600	11300	10800	
Manganese	µg/L	420	282	241	283	246	306	258	
Mercury	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	2.4
Nickel	µg/L	15 U	15 U	15 U	15 U	15 U	15 U	15 U	5400
Potassium	µg/L	3170 B	9650	9250	9690	9560	9850	9510	
Selenium	µg/L	3 U	3 U	3 UJ*	3 U	3 U	3 U	3 UW	10
Silver	µg/L	3 U	3 U	3 U	3 U	3 U	3 U	3 U	8.2
Sodium	µg/L	26400	85400	83400	85300	85100	88900	85600	
Thallium	µg/L	3 U	3 U	3 UJ*	3 U	3 U	3 U	3 UWN	8
Vanadium	µg/L	3 B	5.3 B	4.6 B	6.1 B	5.2 B	4.7 B	5.3 B	
Zinc	µg/L	17 U	17 U	17 U	17 U	17 U	17 U	17 U	1660

Note: Data qualifier symbols are defined in Table 4-11.

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Table 4-10
Site Characterization Surface Water Data
CLP Volatiles

PARAMETER	Laboratory Number: Sample Number: Sample Matrix:	6744.02 SW-1 Water	6744.09 SW-2 Water	6744.10 SW-32 Water	6744.12 SW-3 Water	Class I or II Standards
	UNITS			Duplicate		
Chloromethane	µg/L	10 U	10 U	10 U	10 U	470
Bromomethane	µg/L	10 U	10 U	10 U	10 U	4000
Vinyl Chloride	µg/L	10 U	10 U	10 U	10 U	525
Chloroethane	µg/L	10 U	10 U	10 U	10 U	
Methylene Chloride	µg/L	0.6 J	5 U	2 J	5 U	
Acetone	µg/L	10 U	10 U	10 U	10 U	
Carbon Disulfide	µg/L	5 U	5 U	5 U	5 U	
1,1-Dichloroethene	µg/L	5 U	5 U	5 U	5 U	3.2
1,1-Dichloroethane	µg/L	5 U	5 U	5 U	5 U	
1,2-Dichloroethene (total)	µg/L	5 U	5 U	5 U	5 U	
Chloroform	µg/L	5 U	5 U	5 U	5 U	
1,2-Dichloroethane	µg/L	5 U	5 U	5 U	5 U	99
2-Butanone	µg/L	10 U	10 U	10 U	10 U	
1,1,1-Trichloroethane	µg/L	5 U	5 U	5 U	5 U	
Carbon Tetrachloride	µg/L	5 U	5 U	5 U	5 U	5
Vinyl Acetate	µg/L	10 U	10 U	10 U	10 U	
Bromodichloromethane	µg/L	5 U	5 U	5 U	5 U	
1,2-Dichloropropane	µg/L	5 U	5 U	5 U	5 U	
cis-1,3-Dichloropropene	µg/L	5 U	5 U	5 U	5 U	
Trichloroethene	µg/L	5 U	5 U	5 U	5 U	80
Dibromochloromethane	µg/L	5 U	5 U	5 U	5 U	
1,1,2-Trichloroethane	µg/L	5 U	5 U	5 U	5 U	42
Benzene	µg/L	5 U	5 U	5 U	5 U	71
trans-1,3-Dichloropropene	µg/L	5 U	5 U	5 U	5 U	
Bromoform	µg/L	5 U	5 U	5 U	5 U	
4-Methyl-2-Pentanone	µg/L	10 U	10 U	10 U	10 U	
2-Hexanone	µg/L	10 U	10 U	10 U	10 U	
Tetrachloroethene	µg/L	5 U	5	1 J	5 U	9
1,1,2,2-Tetrachloroethane	µg/L	5 U	5 U	5 U	5 U	11
Toluene	µg/L	5 U	5 U	5 U	5 U	300000
Chlorobenzene	µg/L	5 U	5 U	5 U	5 U	
Ethylbenzene	µg/L	5 U	5 U	5 U	5 U	320
Styrene	µg/L	5 U	5 U	5 U	5 U	
Xylene (total)	µg/L	5 U	1 J	5 U	5 U	

Note: Data qualifier symbols are defined in Table 4-11.

TABLE 4-11
DEFINITIONS FOR DATA QUALIFIERS

INORGANIC COMPOUNDS

- U** - This flag indicates a compound was analyzed for but not detected. The value associated with the "U" flag is the method detection limit, which is defined as the minimum concentration of a substance that can be identified, measured, and reported with 99% confidence that the analyze concentration is greater than zero.
- F** - This flag is used when the target compound is detected in the associated field blank as well as in the sample. A field blank or equipment rinsate blank is collected from HPLC grade water used to rinse field sampling equipment after decontamination has taken place. Field blanks indicate whether any carryover is occurring between sample collection.
- J*** - This flag indicates that the associated numerical value is an estimated quantity as qualified pursuant to a quality control evaluation of the data by Burns & McDonnell Engineering Company. In the event of a "UJ*" flag, the associated numerical value that is qualified as estimated is the method detection limit and not the detected concentration of the compound. One of the reasons for qualifying a value as "estimated" concerns spike analyses of samples. In a spike analysis a known amount of a compound is added to a sample and the percent recovery of this compound is determined. The "J*" qualifier is appropriate where the percent recovery of the spiked compound is out of USEPA specified recovery limits.

Notes: Some sample entries will be qualified with two or more flags, e.g. "BU*". Each individual flag still retains its meaning.

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TABLE 4-11 (continued)
DEFINITIONS FOR DATA QUALIFIERS

ORGANIC COMPOUNDS

- U** - This flag indicates a compound was analyzed for but not detected. The value associated with the "U" flag is the sample quantitation limit, which is a reporting limit for a particular analyte for laboratories under contract to USEPA under the Contract Laboratory Program. The specified quantitation limit is adjusted for sample dilution, level of analysis, percent moisture, and other sample interferences.
- J** - This flag indicates that the associated numerical value is an estimated quantity as qualified by the laboratory. This flag is used when the compound is detected in the sample but the detected quantity is less than the sample quantitation limit but greater than zero. The sample quantitation limit is a reporting limit for a particular analyte for laboratories under contract to USEPA under the Contract Laboratory Program. The specified quantitation limit is adjusted for sample dilution, level of analysis, percent moisture, and other interferences. This flag is also used for estimating a concentration for a tentatively identified compound (TIC).
- B** - This is used when the target compound is detected in the associated laboratory blank as well as in the sample. A laboratory blank is used to define the level of background contamination caused by contaminants in solvents, reagents, glassware, and other sample processing hardware. It is an artificial sample that is carried through the entire analytical procedure. This flag indicates possible blank contamination though it does not necessarily render the data unusable. In some circumstances, blank contamination will render the compound "undetected" (See "U*" flag).
- F** - This flag is used when the target compound is detected in the associated field blank as well as in the sample. A field blank or equipment rinsate blank is collected from HPLC grade water used to rinse field sampling equipment after decontamination has taken place. Field blanks indicate whether any carryover is occurring between sample collection.
- J*** - This flag indicates that the associated numerical value is an estimated quantity as qualified pursuant to a quality control evaluation of the data by Burns & McDonnell Engineering Company. In the event of a "UJ*" flag, the associated numerical value that is qualified as estimated is the sample quantitation limit and not the detected concentration of the compound. One of the reasons for qualifying a value as "estimated" concerns spike analyses of samples. In a spike analysis a known amount of a compound is added to a sample and the percent recovery of this compound is determined. The "J*" qualifier is appropriate where the percent recovery of the spiked compound is out of USEPA specified recovery limits.
- U*** - This flag indicates that the target compound should be considered undetected as qualified pursuant to a quality control evaluation of the data by Burns & McDonnell Engineering Company. One of the reasons for qualifying a value as "undetected" involves the "B" qualifier, i.e., where the target compound is detected in the associated laboratory blank as well as in the sample. If the sample value is less than five times the quantity detected in the blank, then the sample value is qualified as undetected.
- T** - This flag is placed next to an analyte which was also detected in the trip blank.
- R** - This flag is placed next to a value which is considered unusable because the surrogate recovery is below 10%.

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5.0 CONTAMINANT FATE AND TRANSPORT

The transport of a given contaminant is governed by two factors: 1) physical and chemical properties which are specific to the contaminant of concern; and 2) physical characteristics of the medium/media through which the contaminant may be transported. Potential routes of contaminant migration in and around the site include the subsurface route (subsurface soil and groundwater), the surface route (surface soil, sediment, and surface water), and the airborne route (airborne soil/dust particles). This section examines the potential routes of migration and provides information concerning the pertinent physical and chemical properties of selected chemicals of concern. (A description of how these chemicals were selected is presented in Section 2.0 of Appendix C.) A summary of relevant fate and transport mechanisms is provided.

5.1 POTENTIAL ROUTES OF MIGRATION

The major potential routes of migration of contaminants at the site include subsurface, surface, and airborne routes.

5.1.1 Subsurface

Subsurface migration can occur through soil and groundwater. These media are considered exposure pathways as well as reservoirs for contamination.

5.1.1.1 Groundwater

Groundwater at disposal sites may become contaminated from the leaching of on-site subsurface soils. The groundwater migration pathway at this site is a critical route to consider given the location adjacent to the Blue River. The predominant groundwater flow direction appears to be toward the Blue River, therefore any contaminants which have an affinity for transportation in groundwater could potentially enter the Blue River system. The portion of the Blue River which is adjacent to the site is designated for several beneficial uses, including aquatic life protection.

The hydrogeological studies performed at the site indicate that the hydraulic conductivity of the alluvium is low but could be substantially higher in areas

containing gravel. Because of the relatively low permeability of the silty clay soil, the groundwater velocity is expected to be low.

5.1.1.2 Subsurface Soil

The fate of contaminants in the subsurface soils depends primarily upon the rate of leaching into groundwater, the vaporization potential of the contaminants, and the rate of biodegradation of the contaminants. It is also possible for particulate matter to be transferred from soil to groundwater by subsurface erosion. However, soil basically remains in place and acts more like a reservoir or exposure point than a migrational pathway. Soil excavation could cause contaminant migration to occur in the soil phase.

5.1.1.3 Migration of "Free" Products in the Subsurface

If large amounts of contaminants exist in subsurface soil (or surface water) there would be the possibility that the contaminants could exist in the "free" state, i.e., not adsorbed on soil or dissolved in water. Dense non-aqueous phase liquids (DNAPLs) represent one form of free contaminants. Because of the low concentrations of pollutants detected at the site, there is little possibility that any of these contaminants could exist in the free state.

5.1.2 Surface Water Route

Contaminants at any disposal site can be transported in surface water as contaminated sediment, as a soluble constituent in the aqueous phase, or as free product. The major source of surface water for the site is from precipitation events. As stormwater runoff flows across the non-paved one-third the site, contaminants may be entrained and transported off-site.

Sediment is created through the erosion of the surface soil and the subsequent displacement of soil particles from their original location. This is achieved naturally via rainfall and stormwater runoff, wind, and the force of gravity. However, given that approximately two-thirds of the site is covered with asphalt, virtually no erosion will occur from the paved section. Also limited erosion potential exists in the portion of the site which is covered by heavy vegetation. There is very little bare ground at the site.

5.1.3 Air

Contaminant migration, via air, typically occurs as a result of contaminated surface soil and dust particles that become airborne. However, since the majority of the unpaved portion of the site is heavily vegetated, contaminant migration via airborne particulate is unlikely.

Volatilization, defined as the loss of chemicals in vapor form to the atmosphere from soil, plant, or water surfaces, is another means by which chemicals typically enter the atmosphere.

5.2 CONTAMINANT PERSISTENCE AND MIGRATION

Many factors determine the extent to which contaminants can migrate and the amount of time required to do so. Contaminant persistence is one of the most important factors affecting the extent of migration. Persistence is the ability to resist degradation by physical, chemical, or biological means. A contaminant can degrade into a more toxic or less toxic compound.

5.2.1 Organic Chemicals of Concern

Table 5-1 provides some relevant physical properties of the organic chemicals of concern at the site. The environmental characteristics of the chemicals, presented in Table 5-2, are directly related to their physical properties. For example, the higher molecular weight polycyclic aromatic hydrocarbons (PAHs) (Table 5-2) have very low water solubilities, high octanol-water coefficients (K_{ow}), and very low vapor pressures. These properties explain why these compounds are strongly adsorbed on soils and can migrate when the soil erodes, but cannot be easily leached from the soil. These compounds also present insignificant problems with regard to air contamination because of their very low vapor pressures.

The lower molecular weight PAHs in Table 5-2 (2-methylnaphthalene and naphthalene) have higher water solubilities and lower octanol-water coefficients than the other PAHs. However, these compounds would also be expected to be strongly adsorbed on soil and not be easily leached into water.

TABLE 5-1

PROPERTIES OF ORGANIC CHEMICALS OF CONCERN

Parameter	Physical Properties				
	Molecular Weight	Water Solubility (mg/L)	Octanol-Water Coefficient (K_{ow})	Vapor Press (Torr)	Density (g/ml)
Polycyclic Aromatic Hydrocarbons					
Benzo (a) anthracene	228	0.014	407,000	5×10^{-9}	--
Chrysene	228	0.002	407,000	63×10^{-7}	--
Fluoranthene	202	0.26	214,000	6×10^{-9}	--
2-Methylnaphthalene	142	25.4	13,000	--	--
Naphthalene	128	31.7	2,040	--	--
Plasticizer					
Butyl Benzyl Phthalate	312	2.9	23,000	8.6×10^{-6}	1.1
Volatile Organic					
Tetrachloroethene	166	150 - 200	758	14	1.6

Source: Ney, 1990; Verschueren, 1983.

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TABLE 5-2

ENVIRONMENTAL CHARACTERISTICS OF ORGANIC CHEMICALS OF CONCERN

Parameter	Environmental Characteristic			
	Absorb On Soil	Runoff With Soil	Bioaccumulated	Volatility
PAHs				
Benzo (a) anthracene	yes	yes	yes	very low
Chrysene	yes	yes	yes	very low
Fluoranthene	yes	yes	yes	very low
2-Methylnaphthalene	possibly	possibly	yes	very low
Naphthalene	yes	possibly	yes	low
Plasticizer				
Butyl Benzyl Phthalate	yes	yes	yes	low
Volatile Organic				
Tetrachloroethene	possibly	possibly	yes	high

Source: Ney, 1990

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Butyl benzyl phthalate has low water solubility, very low vapor pressure, and a relatively high octanol-water coefficient. It would be expected to behave much like the PAHs, i.e., strongly adsorbed on soil, not easily leached into water, and present no significant air contamination problem.

The environmental characteristics of tetrachloroethene differ greatly from those of PAHs or butyl benzyl phthalate. Tetrachloroethene is volatile and much less likely to be adsorbed and run off with soil. It has an appreciable, but low water solubility and can be leached from soil by water. Also, the high vapor pressure of tetrachloroethene can cause a transfer from soil or water to air.

Table 5-3 presents half-lives for the organic chemicals of concern in various media. Much of this data is based upon the "scientific judgement" of the authors of the Handbook of Environmental Degradation Rates (see Section 8.0), but the data provides important insight to environmental persistence.

PAHs have half-lives of 16 to 1000 days in soil and 1 to 2000 days in groundwater. Their persistence in surface water is about two orders of magnitude less because of the susceptibility of these molecules to destruction by sunlight.

Butyl benzyl phthalate has a relatively short half-life in water and soil (1 to 7 days) because of its susceptibility to hydrolysis.

Tetrachloroethene will evaporate rapidly from soil and is very easily removed from water because of its high vapor pressure and low solubility. In air, tetrachloroethene has a relatively long photooxidation half-life of 16 to 160 days. Its half-life in soil is 180 to 360 days.

Degradation products of tetrachloroethene include trichloroethene, 1,2-dichloroethene and vinyl chloride. (These degradation products were analyzed for, but not detected, in all of the samples taken in the PI and SC).

TABLE 5-3

ENVIRONMENTAL HALF-LIVES OF ORGANIC CHEMICALS OF CONCERN

Parameter	Half-lives (Days)		
	Soil	Surface Water	Groundwater
PAHs			
Benzo (a) anthracene	---	---	---
Chrysene	370 - 1000	0.5	740 - 2000
Fluoranthene	140 - 440	1 - 2.6	280 - 880
2-Methylnaphthalene	---	---	---
Naphthalene	16.6 - 48	0.5 - 20	1 - 258
Plasticizer			
Butyl Benzyl Phthalate	1 - 7	1 - 7	2 - 180
Volatile Organic			
Tetrachloroethene	180 - 360	180 - 360	360 - 720

Source: Howard et al, 1991

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Table 5-4 presents some of the possible sources of the chemicals of concern. PAHs enter the environment from exhausts associated with the burning of fuel, as well as from spills during storage, transport, and the use of fuel oil and coal. PAHs are present in crude oil and in petroleum products which are not highly refined. Used oils frequently contain PAHs as a result of breakdown during use.

Butyl benzyl phthalate is an ubiquitous low-volatility plasticizer for polyvinyl chloride. Tetrachloroethene is a highly volatile solvent used widely for metal degreasing and dry cleaning.

5.2.2 Inorganic Chemicals of Concern

The following paragraphs contain relevant information concerning the inorganic chemicals of concern at the site. These inorganic chemicals are the metals arsenic, cadmium, and lead.

The analytical results only provide information about the "total" metal present. They do not provide information concerning the oxidation states of the metal, whether or not metal ions or compounds are present, or whether some of the metal exists as an organometallic compound. The fate and transport of each of these species would be expected to vary greatly.

5.2.2.1 Arsenic

Arsenic compounds have gained notoriety because of the toxic properties of a few compounds. However, there are great differences in the toxicity of arsenic compounds and the species most commonly found in soils are not the most toxic. Over 200 arsenic-containing minerals have been identified, with approximately 60% being arsenates, 20% sulfides and sulfosalts, and the remaining 20% including arsenides, arsenites, oxides and elemental arsenic.

Arsenic occurs predominantly in soil in an insoluble adsorbed form (USEPA 1989). The main features of the chemistry of arsenic in soil have been investigated. However, the details of many of the processes have not yet been determined precisely enough to allow prediction of the fate of arsenic added to a particular soil. The normal oxidizing conditions in the soil under which

TABLE 5-4

POSSIBLE ENVIRONMENTAL SOURCES OF CHEMICALS OF CONCERN

Parameter	Man Made Sources	Emissions
Polycyclic Aromatic Hydrocarbons		
Benzo (a) anthracene	Gasoline	Internal combustion engines
Chrysene	Used Motor Oil	
Fluoranthene	Coal Tar	Municipal incinerators
2-Methylnaphthalene	Sewage	
Naphthalene	Asphalt Crude Oil	
Plasticizer		
Butyl Benzyl Phthalate	Plasticizer for Polyvinyl Chloride	
Volatile Organic		
Tetrachloroethene	Metal Degreasing Dry Cleaning	
Inorganics		
Arsenic	Arsenic-containing pesticides	
Cadmium	Smelting of Cadmium and Zinc	Atmospheric pollution from metallurgical industries
	Sewage application to land	Incineration of plastic containers and batteries
	Phosphate fertilizers	Burning fossil fuels
Lead	Mining and smelting activities	Vehicle exhausts
	Sewage sludge use in agriculture	
	Ammunition firing at target ranges	

Source: Verschueren, 1983; Alloway, 1990

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weathering takes place produces arsenic in the +5 oxidation state. Reactions in soil can lead to methylation, demethylation, and/or changes in oxidation state. The leaching of arsenic from soils is inhibited by the presence of hydrated oxides of iron and aluminum, clays, and organic matter (Alloway, 1990).

The uptake of arsenic by plants is not very great. Plants do not usually contain dangerous levels of arsenic even when grown on soils with relatively high arsenic levels (Alloway, 1990).

The chemistry of arsenic in water is complex, consisting of chemical, biochemical, and geochemical reactions which together control the concentration, oxidation state, and form of arsenic in water. The four arsenic species commonly found in natural waters are inorganic arsenic(III), inorganic arsenic(V), methanearsonic acid, and dimethylarsinic acid. Under aerobic conditions, arsenic(III) is slowly oxidized to arsenic(V) at neutral pH. The chemical and toxicological properties of these various species appear to be quite different (USEPA 1984).

The chemical species of arsenic in drinking water are predominantly inorganic and typically exist as a mixture of arsenate and arsenite. Over 90 percent of all surface water contains low levels of arsenic (10 $\mu\text{g/L}$ or less). Concentrations above 10 $\mu\text{g/L}$ are often encountered in the Missouri River Basin (USEPA 1989). The maximum contaminated level (MCL) for arsenic in drinking water is 50 $\mu\text{g/L}$ (USEPA, 1989).

5.2.2.2 Cadmium

Cadmium pollution has rapidly been increasing in recent decades as a result of the rising consumption of cadmium by industry. More than half of the cadmium used by industry was produced in the last 20 years. Sources which may cause cadmium contamination of soil are listed in Table 5-4.

As with all metals, the species of the metal present in soil will determine its mobility. The free ion Cd^{+2} is more likely to be adsorbed on the surfaces of soil than other forms of cadmium. The free ion predominates, along with

neutral species such as cadmium sulfate (CdSO_4) or cadmium chloride (CdCl_2) at pH values above 6.5 (Alloway, 1990).

Cadmium tends to be more mobile in soils than many other heavy metals and therefore more available to plants. In contrast to arsenic, cadmium toxicity can occur in plants on severely polluted soils. Accumulation of cadmium in food crops at sub-phytotoxic levels is a cause for concern because of the risk of increased dietary exposure. (Alloway, 1990)

5.2.2.3 Lead

When lead is released into the environment it has a long residence time compared to most other pollutants. Lead and its compounds have low solubilities and are relatively free from microbial degradation. Thus, they tend to accumulate in soils and sediment. Lead has a strong affinity for sulfur and its major ore material is the highly insoluble lead sulfide (galena, PbS). There is little evidence that lead is lost by leaching. Soil is a sink for anthropogenic lead and there are several well recognized major sources (Table 5-4).

In previous years, lead arsenate (PbHAsO_3) was applied to orchard trees as an insecticide and orchard soils may contain elevated concentrations of lead.

Knowledge of the chemistry and speciation of lead in soil is limited. However, only a very small part of the total lead is available for uptake by plants.

Although lead can be regarded as permanent in soils, it has low solubility and low mobility, thus making its bioavailability low. (Alloway, 1990)

5.3 SUMMARY OF FATE AND TRANSPORT OF CONTAMINANTS

Presented below is a summary of the pertinent facts available concerning the fate and transport of chemicals at the site.

Polycyclic Aromatic Hydrocarbons

The PAH compounds of concern are strongly adsorbed on soils and are not leached into water because of their very low solubility. Soil erosion is not a significant transport mechanism at the site. These compounds have relatively long half-lives in soil and groundwater, but are biodegradable. Air contamination is minimal because of their very low vapor pressures. They are rapidly destroyed in surface water because of their susceptibility to photooxidation.

The PAH compounds found at the site were primarily in soil. Their high adsorption potential and low solubility suggest that they will remain in place. Although they have relatively long half-lives, they will eventually degrade in soil.

Butyl Benzyl Phthalate

This compound is strongly adsorbed on soil and is not easily leached into water because of its low solubility. Soil erosion is not a significant transport mechanism at the site. The compound has a relatively short half-life in soil and water. Air contamination is minimal because of low vapor pressure.

Butyl benzyl phthalate (density 1.1 g/ml, water solubility 2900 $\mu\text{g/Kg}$) was detected at one point in subsurface soil at a concentration above its water solubility. However, it was detected in about one-third of the groundwater samples at concentrations two orders of magnitude below its water solubility. Thus, there is little likelihood that free butyl benzyl phthalate is present in the subsurface soil at the site.

Relatively small proportions of this compound can be leached from soil and it has a relatively short half-life in groundwater. Consequently, only small amounts would be expected to reach surface water where its half-life is very short (1 to 7 days).

Tetrachloroethene

Tetrachloroethene has a high vapor pressure and could transfer from soil and water to air. It is soluble in water at low concentrations; can probably be leached from soil by water; and has a fairly long half-life in soil, groundwater, and surface water. It also is biodegraded to other compounds, some of which are more toxic than the parent compound (e.g., vinyl chloride). However, none of its degradation products have been detected at the site.

Tetrachloroethene (density 1.6 g/ml, water solubility 150,000 - 200,000 $\mu\text{g/Kg}$) was detected in surface soil/sediment and in subsurface soil at concentrations which are four orders of magnitude less than its water solubility; it was not detected in the groundwater. Thus, there is little possibility that free tetrachloroethene is present in the subsurface soil at the site.

The detected concentrations of tetrachloroethene at the site are very low, and it is likely that the compound would be degraded to nondetectable levels prior to reaching a surface water body.

Arsenic

Arsenic compounds are not readily leached from soil. Soil erosion is not a significant transport mechanism at the site. The uptake of arsenic by plants is not very great. The chemistry of arsenic in water is complex, consisting of a variety of potential reactions which control its concentration, oxidation state, and form.

The arsenic in the monitoring wells will move with the groundwater toward the Blue River at an approximate flow rate of 1/2 foot per year, depending on precipitation and subsequent recharge of the groundwater aquifer. However, this added recharge water also serves as a diluting factor. Therefore, the concentration of arsenic in the groundwater at the Blue River interface is likely to be lower than that in the monitoring wells. Additional significant dilution will occur in the Blue River.

Arsenic was found primarily in the deep portion of the aquifer, suggesting an off site or natural source.

Cadmium

Cadmium compounds are relatively mobile in soil. Because of this mobility, they are more available to plants. Some cadmium compounds could probably be leached into groundwater.

Cadmium was detected in about one-third of the soil and sediment samples at the site, but was only detected in one out of thirty groundwater samples. Furthermore, when the groundwater sample was filtered, there was no detectable cadmium in the filtrate. These results indicate that the cadmium on site is strongly adsorbed on the soil. Thus, there is no reason to believe that a significant amount of cadmium will be transported by water.

Lead

Lead compounds can be regarded as permanent in soil. However, they have low solubility and low mobility, thus their bioavailability is low. Soil erosion is not a significant transport mechanism. There is little evidence that lead can be leached from soil.

Lead was detected in all soil and sediment samples at the site and in about half of the groundwater samples. Furthermore, some of the groundwater filtrates also contained lead. Since naturally occurring lead should be much less soluble in water, site results suggest that the lead at the site has anthropogenic origins. Although the lead at the site would be expected to be gradually transformed into insoluble forms, the current situation indicates that some soluble lead could be transported with the groundwater. However, as pointed out in the section on arsenic, the groundwater flow is very slow and substantial dilution would occur during migration, resulting in very small amounts of dissolved lead that might be expected to reach the Blue River.

* * * * *

6.0 BASELINE RISK ASSESSMENT SUMMARY

6.1 INTRODUCTION

The purpose of the Baseline Risk Assessment is to determine if any significant human health impact or threat exists due to the presence of the Former Waste Disposal Site. The risk assessment includes identification and characterization of the toxicity and levels of hazardous materials present, environmental fate and transport mechanisms, potential human receptors, potential exposure routes, extent of expected exposure, extent and likelihood of expected impact or threat, and level of uncertainty associated with the evaluation of each of the above.

6.2 SELECTION OF POTENTIAL CHEMICALS OF CONCERN

The investigation data was reviewed to develop lists by chemical group and by media of the chemicals detected on site. The chemical groups were inorganic chemicals, VOCs, and SVOCs. The media sampled were surface soil, sediment, subsurface soil, ground water, and surface water. No air sampling was conducted as there was no expectation of positive results. High OVM readings were only encountered in the boreholes during drilling activities.

The chemicals detected on site are listed by media and group in Table 6-1. (Tables 6-1 through 6-8 are presented at the end of this section.) The data was organized into a form and content appropriate for a Baseline Risk Assessment, following procedures in the Risk Assessment Guidance for Superfund, Human Health Evaluation Manual (USEPA, 1989) to select potential chemicals of concern. All chemicals were initially considered. Those reported as not detected at any level in any media were reviewed to assure that detection limits were sufficiently low to reveal their presence at levels of concern. These levels of concern are health-based standards that are potentially applicable to ground and surface water. This review determined that no chemicals of potential concern had been inadvertently omitted due to detection limitations.

The levels of inorganic chemicals in soils and water were compared to background levels. Tables 6-2 and 6-3 depict these comparisons. Background

levels were determined from on-site and/or upgradient sampling, geochemical survey data for Missouri, and U.S. geochemical soil survey data. These naturally occurring chemicals cannot be said to present landfill-related risks if they are detected only at or near upgradient levels. The most relevant information is the local background data, however the other references were also used to assure that site background levels were appropriate and reasonable.

Naturally occurring inorganic chemicals are generally eliminated from further risk assessment considerations if they are present only at background levels. However, certain of these chemicals may pose significant risk even at background levels and should be retained for assessment. At this site, the inorganic chemicals retained included lead, arsenic, and cadmium. Lead is a no-threshold systemic toxicant; arsenic and cadmium are carcinogens.

The majority of organic chemicals (VOCs and SVOCs) are not naturally occurring and therefore are not eliminated from consideration based on background levels alone. However, an assessment is made of upgradient and site background levels to determine the extent to which the detected constituents are site related. Some organics are ubiquitous in the environment due to their widespread use and persistence.

Organic chemicals may be eliminated from further assessment if specific rationale can be provided. The rationale used in this assessment included frequency of detection, common laboratory contaminants, and low toxicity. Low toxicity alone was not considered sufficient rationale for elimination, but was included in the rationale if the constituent was also infrequently detected. Table 6-4 presents the chemicals eliminated from the risk assessment along with the rationale. Table 6-5 presents a list of potential chemicals of concern retained for further assessment.

The potential chemicals of concern retained for assessment represent members of each chemical group and from each media on the site. They were retained due to their frequent presence in one or more media, their reported concentrations, and/or their toxicity.

6.3 TOXICITY EVALUATION

Toxicity is the inherent capability of a substance to produce a deleterious response in a biologic system. This evaluation briefly reviews the responses possible from exposure to the chemicals of concern. It should be noted that in the absence of exposure, no response will occur. This review is provided only to show the toxicological basis for the selection of potential chemicals of concern.

- Inorganic Chemicals
 - Arsenic is a human carcinogen; oral exposure has caused skin cancer; inhalation exposure has caused lung cancer; ingestion may result in kidney damage.
 - Cadmium is a probable human carcinogen; inhalation has been associated with an increased risk of lung cancer.
 - Lead is a no-threshold poison causing adverse neurological effects, especially in children. It has also been shown to cause renal tumors in rats and mice and is a probable human carcinogen.
- VOCs
 - Tetrachloroethene is a probable human carcinogen by ingestion or inhalation.
 - 1,1,1-Trichloroethane, inhaled at high concentrations for short periods, may cause central nervous system effects such as dizziness; high exposure for longer periods may cause liver damage.
- SVOCs
 - Some of the phthalates have shown carcinogenic activity in animals and are considered probable human carcinogens, others may adversely affect the liver.
 - Benzo(a)anthracene and chrysene are polycyclic aromatic hydrocarbons (PAHs) that have shown carcinogenic activity in animals and are considered probable human carcinogens. They

are found in substances (e.g., coal tars, cigarette smoke) associated with lung cancers in humans. Other PAHs (flouranthene, naphthalene, 2-methylnaphthalene, phenanthrene, and pyrene) are systemic toxicants. Naphthalene is toxic to the retina and lens of the eye.

- The toxicity of 2,4-dimethylphenol has not been well characterized; it may be neurotoxic and may also adversely affect blood cells or blood forming tissues.

6.4 RISK CHARACTERIZATION

Risk characterization summarizes and combines outputs from exposure and toxicity evaluations to characterize baseline risk, either in quantitative expressions, qualitative statements, or both. Chemical toxicity information is compared to measured or estimated exposure levels and to levels predicted by fate and transport assessment.

The exposure assessment at this site examined potentially exposed populations, exposure pathways, and exposure routes. It was determined from this examination that no complete exposure pathways were present at the site nor in the vicinity of the site. Therefore, a quantitative expression of risk is neither possible nor appropriate. Qualitatively, it is apparent that the site currently poses no significant health impact on, or threat to, populations on or near the site.

6.5 COMPARISON OF ENVIRONMENTAL CONCERNS WITH POTENTIAL ARARs

Potentially applicable or relevant and appropriate requirements (ARARs) developed under federal or state law were compared to the concentration of constituents detected on site. The only ARAR possibly exceeded was the Water Quality Criteria (WQC) level, established at zero for arsenic. This level is based on the carcinogenicity of arsenic by ingestion. However, WQC were not intended to be applied to drinking water itself nor to groundwater; they were intended for surface water protection. The Maximum Contaminant Level (MCL) is a more appropriate ARAR for groundwater. The geometric mean concentration of arsenic in site groundwater and surface water did not exceed the MCL.

Further, there is no known use of this aquifer for drinking water purposes. A comparison of site concentrations to ARARs is in Table 6-6.

6.6 UNCERTAINTIES AND LIMITATIONS IN THE RISK ASSESSMENT

Removal of all uncertainty in a site characterization study and baseline risk assessment is neither possible nor practical to attempt. The expected uncertainties can, however, be minimized through planning, quality control, and careful evaluation. Uncertainties related solely to the risk assessment process derive principally from the assumptions made concerning land use, populations potentially affected and their behaviors, and constituent fate and transport.

At the site, general land use is well defined as industrial. That use is very unlikely to change, therefore there is little uncertainty associated with it. The populations identified may change in the future. The workforce may increase in size and outdoor activity; the off-site residential area may be converted to industrial use. These changes, however likely or unlikely, should not result in an unforeseen or completed exposure pathway that would result in exposures at levels of health significance. Comparisons of site constituent levels to ARARs and media-specific action levels proposed by EPA are favorable and indicate little likelihood of any public health impact from any conceivable exposure scenario. The uncertainty produced by population assumptions is, therefore, judged to be without practical effect to the risk assessment outcome.

Fate and transport uncertainties are present. However, the limited extent and level of contamination at the site, combined with the length of time since the landfill was active, imply that any change in environmental levels of the constituents is unlikely to be dramatic and equally unlikely to alter the risk assessment conclusion.

Uncertainties in the toxicity evaluation are judged to be low. The toxicity of the principal chemicals of concern is well understood. The overall uncertainty of this risk assessment is a combination of uncertainties in each

component. Those component uncertainties are low, therefore the overall uncertainty is also judged to be low.

* * * * *

**TABLE 6-1
CHEMICALS DETECTED**

SURFACE SOIL/SEDIMENT – INORGANIC CHEMICALS

Chemical	Frequency of Detection	Range of Detected Concentrations (mg/Kg)
Aluminum	16/16	2840 - 121000
Arsenic	15/16	1.7 - 60.3
Barium	16/16	69.1 - 1800.0
Beryllium	16/16	0.3 - 6.9
Cadmium	7/16	1.5 - 13.8
Calcium	16/16	11000 - 322000
Chromium	16/16	7.7 - 216.0
Cobalt	16/16	2.2 - 86.8
Copper	16/16	11.1 - 223.0
Iron	16/16	5470 - 169000
Lead	16/16	39.3 - 1190.0
Magnesium	16/16	1910 - 27100
Manganese	16/16	299 - 5620
Nickel	3/16	0.19 - 6.4
Potassium	16/16	7.8 - 201.0
Selenium	16/16	651 - 15600
Silver	2/16	1.1 - 5.9
Sodium	10/16	1.3 - 17.2
Vanadium	16/16	6.1 - 248
Zinc	16/16	75.8 - 1550

SURFACE SOIL/SEDIMENT – VOLATILE ORGANIC COMPOUNDS (VOCs)

Chemical	Frequency of Detection	Range of Detected Concentrations (µg/Kg)
Methylene Chloride	13/14	2 - 12
Acetone	1/14	5
Chloroform	1/14	0.8
1,1,1 - Trichloroethane	2/14	3 - 5
Benzene	1/14	2
Tetrachloroethene	14/14	4 - 100
Toluene	1/14	7
Ethylbenzene	1/14	2
Xylene	1/14	9

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TABLE 6-1 (continued)

SUBSURFACE SOIL – INORGANIC CHEMICALS

Chemical	Frequency of Detection	Range of Detected Concentrations (mg/Kg)
Aluminum	42/42	4660 - 21900
Arsenic	41/42	1.6 - 20.41
Barium	42/42	62.3 - 10800
Beryllium	42/42	0.46 - 1.7
Cadmium	42/42	0.68 - 5.9
Calcium	42/42	2340 - 132000
Chromium	42/42	6.8 - 165
Cobalt	42/42	3.5 - 19.1
Copper	42/42	11.0 - 122.0
Iron	42/42	7870 - 31600
Lead	42/42	8.9 - 4490
Magnesium	42/42	1520 - 4330
Manganese	42/42	126 - 1480
Nickel	42/42	8.5 - 46.9
Potassium	42/42	760 - 2810
Selenium	6/42	0.51 - 1.9
Silver	37/42	0.72 - 3.9
Sodium	26/42	117 - 625
Vanadium	42/42	9.1 - 38.0
Zinc	42/42	29.6 - 2060

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TABLE 6-1 (continued)

GROUNDWATER - INORGANIC CHEMICALS

Chemical	Frequency of Detection	Range of Detected Concentrations ($\mu\text{g/L}$) [filtered]	Range of Detected Concentrations ($\mu\text{g/L}$) [unfiltered]
Aluminum	36/44	54.0 - 202.0	80 - 15900
Arsenic	39/44	2.5 - 270.0	3.1 - 250.0
Barium	44/44	90.9 - 678.0	189 - 1300
Beryllium	6/44	-	1 - 3.2
Cadmium	6/44	3.0 - 3.2	3.0 - 7.6
Calcium	44/44	79000 - 293000	83300 - 301000
Cobalt	17/44	3.0 - 7.6	3.9 - 59.6
Iron	44/44	21.7 - 52100	398 - 70300
Lead	17/44	2 - 7.8	2.2 - 114.0
Magnesium	44/44	11600 - 41900	12100 - 43500
Manganese	44/44	415 - 33200	884 - 34700
Nickel	18/44	9.0 - 20.8	11.4 - 131.0
Potassium	44/44	1400 - 5120	1220 - 6760
Sodium	44/44	13900 - 118000	15000 - 116000
Vanadium	23/44	2.0 - 6.7	2.0 - 101.0
Zinc	27/44	12.9 - 195.0	20 - 370

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TABLE 6-1 (continued)

GROUNDWATER – VOCs

Chemical	Frequency of Detection	Range of Detected Concentrations (µg/L)
Methylene Chloride	1/14	1
Chloroform	1/14	170 - 230*
Toluene	4/14	1 - 54000
Ethylbenzene	1/14	1300
Xylene	3/14	0.6 - 9700

GROUNDWATER – SEMIVOLATILES ORGANIC COMPOUNDS (SVOCs)

Chemical	Frequency of Detection	Range of Detected Concentrations (µg/L)
Benzyl alcohol	1/14	50
2-Methylphenol	1/14	300 - 420*
4-Methylphenol	1/14	200 - 290*
2,4-Dimethylphenol	1/14	25 - 45*
Napthalene	1/14	54 - 59*
2-Methylnapthalene	1/14	21 - 22*
Diethylphthalate	1/14	1
Di-n-butylphthalate	6/14	0.5 - 1
Butylbenzphthalate	4/14	0.7 - 20
bis(2-Ethylhexyl)phthalate	10/14	2 - 47

* Duplicate Sample

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TABLE 6-2

COMPARISON OF SOIL CONCENTRATIONS – INORGANIC CHEMICALS

Chemical	On-site Geometric Mean Concentration (Surface/Sediment) (mg/Kg)	On-site Geometric Mean Concentration (Subsurface) (mg/Kg)	Site Background Concentration ^d (mg/Kg)	State & National Concentration (mg/kg)	
				MO ¹	US ²
Aluminum	10808	11100	10095	41000	10000 - 300000
Arsenic	7.5	6.26	7.7	8.7	1.0 - 40
Barium	206	192.3	169	580	100 - 3500
Beryllium	0.82	0.76	0.83	0.8	0.1 - 40
Cadmium	1.3	1.1	ND	< 1	0.01 - 7.0
Calcium	35644 ^a	7046	3807	3300	100 - 400000
Chromium	22.2	17.3	15.5	54	5.0 - 3000
Cobalt	8.3	7.3	8.1	10	1.0 - 40
Copper	28.2	20.1	26.4	13	2.0 - 100
Iron	16710	17858	15619	21000	7000 - 550000
Lead	129	28.4	11.8	20	2.0 - 200
Magnesium	3462	2865	2778	2600	600 - 6000
Manganese	719	578	261	740	100 - 4000
Mercury	0.19 ^b	ND	ND	0.04	0.01 - 0.3
Nickel	24.7	24.8	23	14	5.0 - 1000
Potassium	1801	1570	1758	14000	400 - 30000
Selenium	0.51 ^c	0.78	1.9	0.28	0.1 - 2.0
Silver	1.37	1.1	1.8	-	0.1 - 5.0
Sodium	ND	224	391 ^e	5300	750 - 7500
Vanadium	21.9	23.6	20.3	69	20 - 500
Zinc	197	77.7	65.1	49	10 - 300

¹ - USGS Professional Paper 954-H,Z; Geochemical Survey of Missouri
U.S. Government Printing Office, 1984.

² - USEPA A Compendium of Superfund Field Operations Method, Dec. 1987.

^a - Results affected by high value in one sample (S-3).

^b - Detected in only one sample during Site Characterization.

^c - Detected in one sample only (SED-4).

^d - Site background concentrations represent mean of upgradient sample results.

^e - Non-detected; value is average of detection limits.

ND - Non-detected

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TABLE 6-3

COMPARISON OF WATER CONCENTRATIONS - INORGANIC CHEMICALS

Chemical	Surface Water		Groundwater		
	Upgradient ^a Concentration ($\mu\text{g/L}$)	Downgradient ^a Geometric Mean Concentration ($\mu\text{g/L}$)	Site Background ^{b,c} Concentration ($\mu\text{g/L}$)	U.S. ^d Background Concentration ($\mu\text{g/L}$)	Site ^b Geometric Mean Concentration ($\mu\text{g/L}$)
Aluminum	285	201	112	< 5 - 1000	69.4
Arsenic	ND	5	12	< 1 - 30	23.7
Barium	88.4	87.7	196	10 - 500	311
Beryllium	ND	ND	ND	< 10	ND
Cadmium	ND	ND	ND	< 1	ND
Calcium	48000	65156	91974	1000 - 150000	120844
Cobalt	ND	ND	ND	< 10	2.8
Iron	409	339	634	10 - 10000	2519
Lead	3.9	7.8	1.4	< 15	1.3
Magnesium	5180	10964	14331	1000 - 50000	18537
Manganese	420	290	1644	< 1 - 1000	2642
Nickel	ND	ND	11	< 10 - 50	5.6
Potassium	3170	9730	1965	1000 - 10000	2764
Sodium	26400	86517	19693	500 - 120000	32930
Vanadium	3	5.3	2.3	< 1 - 10	1.8
Zinc	ND	ND	ND	< 10 - 2000	12.8

^a - Unfiltered Samples^b - Filtered Samples^c - Site Background Concentrations determined by results from upgradient sampling.^d - Source: A Compendium of Superfund Field Operations Methods USEPA, Dec. 1987.

ND - Non-Detected

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TABLE 6-4

CHEMICALS ELIMINATED FROM RISK ASSESSMENT

Volatile Organic Compounds (VOCs)	Rationale For Elimination
Acetone	Common lab contaminant of low toxicity; detected in only one medium.
Benzene	Not detected above quantitation limit (QL) in any media; reported below QL in only one sample in each of two media.
Chloroform	Detected below QL in only one sample.
Ethylbenzene	Not detected above QL in any media; reported below QL in less than 10% of samples.
Methylene chloride	Not detected above QL in any media; common laboratory contaminant.
4-Methyl-2-Pentanone	Not detected above QL in any media; reported in only one sample
Toluene	Common lab contaminant of low toxicity; detected above QL in less than 10% of samples.
Trichloroethene	Not detected above QL in any media; reported in only one sample.
Semivolatile Organic Compounds (SVOCs)	
Benzyl alcohol	Reported detected in only one sample and not in the associated duplicate.
Diethylphthalate	Detected below QL in only one sample; phthalates are ubiquitous and common lab contaminants.
Di-n-butylphthalate	Detected below QL and in only one medium.
Bis(2-Ethylhexyl)phthalate	Detected in laboratory blank as well as sample.
Inorganic Chemicals	
Aluminum	Natural; level not elevated.
Barium	Natural; level not elevated.
Beryllium	Natural; level not elevated.
Calcium	Essential nutrient; natural; level within national range.
Copper	Essential nutrient; natural; level not elevated.
Cobalt	Essential nutrient; natural; level not elevated.
Iron	Essential nutrient; natural; level not elevated.
Magnesium	Essential nutrient; natural; level not elevated.
Manganese	Natural; level not elevated.
Mercury	Natural; reported detected in few samples.
Nickel	Natural; level not elevated.
Potassium	Essential nutrient; natural; level not elevated.
Selenium	Essential nutrient; natural; level not elevated.
Silver	Natural; level not elevated.
Sodium	Essential nutrient; natural; level not elevated.
Vanadium	Natural; level not elevated.
Zinc	Essential nutrient; natural; level not elevated.

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TABLE 6-5

**POTENTIAL CHEMICALS OF CONCERN
(Remaining After Initial Eliminations)**

Volatile Organic Compounds (VOCs)

1,1,1 – Trichloroethane
Tetrachloroethene

Semivolatile Organic Compounds (SVOCs)

Fluoranthene
Butyl Benzyl Phthalate
Benzo(a)anthracene
Chrysene
2,4 – Dimethylphenol
Napthalene
2 – Methylnapthalene
Phenanthrene
Pyrene

Inorganic Compounds

Arsenic
Cadmium
Lead

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TABLE 6-6

CHEMICAL SCREENING

Potential Chemicals of Concern	Toxicity Points	Toxicity Score	High Concentration ($\mu\text{g/Kg}$)	Concentration Score	Overall Score
1,1,1-Trichloroethane	53	2	5	1	2
Tetrachloroethene	178	3	12	2	6
Fluoranthene	178	3	290	3	9
Butylbenzylphthalate	178	3	5900	4	12
Benzo(a)anthracene	400	4	150	3	12
Chrysene	178	3	150	3	9
2,4-Dimethylphenol	178	3	45	2	6
Napthalene	178	3	4000	4	12
2-Methylnapthalene	178	3	1700	4	12
Phenanthrene	10	1	250	3	3
Pyrene	10	1	240	3	3
Arsenic	600	5	14.9 (mg/Kg)	5	25
Cadmium	400	4	3.3 (mg/Kg)	4	16
Lead	600	5	797 (mg/Kg)	5	25

Note: Overall Score = Toxicity Score x Concentration Score

<u>Ranking</u>	
Chemical	Overall Score
Arsenic	25
Lead	25
Cadmium	16
Butylbenzylphthalate	12
Benzo(a)anthracene	12
Napthalene	12
2-Methylnapthalene	12
Fluoranthene	9
Chrysene	9
Tetrachloroethene	6
2,4-Dimethylphenol	6
Phenanthrene	3
Pyrene	3
1,1,1-Trichloroethane	2

☐ Top Ten

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TABLE 6-7

CHEMICALS OF CONCERN

Arsenic
Lead
Cadmium
Butylbenzylphthalate
Benzo(a)anthracene
Naphthalene
2-Methylnaphthalene
Fluoranthene
Chrysene
Tetrachloroethene

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TABLE 6-8

SUMMARY OF COMPARISONS TO ARARs

Chemical	Geometric Mean Concentration	ARAR	Proposed Action Level
Surface Water ($\mu\text{g/L}$)			
Arsenic	4.0	50 (MCL)	50
Cadmium	ND	10 (MCL)	10
Lead	1.8	50 (MCL)	50
Tetrachloroethene	2.2*	5 (1992 MCL)	0.7
Groundwater ($\mu\text{g/L}$)			
Arsenic	23.7	50 (MCL)	50
Cadmium	ND	10 (MCL)	10
Lead	1.3	50 (MCL)	50
Tetrachloroethene	ND	5 (1992 MCL)	0.7
B(a)A	ND	NG	NG
Napthalene	7.2	NG	NG
2-Methylnapthalene	6.1	NG	NG
Butylbenzylphthalate	4.4	NG	7
Chrysene	ND	NG	NG
Fluoranthene	ND	NG	NG
Surface Soil (mg/Kg)			
Arsenic	7.5	NG	80
Lead	129	NG	500-1000 (CDC)
Cadmium	1.3	NG	40
Tetrachloroethene	0.023	NG	10

* = Detected in upgradient sample; not detected downgradient.

MCL = Maximum Contaminant Level

1992 MCL = MCL effective July 30, 1992

NG = Not Given/None Established

ND = Not Detected

PAL = Proposed Action Level

CDC = Maximum soil level recommendation of
Federal Centers for Disease Control

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7.0 SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

7.1 SUMMARY AND CONCLUSIONS

Two investigations have been conducted at the GM Leeds Former Waste Disposal Site to characterize potential surface and subsurface contamination at the site. This contamination may have resulted from past landfilling practices. The results of these investigations have been used to identify physical characteristics of the site, address the nature and extent of contamination encountered, develop an evaluation of the fate and transport of these contaminants, and discuss their potential effects upon human health and the environment via a Baseline Risk Assessment. These topics, discussed in detail in the preceding sections of this report, are summarized in the following sections.

7.1.1 Physical Characteristics

Leeds is located in west-central Missouri which experiences wide variations in temperature and humidity. The area of investigation falls within the alluvial valley of the Blue River.

The soils beneath the site consist of fine gravel, silty clays, and clayey silts (26 to 50 feet thick) underlain by silty and clayey gravels. Shale bedrock of the Pleasanton Group exists below this gravel layer at approximately 55 to 60 feet below the surface. Fill material was encountered in 11 of 19 borings and ranged in thickness from 0 to 22 feet.

Depth to groundwater ranges from 13.36 to 22.19 feet below the surface, as measured during the investigation. The groundwater generally flows to the southwest at horizontal velocities ranging from 0.2 to 1.7 ft/yr. Vertical groundwater gradients are also present, ranging from 0.03 in the upward direction to 0.43 in the downward direction.

7.1.2 Nature and Extent of Contamination

Subsurface soil, groundwater, surface soil, sediment, and surface water were sampled during the investigations at the Former Waste Disposal Site. A limited EMS was also conducted during the SC to more clearly define the extent

of fill material below the site. Contour maps depicting the probable fill area are found in Appendix T of this report.

7.1.2.1 Subsurface Soil

Three metals exceeded DOH recommended levels in subsurface soil samples. Beryllium levels were exceeded in all samples from both investigations, ranging from 0.46 mg/Kg to 1.7 mg/Kg. These beryllium concentrations are thought to be due to naturally occurring conditions. DOH levels for lead were exceeded in four samples from the PI. Barium exceeded DOH levels in one PI sample.

The highest detections of VOCs and SVOCs encountered in subsurface soil during these investigations were in the B-2A/B-2B cluster. These borings also emitted a strong hydrocarbon odor. TPH and total phenols were not detected at significant levels in subsurface soil samples. The highest TPH level was 190 mg/Kg in Boring B-6B.

7.1.2.2 Groundwater

Groundwater samples from all 14 monitoring wells exceeded Class VII standards for iron and manganese. Both of these are typical constituents of Missouri groundwater and are not considered to be related to landfilling activities or to present a risk to human health or the environment. Arsenic was consistently encountered above Class VII standards in groundwater samples collected from the deep portion of the aquifer. The highest total arsenic level (270 μ g/L) was encountered in Monitoring Well B-1B. None of the shallow groundwater samples showed the presence of arsenic above Class VII standards. Elevated levels of arsenic were also encountered in the upgradient sample (BG-1B). Barium and selenium were encountered at relatively low levels in two monitoring wells.

Although VOCs and SVOCs were encountered in several groundwater samples, the most significant levels were in the B-2A/B-2B cluster. Toluene, ethylbenzene, and xylene were detected at a combined level of 65 mg/L in B-2A groundwater during the SC.

7.1.2.3 Surface Soil and Sediment

Beryllium levels above DOH criteria were detected in all nine surface soil and three sediment samples. An elevated lead level (242 mg/Kg) was detected in surface soil sample S-2.

Minimal VOCs and SVOCs were detected in all surface soil and sediment samples. Significant TPH values were encountered in most surface soil and sediment samples. The highest detection was 702 mg/Kg in S-4.

7.1.2.4 Surface Water

No significant levels of metals, VOCs, TPH, or total phenols were encountered in the three surface water samples.

7.1.3 Contaminant Fate and Transport

The fate and transport of chemicals of concern at the site were investigated. Physical and chemical properties of these chemicals were examined in order to interpret relevant environmental characteristics such as adsorption on soil, potential runoff with soil, transport to air from soil and water, and bioaccumulation. The persistence of these contaminants in the environment and possible environmental sources were also examined.

Transport via soil erosion was considered insignificant, as two-thirds of the site are paved with asphalt and the remainder is covered by heavy vegetation. Conclusions concerning specific chemicals of concern are stated below.

- The physical properties of certain PAH compounds, found primarily in soils, indicate that they will be strongly adsorbed on soil and will slowly degrade in place.
- Butyl benzyl phthalate, which is also strongly adsorbed on soil, should remain in place and degrade fairly rapidly due to its relatively short half-life in soil and water.
- Tetrachloroethene, detected in very low concentrations at the site, is expected to degrade prior to reaching a surface water

body. Upon reaching surface waters, it will volatilize fairly quickly.

- Arsenic in the soil would be expected to migrate very slowly (one half foot per year) with the groundwater and be substantially diluted prior to reaching the Blue River. No significant contamination is expected to result from the very small quantities which may enter the river.
- Cadmium, present at a few locations on site, is strongly adsorbed on soil and is not expected to migrate.
- Although some groundwater samples contained soluble lead. Only a very small amount of lead, if any, is expected to reach the Blue River. This is due to the following reasons: (1) the groundwater flow is very slow, (2) the soluble lead will gradually be converted to insoluble compounds, and (3) substantial dilution of the groundwater will occur.

7.1.4 Baseline Risk Assessment

The Baseline Risk Assessment contains a review of the chemicals present on site and their concentrations. These chemicals were screened to produce a list of those posing the greatest potential risk, and their toxicity was evaluated. An evaluation of exposure pathways, possible exposure points, and potentially exposed population groups was then accomplished. This evaluation determined that there are no complete exposure pathways; therefore, no exposure is now occurring nor is it expected to occur in the future without the occurrence of uncontrolled excavation. The conclusion of the Baseline Risk Assessment is that the site poses no significant health risk to on-site or off-site populations.

7.1.5 Data Limitations

QA/QC samples were collected during field sampling to ensure the quality of sampling and analytical procedures. The results of these samples were evaluated as part of the QA/QC Evaluation in Appendix D of this report.

Symbols were placed next to sampling results in Tables 4-1 through 4-10 to qualify the use of the data. These symbols are defined in Table 4-11.

Only minor and discrete QA/QC problems were detected. Consequently, the data generated during this investigation is determined to be of acceptable quality upon which the following recommendations may be made.

7.2 RECOMMENDATIONS

The combined results of the PI and SC investigations successfully characterized the nature and extent of the contamination at the site.

The results of the Baseline Risk Assessment indicate that there is no current or expected future risk to human health or the environment from the levels of contaminants encountered; therefore, no further investigation of this site appears warranted and none is recommended.

All monitoring wells installed for the PI and SC should be closed and abandoned in accordance with 10 CSR 23-3.020(5).

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